



# *Fauna of India*

## **INDIAN CLADOCERA**

**(CRUSTACEA : BRANCHIOPODA : CLADOCERA)**

**R. GEORGE MICHAEL**

**AND**

**B. K. SHARMA**



This volume on the Cladocera of India describes about 90 taxa including brief information on the ecology and life cycle studies on these organisms. Other available data on the neighbouring countries in the Indian Subcontinent have also been compiled and presented. The taxonomy of Cladocera has undergone much revision in recent years, since the concept of cosmopolitanism is being questioned. Thus the present work opens up an entirely new field for much further work in India. It is also emphasised that we need to study populations of individual species including all the instars and the reproductive stages like gamogenetic (ephippial) females and the males that are critical in species determination. Apart from morphotaxonomic studies, we need to explore the surface sculpture and design of the Cladocera by employing Scanning Electron Microscopy in the future.

FAUNA OF INDIA  
AND ADJACENT COUNTRIES

INDIAN CLADOCERA  
(CRUSTACEA BRANCHIOPODA CLADOCERA)

By

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## EDITOR'S PREFACE

The Cladocerans, commonly known as "Waterfleas" form a primitive group of microcrustaceans. They invariably constitute a dominant component of freshwater zooplankton, play an important role in the aquatic foodchain and also contribute significantly to zooplankton dynamics and secondary productivity in freshwater ecosystems.

The systematic studies on Indian Cladocera were initiated as early as 1860. Various earlier contributions from this country represent only scattered reports of these organisms and present a number of nomenclatural discrepancies. The present volume is the first attempt to critically review the status of Indian Freshwater Cladocera. It deals with 90 species belonging to 37 genera spread over eleven families. All the taxa are suitably diagnosed and taxonomic keys and illustrations are provided for the various taxa. The authors of this volume, Prof. Michael and Dr. Sharma, have done a very good job for which they deserve congratulations. The illustrations of the different taxa exhibit the necessary taxonomic details and shall serve as ready reference for the future cladocera workers in this country. This fauna will not only be useful for the specialists in the Indian subcontinent but shall be of much help to the fishery scientists, limnologists and naturalists in the Oriental Region.

B. S. LAMBA  
*Jt. Director-in-charge*  
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## AUTHOR'S PREFACE

All over the world freshwater habitats are populated with littoral, planktonic and benthic communities consisting of plants and animals. Among these, the floating animal communities are usually represented by major Invertebrate groups like the Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda. Each of these groups, in turn, is an assemblage of different species populations.

The structure and composition of such communities are influenced by several environmental factors. Among them the abiotic factors like temperature, light, depth, oxygen, carbon dioxide, pH, alkalinity and other mineral concentrations are of importance. In recent years, competition, predation, food selectivity and habitat heterogeneity have been shown to be some of the key biotic mechanisms that regulate both terrestrial and aquatic communities (Hutchinson 1961 ; MacArthur and Wilson 1967 ; Levin 1970 ; Parrish and Sailer 1970 ; Cramer and May 1972 ; Dodson 1970 ; 1974a, b ; Zaret 1972a,b ; 1975 ; 1978 ; Zaret and Kerfoot 1975 ; Kerfoot 1980 ; Lynch 1980). Before one can analyse freshwater communities in detail, it is essential to know what are the species that inhabit a particular ecosystem. It is in this context the taxonomy of any group of animals assumes importance.

Many freshwater organisms pose taxonomic difficulties because of the tendency for species to split into numerous, little-differentiated microgeographical races in part resulting from a high degree of morphological plasticity inherent in them. Such infraspecific variations are known to be mostly nongenetic. At times, these variations may be so great as to obscure the relatively minor, but genetically determined differences which separate subspecies or even species. So workers on freshwater organisms are warned to take cognisance of such small, though relatively constant details that are normally overlooked, precisely because of the very reason that they do not show conspicuous morphological variations (Johnson 1958).

From time to time, freshwater communities as a whole have been worked out for different parts of the world, as found in such works as those of Birge (1918), Thienemann (1950), Ruttner (1952),

Pennak (1978), Edmondson (1959), Illies (1967), Clegg (1969) and Bayly and Williams (1973). Nevertheless, such treatises are relatively few as compared to the magnitude of problem on a global basis.

Among these communities, the crustacean Order Cladocera is an interesting group not only for taxonomic and distributional studies but also in view of the ecological and reproductive strategies employed in their life cycles, with alternating parthenogenetic and gamogenetic phases, phenotypic changes associated with cyclomorphosis even within populations of a single species and the rare occurrence of distinctly dimorphic males. Further, the Cladocera in general and members of the family Chydoridae in particular are well known to be "Guide forms" in establishing the trophic and developmental history of lakes especially in the Quarternary epoch, since the disarticulated parts of their exoskeleton are deposited as well preserved remains in ancient lake sediments and can precisely be determined to species in most cases (Frey 1958 ; 1959 ; 1960 ; 1961 ; 1962 ; Goulden 1964 ; Goulden and Frey 1963). In such paleolimnological endeavours the species diversity and distribution of extant species are of importance to assess paleoenvironmental conditions.

The taxonomy and zoogeography of Cladocera are of interest, since several species are known to show cosmopolitan distribution, although one of the current problems in this group of organisms is to establish the equivalence and confirm the occurrence of such cognate species reported from distantly placed geographical localities often transgressing continents (Frey, 1971b ; Michael & Frey 1983, 1984). This is attested by the fact that attempts are still being made to sort out equivalence or non-equivalence of species claimed to occur in both Europe and North America. A recent discussion with a plea for rethinking on the "Cosmopolitan" distribution of different taxa and their biogeographical significance is to be found in Bayly and Morton (1978). Some of these problems in taxonomy have arisen because of lack of coordination among workers from different parts of the world. The lack of such coordination has resulted in much confusion leading to designation of species with trinomial and quadrinomial nomenclature or the splitting or multiplication of species.

The excellent treatment of the family Moinidae of the world (Goulden 1968) ; World Chydoridae (Smirnov 1971) and revision of Macrothricidae and Moinidae (Smirnov 1976) are examples of the usage of these two divergent trends.

As a result of these developments in the global context, students of Indian Cladocera have to face a peculiar problem, since, contrary to the situation in many other Indian faunal groups, the bulk of the present species is already reported from elsewhere in the world. Thus, obtaining and studying the type material is a stupendous task and is further complicated by the nonexistence of such materials or records for many species, especially those described prior to 1900s as reported for species under the family Moinidae (Goulden 1968). This statement is true as well for the Cladocera as a whole. To obviate this predicament the next possible alternative is to study topotypes.

Faced with this problem of either lack of access to or non-availability of type material, in the present study it was decided to make detailed illustrations of each species from Indian material and compare the same with available holotype, paratype, topotype materials or at times with illustrations on the species from different parts of the world. This is particularly necessary when the same species had already been recorded from more than one country or continent. In this respect, it was a privilege for one of the authors to study the Indian material and to prepare a great part of the illustrations at the Limnology Laboratory of the Department of Zoology, Indiana University, USA that is euphemistically called the "Vatican for Cladoceran studies" Taxonomic preparations of slides, whole mounts and the illustrations for the different species described here were compared with available materials and literature of the above centre and conclusions drawn. Whenever necessary, specimens from type localities or from places situated close to it were picked out from any of the 5000-odd personal Cladoceran collections of Professor Frey at the above laboratory and compared with the present Indian material or descriptions. One of the important constraints in doing taxonomic work on Cladocera is to find proper optics with refinement and higher resolution, the lack of which had led to many an error. Such mistakes are further magnified specially when only illustrations are consulted for identification without recourse to study

of original material. Most of the earlier Indian workers resorted to such a method and by referring to monographs of extra Indian origin, pigeonholed their species into already described taxa elsewhere. Such anomalies have been rectified to a great extent in the present work by critically questioning the presence of a reported species, its distribution and other characteristics in detail. It is hoped therefore, that future workers on Indian Cladocera will use the present volume as a guide to confirm, alter or reject the validity or record of any species by further intensive study. In every instance, wherever possible the original description is taken into account. Reference materials of species used in the present descriptions are available from the authors as permanent mounts, whole animals in liquid collections and as permanent slides prepared for the various illustrated parts. One set of each species as whole specimens will be deposited as reference collections with the Zoological Survey of India at Calcutta for future reference.

The present monograph written under the Fauna of India Series deals with the detailed systematic account and distribution of the Indian Cladocera. In addition to providing the taxonomic status and descriptions for the various species, this work could be of value to fishery scientists in India and neighbouring tropical countries of the Oriental Region, as the Cladocera not only form an integral part of the diet of fry and adults of many commercially important Cyprinid fishes (Alikunhi 1952) but are also increasingly used as target species for mass culture of fish food in aquacultural practices (Nandy *et al* 1977).

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During the intervening years, one of the authors had an opportunity of spending one academic year at the Department of Zoology, Indiana University, USA with Professor David G. Frey whose erudite scholarship and personal knowledge of World Cladocera, extensive literature and reference collections from all over the globe greatly enhanced the quality of the present work. If at all this Fauna Volume has come to fruition it is in no small measure due to Professor Frey who infused confidence, encouragement and all possible help in accomplishing this task. A great part of the illustrations was prepared in his laboratory by using his fine optical facilities. He also permitted the use of his vast personal literature collections and allowed photocopying about 300 of the old and important references on Cladocera. We are much indebted to him for all this help.

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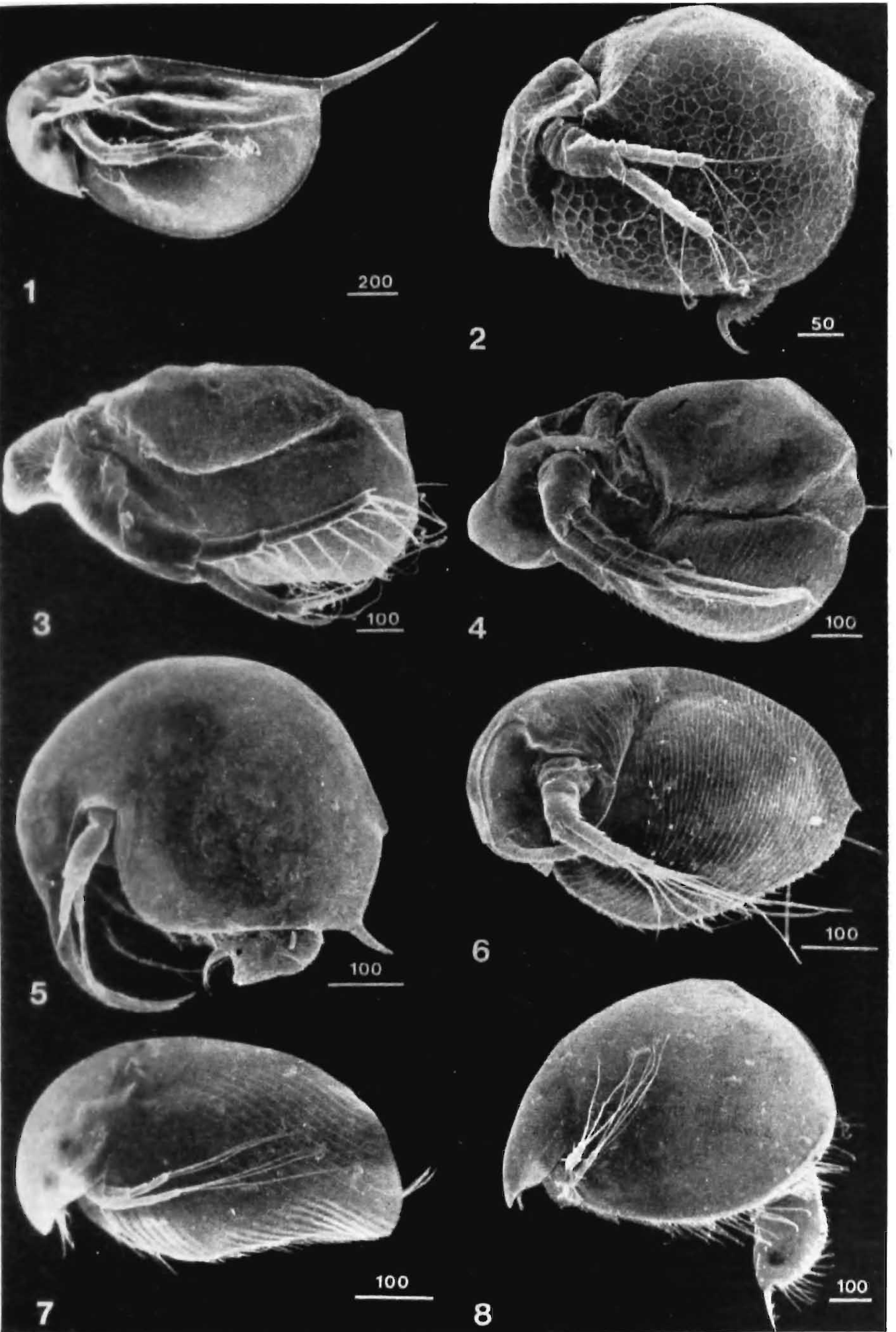
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SEM plate : explanation to the microphotographs

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2. SEM, parthenogenetic female of *Ceriodaphnia cornuta* Sars 1885
3. SEM, parthenogenetic female of *Diaphanosoma sarsi* Richard 1894
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6. SEM, parthenogenetic female of *Echinisca triserialis* (Bready 1886)
7. SEM, parthenogenetic female of *Acroperus harpae* (Baird 1834)
8. SEM, parthenogenetic female of *Leydigia acanthocercoides* (Fischer 1854)



## INTRODUCTION

The Order Cladocera belongs to the Subclass Branchiopoda and includes minute crustaceans generally in the size range of 0.2 to 5.0 mm. The extant Branchiopoda include three other Orders, Anostraca, Notostraca and Conchostraca, which are collectively known as Phyllopoda. Among these Orders, the Cladocera are known to be related to the bivalved Conchostraca, especially to *Cyclestheria hislopi*, since this species bypasses the naupliar stage, young having a full complement of appendages and well developed carapace valves at birth, and the eyes are united into a cyclopean organ as in cladocerans (Sars 1887 ; Tasch 1963). The Cladocera are only remotely related to other crustacean Subclasses like the Copepoda, Ostracoda, and Cirripedia (Scourfield and Harding 1966). This Order has 11 families (Smirnov 1971) and is known to contain about 400 species distributed throughout the world (Frey 1967). The present list of species is much larger.

The Cladocera, commonly known as the "Waterfleas" are mostly to be found in freshwater habitats, although eight species belonging to the three genera i.e., *Penilia*, *Evadne* and *Podon* are known to be truly marine. In addition to these, there are about 25 species belonging to the family Polyphemidae reported from the Caspian sea (Mordukhoy-Boltovskoi 1965a, b). These microcrustaceans usually inhabit every type of habitat in the littoral, limnetic or benthic zones of freshwater lakes and ponds. However, they are known to be generally intolerant to high salt concentrations in the medium, though there are species that frequently occur in brackish water habitat. Most species are transparent, especially those which inhabit the open waters, while others found among the weed beds of the littoral and benthic zones are darkly pigmented with shades of yellow, brown or red. The Cladocera have an interesting life cycle starting as juveniles which are miniature adults except for their size. These undergo a series of moults, as in other crustaceans, when the chitinous exoskeleton is shed off as the *exuvia*. Following a number of such preadult moults, the animal assumes the primiparous condition when the first batch of eggs are formed in the brood pouch through parthenogenesis. Early workers on Cladocera supposed that these eggs were capable of self-fertilisation, since these animals were seen to reproduce without the need of males. In 1845 it was shown that honey bees produce eggs which develop either with or

without fertilisation (Gurney 1905). Von Siebold (1856) was the first to prove that cladocerans were parthenogenetic, but even then his conclusions were disputed by Leydig (1860). The parthenogenetic female goes through a series of adult instars and produces batches of eggs. The eggs are not released to the exterior, but are incubated in the brood pouch of the mother. The embryonic development is completed within the brood pouch and young are released as juveniles. While this is the more common form of reproduction, during certain periods of the year, some of the parthenogenetic females produce males, following which bisexual or gamogenetic reproduction is effected. These fertilised eggs are quite different from the agamic or parthenogenetic eggs and are covered by thick chitinous cases called ephippia. These eggs are also called "resting eggs" as they normally undergo a period of dormancy before hatching as juveniles.

Cladocera have been reported from all over the world. While it is true that several genera and some species are cosmopolitan, certain species are endemic. In view of the cosmopolitan nature of this group particularly at the higher taxonomic categories, treatises from the different parts of the world are of importance for any detailed work. In this context, general compilations of Baird (1850), Lilljeborg (1900), Keilhack (1909), Birge (1918), Henry (1922), Wagler (1937), Bening (1941), Herbst (1962), Sramek-Husek *et al.*, (1962), Manuilova (1964), Scourfield and Harding (1966) and Flössner (1972) are relevant. Other works on specific groups or families such as on Genus *Daphnia* (Johnson 1952 ; Brooks 1957), Moinidae (Goulden 1968), Polyphemidae (Mordukhai-Boltovski 1968), Bosminidae (Deevey and Deevey 1971), Eurycercinae and the aberrant genus *Saycia* (Frey 1971a), Chydoridae (Smirnov 1971) and Macrothricidae and Moinidae (Smirnov 1976) have emerged in recent decades. We owe a great deal to the excellent works of Fryer (1968, 1974) on the evolution and adaptive radiation of Chydoridae and Macrothricidae, who has suggested the study of taxonomy through an understanding of functional morphology. Another original approach to the study of phylogenetic relationships in the family Chydoridae was made by Frey (1959, 1962 and 1965), using mostly the head shield morphology from both the present day forms and skeletal remains of past Cladocera in lake sediments.

In the Indian context the studies on Cladocera usually form part of general limnological investigations in lakes, ponds and reservoirs, wherefrom several genera and species are reported from time to time. For want of treatises on the Indian species based on well illustrated figures and keys, many errors have crept in. The indiscriminate and uncritical use of monographs from other parts of the world has led to reports of the occurrence of several species that have no place in our fauna. While there are occasional papers on the taxonomy of freshwater Cladocera in India (*vide infra*), no comprehensive treatment of this group exists for the country.

Of the 11 families listed under the order Cladocera, nine are known from Indian waters. These families are dealt with in the present account. Available information on the biology and ecology of several species from India has been compiled and presented in the relevant sections. It is hoped that this work will be a pace setter for more studies not only on the taxonomy and distribution of Indian Cladocera but also on several other aspects on the biology and ecology of this group in keeping with the modern taxonomic trend of studying populations.

#### CLASSIFICATION

The Subclass Branchiopoda of the Class Crustacea was originally divided into the Phyllopoda and the Cladocera. Later, Calman (1909) recognised that the differences even among the major groups of the Phyllopoda i.e., Anostraca, Notostraca and Conchostraca were as great as those between Conchostraca and Cladocera. He, therefore, proposed to divide the Branchiopoda into four Orders, Anostraca, Notostraca, Conchostraca and Cladocera.

The Order Cladocera was originally classified into two broad Divisions called Calyptomera and Gymnomera based on the extent of relative covering of the body by the carapace (Sars 1865). Further classification of these divisions, based on gross leg morphology, led him to establish the four tribes namely Ctenopoda, Anomopoda, Onychopoda and Haplopoda the first within the Calyptomera, the other three under Gymnomera. Sars classification was as follows :—

- Division : CALYPTOMERA Sars, 1865  
 Tribe CTENOPODA Sars, 1865  
 Families SIDIDAE Baird, 1850  
 HOLOPEDIDAE Sars, 1865  
 Tribe : ANOMOPODA Sars, 1865  
 Families : DAPHNIIDAE Straus, 1820  
 BOSMINIDAE Sars, 1865  
 LYNCODAPHNIIDAE Sars, 1865  
 LYNCEIDAE Baird, 1850  
 Division : GYMNOMERA Sars, 1865  
 Tribe : ONYCHOPODA Sars, 1865  
 Family : POLYPHEMIDAE Baird, 1845  
 Tribe : HAPLOPODA Sars, 1865  
 Family : LEPTODORIDAE Lilljeborg, 1861

Subsequently Eriksson (1934) while pointing out the distinctiveness of the genus *Leptodora* (Family : Leptodoridae) in having a naupliar stage, considered it more as an aberrant cladoceran. Thus while retaining this genus within the Haplopoda, Eriksson grouped all the other tribes as Eucladocera including the Ctenopoda, Anomopoda and Onychopoda. Later on Brooks (1959), in accordance with the taxonomic rules of formulating family group names, preferred to change Sars' tribes to Super-families, thus replacing Ctenopoda by Sidoidea ; Anomopoda by Chydoroidea and Onychopoda by Polyphemoidea. According to this classification, the order Cladocera had two suborders i.e., Haplopoda with a single family Leptodoridae Sars and Eucladocera having the above three superfamilies. These superfamilies in turn, included 7 families : Sidoidea with the families Sididae and Holopedidae ; Chydoroidea with the Daphniidae, Bosminidae, Macrothricidae and Chydoridae, and Polyphemoidea with the family Polyphemidae. While presenting a critical world review of the genera *Moina* and *Moinodaphnia* Goulden (1968) erected a new family Moinidae. These two genera earlier had belonged to the family Daphniidae. In a very recent monographic treatment of the World Chydoridae, Smirnov (1971) enumerates a total of 11 cladoceran families inclusive of the Podonidae and Cercopagidae. Thus we now recognise the following 11 families under the Order CLADOCERA.

- Family : SIDIDAE Baird, 1850
- Family : DAPHNIDAE Straus, 1820
- Family : MOINIDAE Goulden, 1968
- Family : BOSMINIDAE Sars, 1865
- Family : MACROTHRICIDAE Norman and Brady, 1867
- Family : CHYDORIDAE Stebbing, 1902
- Family : POLYPHEMIDAE Baird, 1845
- Family : LEPTODORIDAE Lilljeborg, 1861
- Family : PODONIDAE Mordukhai-Boltovskoi, 1968
- \*Family : HOLOPEDIDAE Sars, 1865
- \*Family : CERCOPAGIDAE Mordukhai-Boltovskoi, 1958

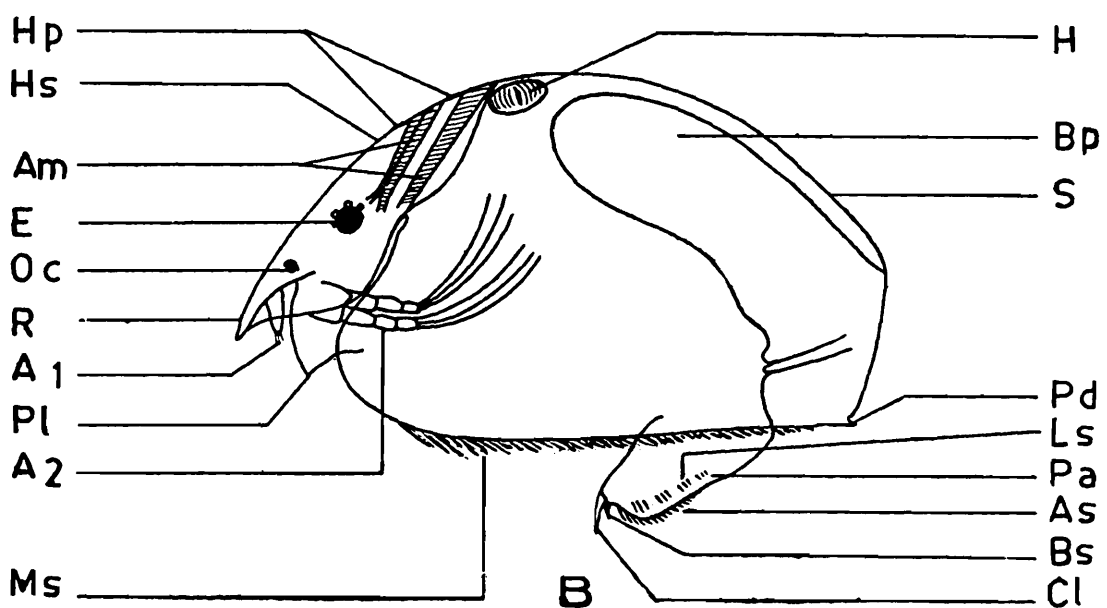
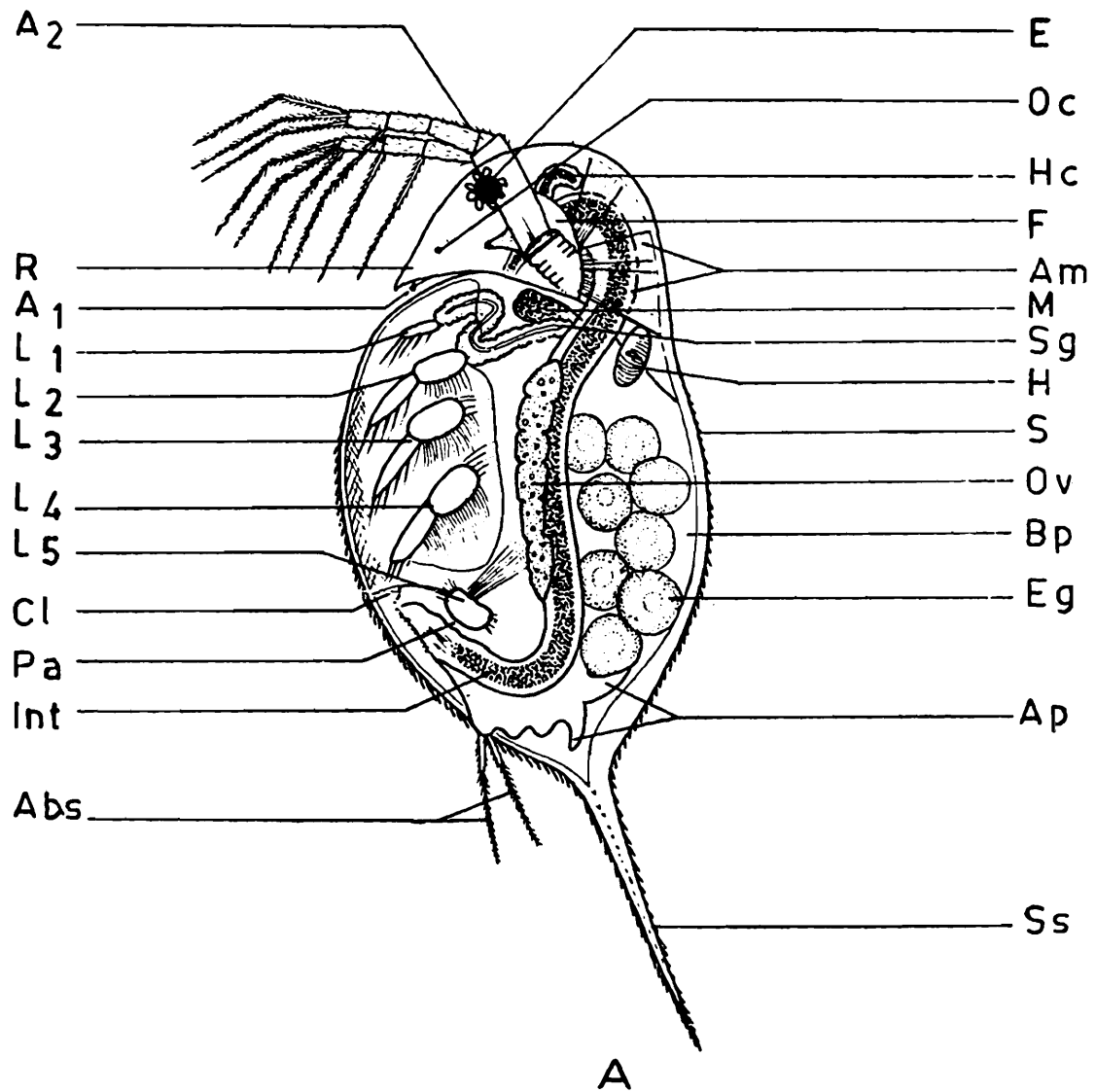
The family Chydoridae, the largest single group among Cladocera has been further divided into four subfamilies based on the head pore morphology, articulation of the mandibles and the number of basal spines on the claw (Frey 1967). These recognised subfamilies are Eurycercinae Kurz, 1895 ; Sayciinae Frey, 1967 ; Chydorinae Stebbing, 1902 and Aloninae Frey, 1967. Of these only three subfamilies are represented in India.

\*not represented in India.

#### MORPHOLOGY AND TERMINOLOGY

Cladoceran morphology can be understood best from illustrations of one or two representative species, which are somewhat generalised in their form (Text Fig. 1, A & B). However, it is to be kept in mind that this Order as a whole shows considerable range of diversity in the general structural plan. Most species show sexual dimorphism, with males generally being smaller than females. Even within a single species, the females are of two kinds—asexual or parthenogenetic, and sexual, gamogenetic or ephippial. The various morphological features and the terminology employed in the present work can be gleaned from the figures.

Most cladocerans have a carapace covering both sides of the body but opening ventrally. However, in Polyphemidae and Leptodoridae only the brood sacs are enclosed by the carapace. In some taxa the head is not clearly demarcated from the trunk ; in others a cervical notch (depression or sinus) marks its posterior boundary.



Text-fig. 1 A—showing general morphology of a daphnid

Text-fig. 1 B—showing general morphology of a chydorid

*Abbreviations : (Text-fig. 1)*

A<sub>1</sub>, antennule ; A<sub>2</sub>, antenna ; Am, antennary muscle ; Ap, abdominal process ; Abs, abdominal seta ; As, anal apines ; Bp, brood pouch ; Bs, Basal spine ; Cl, claw ; E, eye ; Eg, egg ; F, fornix ; H, heart ; Hc, hepatic caecum ; Hp, head pore ; Hs, head shield ; Int, intestine ; L1-L5, thoracic legs ; M, mandible ; Ms, marginal spines ; Oc, ocellus ; Ov, ovary ; Pa, postabdomen ; Pd, posteroventral denticle ; P1 plate of labrum ; R, rostrum ; S, shell ; Sg, shell gland and Ss, shell spine.

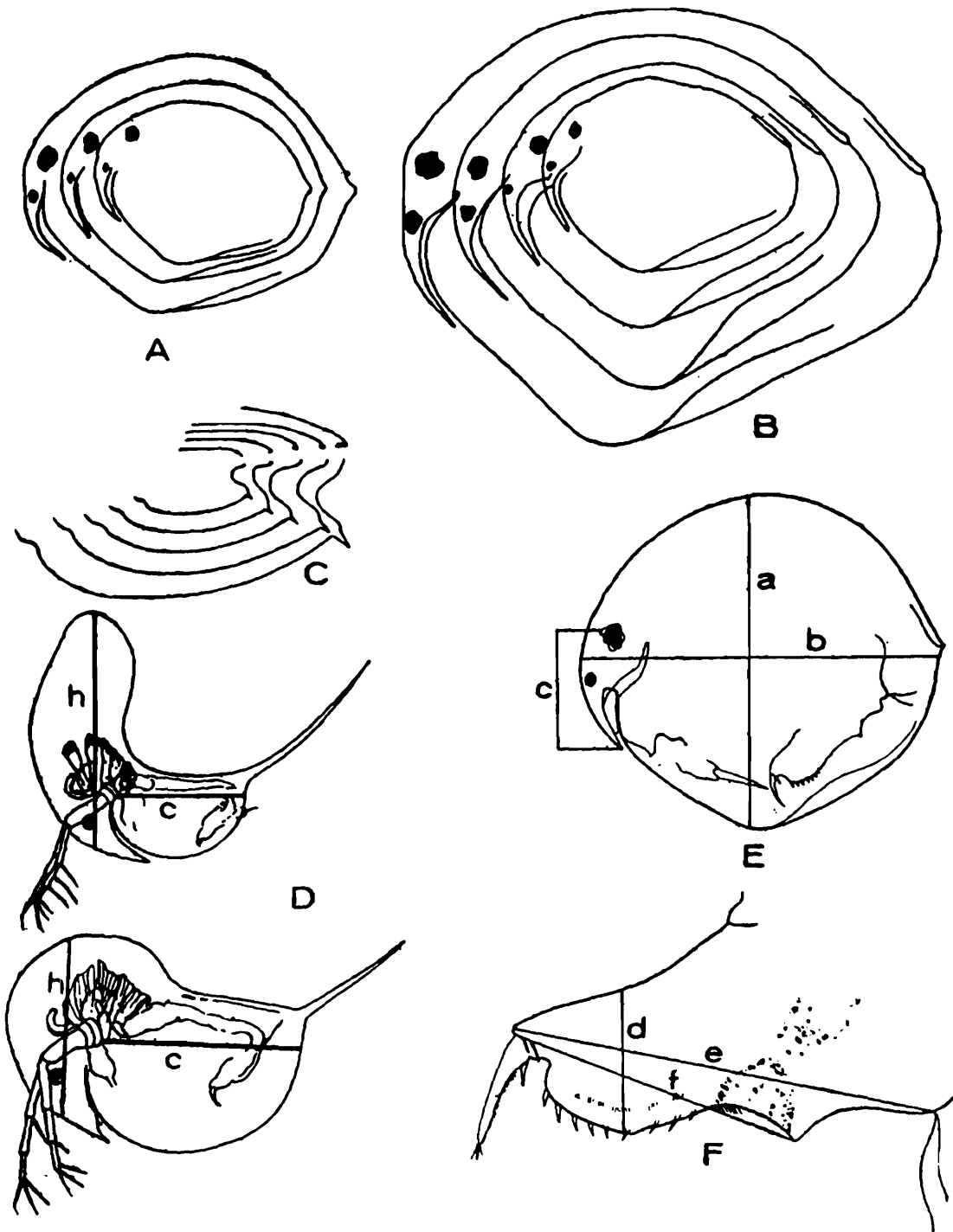
One of the conspicuous organs in the head region is the compound eye and in certain species an ocellus is also present. When present, the size and location of the ocellus with reference to the eye and the tip of the rostrum is, at times, helpful for separation of some taxa. The head bears antennules and antennae. The antennule, in most cases, is a simple structure bearing olfactory setae laterally or terminally. The antennule itself may be situated on the ventral side of the head as in the Moinidae or at the anterior margin as in Macrothricidae. In members of the family Daphniidae the antennules are much reduced and immovable, whereas in Moinidae they are long and mobile as also are those of Macrothricidae. In the latter family the apical enlargement of the antennule along with the pattern of incisions on its anterior margin with the rows of setules therein are structures used in taxonomy. The antennae are attached close to the posterior margin of the head and are usually biramous. The number of segments in each ramus and the arrangement and number of setae in each of them is constant within a species but in some cases differs from species to species and is, therefore, of taxonomic importance. These details may be given as a formula ; as for example, 0-0-1-3/1-1-3 implies that the dorsal and ventral rami have four and three segments each and, again starting from the base, each of the segments bears 0, 0, 1, 3 and 1, 1, 3 setae.

The mouth parts consist of a median labrum which, in the Chydoridae have a well developed plate which is of taxonomic value. There is a pair of hard, toothed mandibles whose structure and point of articulation are considered to be of value in separation of taxa and a pair of small maxillules. Generally the Cladocera have either 5 or 6 pairs of trunk limbs, and their structure and pattern

of setulation are proving to be of increasing importance in taxonomic studies. While in some families like the Sididae all the six pairs of legs are similar in form, in the other families the legs are differentiated in varying degrees. In males the first pair of legs are modified and bear hooks. The posterior part of the body ends in a broad structure called the postabdomen, which usually bears the anus and shows kicking movements while alive and in some species assists locomotion in addition to clearing the unwanted waste. The postabdomen has been the single structure mostly employed in cladoceran taxonomy especially in certain families. Its shape, the number and arrangement of anal spines and the number and location of lateral setae or fascicles are of taxonomic value. The postabdomen terminates in a pair of claws and also bears two long abdominal setae. The size and number of basal spines, the number of spinules making up the pecten and their arrangement and the general shape and structure of the claws are of taxonomic importance. While the postabdomen and the claw structure are of utmost importance in the family Chydoridae, these may not be of much relevance in other families. A few other morphological structures like the abdominal processes, hepatic caecae and the straight or looped nature of the intestine have also been assigned taxonomic value. It should be borne in mind that apart from this plan of the general morphology there are always specific deviations in certain of these structures in different families or other lower taxa of Cladocera.

#### MORPHOMETRIC MEASUREMENTS

Morphometric measurements in Cladocera have often been used to indicate the relationship between any two or more morphological measurements expressed as a ratio. At times such ratios have been found to be extremely useful to segregate a species or the populations of a single species. Some of these ratios are body length : height, head length : carapace length (Text-fig. 2, D-F) or length : height of the postabdomen (Text-fig. 2, D-F). The growth pattern in many cladocerans appears to be isometric for most parts of the anatomy, and the size increment at each instar may, therefore, be easily depicted in the form of a nested diagram (Text-fig. 2, A,B). At times such a construction for even individual parts like the postabdomen can be so depicted (Text-fig. 2, C), which



Text-fig. 2 C : Growth pattern of postabdomen of *Eurycercus glacialis* (after Frey, 1973).

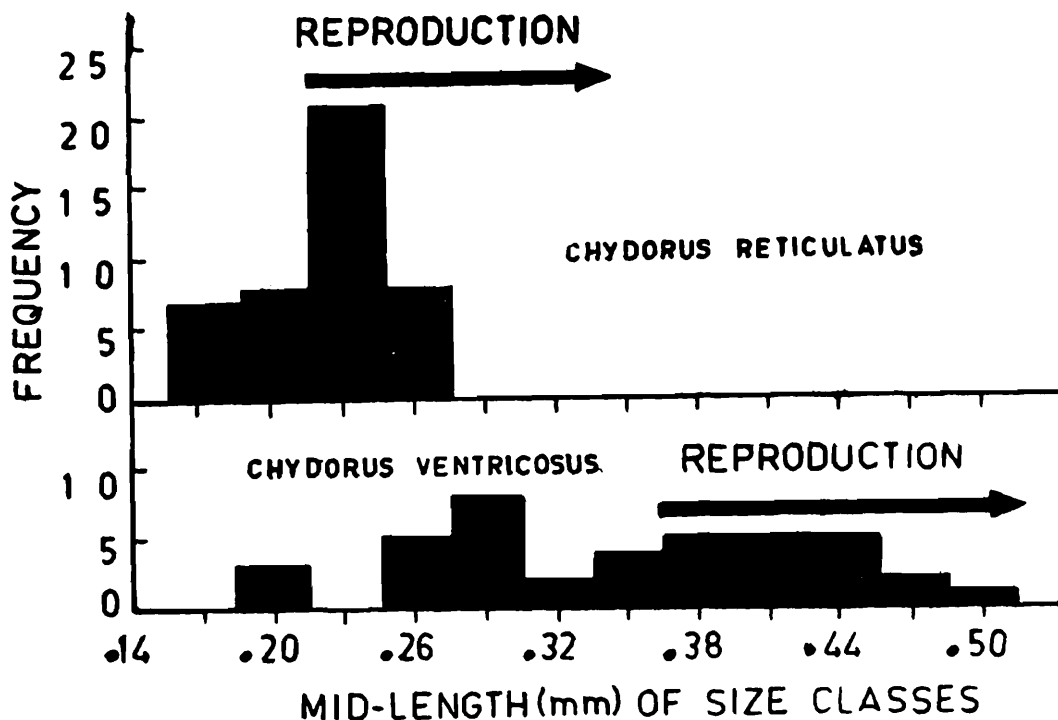
Text-fig. 2 D : Head length : Carapace length (h : c).

Text-fig. 2 E : Morphometric measurements of body. a-height ; b-length ; c-distance between the eye and tip of rostrum.

Text-fig. 2 F : Morphometric measurements of postabdomen. d-height ; e-length and f-length of distal part of postabdomen.

Text-fig. 2 A-B : Nested diagram of instars of *Chydorus reticulatus* and *C. ventricosus*.

will reflect the trend of growth at different instars. In certain species, the posterodorsal margin of the valve shows distinct protruberance in the later instars, and morphological variations of this nature at different instars within the same species can be misleading when



Text-fig. 3 : Size-frequency distribution in *Chydorus reticulatus* and *C. ventricosus*. (after Michael & Hann, 1979)

determining species identity. It is, therefore, suggested that whenever a large number of individuals of a species is available in plankton samples, a length-frequency histogram could be plotted which will not only give the range of size variation but also be of use to distinguish the pre and post reproductive instars (Text-fig. 3). In addition, such an analysis may also help in sorting out coexisting species which otherwise closely resemble each other. The various measurements of these ratios and the length frequencies can easily be made with an eye piece oculometer calibrated with a Stage micrometer.

#### BIOLOGY AND ECOLOGY

Various aspects of the cladoceran biology have been investigated from early times (Weismann, 1876-79 ; Wesenberg-Lund, 1926 ; Brown, 1926 ; Ingle *et al.*, 1937 ; Berg, 1931 ; Cannon and Leak, 1933 ; Banta, 1939 ; Anderson and Jenkins, 1942 ; Hoshi, 1950, 1951). Life cycle problems such as parthenogenesis, gamogenesis,

the control of sex and crowding of the mothers as a means of controlling male production have been extensively investigated (Banta and Brown, 1929a, b,c). The phenomenon of phenotypic variation resulting in cyclomorphosis, its pronounced induction in temperate lakes and the causative factors have attracted several workers (Brooks, 1946 ; 1947 ; 1965 ; Jacobs, 1961, 1967, 1970). However, in recent years, the currently popular predation-avoidance hypothesis to explain cyclomorphosis is being questioned (Hebert, 1978). Many of the North temperate species of Cladocera have been used as experimental animals in physiological, embryological and genetic studies, since they can be easily maintained in the laboratory as pointed out by Goulden (1968). In recent times, Cladocera have been used as indicators as well as test organisms for estimation of toxicity levels of pesticides and other environmental pollutants (Frear and Boyd, 1967 ; Muirhead-Thompson, 1971 ; Canton and Adema, 1978 ; Adema, 1978). Other biological studies pertain to food and feeding propensities (Richman, 1958 ; McMohan and Rigler, 1965 ; Burns, 1968, 1969 ; Arnold, 1971 ; Porter, 1973, 1975). Problems associated with longevity, fecundity, life cycle strategies and instar duration of laboratory populations have been reviewed recently (Lynch, 1980). A "Symposium on the ecology of Cladocera" held under the auspices of American Microscopical Society at Bloomington, Indiana, USA (24-26 Aug, 1970), highlighted some of the current problems as their overall role in limnetic and littoral communities, functional morphology with special reference to crowding, possible environmental control in the alternation of parthenogenesis and gamogenesis, influence of photoperiod and response of cladoceran communities to seasonal and long-term environmental changes including those resulting from human activities (Frey, 1971b). The recent publication on the Special Symposium of the American Society of Limnology and Oceanography held at Dartmouth College, Hanover, New Hampshire, USA has many excellent papers on Cladoceran biology (Kerfoot, 1980). Cladocera occur in all kinds of habitats like ponds, lakes, swamps, rainpools and even in very moist soil and among ~~the~~ mosses and leafy liverworts (Frey, 1980a). These crustaceans live in the open water, among the weeds in littoral zone and on the benthic mud. Generally cladocerans feed on microalgae, bacteria and detritus with a few exceptions like the members of Polyphemidae, Cercopagidae and *Leptodora* which are carnivorous, while a single genus

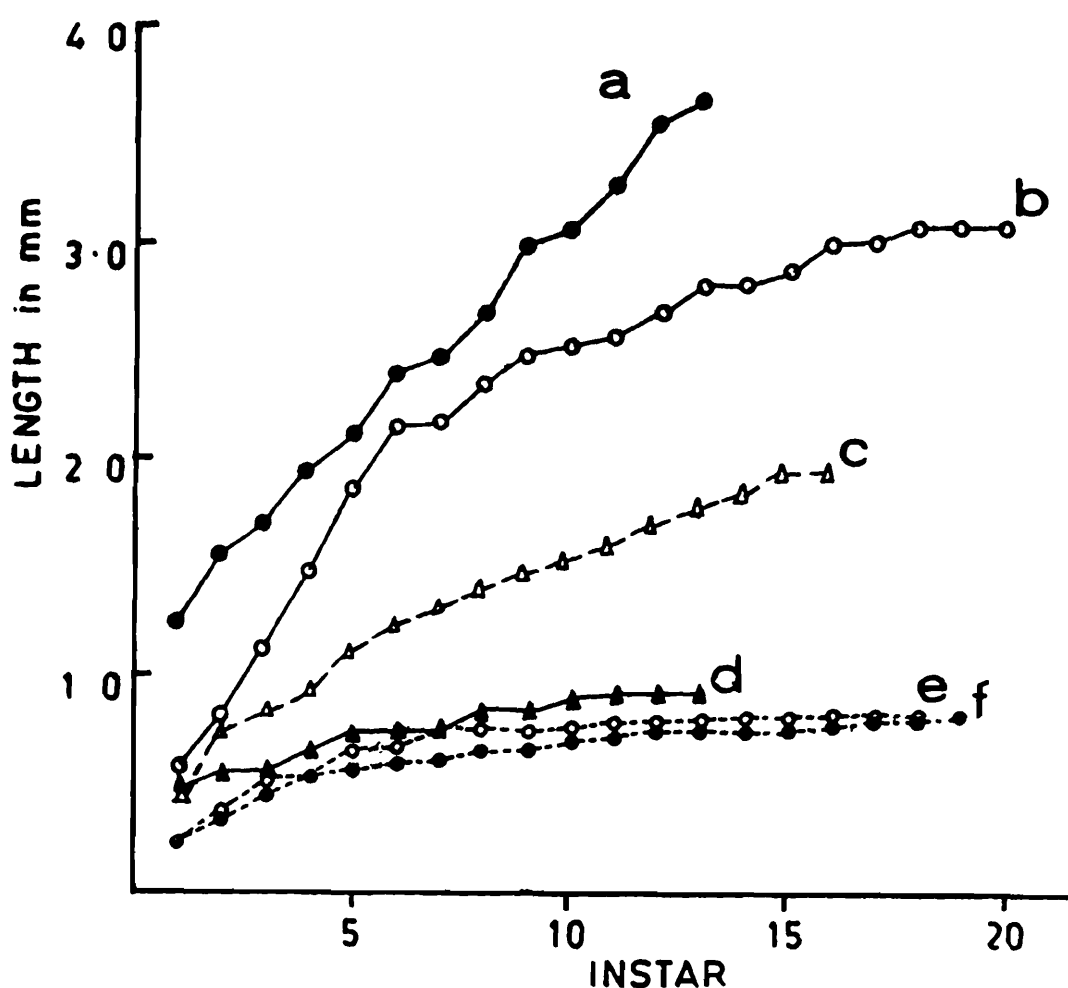
*Anchistropus* lives parasitically on *Hydra*. The limnetic genera like *Daphnia*, *Ceriodaphnia*, *Moina* and *Diaphanosoma* are planktonic algal-bacterial feeders, while the littoral chydorids like *Alona* and *Chydorus* associated with marginal weeds may feed on attached algae or detritus scraped from the substratum. The benthic forms like *Ilyocryptus* and *Leydigia* probably live on detritus or associated bacteria in the bottom mud.

Ecological studies of natural cladoceran populations under Indian conditions always formed a part of general limnological investigations as recently reviewed by Michael (1980). Such ecological studies have shown certain characteristics of the cladoceran populations. One such phenomenon is the sporadic appearance and sudden disappearance of these populations. Further, when these organisms are present in a system, the pattern of their seasonal abundance is quite dissimilar in successive years even in the same habitat, as was reported for *Ceriodaphnia cornuta* (Michael, 1962) and *Daphnia carinata* (Vijayaraghavan, 1970). Year to year studies of several other workers have well attested this sporadic incidence. Many factors such as the initial seeding of an aquatic system, critical life history stages synchronising with the favourable environmental conditions and flooding of temporary pools are responsible for the success of a species. But in addition to these, it is felt that under Indian tropical conditions, the astatic nature of most of the aquatic biotopes, their small and shallow nature, excessive human interference resulting in eutrophication of urban and village ponds are unique features which cladoceran populations have to contend with. It is likely that these factors too contribute to the violent and catastrophic nature of population changes. In terms of cladoceran composition, generally species belonging to genera such as *Moina*, *Ceriodaphnia* and *Diaphanosoma* are the most ubiquitous forms in the limnetic plankton. Species of *Daphnia*, though of rare occurrence, when present seem always to be in swarm proportions. Though comparable data on littoral cladoceran species are still meagre, some of the very few recent studies have shown that chydorid genera like *Pleuroxus*, *Chydorus* and *Alona* seem to be common (Bhattacharya, 1980).

Of the 90 Indian species of Cladocera reported in this text, the aspects of the biology of only six species have been so far investigated from this country. The studies in this direction were initiated

by Michael (1962), who besides observing the seasonal events in a natural population of *Ceriodaphnia cornuta* also worked on its life cycle. The other related studies under Indian conditions are those of Navaneethakrishnan and Michael (1971), Murugan and Sivaramakrishnan (1973, 1976), Murugan (1975a, 1975b), Murugan and Venkataraman (1977), Murugan and Ramaseshan (1978), Das *et al.*, (1984), and Sharma and Sharma (1984). All these studies were restricted to females. The biology of the male of *Daphnia lumholtzi* Sars has been recently investigated for the first time from this country (Das *et al.*, 1981).

The data related to the life cycle studies of various Indian cladoceran representatives have been compiled in Table I and fig. 4.



Text-fig. 4 : Showing length increment against instar numbers in different Indian cladoceran species.

a-*Daphnia carinata* King, b-*Simocephalus acutirostratus* (King), c-*Daphnia lumholtzi* Sars, d-*Moina micrura* Kurz, e-*Ceriodaphnia cornuta* Sars, f-*Scapholeberis kingi* Sars.

TABLE I : COMPARATIVE LIFE HISTORY PARAMETERS OF DIFFERENT SPECIES OF CLADOCERA WORKED OUT UNDER INDIAN CONDITIONS

Species studied	Average maximum length mm	No. of Preadult instars	No. of adult instars	Total No. of instars	Total life span days	Cumulative No. of eggs	Rate of egg production <i>a</i> value	Expt. Temp. °C	Source
<i>FEMALE</i>									
<i>Daphnia carinata</i>	2.900	5	8	13	24.0	42.4	0.7695	29-31	Navaneethakrishnan & Michael, 1971
<i>Ceriodaphnia cornuta</i>	0.660	1-2	9	11	12.0	42.0	1.959	28-30	Michael, 1962
<i>Ceriodaphnia cornuta</i>	0.760	2	18	20	21.2	123.6	1.076	28-30	Murugan, 1975b
<i>Simocephalus acutirostratus</i>	3.200	4	18	22	44.0	248.0	1.139	28-30	Murugan & Sivaramakrishnan, 1973
<i>Scapholeberis kingi</i>	0.920	2	17	19	20.5	239.4	1.333	28-30	Murugan & Sivaramakrishnan, 1976
<i>Moina micrura</i>	1.008	2	11	13	13.0	61.2	1.0368	28-30	Murugan, 1975a
<i>Daphnia lumholtzi</i>	1.750	4-5	11-12	16	42.1	24.2	1.1666	12-18	Sharma (Das) <i>et al.</i> , 1984
<i>MALE</i>									
<i>Daphnia lumholtzi</i>	1.235	—	—	13	30.33	—	—	12-18	Das <i>et al.</i> , 1981

These studies have shown that one of the major differences between the Indian forms and those of the temperate regions is their relatively shorter life spans. Such findings are of theoretical interest, since in terms of energy turnover, the secondary productivity through these organisms could be accelerated under the tropical conditions for the same time interval (Murugan and Sivaramakrishnan, 1973).

Earlier works also indicate a number of differences in the life cycles of the tabulated species. One such difference is evident in the life cycles of *Ceriodaphnia cornuta* studied at two latitudes at 23°N in West Bengal (Michael, 1962) and 9°N at Madurai (Murugan, 1975b). These examples indicate that latitudinal differences could have caused variations in the fecundity, number of instars and mean total life span in this species, though there is no direct evidence to prove it. Such investigations involving the same species from any two distant localities, lying between the extremes of latitudes of 7°N and the 38°N that delimit our Indian landmass, may bring out still more interesting features on the biology of these microcrustaceans.

#### COLLECTION, PRESERVATION AND STUDY

Any plankton net of small mesh size will retain most of the cladoceran species which inhabit the open waters of lakes and ponds, although a mesh size no greater than 150 $\mu$ m is usually recommended to collect even the early instars. For deep waters, it will be necessary to make an integrated vertical haul to obtain a representative collection. On the other hand, in small shallow ponds, buckets of water could be hauled and poured through a fine meshed net which will serve the purpose for the limnetic species. For the weed inhabiting or benthic forms— a net with a long handle and a wire-meshed lid to sieve off the obstructing algae and weeds should prove efficient.

Formalin (4 to 5% concentration) or 70% alcohol is ideal for the preservation of most cladoceran species. However, those with a thin carapace could also be preserved in 80% ethanol. Subsequent to collection, sorting can be done under a Stereo Binocular Microscope at low magnifications. For preparation of permanent

mounts of whole organisms, specimens should be graded through different concentrations of glycerol to avoid shrinkage, particularly the soft shelled forms. Finally the material is placed in a drop of glycerine jelly, suitably oriented and sealed by ringing the coverslip with any sealing medium like glyceel. It is always advisable to study the entire plankton sample, since the exuviae which are sometimes abundant prove very useful in determination of genera and species. In most cases, for the specific identification the various parts are to be dissected out, cleared and mounted in polyvinyl lactophenol preferably stained with lignin pink. Loops made up of tungsten wire are ideal to lift individual specimens or their parts for successive grading and processing. Such fine loops and needles can be made easily from wire of 0.3 mm thickness by electrolysis in 10% KOH. A 2-cm length of wire clamped to one terminal of a 6-volt electrical circuit is dipped into the electrolyte until the desired point is obtained. Depending upon how deep the wire is inserted into the solution, the points can be short and stout or long and slender. For the preparation of loops, the slender points can easily be bent small enough even for handling very small parts. The advantage of using tungsten wire over ordinary steel is that it is not affected by either acid or alkali.

The exuviae are also very useful for examination of the fine morphological details essential in the identification of species. Apart from the naturally occurring exuviae, these can also be prepared from intact animals by heating them in a small quantity of concentrated hydrochloric acid on a cavity slide when the tissues are removed leaving the exoskeleton. This method is particularly necessary to obtain the head shields increasingly used in taxonomy (Megard 1965).

All the drawings for the present study were done using the M 20 Wild Compound Microscope with the Wild drawing-tube system at the Department of Zoology at the Indiana University, USA and a Dialux-20 Model of Leitz Compound Microscope with a Leitz drawing-tube system at the Department of Zoology, Northeastern Hill University at Shillong. In both cases, Phase Contrast Fluotar objectives were used to study the fine setulation in the valves and the postabdomen. The measurements of the described taxa have been given in millimeters (mm).

Most early taxonomic studies on Cladocera were largely based on whole organisms and gross morphological characters. Only in recent years have attributes such as trunk limb morphology, head pore arrangement and structure and even functional morphology been studied for taxonomic purposes. Recently, Scanning Electron Microscope analysis has been done on the fine structure of head pores and their arrangement. Based on this, the possible functions of these organs in mechanoreception or stridulation are postulated and in future, such studies are also expected to throw light on cladoceran taxonomy (Dumont and Van de Velde 1976). It is felt that similar studies should be extended to all genera and superspecies, since these recent tools of taxonomic refinement offer exciting advantage over the conventional morphotaxonomic approach.

Several sources provided the collections examined for the present study. These are designated in the text as *Reference material* and *Other materials* and the illustrations were always made from the reference material. Whenever the figures are adapted from other sources, these are mentioned under the respective species. The five major sources of examined materials are referred to as ZSI, DGF, CHF, RGM and BKS. These abbreviations represent collections of Zoological Survey of India, Prof. D. G. Frey, Prof. C. H. Fernando and those of the present authors respectively. In addition to these, several other collections were examined and have also been included under the category of *Other Materials*. In such instances the locality, name of collector and date of collection are given in detail.

As mentioned earlier, the problem of obtaining type materials for the present study was to some extent circumvented by making the detailed and original illustrations and descriptions of the Indian material and comparing them with types, reference collections and available literature from India and elsewhere in the world. In this connection special mention should be made of a study of certain type and reference materials at Dr. Frey's laboratory who had the following Chydorid species in his collections mostly as mounted slides :

*Chydorus ventricosus* Daday, 1898

*Chydorus pubescens* Sars, 1901

- Alona macrorrhyncha* Daday, 1900 (= *Kurzia longirostris* (Daday, 1898))  
*Alonopsis orientalis* Daday, 1898 (= *Euryalona orientalis* (Daday, 1898))  
*Euryalona tenuicaudis* (Sars, 1862)  
*Alona macrops* Daday, 1898 (= *Dadaya macrops* (Daday, 1898))  
*Alona punctata* Daday, 1898 (= *Alona diaphana* King, 1853)  
*Alonopsis singalensis* Daday, 1898 (= *Oxyurella singalensis* (Daday, 1898))  
*Dunhevedia neglecta* Daday, 1903 (= *Dunhevedia crassa* King, 1853)  
*Dunhevedia crassa* King, 1853  
*Alona karua* King, 1853  
*Alona tenuicaudis* Sars, 1862 (= *Oxyurella tenuicaudis* (Sars, 1862))  
*Alona verrucosa* Sars, 1901  
*Chydorus* cf. *pubescens* Sars, 1901

The specimens of the above mentioned species form a part of original collections of Dr. Daday available at Termesztudományi Múzeum, Budapest from where a portion of the samples were brought by Prof. D. G. Frey after examining them there. Dr. Daday's report in 1898 on the freshwater fauna of Ceylon included the descriptions of several new cladoceran taxa which are of much relevance to India, hence the importance of the study of these collections.

Scanning Electron Micrographs of a few representative species of cladocera are shown in Plate : I to highlight the potential of this technique in future cladoceran studies.

#### REVIEW OF EARLIER INDIAN WORKS

The systematic studies on Indian Cladocera were initiated as early as 1860, when Baird described a new species of Genus *Daphnia* from the material collected by Rev. Hislop from Nagpur, Central India. A review of earlier literature indicates that even after a time lapse of one century and two decades, only two dozen papers dealing with Cladocera from this country has so far been published.

All these previous Indian works have been tabulated below (Table II).

TABLE II : INDICATES A BRIEF REVIEW OF EARLIER INDIAN WORKS ON CLADOCERA

Name of Author and year of Publications	Area of Investigations	Reported taxa Genus Species		Remarks
Baird, W. 1860	In and around Nagpur	1	1	Collections made by Rev. Hislop
Gurney, R. 1906	Kang Kul, Chitral Mission (now in Pakistan) Kyd Street (Museum compound) tank, Calcutta Brackish pools, Port Canning, Calcutta.	5	5	Material present in Indian Museum collected by Dr. Annandale and also material from his aquarium
Gurney, R. 1907	Lower Bengal—Port Canning & Calcutta (Museum Tank, Zoological gardens, tank in Maidan and Aquarium in Museum) Chota Nagpur-Chakradharpur	12	17	1 species unidentified. Collections sent by Dr. Annandale
Daday, J. 1911	Bangalore	1	1	Material sent by Dr. Annandale
Sewell, R.B.S. 1935	Indian Museum tank	10	11	Collections made between 1929-1931
Brehm, V. 1936 and Brehm, V, & Wolterek, R. 1939	Punjab (parts now in Pakistan) Ladakh, Kashmir and Nilgiri Hills.	21	35	2 species unidentified. Material collected by Yale North India Expedition. Brehm & Wolterek studied the Daphniids from this material.

Name of Author and year of Publications	Area of Investigations	reported taxa		Remarks
		Genus	Species	
Brehm, V. 1950	Banikpore and Mirzapur (Bihar); Phagu Village and Kalka (Simla Hills); Pulta water works (W. Bengal) ; Amarkantaha, Rewa State (M.P.)	7	9	4 species unidentified.
Brehm, V, 1952	Bombay	1	1	
Brehm, V. 1953	Nepal; Sikkim; Kali Pokhri (Assam); Burnihat (Meghalaya); Siliguri (W. Bengal); Nagpur (M.P.); Nandlour, Karikal, Latour, Bijapur, Hyderabad, Golconda, Bassein (?), Mysore, Banaras, Meerut, Surate, Ahmedabad, Quilon, Sarnath, Savantvadi (?), Kodikanal, Mahi, Tirupathur, Pondicherry, Ernakulum, Pavai Lake (Bombay), Pandharpur (?);			
„ „	Cochin & Malabar Coast	2	2	Marine cladocerans
Brehm, V 1963	Jamuna River, Delhi	2	2	Sent by Dr. S.V. Ganapati
Biswas, S. 1964a	Rajasthan	1	1	

Name of Author and year of Publications	Area of Investigations	reported taxa		Remarks
		Genus	Species	
Biswas, S. 1964b	Theong & Phagu village (Simla Hills), Kameng Division, NEFA	3	6	ZSI material collected between 1907-1916 from Simla Hills & Collections made by Swiss Entomological Expedition in 1961 from NEFA
Biswas, S. 1966	Dudu, Jaipur District (Rajasthan)	1	1	ZSI Collections
Petkovski, T.K. 1966	Ahmedabad (Gujerat), Nimata Ajwa Reservoir & water works (Baroda)	8	11	sent by Dr. S. V. Ganapati
Biswas, S. 1971	Rajasthan	17	41	total of 45 taxa. ZSI material collected between 1957-61.
Nayar, C.K.G. 1971	Rajasthan	17	18	Collection made during 1962-64.
Michael, R. G. 1973	Madurai (Tamilnadu)	8	3	7 species undetermined. Material locally collected.
Yousuf, A.R. & Qadri, M.Y 1975	Malpur Sar (Kashmir)	6	7	.
Patil, S.G. 1976	Meghalaya & Manipur	13	17	
Shirgur, G.A. & Naik, A.A. 1977	Back Bay opposite Taraporevala Aquarium, Bombay	1	1	

Name of Author and year of Publications	Area of Investigations	reported Genus	Taxa Species	Remarks
Nasar, S.A.K.	Bhagalpur, Bihar	5	11	
Qadri, M.Y & Yousuf, A.R. 1977	Beehama spring (Kashmir)	4	4	
Sharma, B.K. 1978	Calcutta & its environs (W. Bengal)	23	34	total of 36 taxa
Michael, R.G. & Hann, B.J. 1979	Trivandrum	1	2	examined material from collection No. 1524 of Dr. D. G. Frey, Indiana University, USA

Evidently most of the earlier contributions are from scattered localities. Very few instances (Biswas, 1971 ; Nayar, 1971 and Sharma, 1978) deal with comprehensive studies of cladocerans from any particular region of this country. A detailed systematic list of cladocera recorded from India, as an outcome of the forementioned studies, is given below. In addition, the various works that listed the different taxa from this country have also been indicated.

#### LIST OF PREVIOUSLY REPORTED CLADOCERAN TAXA FROM INDIA

##### Family : SIDIDAE

<i>Pseudosida bidentata</i> Herrick	: Brehm, 1953
<i>Pseudosida szalayi</i> Daday	: Brehm, 1953 ; Biswas, 1971
<i>Latonopsis australis</i> Sars	: Biswas, 1971
<i>Latonopsis occidentalis</i> Brige	: Biswas, 1971
<i>Latona tiwari</i> Biswas	: Biswas, 1964a (n. sp) ; Biswas, 1971

- Sida crystallina* (O. F. Muller) : Brehm, 1936  
*Diaphanosoma brachyurum* : Brehm, 1936  
 (Lievin)  
*Diaphanosoma sarsi* Richard : Gurney, 1907 ; Petkovski  
 1966 ; Biswas, 1971 ; Patil  
 1976 ; Nasar, 1977 , Sharma  
 1978  
*Diaphanosoma excisum* Sars : Biswas, 1971 ; Nasar, 1977 ;  
 Sharma, 1978  
*D. excisum* var. *stingelini* Jenkin : Biswas, 1971  
*D. excisum* var. *longiremis* Ekman : Sewell, 1935 ; Biswas, 1971 ;  
 Nasar, 1977  
*Diaphanosoma paucispinosum* : Brehm, 1950  
 Brehm  
*Diaphanosoma hydrocephalus* : Brehm, 1952 (n. sp) ;  
 Brehm  
*Diaphanosoma senegal* Gauthier : Brehm, 1953

## Family : DAPHNIIDAE

- Daphnia carinata* King : Brehm, 1950 ; 1953 ; Biswas,  
 1964b ; 1971 ; Michael, 1973 ;  
 Nasar, 1977 ; Sharma, 1978  
*D. carinata* var. *cephalata* King : Michael, 1973  
*Daphnia lumholtzi* Sars : Brehm, 1950 ; 1953 ; Biswas,  
 1971 ; Nayar, 1971 ; Michael,  
 1973 ; Nasar, 1977 ; Sharma,  
 1978  
*Daphnia magna* Straus : Brehm, 1936 ; 1953  
*Daphnia pulex* (De Geer) : Brehm, 1936 ; 1950 ; Biswas,  
 1964b ; Nasar, 1977  
*Daphnia obtusa* Kurz : Biswas, 1964b  
*Daphnia similis* Claus : Nayar, 1971  
*Daphnia longispina* O.F. Muller : Brehm, 1950  
*Daphnia hyalina* Leydig : Biswas, 1971  
*Daphnia newporti* Baird : Baird, 1960 (n. sp)  
*Daphnia fusca* Gurney : Gurney, 1906 (n. sp)  
*Daphnia tibetana* f. *fusca* Gurney : Biswas, 1964b  
*Hyalodaphnia hypsicephala* Daday : Daday, 1911 (n. sp)  
*Daphniopsis tibetana* Sars : Brehm, 1936

- Ceriodaphnia laticaudata* Brehm, 1953 , Biswas,  
P. E. Muller 1964b ; 1971
- C. reticulata* var. *kurzii* Stingelin : Biswas, 1971
- C. reticulata* var. *serrata* Sars : Biswas, 1971
- Ceriodaphnia quadrangula* Brehm, 1936 , 1953  
(O. F. Muller) :
- Ceriodaphnia setulosa* Matile : Brehm, 1953
- Ceriodaphnia pulchella* Sars 1862 : Brehm, 1936
- Ceriodaphnia cornuta* Sars : Gurney, 1906 ; 1907 (*rigaudi*);  
Sewell, 1935 (*cornuta* and  
*rigaudi*) ; Brehm, 1950 , 1953  
(*rigaudi*) , Petkovski, 1966  
(*C. cornuta* f. *rigaudi*) ;  
Biswas, 1971 (*rigaudi*) ,  
Nayar, 1971 ; Patil, 1976  
(*rigaudi*) ; Nasar, 1977  
(*rigaudi*) , Sharma, 1978
- Scapholeberis kingi* (Sars) : Gurney, 1906 ; 1907 ; Brehm,  
1936 , Biswas, 1971 , Patil  
1976 , Sharma, 1978
- Simocephalus vetulus* (O.F. Muller) : Brehm, 1936 ; 1950 (*S.*  
*vetula*) ; Biswas, 1971 ; Na-  
yar, 1971 ; Nasar, 1971
- Simocephalus vetuloides* Sars : Brehm, 1936 ; 1950
- Simocephalus vetulus* (O.F. Muller) : Sharma, 1978  
*sensu lato* including *S. vetuloides*  
Sars
- Simocephalus elizabethae* (King) : Gurney, 1906 ; 1907 (*simosa*);  
Sewell, 1935 ; Biswas, 1971 ;  
Nasar, 1977 ; Qadri  
and Yousuf, 1977
- Simocephalus exspinosus* (Koch) : Patil, 1976 ; Sharma, 1978
- Simocephalus australiensis* Dana : Biswas, 1971
- Simocephalus acustirostratus* Sars : Brehm, 1953
- Simocephalus latirostris* Stingelin : Biswas, 1971

## Family : MOINIDAE

- Moina brachiata* (Jurine) : Biswas, 1971 ; Nayar, 1971 ;  
Patil, 1976

- Moina rectirostris* (Leydig) : Brehm, 1936 ; Biswas, 1971  
*Moina macrocopa* (Straus) : Biswas, 1971  
*Moina banyffi* Daday : Biswas, 1971  
*Moina weismanni* Ishikawa : Brehm, 1953  
*Moina esau* Brehm : Brehm, 1936 (n. sp)  
*Moina ganapati* Brehm : Brehm, 1953 (n. sp)  
*Moina dubia* Guerne & Richard : Sewell, 1935 ; Brehm, 1936 ;  
1950 ; 1953 ; Biswas, 1971 ,  
Nasar, 1977  
*Moina micrura dubia* Guerne & : Sharma, 1978  
Richard  
*Moina von Mondvi-flouve* : Brehm, 1953  
*Moinodaphnia macleayi* (King) : Brehm, 1953 (*macleayi*) ;  
Sharma, 1978

## Family : BOSMINIDAE

- Bosmina longirostris* (O.F. Müller) : Brehm, 1936 ; Yousuf &  
Qadri, 1975, Patil, 1976 ;  
Sharma, 1978  
*Bosminopsis deitersi* (Richard) : Brehm, 1963

## Family : MACROTHRICIDAE

- Macrothrix tenuicornis* Gurney : Gurney, 1907 (n. sp)  
*Macrothrix triserialis* Brady : Gurney, 1907 ; Biswas, 1971  
*Macrothrix chevreuxi* Guerne & : Biswas, 1971  
Richard  
*Macrothrix laticornis* (Fischer) : Brehm, 1936  
*Macrothrix goeldii* Richard : Gurney, 1907 ; Nayar, 1971 ;  
Sharma, 1978  
*Macrothrix spinosa* King : Biswas, 1971 ; Patil, 1976  
*Macrothrix rectirostris* : Brehm, 1936  
*Macrothrix hirsuticornis* Norman : Brehm, 1936  
and Brady  
*Echinisca triserialis* (Brady) : Sharma, 1979  
*Gurneyella odiosa* (Gurney) : Biswas, 1971  
*Guernella ceylonica* Daday : Brehm, 1953  
*Drepanomacrothrix* : Brehm, 1936 (n.g. n. sp)  
*stschelkanowzewi* Brehm

- Streblocerus serricaudatus* (Fischer) : Biswas, 1971 ; Patil, 1976  
*Thyocryptus longiremis* Sars : Gurney, 1907  
*Ilyocryptus hayli* Brady : Sewell, 1935 ; Biswas, 1971 ; Patil, 1976  
*Ilyocryptus spinifer* Herrick : Sharma, 1978

Family : CHYDORIDAE  
 Sub-Family : CHYDORINAE

- Pleuroxus aduncus* (Jurine) : Brehm, 1936 (cf. *aduncus*) ; Biswas, 1971 ; Nayar, 1971  
*Pleuroxus trigonellus* (O.F. Müller) : Brehm, (cf. *trigonellus*) ; Nayar, 1971  
*Pleuroxus similis* Vavra : Yousuf & Qadri, 1975 ; Qadri & Yousuf, 1977 ; Sharma, 1978  
*Pleuroxus denticulatus* Birge : Sharma, 1979  
*Alonella excisa* (Fischer) : Gurney, 1907 ; Brehm, 1936 ; Yousuf & Qadri, 1975  
*Alonella nana* (Baird) : Brehm, 1936  
*Alonella exigua* (Lilljeborg) : Brehm, 1936 ; Yousuf & Qadri, 1975 ; Qadri & Yousuf, 1977  
*Dunhevedia crassa* King : Gurney, 1907 ; Sewell, 1935 , Brehm, 1953 ; Petkovski, 1966 ; Biswas, 1971 ; Sharma, 1978  
*D. crassa* var. *interrupta* Brehm : Brehm, 1936 (n. var)  
*Dadaya macrops* (Daday) : Brehm, 1953  
*Chydorus globosus* Baird : Gurney, 1907 ; Brehm, 1953 ; Nayar, 1971 ; Patil, 1976  
*Chydorus sphaericus* (O.F. Müller) : Gurney, 1906 , 1907 ; Brehm, 1936 ; Patil, 1976 ; Yousuf & Qadri, 1975 ; Qadri & Yousuf, 1977 ; Sharma, 1978  
*Chydorus reticulatus* Daday : Biswas, 1971 ; Michael & Hann, 1979  
*Chydorus* sp. ? : Brehm, 1936

- Chydorus brehmi* Biswas : Biswas, 1964a (n. sp) ;  
Biswas, 1971
- Chydorus robustus* Stingelin : Brehm, 1953 ; Biswas 1971
- Chydorus barroisi* (Richard) : Petkovski, 1966 ; Sharma,  
1978 (*C. barroisi barroisi*)
- Chydorus eurynotus* Sars : Brehm, 1953 ; Nayar, 1971 ;  
Sharma, 1978
- Chydorus ventricosus* Daday : Petkovski, 1966 ; Biswas,  
1971 ; Michael & Hann, 1979
- Chydorus denticulatus* Henry : Biswas, 1971 ; Patil, 1976

## Sub-Family : ALONINAE

- Alona quadrangularis* (O.F. Müller) : Brehm, 1953
- Alona rectangula* Sars : Gurney, 1907 (*Lynceus*) ;  
Brehm, 1936 ; Petkovski,  
1966 ; Biswas, 1971 ; Nayar,  
1971 ; Yousuf & Qadri, 1975 ;  
Patil, 1976
- A. rectangula rectangula* Sars : Sharma, 1978
- A. rectangula richardi* (Stingelin) : Sharma, 1978
- Alona davidi davidi* Richard : Sharma, 1978
- Alona davidi punctata* Daday : Sharma, 1978
- Alona costata* Sars : Biswas, 1964b ; Patil, 1976
- Alona pulchella* Sars : Nayar, 1971 ; Sharma, 1978
- Alona guttata* Sars : Gurney, 1907 (*Lynceus gutta-*  
*tus*) ; Brehm, 1936
- Alona bukobensis* Weltner : Brehm, 1936 (cf.) ; Biswas,  
1971
- Alona ladacensis* Brehm : Brehm, 1936 (n. sp) ;
- Alona cambouei* Guerne & : Gurney, 1907 (*Lynceus*) ;  
Richard : Biswas, 1971
- Alona glabra* Sars : Biswas, 1971
- Alona protzi* Hartwig : Sewell, 1935
- Alona taraporevalae* : Shirgur & Naik, 1977 (n.sp)  
Shirgur & Naik : Sharma & Michael 1983  
(redescription)
- Alona intermedia* var. *minor* : Biswas, 1971  
Stingelin
- Alona verrucosa* Sars : Petkovski, 1966 ; Nayar, 1971

- Acroperus harpae* (Baird) : Brehm, 1936 ; Yousuf & Qadri, 1975 ; Patil, 1976 ; Sharma, 1978
- Camptocercus rectirostris* Schoedler : Brehm, 1936 ; Petkovski, 1966 ; Patil, 1976 ; Sharma, 1978
- Camptocercus australis* Sars : Gurney, 1907 ; Yousuf & Qadri, 1975
- Graptoleberis testudinaria* (Fischer) : Brehm, 1936 ; 1950
- Leydigia acanthocercoides* (Fischer) : Gurney, 1907 ; Petkovski, 1966 ; Biswas, 1971 ; Nayar, 1971 ; Sharma, 1978
- Leydigia australis* Sars : Gurney, 1907 ; Sewell, 1935
- Leydigia laevis* Gurney : Biswas, 1971
- Leydigia hardingi* Nayar : Nayar, 1971 (n. sp)
- Biapertura affinis* (Leydig) : Patil, 1976 (*Alona*) ; Sharma 1978
- Biapertura karua* (King) : Brehm, 1936 (*Alonella*) ; Petkovski, 1966 (*Alona*) ; Sharma, 1978
- Oxyurella singalensis* (Daday) : Sharma, 1978
- Oxyurella tenuicaudis* (Sars) : Sharma, 1978
- Oxyurella lindbergi* Brehm : Brehm, 1953 (n. sp)
- Kurzia longirostris* (Daday) : Sewell, 1935 (*Pseudoalona*) ; Sharma, 1978
- Euryalona orientalis* (Daday) : Brehm, 1953 ; Sharma, 1978
- Indialona ganapati* Petkovski : Petkovski, 1966 (n. gen. n. sp)
- Indialona globulosa* (Daday) : Sharma, 1978

## Family : POLYPHEMIDAE

- Polyphemus pediculus* (Linné) : Brehm, 1936

## Family : LEPTODORIDAE

- Leptodora hyalina* Lilljeborg : Brehm, 1936

Following are the known species of marine cladocerans reported from Indian waters :

## Family : SIDIDAE

*Penilia avirostris* Dana : Brehm, 1953

## Family : PODONIDAE

*Evadne tergestina* Claus : Brehm, 1953

The above list is based exclusively on the reports of earlier workers. Apparently the list seems too long and at times confusing as some nomenclatural changes do not figure in it. In addition, because of lack of detailed descriptions and insufficient illustrations, the validity of a number of reported taxa is still questionable. Furthermore, difficulty arises because of non-availability of most of the earlier collections, which renders the task much more difficult to assign correct names. The effect of distortion because of improper fixation and preservation in some previous collections is yet another handicap in some cases. Though efforts have been made to examine all the available earlier materials and to find equivalents for some uncertain taxa, nevertheless, all the ambiguities could not be completely resolved because of reasons detailed above. The nomenclatural status and validity of some reported taxa have been questioned and corrected in the present text in relevant sections. Besides, some of the nomenclatural changes which have relevance to Indian cladoceran representatives are also given below. The names given in parentheses refer to those who synonymised.

- |   |  |
|---|--|
| <i>Pseudosida szalayi</i> Daday   | = <i>Pseudosida bidentata</i> Herrick<br>(Thomas, 1961b) |
| <i>Latonopsis occidentalis</i> Birge                                      | = <i>Latonopsis australis</i> Sars                       |
| <i>Diaphanosoma paucispinosum</i><br>Brehm (Harding &<br>Petkovski, 1963) | = <i>Diaphanosoma excisum</i> Sars                       |
| <i>Diaphanosoma hydrocephalus</i><br>Brehm                                | = <i>Diaphanosoma senegal</i> Gauthier<br>(Brehm, 1953)  |
| <i>Daphnia carinata</i> var.<br><i>cephalata</i> King                     | = <i>Daphnia cephalata</i> (King)<br>(Hebert, 1977)      |
| <i>Simocephalus vetuloides</i> Sars<br>(Fryer, 1957)                      | = <i>Simocephalus vetulus</i> (O. F.<br>Müller)          |
| <i>Simocephalus australiensis</i><br>Dana (Harding, 1957)                 | = <i>Simocephalus exspinosus</i> (Koch)                  |

<i>Moina rectirostris</i> (Leydig)	=	<i>Moina brachiata</i> (Jurine)
<i>Moina banyffi</i> Daday	}	= <i>Moina macrocopa</i> (Straus)
<i>Moina esau</i> Brehm		
<i>Moina ganapati</i> Brehm	}	= <i>Moina weismanni</i> Richard
<i>Moina von Mandvi-flouve</i>		
<i>Moina dubia</i> Guerne & Richard	}	= <i>Moina micrura</i> (Kurz)
<i>Moina weismanni</i> Ishikawa ?		
<i>Moina micrura dubia</i> (Guerne & Richard) (Goulden, 1968)		
<i>Macrothrix triserialis</i> Brady	}	= <i>Echinisca triserialis</i> (Brady)
<i>Macrothrix chevreuxi</i> Guerne & Richard		
<i>Macrothrix tenuicornis</i> Gurney	}	= <i>Echinisca odiosa</i> (Gurney)
<i>Gurneyella odiosa</i> (Gurney)		
<i>Guernella ceylonica</i> Daday	=	<i>Guernella raphaelis</i> Richard
<i>Drepanomacrothrix</i> <i>stschelkanowzewi</i> Brehm	=	<i>Macrothrix grönlandica</i> Lilljeborg
<i>Ilyocryptus halyi</i> Brady	}	= <i>Ilyocryptus spinifer</i> Herrick
<i>Thyocryptus longiremis</i> Sars (Smirnov, 1976)		
<i>Chydorus globosus</i> Baird	=	<i>Pseudochydorus globosus</i> (Baird) (Fryer, 1968)
<i>Chydorus</i> sp.	}	= <i>Chydorus ventricosus</i> Daday (Michael & Hann, 1979)
<i>Chydorus brehmi</i> Biswas		
<i>Chydorus robustus</i> Stingelin	=	<i>Chydorus parvus</i> Daday (Fryer, 1957)
<i>Chydorus denticulatus</i> Henry	=	<i>Chydorus eurynotus</i> Sars (Biswas, 1971)
<i>Alona verrucosa</i> Sars	= transferred to Genus :	<i>Biapertura</i> (Smirnov, 1971)
<i>Oxyurella lindbergi</i> Brehm	=	<i>Oxyurella singalensis</i> (Daday) (Fryer, 1957)

In addition, the following cladocerans have been included in SPECIES INCERTAE SEDIS by Smirnov, 1971 :

*Alona ladacensis* Brehm, 1936, p. 295-296, figs. 4A-E.

*Leydigia hardingi* Nayar, 1971, p. 516, figs. 49-51.

SYSTEMATIC LIST OF PRESENTLY DESCRIBED CLADOCERAN TAXA

Class : CRUSTACEA

Sub-Class : BRANCHIOPODA

Order : CLADOCERA

Family : SIDIDAE Baird, 1850

*Pseudosida bidentata* Herrick, 1884 including var. *szalayi* (Daday, 1898)

*Sida crystallina* (O.F. Müller, 1776)

*Latonopsis australis* (Sars, 1888)

*Diaphanosoma sarsi* Richard, 1894a

*Diaphanosoma excisum* Sars, 1885

*Diaphanosoma senegal* Gauthier, 1951

Family : DAPHNIIDAE Straus, 1820

*Ceriodaphnia cornuta* Sars, 1885

*Ceriodaphnia reticulata* (Jurine, 1820)

*Ceriodaphnia quadrangula* (O.F. Müller, 1776)

*Ceriodaphnia laticaudata* P.E. Müller, 1867

*Ceriodaphnia pulchella* Sars, 1862b

*Daphnia carinata* King, 1853

*Daphnia cephalata* (King, 1853)

*Daphnia lumholtzi* Sars, 1885

*Daphnia pulex* Leydig, 1860 emend Scourfield, 1942

*Daphnia obtusa* Kurz, 1874

*Daphniopsis tibetana* Sars, 1903a

*Scapholeberis kingi* Sars, 1903b

*Simocephalus vetulus* (O.F. Müller, 1776) *sensu lato* including *S. vetuloides* Sars, 1898

*Simocephalus exspinosus* (Koch, 1841)

*Simocephalus latirostris* Stingelin, 1906

*Simocephalus acutirostratus* (King, 1853)

*Simocephalus serrulatus* (Koch, 1841)

Family : MOINIDAE Goulden, 1968

*Moina micrura* Kurz, 1874

*Moina macrocopa* (Straus, 1820)  
*Moina brachiata* (Jurine, 1820)  
*Moina weismanni* Ishikawa, 1896  
*Moinodaphnia macleayi* (King, 1853)

- Family : BOSMINIDAE Sars, 1865  
*Bosmina longirostris* (O.F. Müller, 1776)  
*Bosminopsis deitersi* Richard, 1895c
- Family : MACROTHRICIDAE Norman & Brady, 1867  
*Macrothrix spinosa* King, 1853  
*Macrothrix goeldii* Richard, 1897  
*Macrothrix laticornis* (Jurine, 1820)  
*Macrothrix grönlandica* Lilljeborg, 1900  
*Echinisca triserialis* (Brady, 1886)  
*Echinisca odiosa* (Gurney, 1907)  
*Streblocerus serricaudatus* (Fischer, 1849)  
*Ilyocryptus spinifer* Herrick, 1882
- Family : CHYDORIDAE Stebbing, 1902
- Sub-Family : EURYCERCINAE Kurz, 1875  
*Eurycercus lamellatus* (O.F. Müller, 1776)
- Sub-Family : CHYDORINAE Stebbing, 1902  
*Pleuroxus aduncus* (Jurine, 1820)  
*Pleuroxus trigonellus* (O.F. Müller, 1776)  
*Pleuroxus similis* Vavra, 1900  
*Pleuroxus laevis* Sars, 1862a  
*Pleuroxus denticulatus* Birge, 1879  
*Alonella excisa* (Fischer, 1854)  
*Alonella nana* (Baird, 1850)  
*Chydorus sphaericus* (O.F. Müller, 1776)  
*Chydorus parvus* (Daday, 1898)  
*Chydorus faviformis* Birge, 1893  
*Chydorus* cf. *herrmanni* Brehm, 1933a  
*Chydorus kallipygos* Brehm, 1934  
*Chydorus barroisi* Richard, 1894b  
*Chydorus reticulatus* Daday, 1898  
*Chydorus ventricosus* Daday, 1898

*Chydorus pubescens* Sars, 1901  
*Dunvehedia crassa crassa* King, 1853  
*Dunhevedia crassa cilio-caudata* (Sovinski, 1891)  
*Dunhevedia serrata* Daday, 1898  
*Dadaya macrops* (Daday, 1898)  
*Pseudochydorus globosus* (Baird, 1843)

Sub-Family : ALONINAE Frey, 1967

*Alona quadrangularis* (O.F. Müller, 1776)  
*Alona rectangula rectangula* Sars, 1862a  
*Alona rectangula richardi* (Stingelin, 1895)  
*Alona davidi davidi* Richard, 1895a  
*Alona davidi punctata* (Daday, 1898)  
*Alona costata* Sars, 1862b  
*Alona monacantha tridentata* (Stingelin, 1905)  
*Alona pulchella* King, 1853  
*Alona guttata* Sars, 1862b  
*Alona taraporevalae* Shirgur & Naik, 1977 ex Sharma  
 & Michael, 1983  
*Acroperus harpae* (Baird, 1834)  
*Acroperus angustatus* Sars, 1863  
*Camptocercus rectirostris* Schoedler, 1862  
*Graptoleberis testudinaria* (Fischer, 1848)  
*Leydigia acanthocercoides* (Fischer, 1854)  
*Leydigia australis ceylonica* Daday, 1898  
*Biapertura affinis* (Leydig, 1860)  
*Biapertura karua* (King, 1853)  
*Biapertura verrucosa* (Sars, 1901)  
*Oxyurella singalensis* (Daday, 1898)  
*Oxyurella tenuicaudis* (Sars, 1862b)  
*Kurzia longirostris* (Daday, 1898)  
*Kurzia latissima* (Kurz, 1875)  
*Euryalona orientalis* (Daday, 1898)  
*Indialona ganapati* Petkovski, 1966  
*Indialona globulosa* (Daday, 1898)

Family : POLYPHEMIDAE Baird, 1845  
*Polyphemus pediculus* (Linné, 1761)

Family : LEPTODORIDAE Lilljeborg, 1861  
*Leptodora kindti* (Focke, 1844)

*Note* : The list is based almost exclusively on the study of material by the authors. In a few instances, the species reported by earlier workers have been included, as sufficient details have been given in their reports. All the listed taxa are described to serve as ready reference for other Indian workers. Keys to the recorded taxa are also given.

However, there are still some cases, where reported species have not been sufficiently described or illustrated and where such taxa also were not present in the examined collections. Since these species are considered valid, these are only mentioned under the respective genera as ADDITIONAL SPECIES. In addition, one species of genus *Guernella* i.e., *G. ceylonica* Daday (= *raphaelis* Richard) has been previously reported from India but not represented in the examined material. Hence, the report of *Guernella* and its species have been included under ADDITIONAL GENUS AND SPECIES under the family Macrothricidae.

*Key to the Indian Families of CLADOCERA*

- |   |                            |
|---|----------------------------|
| 1. Body and legs covered with valves.   | .2                         |
| Body and legs not covered with valves.  | 7                          |
| 2. With six pairs of identical legs. Dorsal ramus (exopodite) of antenna 2 or 3 segmented and ventral ramus (endopodite) 3-segmented. | SIDIDAE Baird, 1850        |
| Five or six pairs of different legs. Dorsal ramus of antenna 3-segmented, ventral ramus 3 or 4-segmented                              | .3                         |
| 3. Antennules fused with rostrum, forming a snoutlike formation.  | .BOSMINIDAE Sars, 1865     |
| Antennules not fused with rostrum.  | .4                         |
| 4. Dorsal ramus of antenna 3-segmented, ventral ramus 4-segmented   | .5                         |
| Both rami of antenna 3-segmented.   | .CHYDORIDAE Stebbing, 1902 |
| 5. Antennules short and immobile.   | .DAPHNIDAE Straus, 1820    |
| Antennules long and movable.  | .6                         |

6. Antennules located on ventral side of head .MOINIDAE Goulden, 1968  
 Antennules located on anterior side of head .MACROTHRICIDAE Norman & Brady 1867
7. Head short .8  
 Head oblong. .LEPTODORIDAE Lilljeborg, 1861
8. Caudal appendages well developed, slightly shorter than body. .POLYPHEMIDAE Baird, 1845  
 Caudal appendages very short. .PODONIDAE Mordukhai-Boltovskoi, 1968

### Family I. SIDIDAE Baird, 1850

Carapace without any gelatinous mantle. Head large, cervical sinus present. Antennules large and movable, with 9 olfactory setae. Antennae biramous, with flattened rami; dorsal ramus with numerous setae (both lateral and terminal), ventral ramus with only terminal setae. Eye large, ocellus small or absent. Midgut straight, with a median hepatic caeca; rarely with two hepatic caecae. Six pairs of similar, flattened legs.

*Type Genus : Sida* Straus, 1820

In the present material, this family is represented by four genera.

#### *Key to the Indian genera of SIDIDAE*

1. Dorsal ramus of antenna 3-segmented. .*Sida* Straus, 1820  
 Dorsal ramus of antenna 2-segmented. .2
2. Postabdomen without anal spines. .*Diaphanosoma* Fischer, 1850  
 Postabdomen with anal spines. .3
3. Rostrum present. .*Pseudosida* Herrick, 1884  
 Rostrum absent. .*Latonopsis* Sars, 1888

#### Genus 1. *Pseudosida* Herrick, 1884

*Pseudosida* Herrick, 1884, p. 20

*Parasida* Daday, 1904a; Daday, 1905

Antennules of female with a long flagellum, sensory setae lateral. Dorsal ramus of antenna 2-segmented, ventral ramus 3-segmented; antennal setae  $\frac{3-3}{0-3-3}$  Postabdomen with bundles of spinules.

Claws bidentate.

*Type species* : *Pseudosida bidentata* Herrick, 1884

1. ***Pseudosida bidentata* Herrick, 1884**  
including var. *szalayi* (Daday, 1898)  
(Text-figs. 5, a-d ; 6, a-e)

*Pseudosida bidentata* Herrick, 1884, p. 20, pl. K, fig. 9 ; Birge, 1910, p. 1017, pl. LXVII, figs. 1-9 ; Stingelin, 1913, p. 605, figs. 4-6 ; Brehm, 1933b, p. 53 ; Brehm, 1953, p. 316, fig. 84 ; Thomas, 1961a, p. 114 ; Thomas, 1961b, p. 2-4 figs. 2-3 ; Fernando, 1974, figs. 34-37 ; Mamaril Sr. & Fernando, 1980, p. 132, fig. 93.

*Pseudosida tridenta* Herrick, 1887, p. 33, pl. 3, figs. 2-6; Herrick & Turner, 1895, p. 147, pl. 36, figs. 2-6 ; pl. 1, fig. 9.

*Pseudosida szalayi* Daday, 1898, p. 64, fig. 33 ; Stingelin, 1904, 335, pl. 11, figs. 1-2 ; Rzoska, 1952, p. 468, figs. 4-5 ; Fryer, 1957, p. 224 ; Harding, 1957, p. 59 ; Green, 1962, p. 417-418, fig. 2 ; Biswas, 1971, p. 110, figs. 2G-H.

*Parasida szalayi* Daday, 1910, p. 151, figs. 4, a-c.

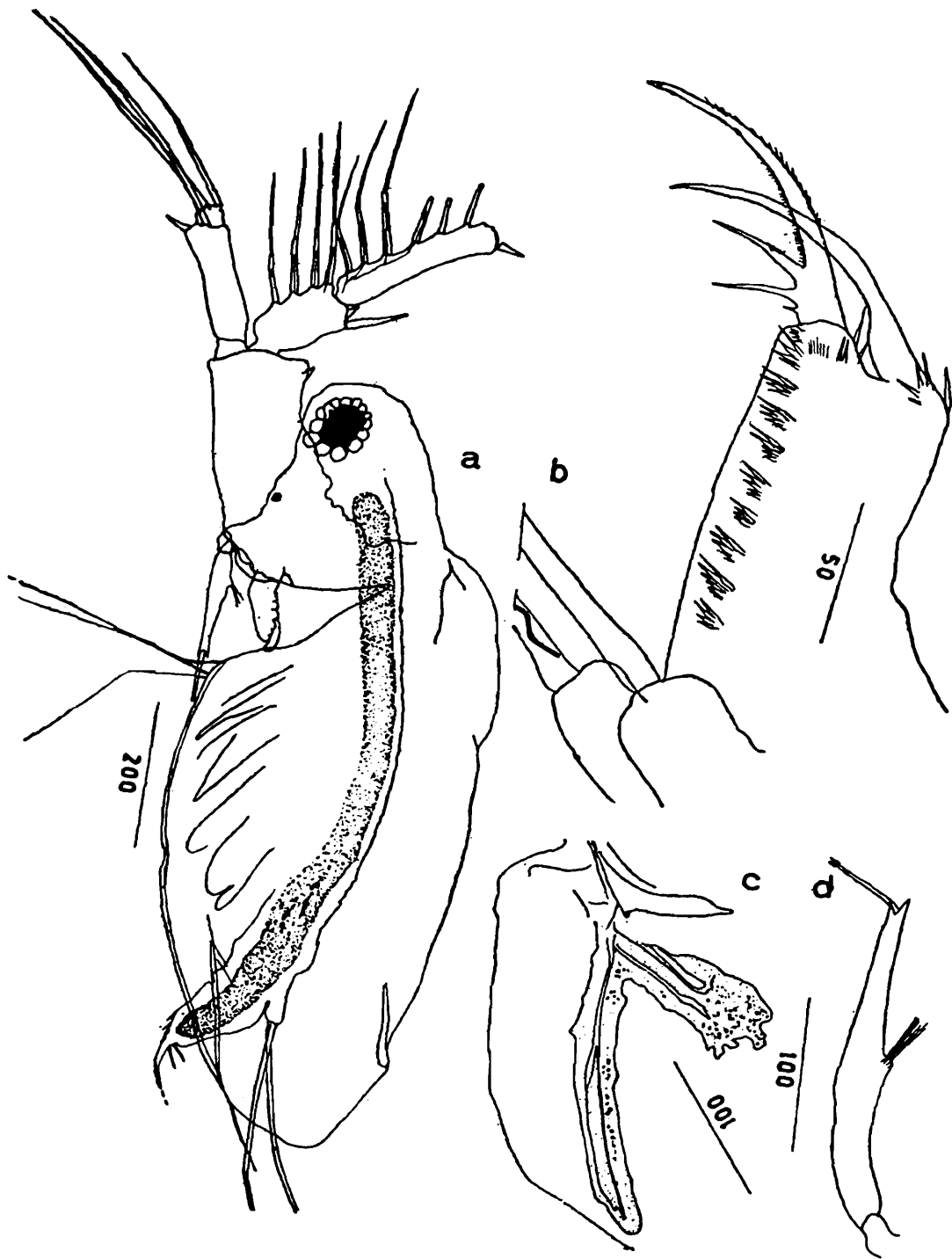
*Parasida variabilis* Daday, 1905, p. 220, pl. 14, figs. 8-12.

*Pseudosida szalayi* Brehm, 1953, p. 315-316, figs. 83, a-b.

*Latona tiwari* Biswas, 1964a, p. 140-152, fig. 182 ; Biswas, 1971, p. 106-107.

**MATERIAL EXAMINED** : *Reference material* : DGF 1521, Shallow tank, near Narasingam village, Madurai, 9.1.65. Other materials : DGF 117, 120, 123, 128, 132a, 139, 140, 141, 142, 149, 150, 152, 154, 166, 171, 184, 187, 188 (lakes and ponds in USA) ; Sample 2, Irinjalakuda, Kerala, collected by Dr. C. K. G. Nayar, 9.12.77 ; Collairu Lake (Manguluru Stn.), 15.10.73 ; ZSI C 4518/1 (Holotype of *Latona tiwari*), ditch at Barbarya village, Narayan, Rajasthan, 1.11.58 ; ZSI C 4519/1 (Paratypes of *Latona tiwari*) ; Sample 4, Madurai, collected by Mr. Anthony Basil, 11.12.77 ; DGF 1519, Oothangudi tank, Madurai, 9.1.65 (*P. szalayi*) ; Collairu lake, (Manguluru Stn.) 19.1.73 (*P. szalayi*) ; ZSI C 1982/2 Dobala Talao, Jaipur District, collected by Mr. S. Biswas, 29.10.58 (*P. szalayi*).

*Female*: Body elongate, head short and depressed ; dorsum more arched. Rostrum present ; no fornix or cervical glands. Antennules attached to the ventral side of rostrum ; with long basal



\*Text-fig. 5, a-d : *Pseudosida bidentata* (Herrick) : a. female ; b. postabdomen ; c. shell gland and d. antennule.

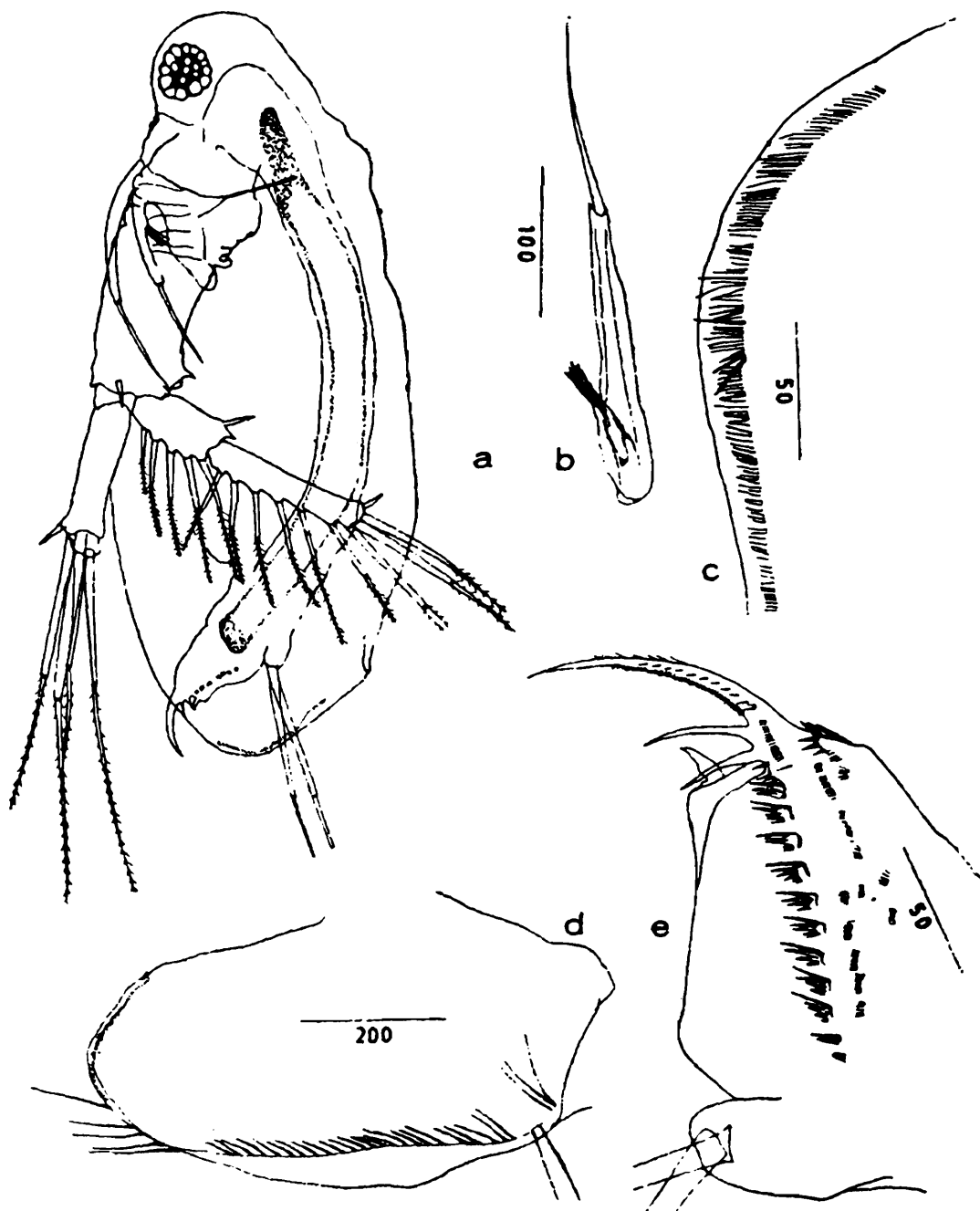
part, with olfactory setae on each side and a long flexible flagellum. Postabdomen with about 10-11 clusters of spinules. Claw with two large basal spines and a very small spine proximal to them.

*Length:* 1.0 mm.

- These measurements throughout the text refer to actual size of the mature animal as shown in figures.

*Male:* Not reported from India.

*Remarks:* There has been lot of confusion between *P. bidentata* Herrick and *P. szalayi* Daday (see: Thomas, 1961b). The only distinguishing character between the two (Birge, 1910, p. 1028) is the absence of the median projection in *bidentata* and its presence in *szalayi*, at base of claws on the ventral aspect. This difference being



Text-fig. 6, a-e : *Pseudosida bidentata* var. *szalayi* (Daday) : a. female ; b. antennule ; c. posterior margin of left valve (enlarged) ; d. left valve and e. postabdomen.

not sufficient to differentiate the two species, Thomas proposed to retain the name of *P. bidentata* (with *szalayi* as its synonym). Further, he mentioned that the specimens with a median projection may be retained as *P. bidentata* var. *szalayi* (Daday). In the present collections, both forms were found in the same population. Hence, following Thomas, typical specimens are identified as *P. bidentata* (Text-fig. 5, a-d) and those with a median projection are treated as var. *szalayi* (Daday) as illustrated in Text-fig. 6, a-e. Biswas (1964b) described a new species *Latona tiwari* from Rajasthan. Examination of two paratypes from his collections, showed these to be identical with *P. bidentata*.

*Distribution* : INDIA—Burnihat, Nandalur & Karikal (Brehm, 1953), Rajasthan (Biswas, 1971) identified by both as *P. szalayi*, Brehm (1953) also identified some specimens as *P. bidentata* Herrick. Elsewhere—Many parts of tropics or near tropics ; Sumatra, Sri Lanka, Malaysia, South Africa, Southern United States.

## Genus 2. *Sida* Straus, 1820

Dorsal ramus of antenna 3-segmented, ventral ramus 2-segmented. Head with large gland on dorsal side. Rostrum pointed. Antennule attached to lateral aspect of rostrum.

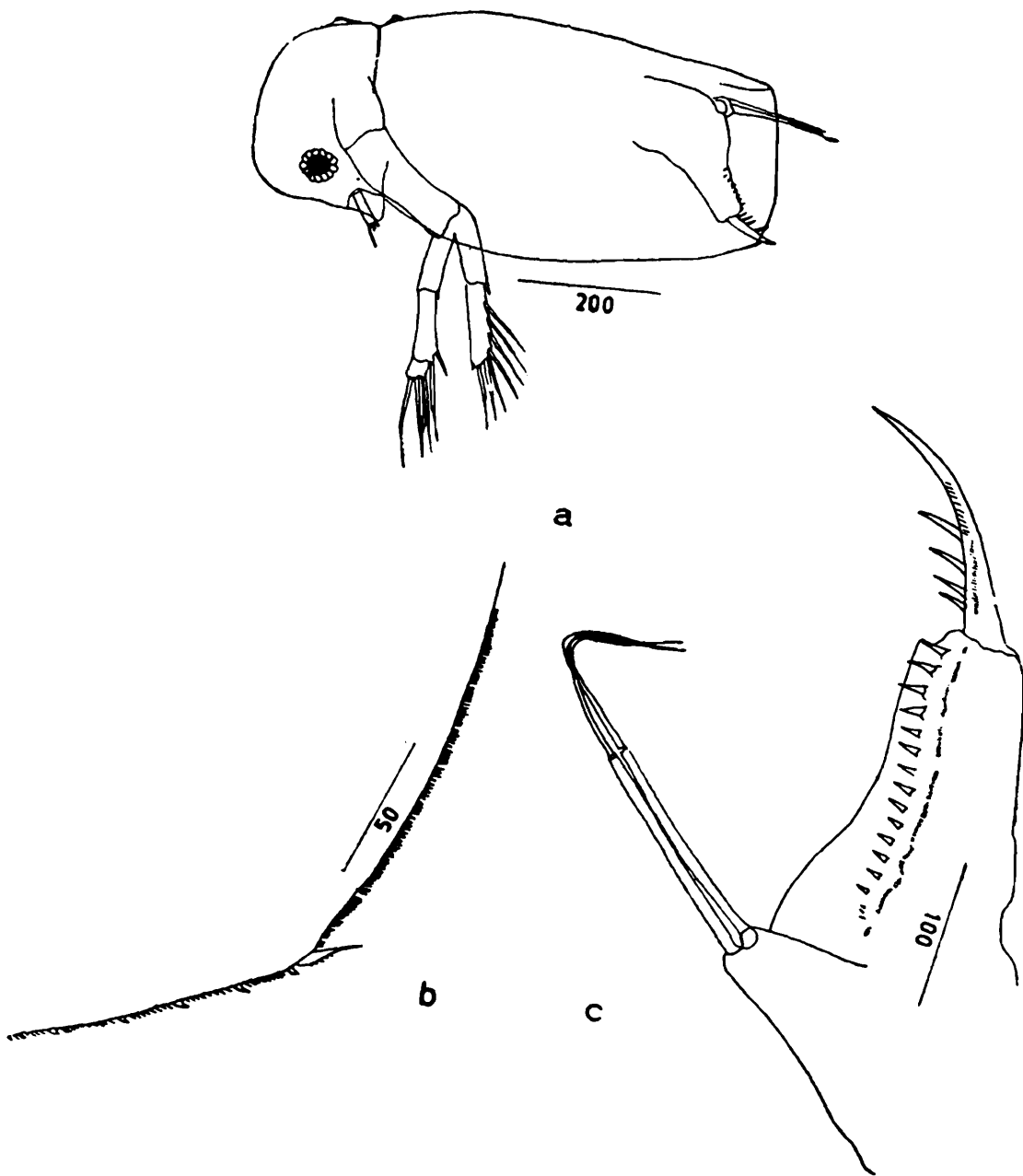
*Type species*: *Sida crystallina* (O.F. Müller, 1776) Only one known species.

### 2. *Sida crystallina* (O.F. Müller, 1776) (Text-fig. 7, a-c)

*Sida crystallina* Richard, 1895b, p.337, pl.xv, figs. 2-4 & 16 ; Lilljeborg, 1900, p.18, pl.1, figs. 1-10 ; Sars, 1903c, p.2 ; Keilhack, 1909, p.13, figs. 20-20 ; Stingelin, 1913, p.604-605, figs. 1-3 ; Ueno, 1927, p.278, pl. XXI, fig.1,a-c ; Ueno, 1932, p.214 ; Ueno, 1937, p.199 ; Ueno, 1938a, p.1 ; Ueno, 1938b, p.126, fig. 1 ; Brooks, 1959, p.599-600, fig. 274 ; Scourfield and Harding, 1966, p.12, fig. 17.

**MATERIAL EXAMINED** : *Reference material* : RGM 9, Kokrajhar, Assam, 10.4.78.

*Female*: Carapace transparent or yellowish. Body slightly oblong. Head very large, quadrate and clearly separable from the body by a cervical depression. A large dorsal gland present in littoral forms. Eye small, located in the ventral region of head, rostrum small and pointed. Antennules short, truncate, with short flagellum ; attached to side of rostrum. Post-abdomen with about 14 lateral anal spines ; groups of lateral setae arranged almost in a single row. Claw with four basal spines ; with a row of setae distal to the basal spines.



Text-fig. 7, a-c : *Sida crystallina* (O.F. Muller) : a. female ; b. posteroventral margin of right valve (enlarged) and c. postabdomen.

*Length:* 0.68 mm.

*Male:* Not known from India.

*Distribution:* INDIA—Kashmir (Brehm, 1936). Elsewhere—Holarctic and neotropical.

### Genus 3. *Latonopsis* Sars, 1888

*Latonopsis* Sars, 1888, p.6 ; Brooks, 1959, p.602 ; Thomas, 1961b, p.7.

Dorsal ramus of antennae 2-segmented, ventral ramus 3-segmented ; basal segment of dorsal ramus without lateral projection. No tongue-shaped process on ventral side of head. Antennule with flagellum distinctly articulated to the basal part. Eye dorsal, far from insertion of antennule and optic ganglion. Rostrum absent. Posterior margin of valves with very long setae. Shell gland very remarkable, tripartite.

*Type species:* *Latonopsis australis* Sars, 1888

### 3. *Latonopsis australis* Sars, 1888 (Text-fig. 8, a-e)

*Latonopsis australis* Sars, 1888, p.6, pl.1, figs. 1-6 ; Richard, 1895b, p.378-380, pl.16, figs. 11, 13 & 20 ; Thomas, 1961b, p.7 ; Harding & Petkovski, 1963, pl. 1-4, figs. 1-4 ; Ueno, 1966c p. 97-98, figs. 6-9 ; Biswas, 1971, p. 110, Text-figs. 8 A-C, Fernando, 1974, p. 38 ; Mamaril Sr. & Fernando, 1980, p. 132, figs. 91 & 92.

*Latonopsis occidentalis* Birge, 1892, p. 383-388, pl. 13, figs. 1-5 ; Richard, 1895b, p. 380-381, pl.16, fig. 12 ; Thomas, 1961b, p.7 ; Biswas, 1971, p.109, Text-figs. 2 I & J.

**MATERIAL EXAMINED :** *Reference material:* Sample 4, Madurai, collected by Dr. N. Murugan, 10.4.78. *Other materials :* DGF 1513, Kovur Village Tank near Madurai, 7.1.65 ; DGF 1529, Tulsi Dam, near Bombay, 17.1.65 ; ZSI C 1944/2 (*Latonopsis occidentalis*) pumping enclosure, Gudha Kyar, Sambhar Lake, Rajasthan, 11.10.58 ; ZSI C 1946/2 cemented tank, Gudha Kyar, Sambhar lake, Rajasthan, 15.10.58 ; Collairu Lake, (Kelletikota Stn.), 17.11.73.

*Female:* Body elongated; ventral margin of valves with numerous long setae, three setae at the posteroventral corner especially long. Head large, without a distinct rostrum. Eye located in the middle or dorsal part of head at a great distance from the



Text-fig. 8, a-e : *Latonopsis australis* (Sars) : a. female ; b. antennule ; c. posterior margin of right valve ; d. right valve with shell gland (entire) and e. postabdomen.

optic ganglion. Ocellus minute, located immediately in front of the base of the labrum. Flagellum of antennule about three times as long as the basal part, distinctly articulated into more than 10 joints and finely setose ; olfactory setae terminal. Shell-gland characteristic ; posterior branch much longer than anterior and extend beyond the middle of the valve. Postabdomen small, with about 7 marginal spines on each side or near the dorsal margin in the examined specimens ; lateral setae irregularly located. Claw large, with two slightly curved basal spines and with a few denticles on concave margin.

*Length:* 1.10 mm.

*Remarks:* In regarding *L. occidentalis* Birge as a synonym of *L. australis* Sars, 1888, account has been followed of Harding and Petkovski (1963).

*Distribution:* INDIA—Rajasthan (Biswas, 1971). Elsewhere—Australia, Oriental Regions.

#### Genus 4. *Diaphanosoma* Fischer, 1850

Head large, without rostrum, fornix or ocellus. Antennules small, truncated ; with terminal olfactory setae and a single flagellum. Dorsal ramus of antenna 2-segmented, ventral ramus 3-segmented, Postabdomen without anal spines. Claw with three basal spines.

Male with long antennules, copulatory organ and hook on first leg.

*Type species:* *Sida brachyura* (Liévin, 1848)

This genus is represented by three species in the examined Indian collections.

#### *Key to the reported Indian species of genus Diaphanosoma*

1. Distal part of ventral shell margin with short row of gradually diminishing setae, followed by rows of denticles. *D. senegal* Gauthier, 1951
- Distal part of ventral shell margin with small denticles. 2

2. Shell duplicature rounded at distal end. .*D. sarsi* Richard, 1894a  
 Shell duplicature joining ventral shell margin  
 at nearly right angle. .*D. excisum* Sars 1885

4. *Diaphanosoma sarsi* Richard, 1894a  
 (Text-fig. 9, a-d)

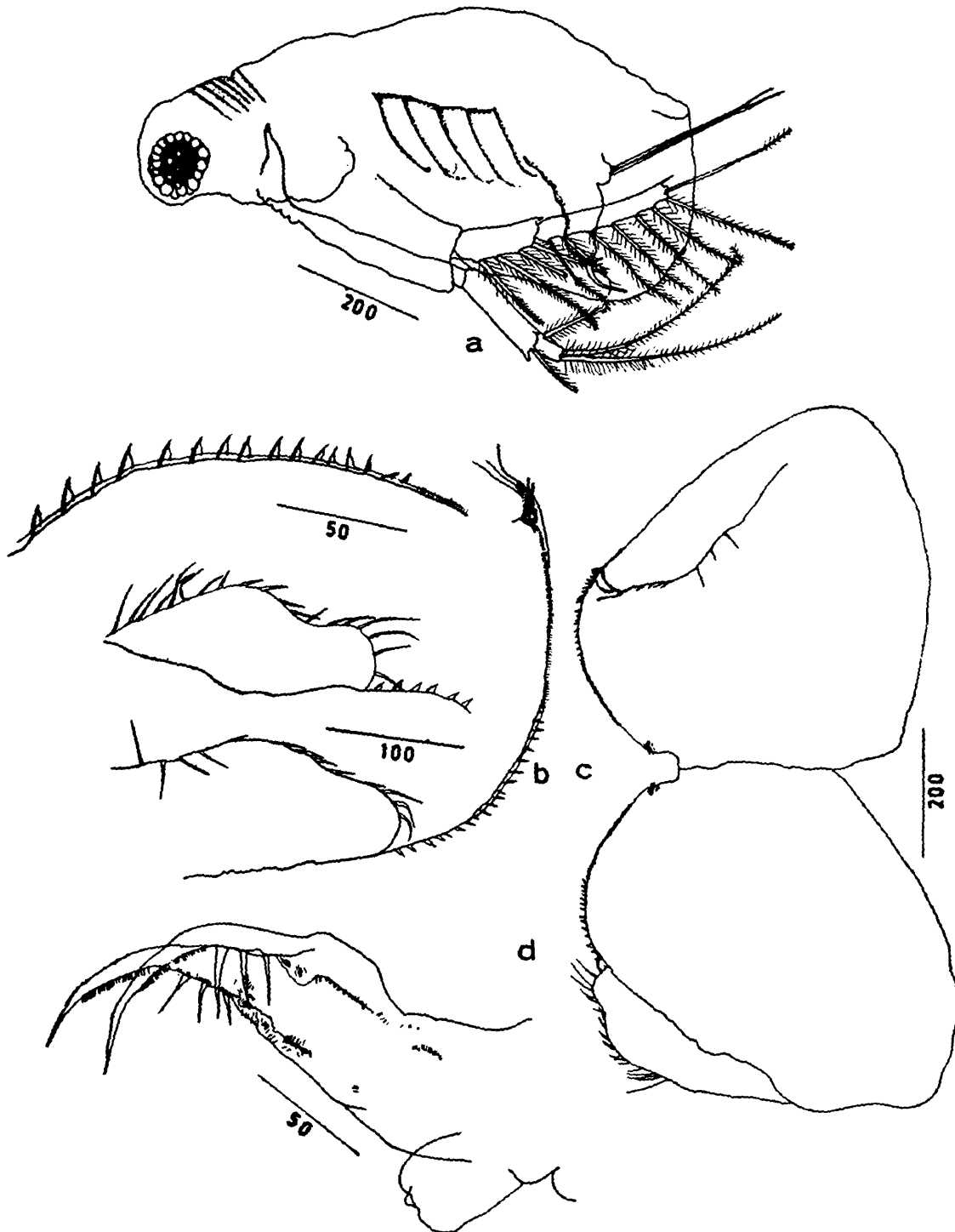
*Diaphanosoma sarsi* Richard, 1894a, p.365, pl.15, figs. 1-8; Richard, 1895c, p.568, figs. 4-5; Daday, 1901, p.41, fig. 19; Sars, 1901, p. 10-13, pl. II, figs. 1-10; Gurney, 1907, p.24; Bar, 1924, p.87, figs. 1-3; Jenkin, 1929, p.247, fig. X; Ueno, 1932, p.244-245, fig. 2; Brehm, 1933a, p.653, figs. 2,5, pl. 78, figs. 6-10, pl.79, figs. 11-14, pl.80, figs. 15-16; Ueno, 1938b, p.126-127, figs. 2, a-c & 3; Harding, 1957, p.59-60, figs. 1-2; Petkovski, 1966, p.163; Ueno, 1966c, p.100, figs. 16-17; Biswas, 1971, p.109, figs. 2 E & F; Green, 1972, p.217; Fernando, 1974, p.46, figs. 31-33; Nasar, 1977, p.35, fig. 5; Sharma, 1978, p.149; Mamaril Sr. & Fernando, 1980, p.131, figs. 79, 85 & 86.  
*Diaphanosoma singalense* Daday, 1898, p.62-64, fig. 32, a-b.

MATERIAL EXAMINED : *Reference material* : DGF 1513, Kovur village tank, near Madurai, 7.1.65. *Other materials* : DGF 2780, roadside ditch between New Delhi and Agra, 3.8.68. Sample 3, Madurai, collected by Dr. N. Murugan, 10.4.78; ZSI 5410/10, Chakradharpur, Chotanagpur, collected by Dr. N. Annandale; ZSI 1908/2, Narayana Talao, Narayan, Rajasthan, 2.11.58; Sample 5, fish nurseries, Calcutta sent by Dr. B. S. Bhimachar, 20.10.70; BKS—West Bengal : Budge Budge (24-Parganas), 16.1.75; Tank in maidan opposite Birla planetarium (Calcutta), 1.1.75; Tank opposite Lindsay Street (Calcutta), August-October, 1975 and 1976.

*Female*: Carapace oblong in outline; transversely truncate behind, with almost rectangular posterodorsal corner. Postero-ventral corner obliquely cut off and armed with a series of small denticles (12-20) followed by small setae. Dorsal margin more arched, ventral margin almost straight or slightly ascending. Shell duplicature broad on distal end. Head well defined, rather narrow, slightly tapering distally and almost obliquely truncated at frontal end. Eye exceedingly large and situated near anterior margin of head. Antennae not reaching hind edge of carapace. Postabdomen narrow. Claw with three basal spines rapidly decreasing in size proximally.

*Length:* 0.70 mm.

*Male:* Not recorded from India.



Text-fig. 9, a-d : *Diaphanosoma sarsi* Richard : a. female ; b. valves showing shell duplicature (enlarged) ; c. right and left valves ; and d. postabdomen.

\*Unless otherwise stated, the specimens for all the text figure drawings are taken from the 'REFERENCE MATERIAL' mentioned in the Text. All measurements in text are in mm, while those in drawings are in  $\mu\text{m}$

*Distribution:* INDIA—Bihar (Gurney, 1907 ; Nasar, 1977), (Petkovski, 1966), Rajasthan (Biswas, 1971), Meghalaya (Patil, 1976) and West Bengal (Sharma, 1978). Elsewhere—pantropical.

### 5. *Diaphanosoma excisum* Sars, 1885

(Text-fig. 10, a-e)

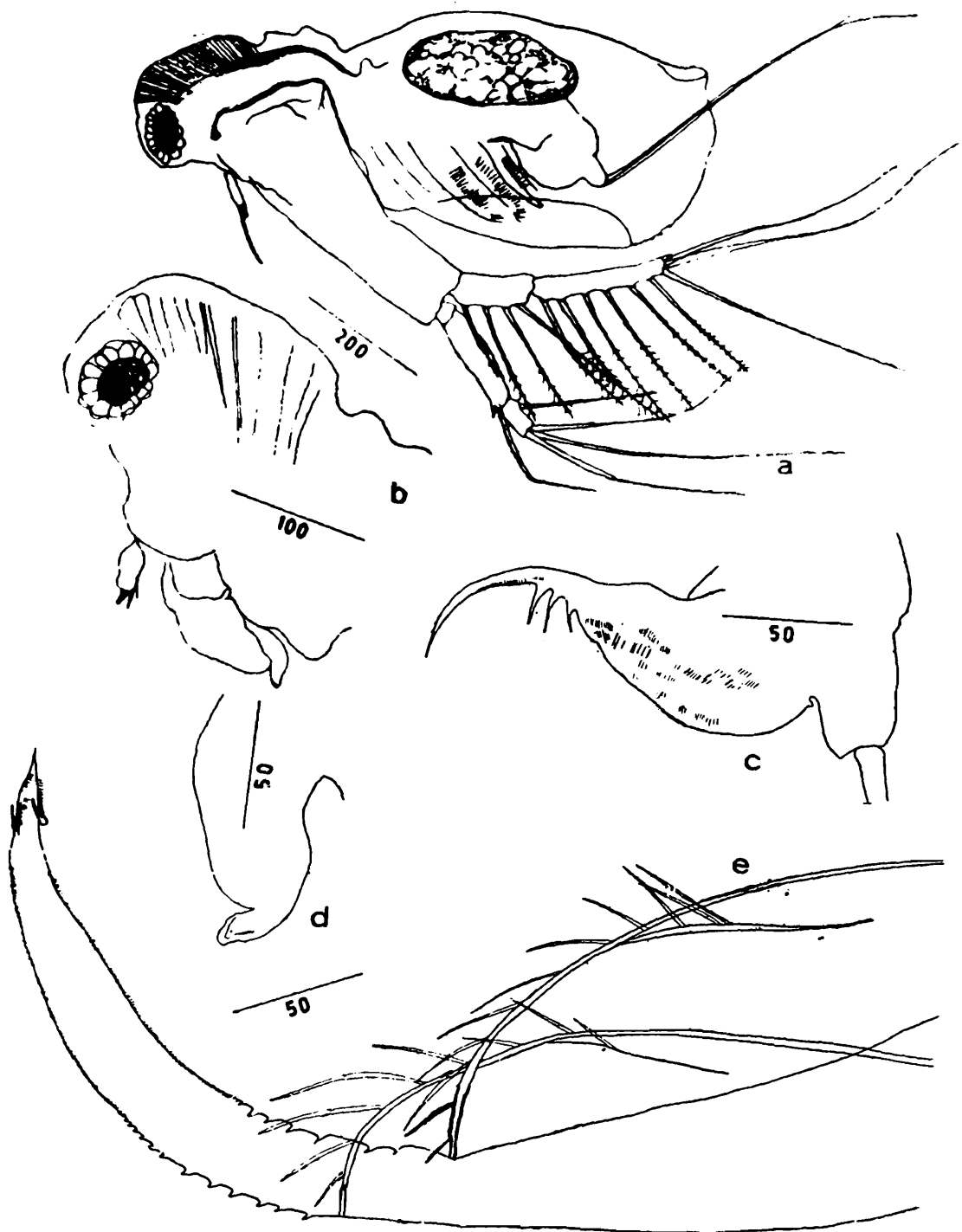
- Diaphanosoma excisum* Sars, 1885, p.13-18, pl.2, figs.1-3; Richard, 1895b, p.367 pl.16, fig. 9 ; Daday, 1910, p.150, pl.VIII, figs. 19-20 ; Gurney, 1911, p. 26 ; Gurney, 1916, p.333 ; Delachaux, 1917, p.79-80 ; Harding, 1957, p.35-36 ; Green, 1962, p.418 ; Rey and Saint-Jean, 1968, p.84, figs. 3 A-D ; Biswas, 1971, p.108, figs. 2 A & B ; Nayar, 1971, p.509 ; Fernando, 1974, figs.28-30 ; Nasar, 1977, p.35, fig. 6 ; Sharma, 1978, p.149 ; Swar & Fernando, 1979, p.116-117, figs. 2-4 ; Mamaril Sr. & Fernando, 1980, p.132, figs. 87-88.
- Diaphanosoma excisum* var. *stingelini* Jenkin, 1934, p.140-143, figs. 1, 1a ; Biswas, 1971, p.108, figs. 2 C, D.
- Diaphanosoma excisum* var. *longiremis* Ekman, 1904, p.1-2, figs. 2-3; Sewell, 1935, p.210 ; Biswas, 1971, p.108-109 ; Nasar, 1977, p.35.
- Diaphanosoma paucispinosum* Brehm, 1933a, p.656-659, fig. 3 : Uéno, 1938b, p.126 ; Uéno, 1966c, p.98-100, figs. 10-15.

**MATERIAL EXAMINED :** *Reference material :* Sample 1, Irinjalkuda, Kerala, collected by Dr. C. K. G. Nayar, 8.12.77. *Other materials :* Sample 3, Irinjalkuda, Kerala ; ZSI C 1907/2, C 1910/2, C 1912/2 (Jaipur, Rajasthan) 1.11.58; RGM 4, Kokrajhar, Assam, 10.4.78 ; Sample 10, Collairu Lake, (Kolletikota Stn), 17.12.73 ; rainwater puddle, Nidubrolu, 19.11.74, collected by Prof. Y Radhakrishna ; BKS—West Bengal : Barisha (24-Parganas), 3.2.77 ; Baranagar (Calcutta), 9.5.77 ; Sarisha (24-Parganas), 4.1.75 ; Maheshtala (24-Parganas), 30.11.77.

*Female:* Carapace almost oblong in outline, posterior end abruptly truncate. Posterodorsal corner of valves almost ending in a right angle. Posteroventral corner with variable number of denticles followed by delicate cilia ; number of denticles sometimes differing even on the two valves. Duplication joining ventral shell margin at nearly right angle. Head large, oblong-quadrate and obtusely truncate anteriorly. Eye relatively large, with numerous crystalline lenses ; located in the frontal portion of head, close to the ventral margin. Reflexed antennae not reaching posterior margin of valves. Postabdomen narrow with fine setules. Claw with three basal spines, decreasing in size proximally.

*Length:* 0.82 mm.

*Male:* Not known from India.



Text-fig. 10, a-e : *Diaphanosoma excisum* Sars : a. female ; b. head (enlarged) ; c. postabdomen ; d. plate of labrum ; and e. valves showing duplication and spines (enlarged).

*Remarks:* The presence of fine setules on postabdomen, a feature noticed by Jenkin (1934) and Rey and Saint-Jean (1968) is also evident in the examined specimens. Further, the present findings support the works of Jenkin (1934), Green (1962) and Nayar (1971) that the number of denticles on the posteroventral corner of the valves is variable.

*Distribution:* INDIA—West Bengal (Sewell, 1935 ; Sharma, 1978) ; Rajasthan (Biswas, 1971 ; Nayar, 1971) and Bihar (Nasar, 1977). Elsewhere—common in tropics and subtropics.

### 6. *Diaphanosoma senegal* Gauthier, 1951 (Text-fig. 11, a-c)

*Diaphanosoma senegal* Gauthier, 1951, p.43-45, pl. IX a-j ; Brehm, 1953, p.316-318, abb. 85-88.

*Diaphanosoma hydrocephalus* Brehm, 1952, p.138-140, abb. 1-4.

**MATERIAL EXAMINED :** *Reference material :* CHF 16, edge of Dam on river Khan, Indore, collected by Mrs. Vaidya, 21.1.76.

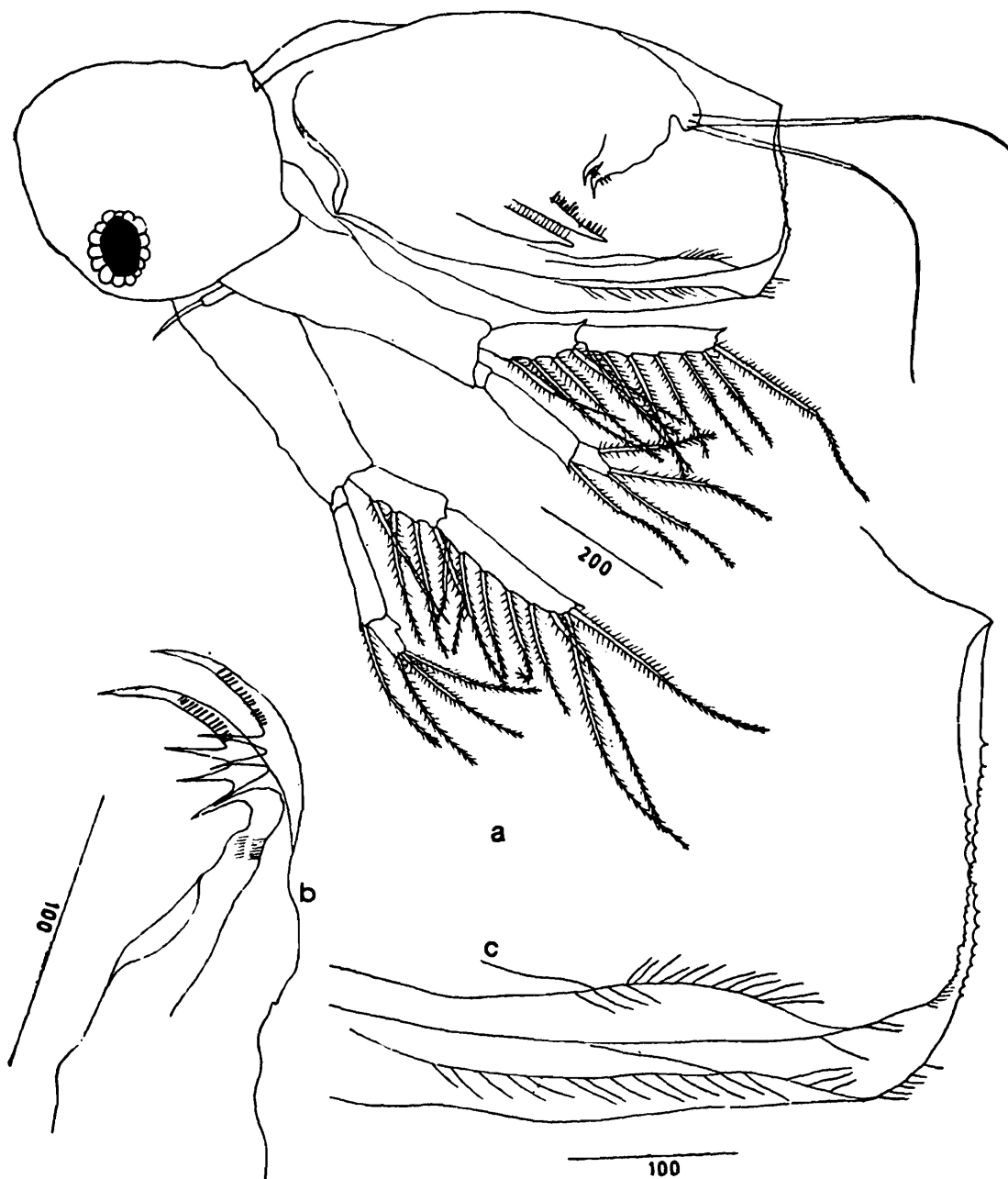
*Female :* Carapace almost oblong in outline ; posterodorsal corner with a distinct angle, dorsal margin slightly arched. Ventral margin of valves almost straight ; distal part of ventral shell margin with short row of gradually decreasing setae, followed by row of denticles. Shell duplicature narrow. Head markedly large, with sloping anterior margin. Eye moderately large ; located near the anterior ventral margin of head. Antennae not reaching posterior end of valves. Claw short ; with three basal spines increasing in length distally and with setae on its concave margin.

*Length :* 1.6 mm

*Male :* Not known from India.

*Distribution :* INDIA—Bombay (Brehm, 1952, 1953). Elsewhere—Senegal.

An additional species, *Diaphanosoma brachyurum* (Liévin, 1848) was reported from Kashmir (Brehm, 1936).



Text-fig. 11, a-c : *Diaphanosoma senegal* Gauthier : a. female ; b. postabdomen ; and c. posteroventral part of valves (enlarged).

### Family II. DAPHNIIDAE Straus, 1820

Antennules generally small, immobile or rudimentary. Antennae long, cylindrical, dorsal ramus 4-segmented, ventral 3-segmented. Antennal setae : 0-0-1-3/1-1-3. Eye large, ocellus small or wanting. Postabdomen distinctly set off from the body, usually more or less compressed and always with anal spines. Claws mostly denticulate, sometimes pectinate ; never with basal spine. Intestine not

convoluted, with two hepatic caecae. Five pairs of legs ; first two pairs prehensile and without branchial lamella. Parthenogenetic eggs numerous ; ephippium containing 1 or 2 eggs.

Male without rostrum, antennules large, movable. First leg with a hook.

*Type genus* : *Daphnia* O.F. Müller, 1785.

Represented by five genera in the Indian material.

*Key to the Indian genera of DAPHNIIDAE*

- |   |  |
|---|--|
| 1. Rostrum present                                    | .2                                     |
| Rostrum absent  | . <i>Ceriodaphnia</i> Dana 1853        |
| 2. Without any cervical sinus.                        | . <i>Daphnia</i> O. F. Müller, 1785    |
| Cervical sinus present                                | .3                                     |
| 3. Postabdomen conically tapering.                    | . <i>Daphniopsis</i> Sars, 1903a       |
| Postabdomen not conically tapering.                   | .4                                     |
| 4. Valves obscurely reticulated and with some striae. | . <i>Scapholeberis</i> Schoedler, 1858 |
| Valves transversely striated.                         | . <i>Simocephalus</i> Schoedler, 1858  |

**Genus 5. *Ceriodaphnia* Dana, 1853**

Body form rounded or oval. Valves oval or round to subquadrate, usually ending posteriorly in a sharp angle or short spine. Vertex with a rounded or angular projection, usually nearly filled by eye. Head small and depressed. Antennules small, not freely movable. One abdominal process ordinarily developed. Postabdomen large and quite variable in shape.

*Type species* : *Ceriodaphnia quadrangula* (O.F. Müller, 1776).

This genus is represented by five species in the examined material.

*Key to the Indian species of genus Ceriodaphnia*

- |   |                                |
|---|--------------------------------|
| 1. Head produced anteriorly into a short conical beak | . <i>C. cornuta</i> Sars, 1885 |
|---|--------------------------------|

- |  |   |    |
|--|---|----|
| 2. Claw with proximal pecten.                          | <i>C. reticulata</i> (Jurine, 1820)       |    |
| Claw without pecten.                                   |   | .3 |
| 3. Postabdomen dilated in the middle.                  | <i>C. laticaudata</i> P.E. Müller, 1867   |    |
| Postabdomen not dilated in the middle.                 |   | .4 |
| 4. Head angulated, not inflated in front of antennules | <i>C. quadrangula</i> (O.F. Müller, 1776) |    |
| Head inflated in front of antennule.                   | <i>C. pulchella</i> Sars, 1862b           |    |

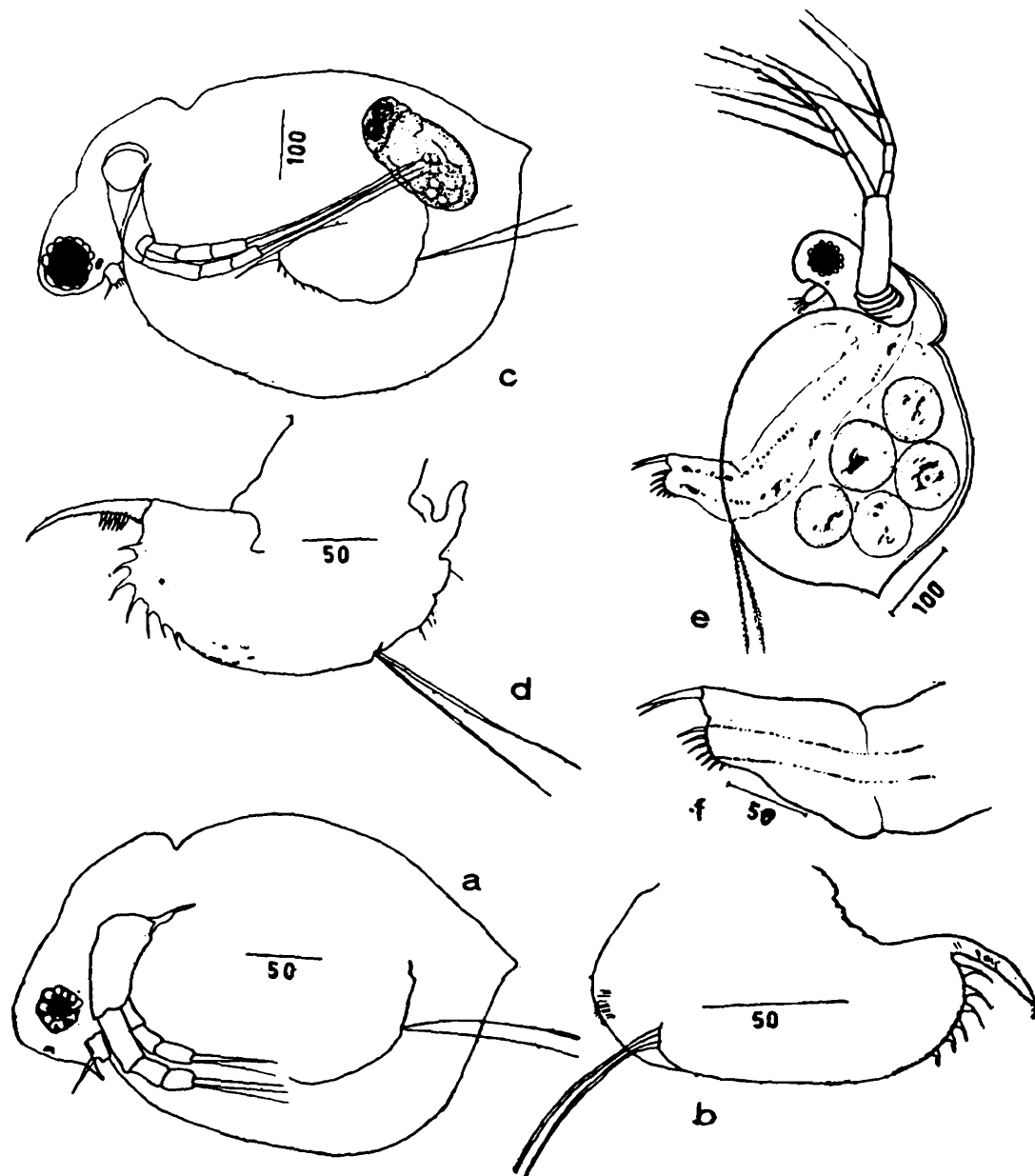
**7. *Ceriodaphnia cornuta* Sars, 1885**  
(Text-fig. 12,a,b)

*Ceriodaphnia cornuta* Sars, 1885, p. 26-28, pl. 5, figs. 1-3 ; Daday, 1898, p. 60-61, fig. 30, a-d ; Daday, 1901, p. 41 ; Gurney, 1911, p. 27 ; Delachaux, 1917, p. 81-83, figs. 8-9 ; Gurney, 1916, p. 334 ; Sewell, 1935, p. 212 ; Henry, 1922, p. 32, pl. IV, fig. 4 ; Fryer, 1957, p. 227 ; Harding, 1957, p. 63, fig. 5 ; Thomas, 1961a, p. 115-116 ; Green, 1962, p. 420 ; Uéno, 1966c, p. 100-101, figs. 18-23 ; Nayar, 1971, p. 511, figs. 8-11 ; Fernando, 1974, fig. 39 ; Sharma, 1978, p. 149 ; Swar & Fernando, 1979, p. 117-119, Figs. 9-10 ; Mamaril Sr. & Fernando, 1980, p. 134, figs. 81, 105 & 106.

*Ceriodaphnia rigaudi* Richard, 1894b, p. 367 ; Richard, 1894c, p. 239 ; Sars, 1895, p. 12-15, pl. 2, figs. 9-15 ; Sars, 1901, p. 20-21 ; Daday, 1905, p. 206, pl. 13, figs. 14 & 15 ; Gurney, 1906, p. 227 ; Apstein, 1907, p. 218 ; Gurney, 1907, p. 24 ; Daday, 1901, p. 145, pl. 8, fig. 10 ; Sars, 1916, p. 319, pl. XXXIV, figs. 3, 3a & 3b ; Delachaux, 1917, p. 81-83, figs. 3-7 ; Arora, 1931, p. 15, Pl. 5 fig. 13 ; Uéno, 1932, p. 246-247, fig. 4 ; Jenkin, 1934, p. 144-149, figs. 3-6 ; Uéno, 1937, p. 203 ; Uéno, 1928b, p. 128 ; Harding, 1961, p. 42-43 ; Biswas, 1971, p. 117, figs. 5 C & D ; Nasar, 1977, p. 35, fig. 2.

**MATERIAL EXAMINED :** *Reference material :* DGF 1512, Chetpet Fish Farm, Madras, 6.1.65. *Other material :* Sample 1, Irinjalakuda, Kerala, collected by Dr. C. K. G. Nayar, 8.12.77 ; Sample 6, Kalyani, collected by Dr. B. B. Jana, 1.10.78 ; Sample 4, Madurai, collected by Mr. Anthony Basil, 11.2.77 ; ZSI 5225/10 Calcutta, collected by Dr. N. Annandale, 10.4.1905 (labelled as *C. rigaudi*) ; ZSI C 1880/2, 1881/2, 1882/2, 1883/2, 1884/2, 1885/2, Julga lake, Gudha, Rajasthan, collected by Mr. S. Biswas, 24.11.58 ; Sample 6 (fish farm, Bangalore), Sample 9 (Govindnagar, Rewa), Sample 10 (Kulgari reservoir, Rewa) and Sample 22 (Jabalpur), collected by Dr. B. S. Bhimachar, 20.10.70 ; BKS—West Bengal : Achipur (24-Parganas), 4.12.77 ; Amtala (24-Parganas), 3.2.77 ; Barrackpore (24-Parganas), 1.4.75 ; Baruipur (24-Parganas), 1.9.75 ; Bon-Hooghly

(24-Parganas), 19.4.75 ; Baranagar (24-Paraganas), 29.4.75 ; Thakurpukur (24-Parganas), 3.2.77 ; Indian Museum Tank (Calcutta), 1.5.75 ; Sarisha (24-Parganas), 8.5.75 ; Tank opposite Lindsay Street (Calcutta), Jan. 1975 to Dec. 1976 ; Tank opposite to Park Street (Calcutta), 3.1.75 ; Victoria Memorial lake (Calcutta), 1.2.75 ; Dhakuria lake (Calcutta), 4.7.76, 12.1.78 ; BKS—N.W. India : Bhatinda (Punjab) 8.3.76 ; Behman Dewana village,



Text-fig. 12, a-b : *Ceriodaphnia cornuta* Sars : a. female ; and b. postabdomen.

Text-fig. 12, c-d : *Ceriodaphnia reticulata* (Jurine) : c. female ; and d. postabdomen.

Text-fig. 12, e-f : *Ceriodaphnia quadrangula* (O.F. Müller) : (after Lilljeborg, 1900) : e. female ; and f. postabdomen.

Bhatinda (Punjab), 16.6.75 ; Patiala (Punjab), 21.6.75 ; Ambala City (Haryana), Nov. 1972—April, 1973 ; Kalka (Himachal Pradesh), 25.7.75.

*Female* : Carapace of female rather tumid, broadly oval in outline ; produced posteriorly into a short projection, lying slightly above the longitudinal axis. Valves distinctly reticulate with large polygonal or hexagonal meshes, free edges of valves smooth. Head small, depressed and separated from body by a distinct ocular depression ; with rounded frontal part and produced in front of antennules into a very acute, short and deflexed rostrum. Head also with short spine or horn over eye on anterior margin in some specimens. Eye large, ocellus small and punctiform. Antennules small, fusiform not extending to tip of rostrum ; lateral sensory seta somewhat distal to middle. Postabdomen moderately broad, with 5-6 anal spines. Claw short, stout and finely setulate.

*Length* : 0.62 mm

*Male* : Not known from India.

*Distribution* : INDIA—Widely distributed and has so far been reported from West Bengal (Gurney, 1906, 1907 ; Sewell, 1935 and Sharma, 1978), Bihar (Brehm, 1950 ; Nasar, 1977), Quilon (Brehm, 1953), Rajasthan (Biswas, 1971 ; Nayar, 1971), Meghalaya (Patil, 1976). Elsewhere—Cosmotropical, also recorded from China and Japan.

#### 8. *Ceriodaphnia reticulata* (Jurine, 1820) (Text-fig. 12,c-d)

*Monoculus reticulatus* Jurine, 1820, p. 139, pl. 14, figs. 3,4.

*Ceriodaphnia reticulata* Sars, 1901, p. 21 ; Uéno, 1933, p. 308 ; Brooks, 1959, p. 618, figs. 27-36 ; Harding, 1961, p. 42 ; Scourfield & Harding, 1966, p. 22, fig. 48 ; Nayar, 1971, p. 511, figs. 6-7 ; Nasar, 1977, p. 35, fig. 8.

**MATERIAL EXAMINED** : *Reference material* : CHF 16, edge of dam on river Khan, Indore, collected by Mrs. Vaidya, 21.1.76 *Other material* : ZSI C 1893/2, Debdani, Rajasthan, collected by Mr. S. Biswas, 13.11.58 ; ZSI C 1894/2, Narain Sar, 6 km on Phulera

Road from camp, Sambhar lake, collected by Mr. S. Biswas and Dr. K. K. Mahajan, 6.10.63.

*Female* : Carapace almost rounded oval in outline ; produced posteriorly into a rather small protuberance above the longitudinal axis of the body. Valves reticulated. Head rounded or obtusely angulated in front of antennules. Antennules small ; sensory seta near apex of antennule. Eye large, nearly filling frontal region of head ; ocellus small and rounded. Postabdomen with 7 marginal anal spines. Claw with a distinct pecten of 6 teeth.

*Length* : 0.87 mm.

*Male* : Not known from India.

*Distribution* : INDIA—Rajasthan (Nayar, 1971), Bihar (Nasar, 1977). Elsewhere—Holarctic, Neotropical and Ethiopian regions.

### 9. *Ceriodaphnia quadrangula* (O.F. Müller, 1776) (Text-fig. 12,e-f)

*Daphnia quadrangula* O. F. Müller, 1785, p. 90, pl. XIII, figs. 3,4.

*Ceriodaphnia quadrangula* Lilljeborg, 1900, p. 193, pl. XXVII, figs. 16-25 ; pl. XXVIII, figs. 1-5 ; Herrick & Turner, 1895, p. 172, figs. 16-18 ; Keilhack, 1909, p. 41, figs. 93-95 ; Sars, 1916, p. 317, pl. 33, figs. 3, 3a-b ; Uéno, 1927, p. 283, pl. 25, figs. 12, 12a-f ; Brehm, 1953, p. 321 ; Harding, 1955, p. 335-336 ; Brooks, 1959, p. 620, figs. 27, 41.

**MATERIAL EXAMINED** : *Reference material* : description taken from literature, since no material was available.

*Female* : Carapace rounded quadrangular in outline, posterior protuberance distinctly produced and far above the axis of the body. Valves reticulated, often not plainly marked. Head angulate but not inflated in front of antennules. Antennules small, sensory seta near the apex. Eye of moderate size. Postabdomen slightly narrowing towards apex, sinuate above anal spines ; with 7-9 anal spines. Claw large and finely setulate.

*Male* : Not known from India.

*Distribution* : INDIA—Kashmir, Ladakh & Nilgiri Hills (Brehm, 1936) ; Savantvadi, S. India (Brehm, 1953). Elsewhere—throughout Europe, Central Asia, Greenland.

10. *Ceriodaphnia laticaudata* P.E. Müller, 1867  
(Text-fig. 13,a-c)

*Ceriodaphnia laticaudata* P. E. Müller, 1867, p. 130, pl. 1, fig. 19 ; Sars, 1916, p. 318, pl. 34, figs. 2, a-b ; Uéno, 1937, p. 203 ; Brooks, 1959, p. 620 ; figs. 27, 92 ; Biswas, 1964b, p. 92-93, fig. 1e ; Scourfield & Harding, 1966, p. 25 ; Uéno, 1966a, p. 292 ; Biswas, 1971, p. 119-120, fig. 6c.

MATERIAL EXAMINED : *Reference material* : CHF 1, eutrophic pond, Srinagar, Kashmir, 1977. *Other material* : ZSI C 1895/2, Narayana canal water at Dhobala Talao, collected by Mr. S. Biswas. 29.10.58 ; Samples 11, 12, 15, 17 of Nainital collected by Mr. P. C. Sharma, 30.8.77 ; Sample 5, Collairu lake, collected by Prof. Y Radhakrishna, 14.4.74.

*Female* : Carapace rounded quadrangular in outline ; posterior protuberance not very prominent. Valves conspicuously reticulated, edges of valves smooth. Head comparatively small ; vertex evenly rounded, without spines. Eye of moderate size, nearly filling vertex of head. Antennules of moderate length, somewhat produced. Postabdomen large, dilated near middle, obliquely truncate and with 8-10 marginal anal spines ; groups of lateral setae present in the examined specimens. Claw long, ciliated and denticulate.

*Length* : 0.80 mm.

*Male* : Not known from India.

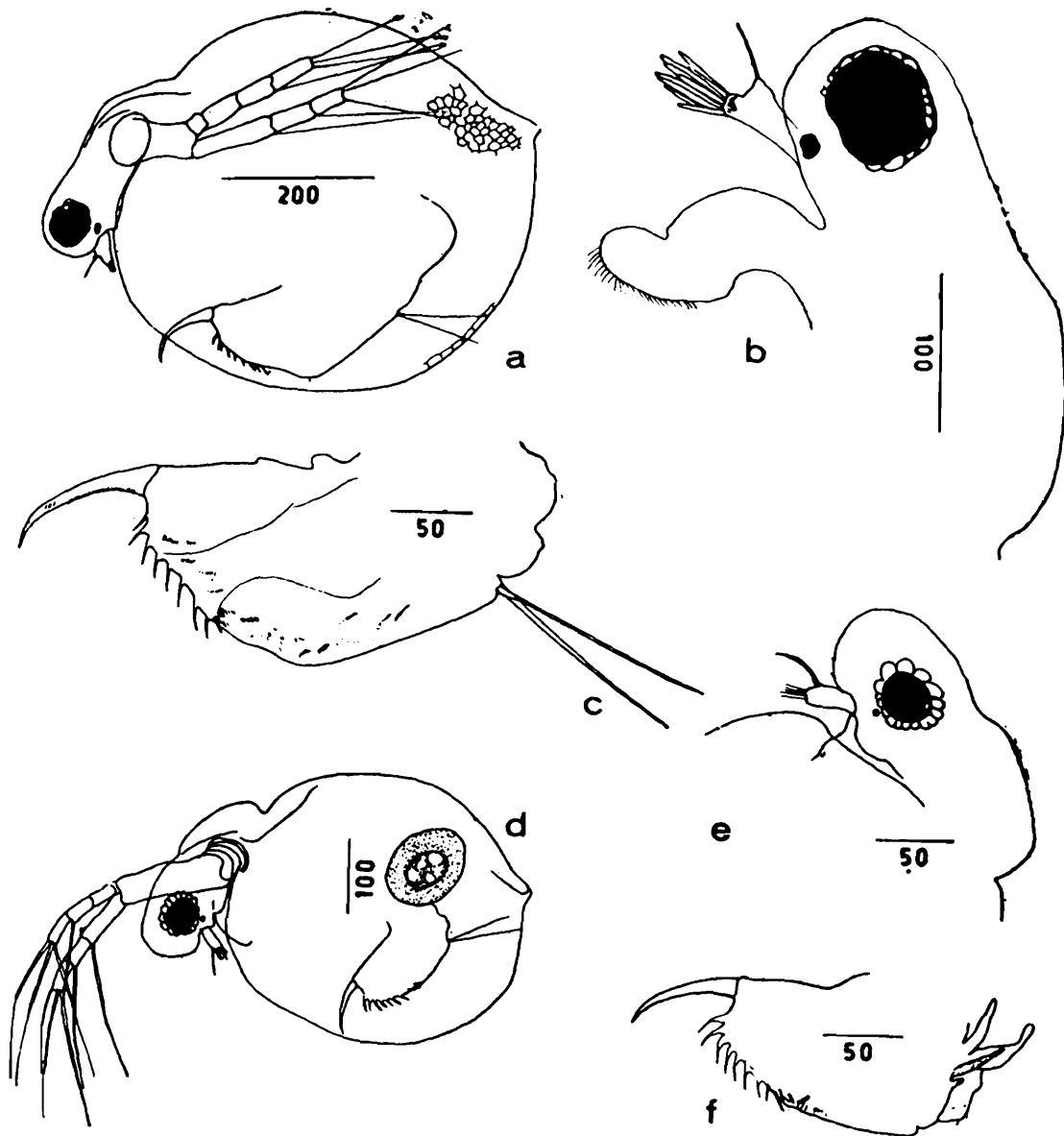
*Distribution* : INDIA—Pune (Brehm, 1953), Simla Hills. (Biswas, 1964b), Rajasthan (Biswas, 1971). Elsewhere—Central Asia, Japan, Africa, Europe and North America.

11. *Ceriodaphnia pulchella* Sars, 1862  
(Text-fig. 13,d-f)

*Ceriodaphnia pulchella* Sars, 1862 ; Sars, 1903a, p. 177 ; Daday, 1908, p. 329 ; Uéno, 1933, p. 308 ; Brooks, 1959, p. 619, figs. 27, 40 ; Scourfield & Harding, 1966, p. 24, figs. 53-54 ; Swar & Fernando, 1979, p. 119, figs. 11-12 ; Mamaril Sr. & Fernando, 1980, p. 135, figs. 107-108.

**MATERIAL EXAMINED :** *Reference material :* CHF 9, pond, Srinagar, Kashmir, collected by Dr. M. A. Khan, 1976.

*Female :* Specimens smaller in size than in earlier reports of this species. Carapace almost oval-rounded in outline, with a very small posterior protuberance. Valves reticulated. Head rounded in front, inflated in region behind eye and angulated in front of the antennules. Antennules moderately long, with sensory seta near distal



**Text-fig. 13, a-c :** *Ceriodaphnia laticaudata* (P.F. Müller) : a. female ; b. head (enlarged) ; and c. postabdomen.

**Text-fig. 13, d-f :** *Ceriodaphnia pulchella* Sars : d. female ; e. head (enlarged) ; and f. postabdomen.

end. Postabdomen not sinuate above anal spines ; with 7 marginal anal spines and a row of 3-4 long, slender anal spines somewhat inner to proximal spines. Claw long and finely setulate.

*Length* : 0.53 mm.

*Male* : Not known from India.

*Distribution* : INDIA—Punjab (parts now in Pakistan), Kashmir, Ladakh (Brehm, 1936). Elsewhere—Europe, Siberia, Turkestan, America.

An additional species *Ceriodaphnia setosa* Matile 1890 was reported from Sarnath (Brehm, 1953).

#### Genus 6. *Daphnia* O.F. Müller, 1785

Body compressed ; form oval or elliptical in outline, except as modified by crest on head (helmet) in some species. Valves reticulated ; dorsal and ventral margins rounding over toward each other and provided with spinules and a posterior spine. Cervical sinus absent. Rostrum well marked and pointed. Antennules small or rudimentary, not movable ; located behind rostrum. Addominal processes 3-4 ; the anteriormost long and horseshoe-shaped. Parthenogenetic eggs often numerous. Ehippium with two eggs.

Male without rostrum ; antennules large, movable and first legs with hook and flagellum.

*Type species* : *Daphnia longispina* O.F. Müller, 1785

Wagler (1936) divided the genus *Daphnia* into two subgenera i.e., *Ctenodaphnia* Dybowski & Grochowski, 1895 and *Hyalodaphnia* Schoedler, 1866. However, Johnson (1952) proposed the usage of the sub-genus *Daphnia* O.F. Müller, 1785 instead of *Hyalodaphnia*.

The differences between the two sub-genera as summarised by Wagler (1936) are given below :—

<i>Ctenodaphnia</i>	<i>Daphnia</i>
Fornices more or less strongly projecting and angular, or with a spine.	Fornices usually not strongly projecting, smoothly arched.
Secondary fornices usually present and sometimes very large.	Secondary fornices rarely present and if present, vestigial.
Dorsal portion of head-carapace suture directed anteriorly so that carapace extends forwards into head-shield, atleast for a short distance.	Dorsal portion of head-carapace suture directed posteriorly so that head-shield extends backwards, between carapace valves.
Ephippium sub-rectangular and egg-spaces directed obliquely to longitudinally.	Ephippium sub-triangular, apex of triangle being posterior ; eggs placed almost at right angles to dorsal edge.

The sub-genus *Ctenodaphnia* is represented in India by *D. carinata*, *D. lumholtzi* and *D. cephalata*, and the sub-genus *Daphnia* by *D. pulex* and *D. obtusa*.

There is still considerable uncertainty regarding the different species of genus *Daphnia* all over the globe. The important works of Scourfield (1942), Johnson (1952) and Brooks (1957) gave valuable information on European and North American species. Recently, Hebert (1977) provided a taxonomic revision of this genus in Southeastern Australia. Further, he made use of electrophoretic studies of allozyme variations in populations of *D. carinata* s.l. for intraspecific differentiation. Much remains to be done on the Indian species of *Daphnia*. Further investigations involving electrophoretic studies of populations of the different reported species need to be conducted in future studies.

*Key to the Indian species of genus DAPHNIA*

1. Carapace (when viewed dorsally) continuing anteriorly along mid-dorsal line as median strip between halves of head shield .2
- Apex of head shield continuing posteriorly along mid-dorsal line into carapace. .4

2. Anterior end of head produced into a spine of variable length. .*D. lumholtzi* Sars, 1885  
 Anterior end of head not produced into spine .3
3. Head with large crest (helmet) above the heart. Rostrum acute, well away from ventrolateral carapace margin. Antennular mounds at some distance from rostrum. .*D. cephalata* King, 1853  
 Head usually without any crest (helmet), if present very small. Rostrum recurved, generally close to or in contact with ventrolateral carapace margin. Antennular mounds set close to rostrum. .*D. carinata* King, 1853
4. Antennular mound short and high. Inner ventral margin of carapace with a shallow emargination, bearing a short row of long setae directed obliquely inwards and posteriorly .*D. obtusa* Kurz 1874  
 Antennular mound long and high. Inner ventral margin of carapace not emarginate; setae lacking .*D. pulex* Leydig, 1860 emend. Scourfield, 1942

12. ***Daphnia carinata* King, 1853**  
 (Text-figs. 14,a-h ; 15,a-b)

*Daphnia carinata* form a, King, 1853, p. 246.

?*Daphnia carinata* var. *gravis* King, 1853, p. 253 ; Sars, 1914, p. 9.

*Daphnia macrura* Dana, 1853, p. 1272.

*Daphnia carinata* Schoedler, 1877, p. 10 ; Sars, 1903a, p. 159-160, pl. 1, figs. 1-10; Brehm, 1933a, p. 660-663, figs. 6-9; Wagler, 1936, p. 552 ; Brehm, 1950, p. 21-22, figs. 5a-d, 6a-d ; Harding, 1955, p. 330-332, figs. 2-9 ; Biswas, 1964b, p. 94 ; Biswas, 1971, p. 112, figs. 3D,E ; Michael, 1973, p. 76, figs. 1, a-f ; Fernando, 1974, figs. 42-44 ; Hebert, 1977, p. 375-378, figs. 6a. 15-22 ; Sharma, 1978, p. 149.

? *Daphnia gravis* Schoedler, 1977, p. 11.

*Daphnia carinata* form a *typica* Sars, 1896, p. 7 ; Sars, 1914, p. 6.

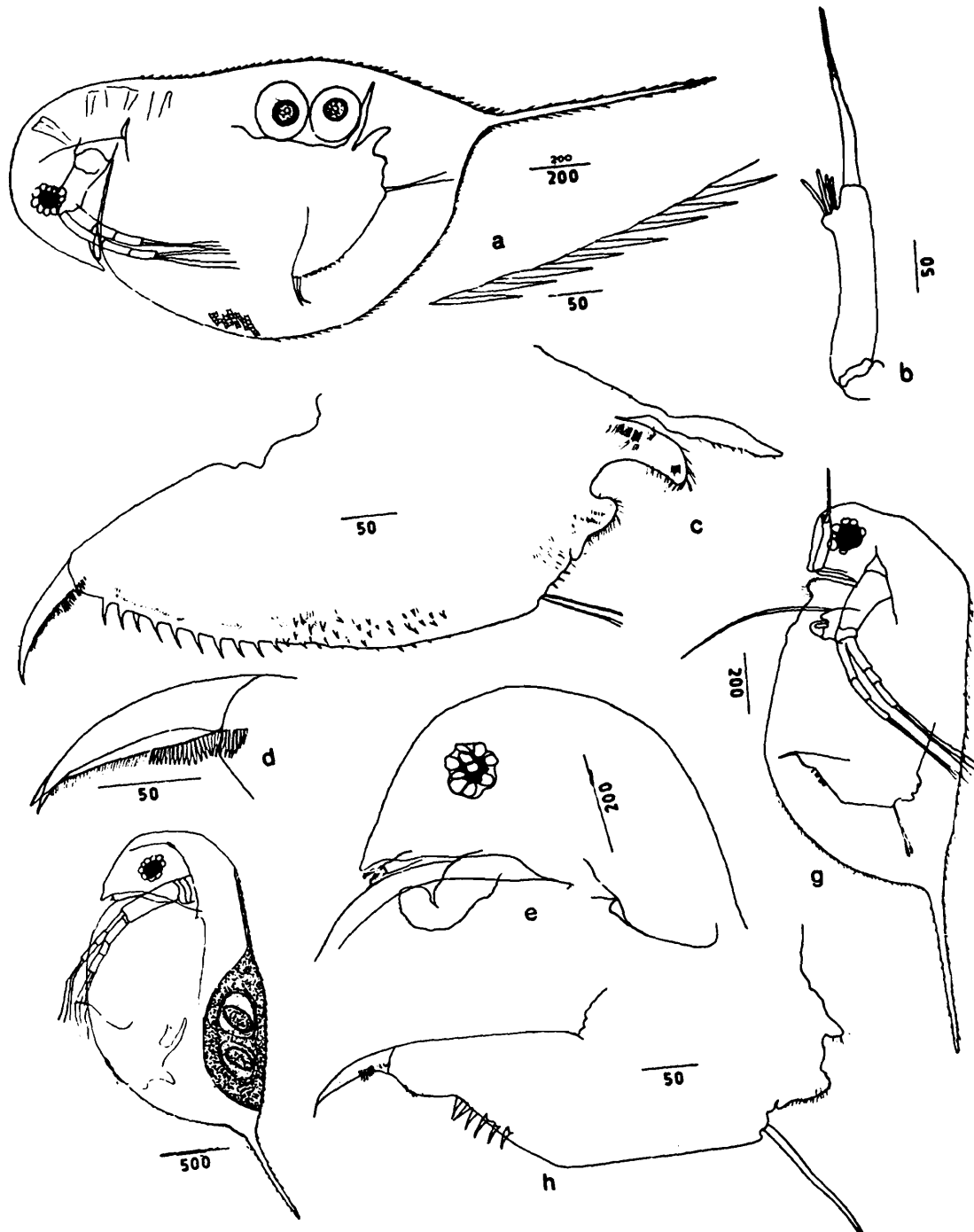
*Daphnia carinata* var. *intermedia* Sars, 1846, p. 9.

*Daphnia similis* Claus, Nayar, 1971, p. 511.

*Daphnia hyalina* Leydig, Biswas, 1971, p. 112-113, figs. 3B,C, 4 A,B.

MATERIAL EXAMINED : *Reference material* : Sample 2, Madurai, collected by Dr. N. Murugan, 10.1.77. *Other material* : Sample 6, Nainital, collected by Mr. P. C. Sharma, 30.8.77 ; Sample 3

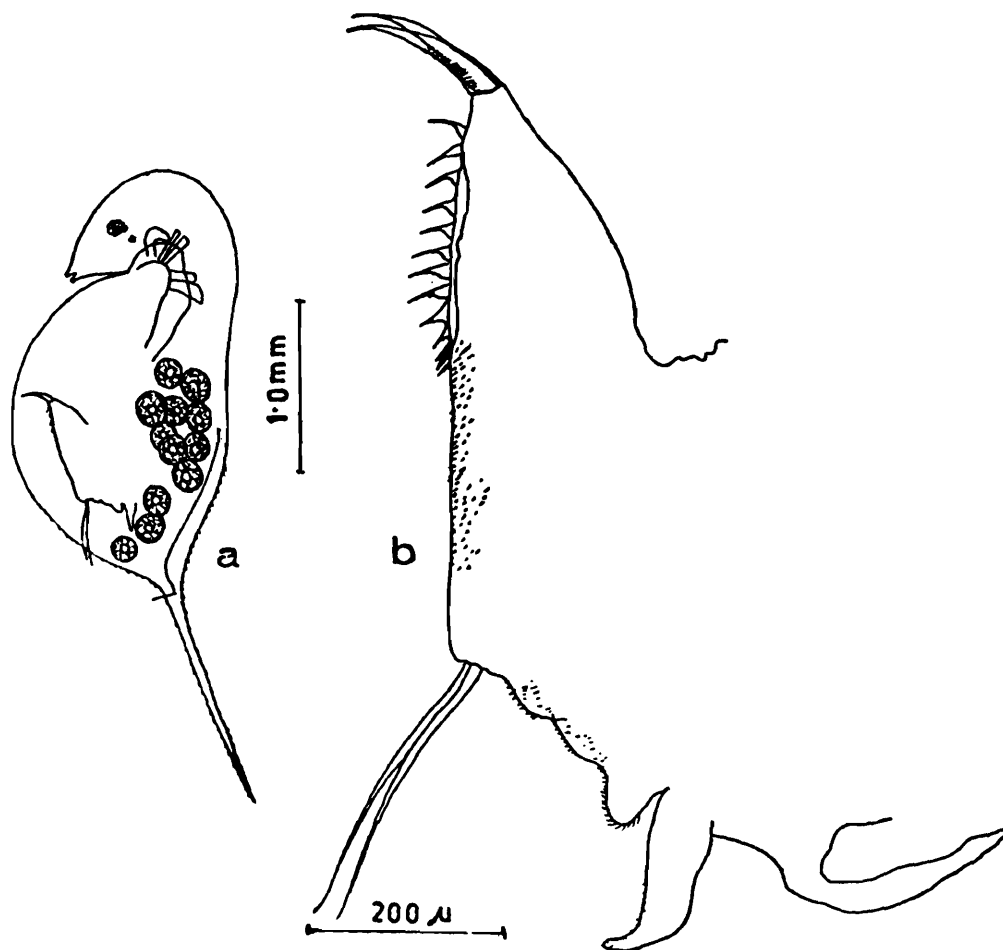
Kalyani, collected by Dr. B. B. Jana, 1.10.78 ; Sample 6, (Fish farm, Bangalore), Sample 10 (Kulgari Reservoir, Rewa), Sample 15 (Imphal Fish farm, Manipur), Sample 19 (Hyderabad Fish farm), sent by Dr. B. S. Bhimachar, 20.10.70 ; ZSI C 4319/1, Simla Hills, collected by Dr. N. Annandale, 18.5.1916 ; ZSI C 4258/1, Sikar District, Rajasthan, 8.11.60 ; ZSI C 1906/2 (*Daphnia hyalina*), Bala-



Text-fig. 14, a-h : *Daphnia carinata* King : a. female ; b. antennule ; c. postabdomen ; d. claw (enlarged) ; e. head (enlarged) ; f. ephippial female ; g. male ; and h. male postabdomen.

nadi, Dudu, Rajasthan, 6.1.59 ; BKS—West Bengal : Amtala (24-Parganas) 3.2.77 ; Bon-Hooghly, (24-Parganas), 16.1.75 ; Behala (Calcutta), 3.2.77 ; 1.9.75 ; Baranagar (Calcutta), 16.1.75 ; Barrackpore (24-Parganas), 3.2.75, 1.4.75 ; Tank opposite Lindsay Street, (Calcutta), January-June, 1975, 1976 ; Thakurpukur (24-Parganas), 8.5.75 ; Maheshtala (24-Parganas), 4.12.77 ; BKS—N.W. India : Bhatinda (Punjab), 15.6.75, 8.3.76, 14.10.76 ; Deon village, Bhatinda (Punjab), 16.6.75 ; Baluana village, Bhatinda (Punjab) 16.6.75 ; Behman Dewana village, Bhatinda (Punjab), 16.6.75 ; Nabha (Punjab), 19.6.75 ; Patiala (Punjab), 21.6.75 ; Ambala Cantt. (Haryana), 1.4.76 ; Kalka (Himachal Pradesh), 10.4.76.

*Female* : Carapace oblong and reticulated, dorsal margin evenly arched and forming a slight concavity in anterior region ; posterior spine rather elongated and slightly upturned. Posterior spine with small spines which extend to the middle region of ventral margin of valves, those on dorsal margin extend to cervical region. Head



Text-fig. 15, a-b : *Daphnia carinata* King : a. female ; and b. postabdomen.

large, with roughly semicircular anterior margin. Fornix appearing as a curved elevated line, extending from ocular region to point of origin of valves. Rostrum recurved and generally in contact with ventrolateral carapace margin. Antennular mounds very small and set close to rostrum, ocellus small. Abdominal processes three ; first longer than second, sparsely covered with setules, other processes distinctly setose. Postabdomen conically tapering distally ; with 10-13 anal spines. Claws short, stout and curved ; three combs with 12, 17 and 30 teeth respectively. Ehippium produced anteriorly in the form of a stipe, with two eggs ; egg locules obliquely disposed, separated by unmelanised ehippial matrix.

*Length* : 1.9 mm

*Male* : Small and slender, valves oblong and narrow ; dorsal margin almost straight. Head ventrally flattened, without rostrum ; eye large, ocellus conspicuous. Antennules well developed, movable ; each with one flagellum elongated and characteristic of males. Abdominal process reduced to slight bulges. First leg modified. Postabdomen with 6-8 anal spines.

*Length* : 1.2 mm

*Remarks* : The specimens designated *D. hyalina* Leydig by Biswas (1971) from Rajasthan were examined and were found to agree with *D. carinata* King (Text-fig. 15,a-b).

*Distribution* : INDIA—Simla Hills (Brehm, 1950 ; Biswas, 1966), Mysore, Banaras, Meerut and Surat (Brehm, 1953), Rajasthan (Biswas, 1971 ; Nayar, 1971), Tamil Nadu (Michael, 1973), Bihar (Nasar, 1977) and West Bengal (Sharma, 1978). Elsewhere—Australia, Africa, Indonesia and Sri Lanka.

### 13. *Daphnia cephalata* (King, 1853) (Text-fig. 16,a-e)

*Daphnia carinata* var. *cephalata* King, 1853, p. 254 ; Sars, 1914, p. 11, fig. 62 ; Henry, 1922, p. 29 ; Michael, 1973, p. 76, fig. 2,e-f.

*Daphnia cephalata* Schoedler, 1877, p. 13 ; Hebert, 1977, p. 385-388, figs. 8b, 51-58.

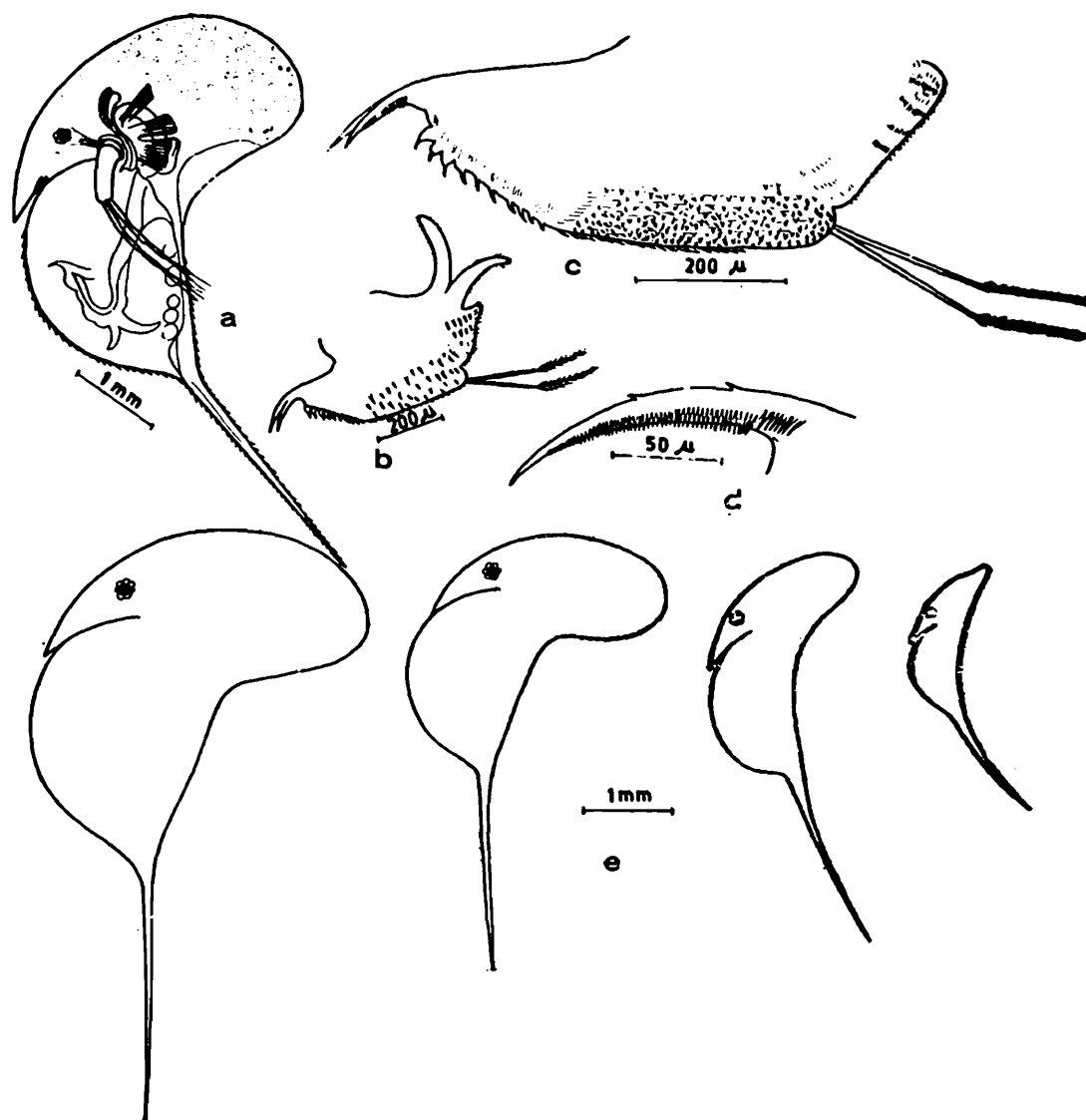
*Daphnia carinata* var. *lamellata* Sars, 1914, p. 13.

*Daphnia carinata* Wagler, 1936, p. 522.

*Hyalodaphnia hypsicephala* Daday, 1911, p. 63-66, figs. 1,a-d.

**MATERIAL EXAMINED :** *Reference material :* RGM 29, Madurai, 1.11.72. *Other material :* ZSI 6857/10 (Type material of *Hyalodaphnia hypsicephala* Daday), Bangalore, collected by Dr. N. Annandale, 16.10.1910 (one specimen with broken spine); RGM 30, Sawyerpuram, Tamil Nadu, 20.3.73.

*Female :* Carapace almost oblong ; ventral carapace margin broadly oval. Posterior spine long and turned upwards. Head produced dorsally into an expansion (helmet) above heart. Rostrum acute, often well away from ventrolateral carapace margin. Antennular mounds very small, at some distance from rostrum. Eye moderately large ; ocellus minute. First abdominal process nearly twice as long as second, sparsely covered with setules ; other



Text-fig. 16, a-e : *Daphnia cephalata* (King) : a. female ; b. postabdomen ; c. postabdomen (enlarged) ; d. claw (enlarged) ; and e. instars.

processes more pubescent. Postabdomen tapering distally ; with 11-14 anal spines. Claw curved ; with three combs having 11, 14 and 28 teeth respectively.

*Length* : 4.0 mm

*Male* : Not known from India

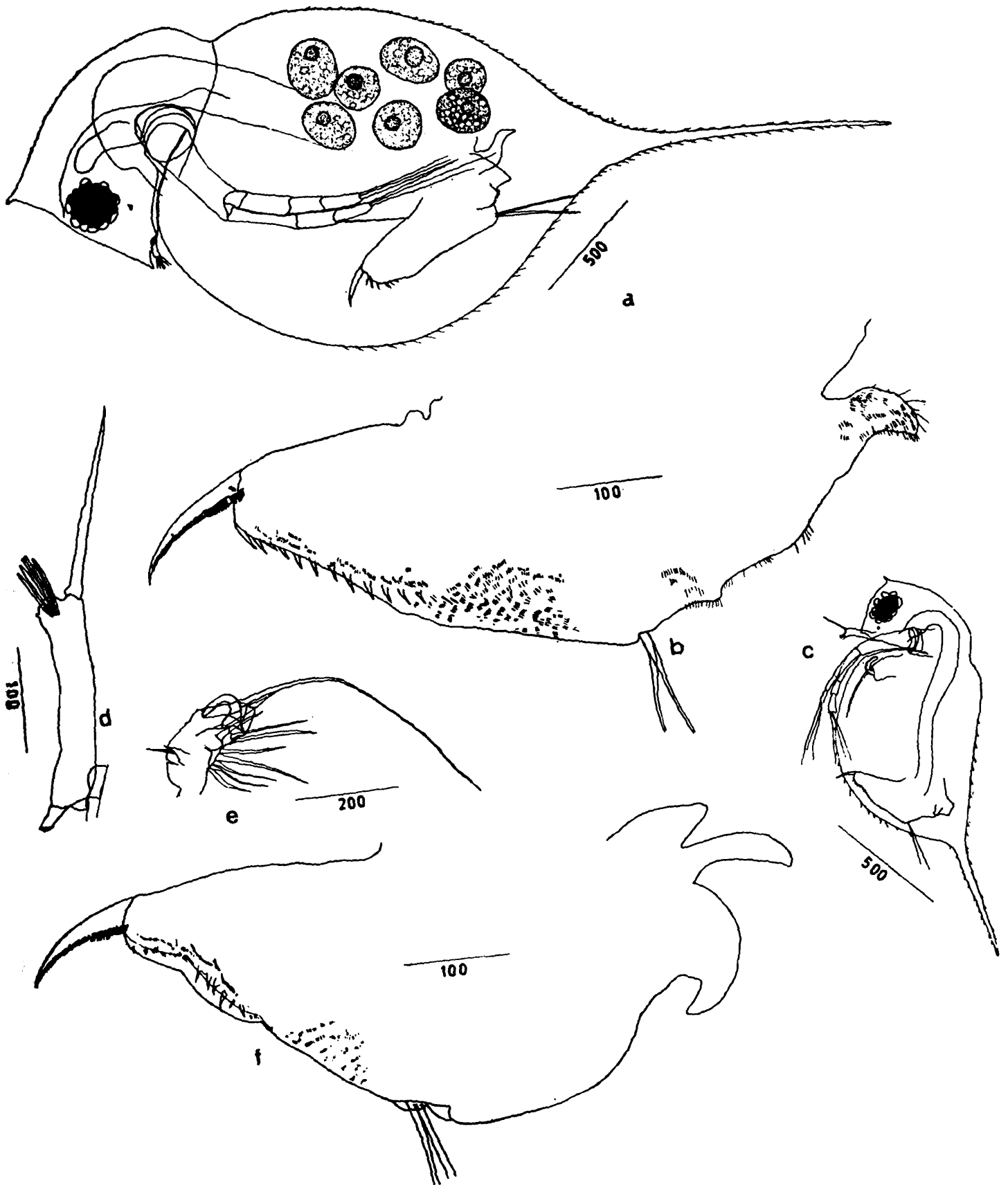
*Remarks* : Hebert (1977) mentioned that *D. cephalata* have been reported from India (Daday, 1911) though not listed in the synonymy. A paratype from Daday's material deposited in ZSI, Calcutta was examined and found to be identical with the description and figures given by Hebert (loc. cit.). Hence in the present account Daday's species has been included under *D. cephalata* King.

*Distribution* : INDIA—Tamil Nadu (Michael, 1973). Elsewhere W. Australia, Sri Lanka, Argentina.

#### 14. *Daphnia lumholtzi* Sars, 1885 (Text-fig. 17,a-f)

*Daphnia lumholtzi* Sars, 1885, p. 18-26, pl. 1, figs. 1-10, pl. 3,4 ; Richard, 1894b, p. 364 ; Daday, 1910, p. 147. pl. 8, figs. 11-15 ; Gurney, 1921, p. 838 ; Brehm, 1950, p. 19-21, figs. 3,a-g, 4a-e ; Fryer, 1957, p. 224-225 ; Biswas, 1971, p. 111-112, figs. 3A, 4C, D ; Nayar, 1971, p. 509-510, figs. 1-5 ; Michael, 1973, p. 77, figs. 2,a-d ; Fernando, 1974, fig. 45 ; Hebert, 1977, p. 395-397, figs. 1a, 3a, 93-101 ; Nasar, 1977, p. 33, fig. 9 ; Sharma, 1978, p. 149 ; Swar and Fernando, 1979, p. 117, figs. 7-8.

**MATERIAL EXAMINED** : *Reference material* : CHF 14, Karamadai lake, Coimbatore, India, 8.3.77. *Other Material* : ZSI C 4610/1, Hyderabad fish seed farm, collected by Staff, fisheries extension unit ; RGM 45, Ward lake, Shillong, collected by Mr. B. Bhattacharya, 12.4.78 ; CHF 16, edge of dam on river, Khan, Indore, 21.1.76 ; Sample 7 (Kakrapara Farm, Gujarat), Sample 9, (Govindsagar, Rewa), collected by Dr. B. S. Bhimachar, 20.10.70 ; Sample 1, Nainital, collected by Mr. P.C. Sharma, 30.8.77 ; BKS—West Bengal : Bon-Hooghly (24-Parganas), 16.1.75 ; Baranagar (Calcutta), 16.1.75, 29.3.75 ; Sarisha (24-Parganas), 4.1.75 ;



Text-fig. 17, a-f : *Daphnia lumholtzi* Sars : a. female ; b. postabdomen ; c. male ; d. male antennule ; e. leg I of male ; and f. male postabdomen.

Thakurpukur (24-Parganas), 3.2.77 ; BKS—N. W. India : Giddarbaha, Ferozepur district, (Punjab), 18.6.75 ; Chandigarh (U.T.), 3.4.76 ; Ambala City (Haryana), 15.1.73, 30.1.73.

*Female* : Carapace broadly oval, narrowed posteriorly and continued into a considerably long posterior spine. Dorsal surface of valves moderately arched and armed with elongated and distant spinules, which continue to posterior spine ; spinules extending till behind middle region of ventral surface of valves. Head of distinct dorsal depression above heart ; produced anteriorly in the form of a helmet of variable length. Rostrum somewhat variable in shape. Antennular mounds very well developed, situated close to rostrum. Eye large ; ocellus small. Fornices extremely well developed, produced into a spine. First abdominal process nearly twice length of second ; all processes except first distinctly pubescent. Postabdomen tapering distally, its dorsal surface weakly sinuate ; with 10-13 anal spines and groups of lateral setae. Claws stout, curved ; with three setae having 10, 18 and 40 teeth respectively. Ehippium relatively broad. Egg chambers obliquely placed and well separated by un-melanised ehippial matrix.

*Length* : 2.6 mm

*Male* : Valves oblong and narrow. Head set off from carapace by a distinct depression above heart ; produced anteriorly as in female. Fornices well developed. Antennules large and movable ; each with a long flagellum. Eye large ; ocellus moderately large. Postabdomen strongly sinuate. First leg modified as shown in figure.

*Length* : 1.1 mm

*Distribution* : INDIA—Mirzapore, West Bengal and Cuttack, Orissa (Brehm, 1950) ; Hyderabad and Golconda (Brehm, 1953) ; Rajasthan (Biswas, 1971 ; Nayar, 1971) ; Tamil Nadu (Michael, 1973) ; Bihar (Nasar, 1977) and West Bengal (Sharma, 1978). Elsewhere—Australia, Africa, Egypt, widespread in Asia.

15. **Daphnia pulex** Leydig, 1860 emend. Scourfield, 1942  
(Text-fig. 18,a-d)

? *Monoculus pulex* De Geer, 1778

*Daphnia pulex* Leydig, 1860, p. 117, pl. 1, figs. 1-7.

*Daphnia pulex* De Geer var. *denticulata* Birge, 1879, p. 11-12, pl. 1, fig. 11.

*Daphnia pulex* Müller var. *nasutus* Herrick, 1884, p. 57, pl. N, fig. 1-4.

*Daphnia minnihaha* Herrick, 1884, p. 57-58, pl. K. figs. 1-2 ; pl. L, figs. 1-2.

*Daphnia pulex* var. *pulicaria* Forbes, 1893, p. 242, pl. 37, fig. 1 ; Birge, 1893, p. 295-296, pl. 12, figs. 1-4 ; Birge, 1918, p. 695.

*Daphnia pulex* Leydig, s. str. Richard, 1896, p. 232-237, pl. 21, figs. 6, 10 ; pl. 22, figs. 11, 13.

*Daphnia pulex* Leydig var. *pulicaria* Forbes, Richard, 1896, p. 237-239.

? *Daphnia pulex* Leydig var. *minnihaha* Herrick, Richard, 1896, p. 239-241, pl. 21, figs. 9-13.

*Daphnia pulex* Leydig var. *denticulata* Birge, Richard, 1896, p. 244-245, pl. 22, fig. 19.

*Daphnia pulex* Leydig var. *nasuta* Herrick, Richard, 1896, p. 245.

*Daphnia pulex* (De Geer) s. str., Birge, 1918, p. 695.

*Daphnia pulex* var. *minnihaha* Herrick, Birge, 1918, p. 695.

*Daphnia pulex* (De Geer) var. *typica* Mackin, 1931, p. 26-27, figs. 4, 6, 8.

*Daphnia pulex* (De Geer) Scourfield, 1942, p. 202-219 ; Brehm, 1953, p. 319-320 ; Biswas, 1964b, p. 94-95, figs. 3,c-e ; ?Nasar, 1977, p. 33.

*Daphnia pulex* (De Geer) subsp. *pulex* Kiser, 1950, p. 11-12, pl. II, figs. 6-10.

*Daphnia pulex* (De Geer) subsp. *minnihaha* Herrick, Kiser, 1950, p. 13, pl. II, figs. 4-5, 11-15.

*Daphnia pulicaria* Forbes, Frank, 1952, p. 178-203.

*Daphnia pulex* (De Geer) emend. Scourfield, Johnson, 1952, p. 443-445, fig. 4a.

*Daphnia pulex* var. *pulicaria* Forbes, Brooks, 1953, p. 773-784, fig. 1.

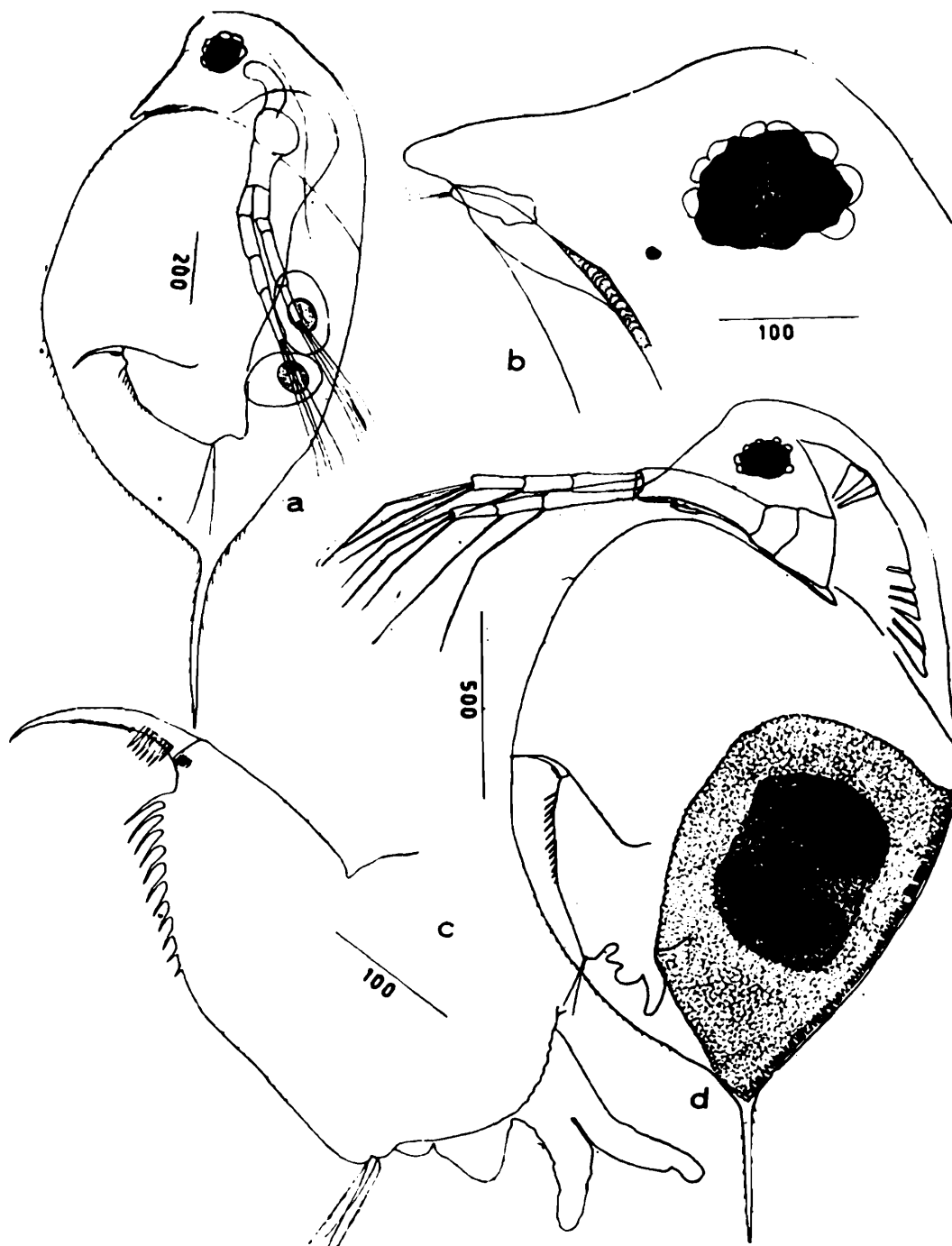
*Daphnia pulex* Leydig, emend. Richard, Brooks, 1957, p. 58-66, pl. 15-18 ; Brooks, 1959, p. 613-614, fig. 27.

*Daphnia pulex* Leydig, emend. Scourfield, Brandlova et al., 1972, p. 1382-1384, figs. 13-22.

**MATERIAL EXAMINED :** *Reference material :* CHF 2, eutrophic pond, Srinagar, Kashmir, 1977. *Other material :* ZSI C 4330/1 below Kufri in muddy ponds, 7200 feet, Simla Hills, collected by Dr. S. W. Kemp, 28.9.1921 ; ZSI C 1914/2, Phalodi, Ranisar, Jodhpur, collected by Dr. K. K. Tiwari and Mr. S. Biswas, 18.12.57 ; (sample labelled as *D. pulex*, but specimens skewed and flattened beyond recognition) ; Sample 1, Nainital, collected by Mr. P. C. Sharma, 30.8.77.

**Female :** Valves broadly oval in outline ; spinules confined to posterior half of ventral margin, but on dorsal margin extending

nearly to junction with head. Posterior spine of variable length, usually short ; about  $1/4$  to  $1/5$  length of valves. Head longest dorsally, optic vesicle reaching anterior margin of head ; anterior margin of head broadly rounded, ventral margin concave. Shape of rostrum variable usually directed posteroventrally. Eye large ; ocellus of moderate size. Abdominal processes gradually decreasing in size ; the second about  $3/4$  as long as first. Postabdomen slightly



Text-fig. 18, a-d : *Daphnia pulex* Leydig emend. Scourfield : a. female ; b head (enlarged) ; c. postabdomen ; and d. ephippial female.

tapering, dorsal margin convex ; with 10-16 anal spines. Claw long and curved ; with 5-7 teeth in the middle pecten and 4-8 teeth in proximal pecten. Ehippium broad , egg chambers obliquely placed.

*Length* : 1.36 mm

*Male* : Not recorded from India.

*Remarks* : Leydig (1860) is cited with the descriptions of *D. pulex*, as the earlier descriptions are not determinable. There is no evidence to indicate that *Monoculus pulex* De Geer is the same as what we designate *D. pulex*. Hence, *D. pulex* Leydig, 1860 emend. Scourfield, 1942 is taken to be the correct name as it was redefined by Scourfield (1942). However, *D. pulex* (De Geer) emend. Scourfield and *D. pulex* Leydig emend. Richard also refer to the same animal.

*Distribution* : INDIA—Kashmir (Brehm, 1936), Nepal, Sikkim and Assam (Brehm, 1953), Rajasthan (Biswas, 1971), Bihar (Nasar, 1977). Elsewhere—Widely distributed in Europe.

16. ***Daphnia obtusa* Kurz, 1874**  
(Text-fig. 19,a-c)

*Daphnia obtusa* Kurz, 1874 ; Scourfield, 1942, p. 202, figs. 1,3,5,8,10,15,18,20 ; Johnson, 1952, p. 446-448, figs. 4c, 5, a-c ; Harding, 1955, p. 334 ; Biswas, 1964b, p. 96-97, figs. 1,a-c ; Scourfield and Harding, 1966, p. 17, fig. 29.

*Daphnia brevispina* Daday, 1883.

*Daphnia ornata* Daday, 1888.

*Daphnia alpina* Daday, 1888.

*Daphnia jurine* Stingelin, 1895.

*Daphnia propinqua* Sars, 1895.

*Daphnia pulex* v. *obtusa* v. *brevispina* Daday ; Brady, 1898.

*Daphnia pulex* v. *obtusa* v. *propinqua* Sars ; Brady, 1898.

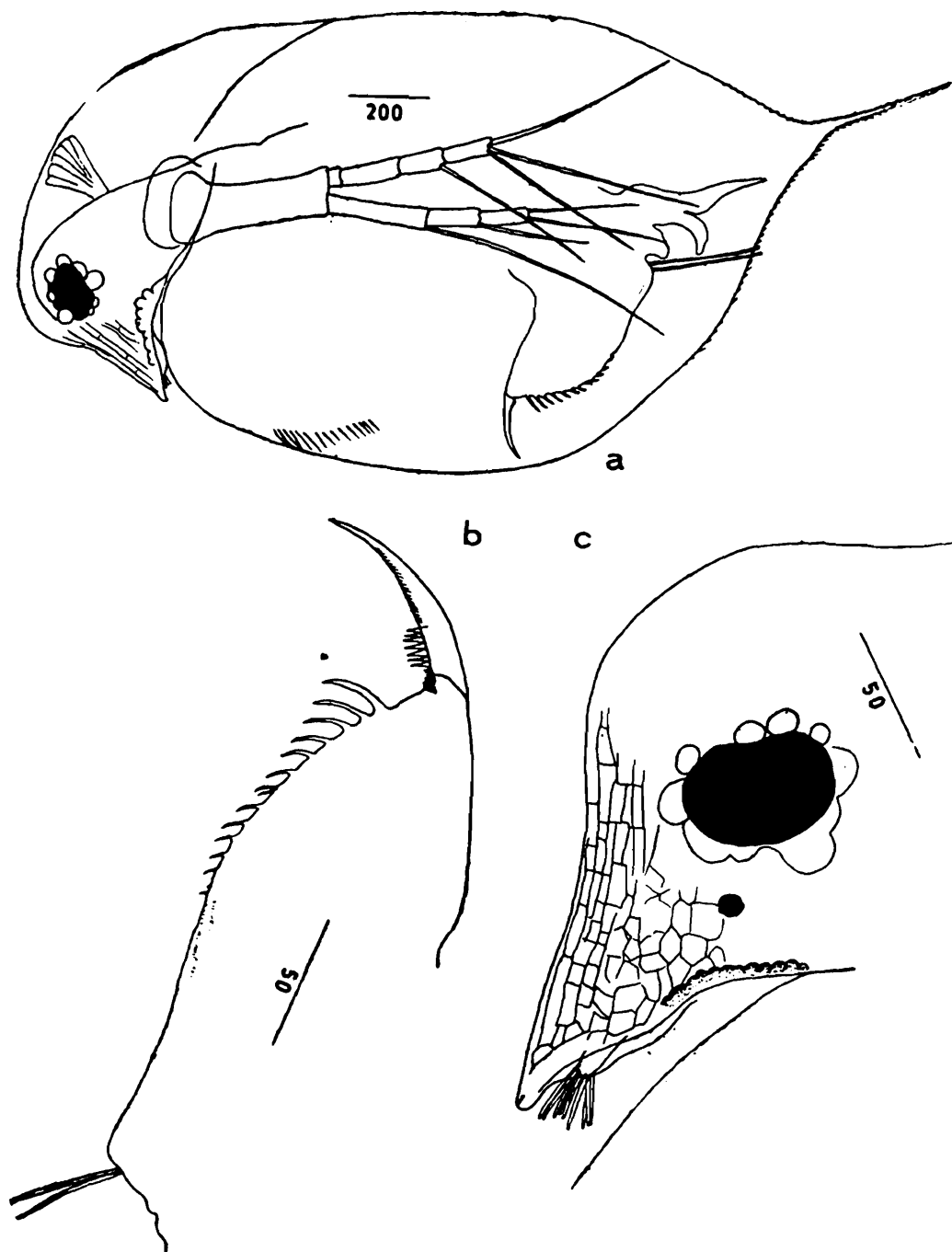
? *Daphnia tenuispina* Sars. 1916, p. 310-311, pl. 31, figs. 2,2a-b.

*Daphnia pulex* v. *obtusa* Kurz ; Wagler, 1936 ; Wagler, 1937 (part).

**MATERIAL EXAMINED** : *Reference material* : CHF 2, eutrophic pond, Srinagar, Kashmir, 1977.

*Female* : Carapace almost oval in outline. Posterior spine usually short. Inner ventral carapace margin with a shallow emargination,

which bears a row of setae, directed obliquely inwards and posteriorly. Spinules on dorsal and ventral margins few in number, normally much fewer than 25. Head comparatively small, with rounded dorsal margin and more or less concave ventral margin. Rostrum usually short ; slightly upturned. Antennules arising from ventral end of antennular mound and directed almost parallel to rostrum ; antennular mound short and high. Eye moderately large,



Text-fig. 19, a-c : *Daphnia obtusa* Kurz ; a. female ; b. postabdomen ; and c. head (enlarged).

located in vertex of head ; ocellus small and distinct. Abdominal processes setose. Postabdomen tapering distally, its dorsal margin convex ; with 10-13 curved anal spines. Claw long and curved ; proximal and distal pectens with 10-12 and 6-10 teeth respectively.

*Length* : 1.9 mm

*Male* Not known from India.

*Distribution* : INDIA—Simla Hills (Biswas, 1964b). Elsewhere—Palaeartic & Nearctic regions and Argentina, Brazil, Chile, Patagonia, Uruguay and Columbia.

ADDITIONAL SPECIES : *Daphnia magna* Straus—reported from Kashmir (Brehm, 1936) and Latour and Bijapur (Brehm, 1953). ZSI C 4460/1 collection from Dehra Dun marked *D. magna* was examined but the sample was dried up beyond recognition of details. *Daphnia longispina* Müller—reported from Kumaon, W. Himalayas (Brehm, 1950).

INCERTAE SEDIS : *Daphnia newporti* Baird—described by Baird (1860) in collection from Nagpur, India. *Daphnia fusca* Gurney—described by Gurney (1907). No material could be obtained for study. *Daphnia tibetana* f. *fusca* Gurney—reported by Biswas (1971) from Rajasthan.

#### Genus 7. *Daphniopsis* Sars, 1903a

*Daphniopsis* Sars, 1903a, p. 15.

Shell without any dorsal carina or a posterior spine ; carapace not denticulate. Head well defined from carapace, ventrally compressed and projecting as a well-marked rostrum ; fornix greatly developed. Ocellus distinct. Antennules small and immobile. Postabdomen conically tapering, with small anal denticles. Abdominal processes as in *Daphnia*, only the upper two distinctly developed. Ehippium not known.

*Type species* : *Daphniopsis tibetana* Sars, 1903a.

Represented only by the mentioned species from India.

17. *Daphniopsis tibetana* Sars, 1903a

*Daphniopsis tibetana* Sars, 1903a, p. 16-17, pl. VI, figs. 1,a-e.

*Daphnia tibetana* Brehm & Woltereck, 1939, p. 6-10, pl. 1,3, figs. 6,a and 21.

**MATERIAL EXAMINED :** *Reference material :* Description taken from literature, since no material was available.

*Female :* Carapace slightly compressed and oval in outline ; dorsal and ventral margins almost evenly arched ; posterior end terminating in an obtuse protuberance, occurring somewhat above the axis of body. Shell finely reticulate, free edges of valves smooth. Head defined from the carapace by a well-marked depression, its ocular region slightly protuberant and ventral edge slightly concave. Rostrum prominent, obtuse at its tip. Fornix extending in front as far as the ocular region and evenly arched. Eye moderately large ; ocellus rounded. Antennules small and distinctly projecting below the rostrum. Postabdomen tapering distally, dorsal margin slightly sinuate ; with about 10 small anal denticles. Claw with setae on its concave margin. First abdominal process longest.

*Male :* Unknown.

*Distribution :* INDIA—Ladakh (Brehm, 1936). Elsewhere—Tibet, Mongolia.

Genus 8. *Scapholeberis* Schoedler, 1858

Body almost quadrate, not compressed. Head small and depressed ; fornix and rostrum well developed. Cervical sinus deep. Antennules small and situated behind rostrum. Valves almost rectangular, posteroventral corner of valves produced as a shorter or longer spine ; ventral margins with fine setae. One abdominal process developed. Postabdomen well-marked ; with anal spines. Claws denticulate, not pectinate.

*Type species :* *Daphnia mucronata* O.F. Müller, 1785.

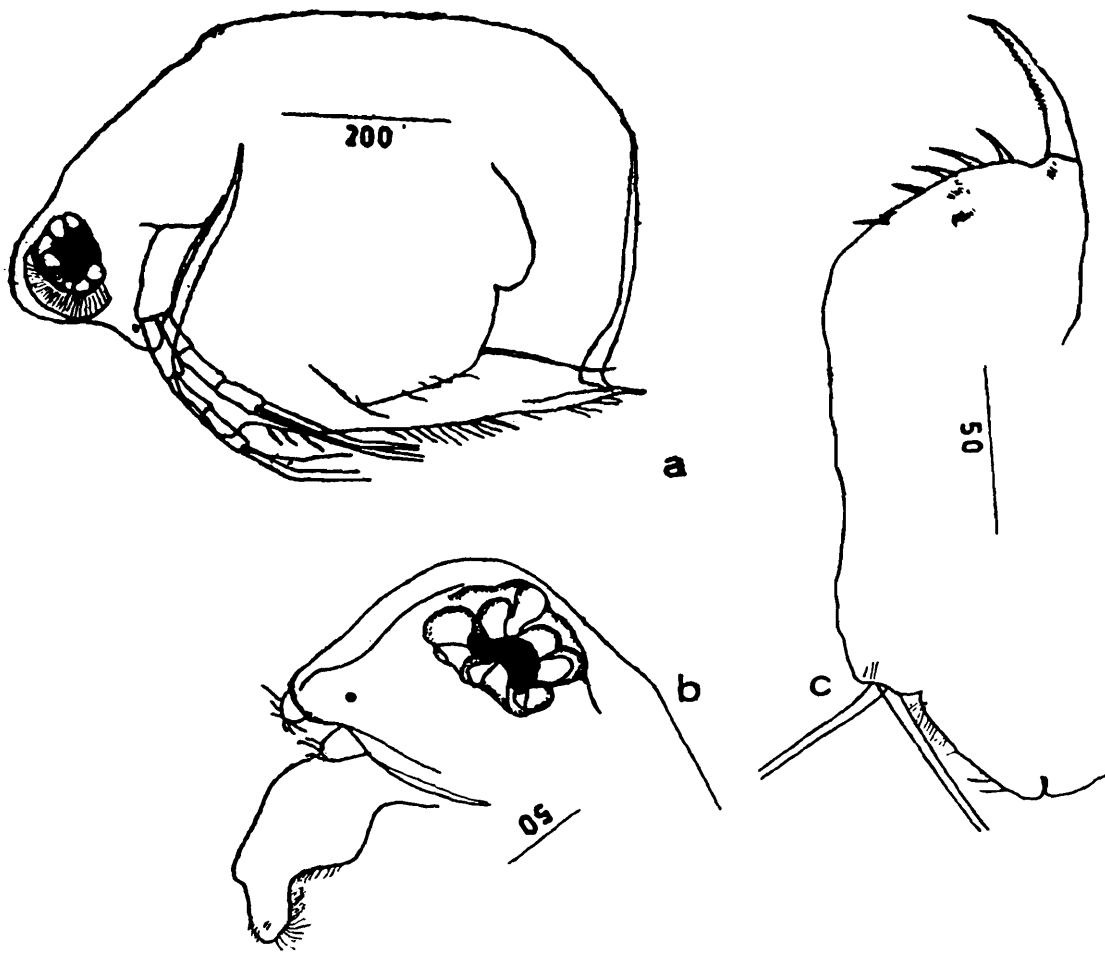
This genus is represented by one species from India.

18. *Scapholeberis kingi* Sars, 1903b  
(Text-fig. 20,a-c)

*Scapholeberis kingi* Sars, 1903b, p. 8-10, pl. I, figs. 2, a-c ; Gurney, 1906, p. 277-278 ; Gurney, 1907, p. 25 ; Sars, 1916, p. 314-315, pl. 32, figs. 3,a-b ; Biswas, 1971, p. 117, fig. 5b ; Fernando, 1974, fig. 46 ; Sharma, 1978, p. 149 ; Mamaril Sr. & Fernando, 1980, p. 135, figs. 109-110.

*Daphnia mucronata* King, 1853, pl. 2E (not Müller).

MATERIAL EXAMINED : *Reference material* DGF 1517, Buder tank, near Poondi Reservoir, Madras, 7.1.65. *Other materials* : ZSI 5228/10, Calcutta, collected by Dr. N. Annandale ; ZSI C 1984/2, Abalpura Bundh, Phulera, Jaipur, Rajasthan, collected by Mr. S. Biswas, 5.12.58 ; Sample 4, Madurai, collected by Mr. Anthony Basil, 11.12.77 ; RGM 47, 23, 81, 44, Shillong, 14.3.78 ; BKS—West Bengal : Baranagar (Calcutta), 16.1.75 ; Bon-Hooghly (24-Parganas), 16.1.75.



Text-fig. 20, a-c : *Scapholeberis kingi* Sars : a. female ; b. head (enlarged) ; and c. postabdomen.

*Female* : Carapace rather tumid, oval-quadrangular in outline ; transversely truncated at posterior margin. Posteroventral corner of each valve produced into a short spine pointing backwards. Ventral margin of valves almost straight and slightly angular in front ; densely ciliated. Valves sculptured with distinct transverse striae, particularly strong and ridge-like in the posterior part. Head with narrowly rounded anterior region, ventral margin deeply concave ; cervical sinus well-marked. Rostrum short and blunt. Eye large ; ocellus relatively small and located close to tip of rostrum. Antennules short, almost immovable ; located behind the rostrum ; postabdomen short and broad, rounded at the posterior end with 4-5 anal spines. Claw moderately long, stout and with setae on its concave margin.

*Length* : 0.76 mm.

*Male* : Not known from India.

*Distribution* : INDIA—West Bengal (Gurney, 1906, 1907 ; Sharma, 1978) ; Kashmir & Nilgiri Hills (Brehm, 1936) ; Rajasthan (Biswas, 1971) ; Meghalaya & Assam (Patil, 1976). Elsewhere—Africa, Australia, North America, Sri Lanka, Germany, China, Thailand, Indonesia.

#### Genus 9. *Simocephalus* Schoedler, 1858

Body large and heavy ; carapace thick. Valves broad, almost quadrate and marked with oblique striae ; with rounded angles and sometimes with a short posterior protuberance, rarely with a short spine. Ventral margin of valves merging into posterior margin in a broad curve. Head and rostrum small. Eye of moderate size ; ocellus rhomboidal, rounded or elongated. Two abdominal processes developed. Postabdomen large, broad and truncate ; with emarginate posterior end and bearing anal spines. Claw almost straight ; with setae on its concave margin, sometimes pectinate.

*Type species* : *Simocephalus vetulus* (O.F. Müller, 1776).

This genus is represented by five species from this country.

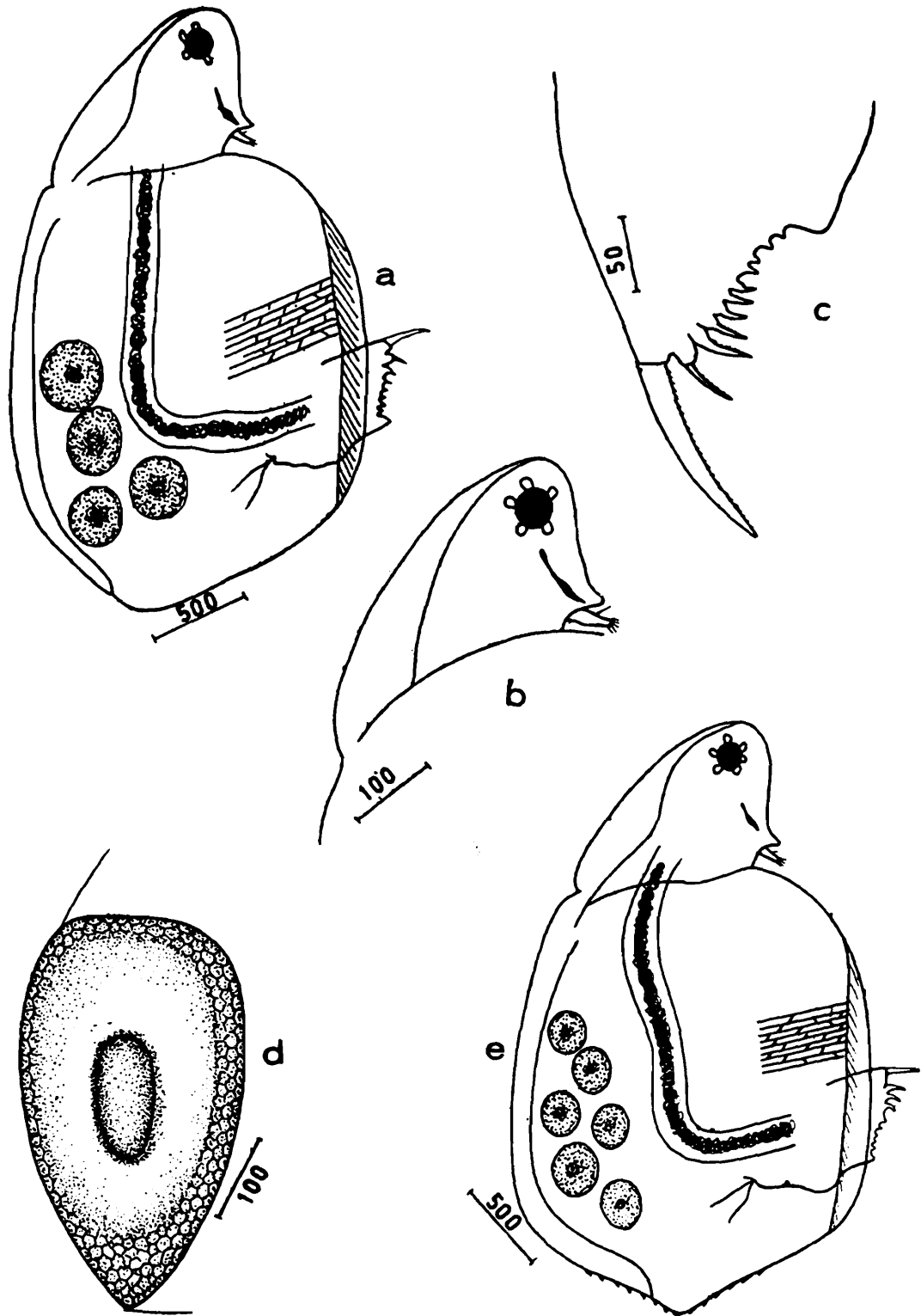
*Key to the Indian species of genus SIMOCEPHALUS*

1. Claw with a pecten. Ocellus rhomboidal or rounded .2  
 Claw without pecten. Ocellus elongated or rhomboidal .. .3
2. Head not produced anteriorly into an acute projection .. *S. exspinosus* (Koch, 1841)  
 Head produced anteriorly into an acute projection .. *S. acutirostratus* (King, 1853)
3. Posterior emargination of body with a short spine .. *S. latirostris* Stingelin, 1906  
 Posterior emargination of body without any spine; with or without a short protuberance. .4
4. Vertex rounded, without spinules. Ocellus elongated .. *S. vetulus* (O.F. Muller, 1776)  
 Vertex angulate, spinous. Ocellus usually rhomboidal .. *S. serrulatus* (Koch, 1841)

**19. *Simocephalus vetulus* (O.F. Müller, 1776)  
 sensu lato including *S. vetuloides* Sars, 1898  
 (Text-fig. 21, a-e)**

- Daphnia vetula* O.F. Müller, 1776, p. 199, No. 2399 ; Baird, 1850, p. 95-96, pl. 10, fig. 1.  
*Monoculus sima* Jurine, 1820, p. 129, pl. 12, figs. 1-2.  
*Daphnia sima* Leydig, 1860, p. 153, pl. 1, figs. 11-12, pl. 3, figs. 24-29.  
*Simocephalus vetulus* Schoedler, 1858, p. 18 ; P.E. Müller, 1867, p. 122, tab. 1, figs. 26-27 ; Stingelin, 1895, p. 205, pl. 5, figs. 8-12 ; Scourfield, 1903, p. 435 ; Daday, 1910, p. 149 ; Arora, 1931, p. 70-71, pl. 5, fig. 11 ; Fryer, 1957, p. 225 ; Scourfield and Harding, 1966, p. 21, figs. 9, 43 ; Biswas, 1971, p. 115, figs. 4c, 6a ; Nayar, 1971, p. 511 ; Fernando, 1974, figs. 47-60 ; Nasar, 1977, p. 33-34, fig. 3 ; Mamaril Sr. & Fernando, 1980, p. 134, fig. 102.  
*Simocephalus vetula* Brehm, 1936, p. 285-288 ; Brehm, 1950, p. 9.  
*Simocephalus vetuloides* Sars, 1898, p. 5-6, pl. VI, figs. 11-12 ; Sars, 1916, p. 5, pl. 6, figs. 11-12 ; Brehm, 1936, p. 285-288 ; Brehm, 1950, p. 10.  
*Simocephalus vetulus* (O.F. Müller, 1776) *sensu lato* including *S. vetuloides* Sars, 1898 ; Harding, 1961, p. 41-42 ; Sharma, 1978, p. 149.  
 ?*Simocephalus elizabethae* (King) : Gurney, 1906, p. 277 (*simosa*) ; Gurney, 1907, p. 24 (*simosa*) ; Sewell, 1935, p. 210-211 ; Biswas, 1971, p. 114, figs. 3G, 4H, G ; Nasar, 1977, p. 34 ; fig. 4 ; Qadri & Yousuf, 1977, p. 859, fig. 1.

MATERIAL EXAMINED : *Reference material* : BKS 10, Achipur, (24-Parganas), 30.11.77. *Other materials* : BKS—Amtala (24-



Text-fig. 21, a-e : *Simocephalus vetulus* (O.F. Müller) *sensu lato* including *S. vetuloides* Sars : a. female ; b. head (enlarged) ; c. postabdomen ; d. ehippium ; and e. female (*S. vetuloides*).

Parganas) 8.1.78 ; Bon-Hooghly (24-Parganas) 16.1.75 ; Behala (Calcutta) 3.2.77 ; Baranagar (Calcutta) 16.1.75 ; Dhakuria lake (Calcutta) 12.2.78 ; Indian Museum tank (Calcutta) 1.1.75, 8.12.76 ; Thakurpukur (24-Parganas) 1.9.75, 3.2.77 ; DGF 1513, Kovur village tank, near Madras, 7.1.65 ; Sample 6, Nainital, collected by Mr. P. C. Sharma, 30.8.77 ; Sample 10 Collairu lake, collected by Prof. Y Radhakrishna, 17.12.73 ; ZSI C 1987/2, Abalpura bundh, Phulera, Jaipur, Rajasthan, collected by Mr. S. Biswas, 5.12.68 ; ZSI 5581/10 (Tibet, Khan-tso), 5590/10 (Tibet, Mang-tso) and 5594/10 (Tibet, Gyang-tso) collected by Capt. F. H. Stewart, July, 1907.

*Female* : Carapace rounded trigonal in outline, considerably extended posteriorly ; no posterior spine present ; posterodorsal corner with blunt angle. In a few specimens (= *vetuloides*) carapace terminating at posterior extremity in a short and obtuse protuberance located at the level of axis of body. Dorsal margin moderately to strongly arched, posterior part of dorsal margin with distinct denticles. Head small, prominent ; rounded in front. Eye moderately large ; ocellus large and elongated. Postabdomen very broad, deeply emarginate ; with about 10 anal spines curved and ciliated, decreasing proximally. Supra anal angle prominent. Claw long, curved and denticulate.

*Length* : 3.0 mm

*Male* : Not known from India.

*Remarks* : Some specimens identical with *S. vetuloides* Sars were also observed in the examined material and have been included in *S. vetulus* following the works of Fryer (1957) and Harding (1961).

Dumcmt and Van de Velde (1977) considered *S. elizabethae* (King) as a subspecies of *S. vetulus* (O.F. Muller). *S. elizabethae* has been reported from India by a number of workers. Of the earlier Indian records, this species has been illustrated only by Biswas (1971), Nasar (1977) and Qadri & Yousuf (1977). From the last two papers, it is difficult to ascertain the identity of the species from the illustrations. However, Biswas's specimens were studied and found to be identical with *S. vetuloides* Sars, which has been included under

*S. vetulus* (O.F. Müller) in this account. As the identity of reports of *S. elizabethae* from India is questionable, all the earlier reports are included in *S. vetulus*.

*Distribution* : INDIA—Punjab, Kashmir & Mysore (Brehm, 1936) ; Kumaon, W. Himalaya (Brehm, 1950) ; Rajasthan, (Biswas, 1971, Nayar, 1971) ; Bihar (Nasar, 1977) ; Kashmir (Qadri & Yousuf, 1977) and West Bengal (Sharma, 1978). Elsewhere—Cosmopolitan.

20. ***Simocephalus exspinosus*** (Koch, 1841)  
(Text-fig. 22,a-c)

*Daphnia exspinosus* Koch, 1841, pl. 11.

*Monoculus exspinosus* De Geer, 1778, p. 457.

*Daphnia australiensis* Dana, 1853, p. 1271, pl. 39, figs. 4, a-e.

*Simocephalus congener* Schoedler, 1858, p. 20 ; Daday, 1888, p. 114.

*Simocephalus exspinosus* Schoedler, 1858, p. 21 ; P.E. Müller, 1867, p. 121 ; Hellich, 1877, p. 42 ; Lilljeborg, 1900, p. 173, pl. 25, figs. 8-18, pl. 26, figs. 1-8 ; Uéno, 1937, p. 203 ; Uéno, 1938a, p. 1, fig. 2 ; Bening, 1941, p. 184, fig. 79 ; Harding, 1957, p. 62-63 ; Brooks, 1959, p. 616, figs. 27-30 ; Thomas, 1961a, p. 115 ; Herbst, 1962, p. 56, figs. 28,a-e ; Manuilova, 1964, p. 152, fig. 53 ; Scourfield & Harding, 1966, p. 21, figs. 42-45 ; Sharma, 1978, p. 149.

*Simocephalus australiensis* Sars, 1888, p. 15, pl. 2, figs. 1-5 ; Henry, 1922, p. 31, pl. V, figs. 1, 1c ; Biswas, 1971, p. 114, figs. 3H, 5A.

*Simocephalus productus* Sars, 1903c, p. 17-18, pl. VI, fig. 2.

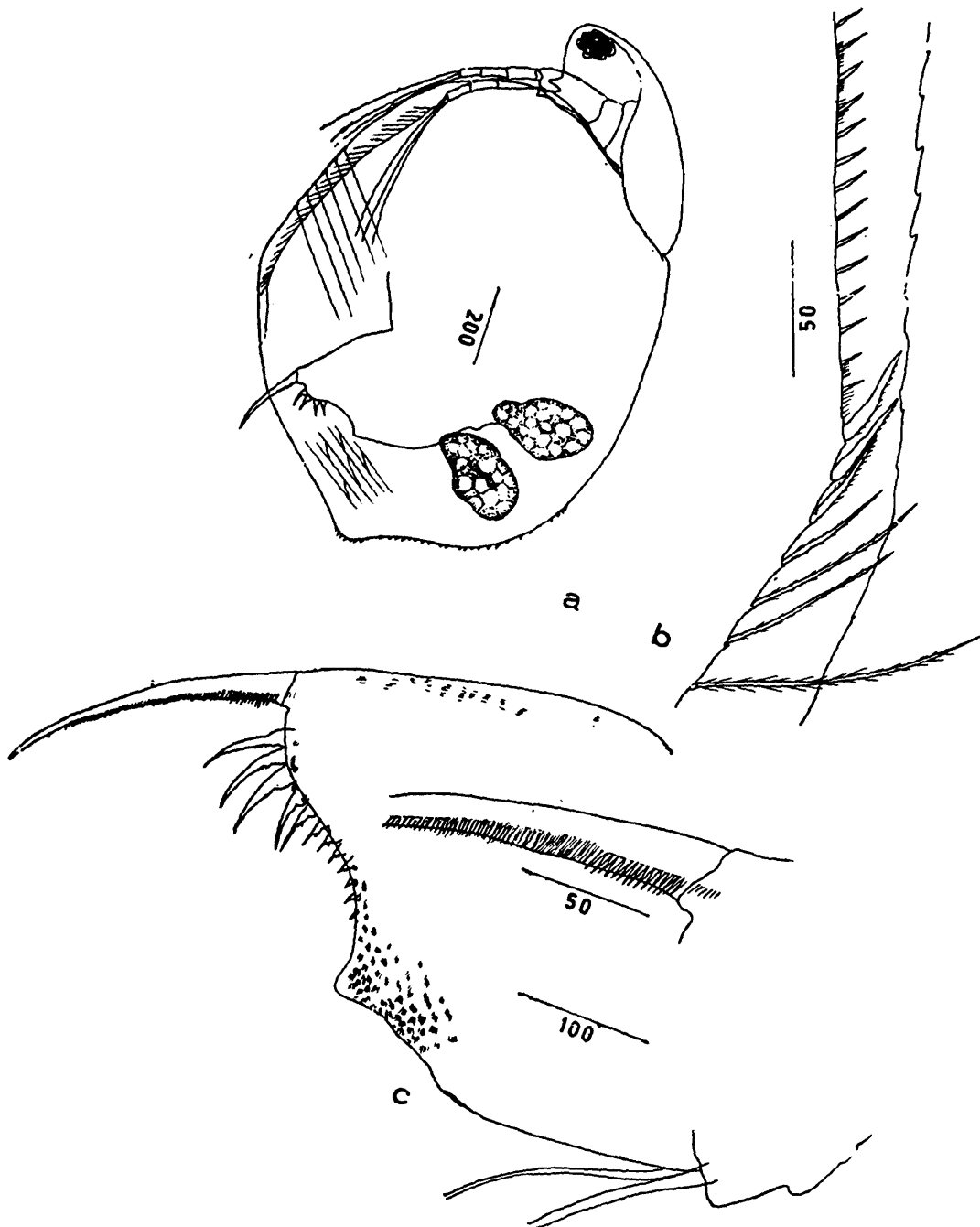
*Simosa australiensis* Sars, 1916, p. 311, pl. 31, figs. 3, 3a-b.

**MATERIAL EXAMINED** : *Reference material* : RGM 2, Shillong, 12.4.78. *Other materials* : RGM 100, Shillong, 10.4.78 ; ZSI C 1985/2, C 1986/2, Julga lake and Geodisar, Rajasthan, collected by Dr. K. K. Tiwari and Mr. S. Biswas, 24.11.58, 28.12.57 (samples labelled as *S. australiensis*) ; BKS—West Bengal : Budge Budge (24-Parganas) 4,12,77 ; Memanpur (24-Parganas) 30.11.77.

*Female* : Carapace oval or sub-rhomboidal in outline ; slightly expanded posteriorly. Dorsal margin almost straight in greater part of its extent, but forming behind an abrupt curve before joining distinct posterior protuberance ; posterior part of dorsal margin distinctly denticulate. Shell sculpture as in *S. vetulus*. Head small and triangular, front abruptly curved at the ocular region, dorsal

margin evenly acute and ventral margin almost straight ; rostrum small. Eye small, situated in vertex of head ; ocellus small, mostly rhomboidal. Postabdomen broad and deeply emarginate, slightly narrowed towards apex ; 10-12 anal spines ciliated. Claw long, with a distinct pecten at its base and with setae on its concave margin.

*Length* : 1.4 mm



Text-fig. 22, a-c : *Simocephalus exspinosus* (Koch) : a. female ; b. ventral portion of left valve (enlarged) ; and c. postabdomen.

*Male* : Not known from India.

*Remarks* : Sars (1903c) while describing *S. productus* mentioned that perhaps it ought to be regarded as a variety of *S. exspinosus*. Uéno (1966a) got some specimens (= *productus*) but identified the same as *S. exspinosus*. Further, he regarded *S. productus* as a variety of *S. exspinosus*. In the present material, besides the typical specimens of *S. exspinosus*, some forms identical with Sars' species were also observed and are included in *S. exspinosus* following Uéno (*loc. cit.*).

*Distribution* : INDIA—Meghalaya (Patil, 1976) and West Bengal (Sharma, 1978). Elsewhere—Cosmopolitan.

21. ***Simocephalus latirostris*** Stingelin, 1906  
(Text-fig. 23, a-c)

*Simocephalus latirostris* Stingelin, 1906, p. 187, figs. 5-7 ; Fryer, 1957, p. 226-227 ; Biswas, 1971, p. 115, figs. 6 B,D ; Mamaril Sr. & Fernando, 1980, p. 134, figs. 100-101.

**MATERIAL EXAMINED** : *Reference material* : DGF 1521, shallow tank near Narasingam village, Madurai, 9.1.65. *Other materials* : ZSI C 1983/2, Julga lake, Jaipur, collected by Mr. S. Biswas, 24.11.58, (only one specimen, flattened, badly preserved, identity uncertain).

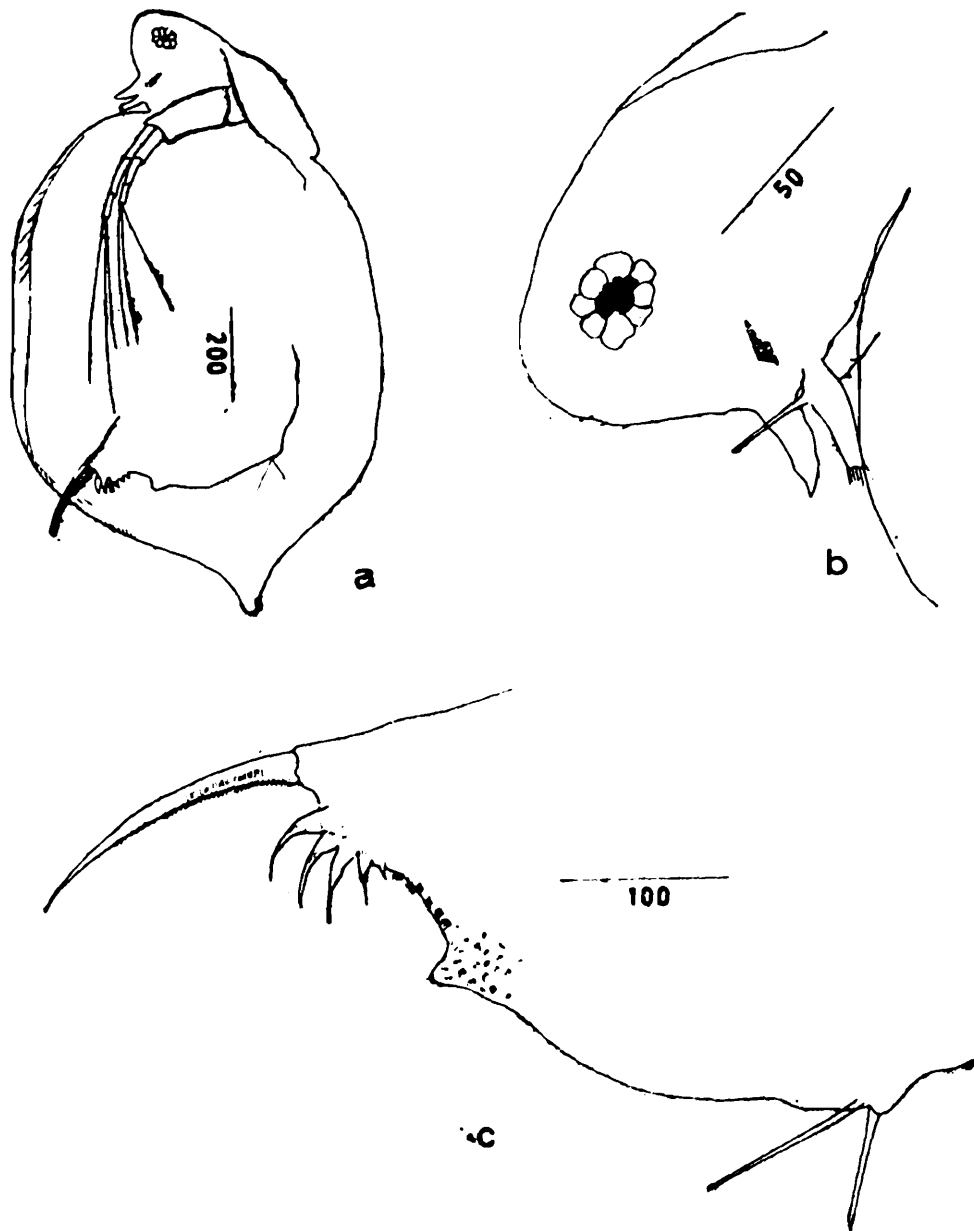
*Female* : Carapace almost oval in outline ; produced posteriorly into a distinct conical spine bearing hyaline spinules near tip. Posterior region of dorsal margin of valves with spinules. Inner ventral margins with setae ; anterior setae longer than those located posteriorly. Carapace markings (nor easily seen in preserved material) reticulate with hexagons, discernible in places. Head rather small, slightly depressed ; ventral margin strongly concave and drawn out into long and laterally broadened rostrum. Frons evenly rounded. Eye moderately large ; ocellus conspicuous, roughly triangular or rhomboidal in form. Antennules slightly longer than rostrum, slightly tapering ; lateral seta inserted near the base. Postabdomen as in *S. vetulus* but less broad ; with only 5 anal spines,

proximal most anal spine very small. Claw long slender and with ciliated concave margin.

*Length* : 1.2 mm

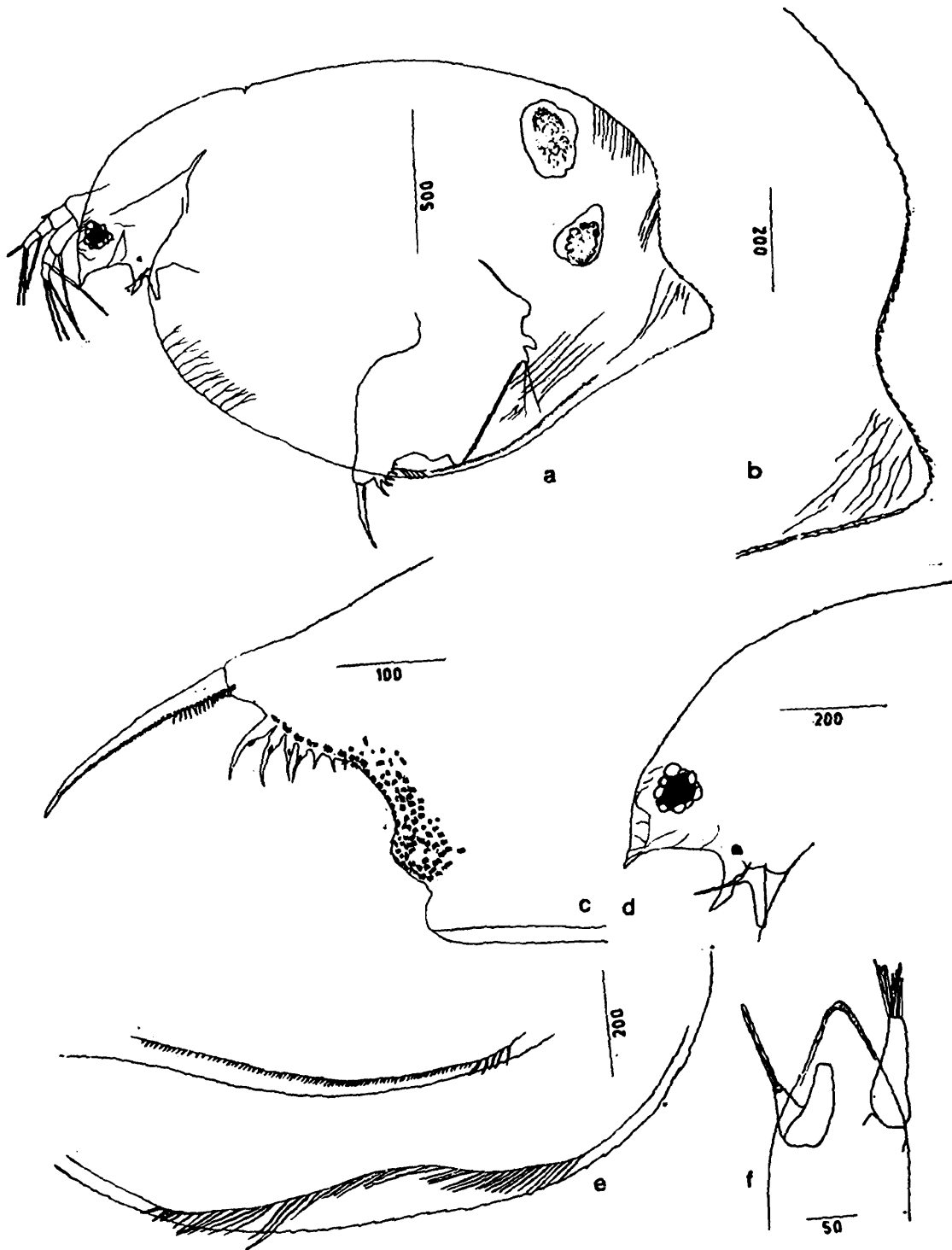
*Male* : Not known from India.

*Distribution* : INDIA—Rajasthan (Biswas, 1971). Elsewhere—Pantropical.



**Text-fig. 23, a-c :** *Simocephalus latirostris* Stingelin : a. female ; b. head (enlarged) ; and c. postabdomen.

22. *Simocephalus acutirostratus* (King, 1853)  
(Text-fig. 24, a-f)



Text-fig. 24, a-f : *Simocephalus acutirostratus* (King) : a. female ; b. posterior margin of valve (enlarged) ; c. postabdomen ; d. head (enlarged) ; e. ventral margin of right valve (enlarged) ; and f. labral plate with antennules.

*Daphnia elizabethae* var. *acutirostrata* King, 1953.

*Simocephalus acutirostris* Sars, 1896.

*Simocephalus acutirostratus* Henry, 1922, p. 31, pl. V, figs. 4, 4a; Brehm, 1953, p. 323 ; Mamaril Sr. & Fernando, 1980, p. 134, figs. 103-104.

**MATERIAL EXAMINED** : *Reference material* : Sample 3, Madurai, collected by Dr. N. Murugan, 10.4.78. *Other materials* : Sample 4, Madurai, collected by Mr. Anthony Basil, 11.12.77.

*Female* : Carapace oval or trigonal in outline, dorsal and ventral margins evenly arched ; posterior protuberance obtuse and produced, situated in the longitudinal axis of body. Posterior region of dorsal surface and posterior prominence marked distinctly with denticles. Head small and produced anteriorly into an acute projection, ventral surface of head almost straight. Rostrum small and pointed. Eye comparatively small ; ocellus small and punctiform. Postabdomen very broad, its posterior end forming an expansion in front of anal sinus ; about 7 anal spines, increasing in size distally. Claw long and slender ; with pecten of 10-12 teeth and denticulate.

*Length* : 2.0 mm

*Male* : Not known from India.

*Distribution* : INDIA—Kodaikanal, South India (Brehm, 1953). Elsewhere—Australia, Philippines, Sri Lanka.

### 23. *Simocephalus serrulatus* (Koch, 1841) (Text-fig. 25, a-f)

*Daphnia serrulata* Koch, 1841, pl. 14.

*Simocephalus serrulatus* Lilljeborg, 1900, p. 179, pl. 26, figs. 9-16 ; Stingelin, 1913, p. 611-613, figs. 14-16 ; Uéno, 1927, p. 282, pl. 24, figs. 10, a-i ; Fryer, 1957, p. 225-227 ; Harding, 1961, p. 41 ; Green, 1962, p. 420.

*Simocephalus capensis* Sars, 1895, p. 15-18, pl. 3, figs. 1-7.

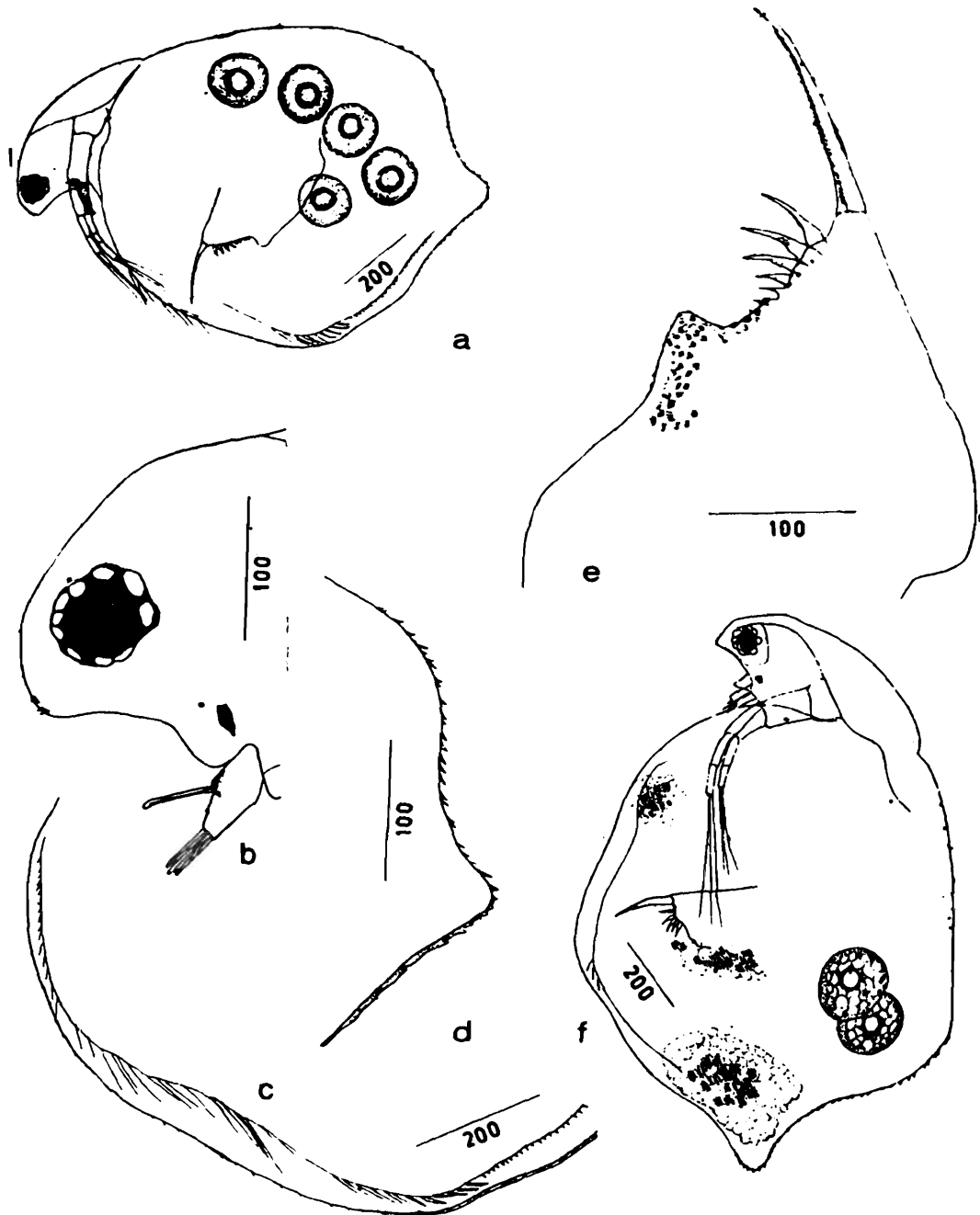
*Simocephalus inflatus* Vavra, 1900, p.12, figs. 1, a-c.

*Simosa semiserrulata* Sars, 1901, p. 23-25, pl. IV, figs. 1-9.

*Simosa capensis* Sars, 1916, p. 313, pl. CCVI, figs. 2, 2a-b.

*Simosa serrulata* Gauthier, 1951, p. 49, pl. 10, figs. f-j.

MATERIAL EXAMINED : *Reference material* : Sample 3, Silver Cascade, Kodaikanal Hills, Tamil Nadu, collected by Mr. Anthony Basil, 11.12.77. *Other materials* : RGM 17, Tasek lake, Garo Hills, Meghalaya, collected by Mr. P. K. Das, 20.4.78.



Text-fig. 25, a-f : *Simocephalus serrulatus* (Koch) : a. female ; b. head (enlarged) ; c. ventral margin of left valve (enlarged) ; d. posterior margin of valve (enlarged) ; e. postabdomen ; and f. female from another population.

*Female* : Carapace broadly oval or somewhat rhomboidal in outline, slightly widened behind. Dorsal margin evenly arched, ventral margin bulging in middle ; posterior protuberance slightly above median axis of body. Posterior part of the dorsal margin and terminal protuberance denticulated. Head comparatively small ; with dorsal margin evenly curved and front forming below an acute angle armed with a number of minute denticles ; rostral projection small. Eye comparatively large ; ocellus small, almost rhomboidal in form. Postabdomen less broad than in other species with about 8 anal denticles. Claw long, slender with fine setules on its concave margin.

*Length* : 1.20 mm

*Male* : Not known from India.

*Distribution* : INDIA—New record. Elsewhere—North and South America, Africa, Java, Europe, Australia, New Zealand.

### Family III. MOINIDAE Goulden, 1968

Moinids are characterised by their rather prominent head, with a pair of long and thin “cigarette shaped” antennules. These arise from ventral surface of head while in the males the antennules are attached to anterior end of head. Most species have hairs on head region or on shell surface. Ocellus is usually absent. Some species have a distinct supraocular depression. Postabdomen has only a row of lateral teeth with no marginal spines ; distalmost lateral tooth is usually bident. Abdominal processes lacking. Claw smooth or with pecten.

Type genus : *Moina* Baird, 1850

This family is represented by two genera, in this present study.

#### *Key to the Indian genera of Family MOINIDAE*

Body thick and heavy ; ocellus usually absent  
 except in one species .....*Moina* Baird, 1850  
 Body laterally compressed; ocellus present.....*Moinodaphnia* Herrick, 1887



1919, p. 112-117, figs. 31-37 ; Srámek-Husek, 1940, p. 204-214, fig. 1 ; Srámek-Husek *et al.*, 1962, p. 249-252, pl. 90, figs. A-L ; Goulden, 1968, p. 28-37, figs. 8-13 ; Smirnov, 1976, p. 194-200, figs. 171-179 ; (subspecies designated) ; Mamaril Sr. & Fernando, 1980, p. 135-136, figs. 82, 114-119.

*Moina propinqua* Sars, 1885, p. 29-35, pl. 5, figs. 4-5, pl. 6, figs. 1-5.

*Moina weberi* Richard, 1891, p. 120-123, pl. 10, figs. 1-3.

*Moina dubia* Guerne *et.* Richard, 1892, p. 527-530, figs. 1-2 ; Gurney, 1927 p. 66-67, figs. 5E-F ; Sewell, 1935, p. 212-216, figs. 1-2 ; Steuer, 1939, p. 267-278, figs. 1-2 ; Brehm, 1953, p. 334-336 ; Rey, 1966, p. 177-182, figs. 1-7 ; Rey & Saint-Jean, 1968, p.93, fig. 9 ; Biswas, 1971, p. 120, figs. 5.E-G, 6 G-H.

*Moina paradoxa* Stingelin, 1900, p. 196-197, fig. 3.

*Moina ciliata* Daday, 1905, p. 201-202, pl. 13, figs. 9-13.

*Moina makrophthalma* Stingelin, 1904, 614-615, fig. 17.

*Moina macrocopa* var. *brevicaudata* Bar, 1924, p. 102-104, pl. 6, figs. 4-5.

*Moina dubia macrocephala* Rammner, 1933, p. 362-366, figs. 5-8.

*Moina dubia lacustris* Rammner, 1931, p. 623-634, figs. 1-4, 6.

*Moina latidens* Brehm, 1933c, p. 684-685, fig. 11.

*Moina dubia* var. *parva* Jenkin, 1934, p. 151-154, figs. 8, 8a, 9, 9a.

*Moina dubia* var. *baringoensis* Jenkin, 1934, p. 155-160, figs. 10, a-c, 11, 12, 12a-b.

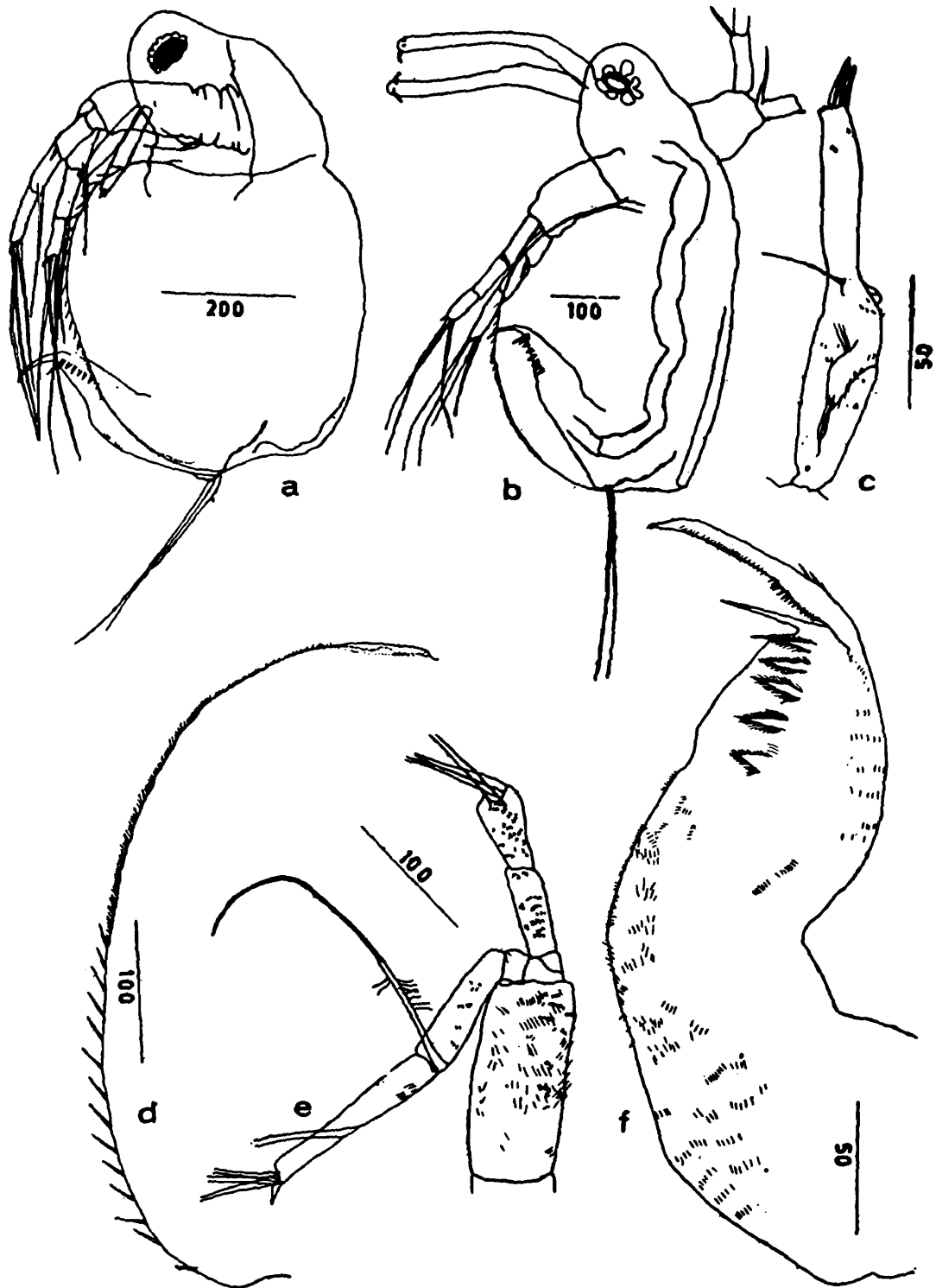
*Moina* sp. Hensen, 1952, p. 597-598, figs. 6-7.

*Moina* cf. *weismanni* Brehm, 1953, p. 328-330, figs. 96-98.

*Moina weismanni* Tsi-Chung and Clemente, 1954, p. 106-107, pl. 2, figs. 6, 6a-d.

**MATERIAL EXAMINED** : *Reference material* : Sample 4, Madurai, collected by Mr. Anthony Basil, 11.12.77. *Other material* : Sample 1, Irinjalakuda, Kerala, collected by Dr. C.K.G. Nayar, 8.12.77 ; Sample 4, Kalyani, collected by Dr. B. B. Jana, 1.10.78 ; ZSI C 1968/2, Suratgarh, collected by Dr. B. Biswas, 9.10.60 (*Moina affinis*) ; ZSI 1962/2, New Kyar, Sambhar lake, collected by Dr. B. Biswas, 21.11.58 (*Moina banffy*) ; ZSI C 1978/2, Gudha Talao, collected by Mr. S. Biswas, 22.10.58 (*Moina brachiata*) ; ZSI C 1961/2, Julga lake, collected by Mr. S. Biswas, 24.2.58 (*Moina dubia*) ; ZSI C 1966/2, Guda Talao, collected by Mr. S. Biswas, 22.10.58 (*Moina flagellata*) ; ZSI C 1977/2, Ganganagar district, collected by Dr. B. Biswas, 16.10.60 ; ZSI C 1979/2, Nawa on Sambhar lake, collected by Mr. S. Biswas, 19.6.58, 25.9.58 (*Moina rectirostris*) ; BKS—West Bengal : Behala (Calcutta) 1.9.75 ; Barisha (24-Parganas) 7.1.78 ; Barrackpore (24-Parganas) 1.4.78 ; Baruipur (24-Parganas) 1.9.75 ; Amtala (24-Parganas) 3.2.77 ; Maheshtala (24-Parganas) 4.12.77 ; Sarisha (24-Parganas) 8.5.75 ; Tank opposite Lindsay Street (Calcutta) Jan-Dec., 1975, May-Dec.

1976 ; BKS—N. W. India : Bhatinda (Punjab) 8.11.76 ; Deon village, Bhatinda (Punjab) 16.6.75 ; Giddarbaha, Ferozepur district, (Punjab), 17.6.75 ; Nabha (Punjab) 19.6.75 ; Ambala Cantt. (Haryana) 1.4.76.



Text-fig. 26, a-f : *Moina micrura* Kurz : a. female ; b. male ; c. female antennule ; d. left valve (enlarged) ; e. antenna ; and f. postabdomen.

*Female* : Head large, extended in anteroventral direction and with well developed supraocular depression. Anterior and ventral margins of head evenly rounded. Eye large. Valves oblong or rotund in shape. No setules either on head or valves. Valves reticulated ; ventral margin of valves with 11-25 long setae followed by groups of short setae on the posterior margin. Antennules originating well behind the eye ; antennules large, thin and with a long basal seta. When extended, terminal segments of antennae almost reach up to middle part of valves, while their setae extend even up to the posterior margin of valves. Postabdomen short, slender and with distal conical part. Dorsal margin of postabdomen with groups of short setae, distal margin with bident and 5-9 feathered lateral setae, decreasing in size proximally. Claw long and curved, ventral base of claw with 3-7 teeth ; concave margin of each claw with fine setae, proximal setae comparatively larger and forming distinct pecten.

*Length* : 1.1 mm

*Distribution* : INDIA—West Bengal (Sewell, 1935, Sharma, 1978), Nilgiri Hills (Brehm, 1936), Bihar (Brehm, 1950), Bijapur (Brehm, 1953), Rajasthan (Biswas, 1971). Elsewhere—Africa, Syria, USSR, France, Philippines.

25. *Moina macrocopa* (Straus, 1820)  
(Text-fig. 27, a-d)

*Daphnia macrocopus* Straus, 1819, 29-30 ; Straus, 1820, pl. 161 ; Robin, 1872, p. 452-465, pl. 16, figs. 1-5, pl. 17, figs. 2,4,5,; pl. 18, fig 3 ; pl. 19, figs. 1-2.

*Moina flagellata* Hudendorff, 1876, p. 39-40 ; Matile, 1891, p. 130, pl. 4, figs. 19 19a ; Birge, 1893, p. 292-293, pl.10, figs. 2,4,6,9-11.

*Moina fischeri* Hellich, 1877, p. 55-56, fig. 22.

*Moina paradoxa* Weismann, 1877b, p. 227-228, pl. 10, figs. 36-45 ; Gruber & Weismann, 1880, p. 82-92, pl. 3, figs. 1-2 ; pl. 4, figs. 6,8,9 ; pl. 5, figs. 16,18,20 ; pl. 7, figs. 25-28 ; Eylmann, 1887, p. 71-74, pl. 5, fig. 3.

*Moina banffyi* Daday, 1883, Daday, 1888, p. 112-113, pl. 3, figs. 1-2 ; Scourfield, 1903, p. 437-438, pl. 24, figs. 5-8 ; Scourfield, 1903, pl VI, fig. 16 ; Biswas, 1971, p. 122, fig. 10A-E.

*Moina azorica* Moniez, 1888, p. 14-15.

*Moina macrocopus* Blanchard et Richard, 1892, p. 512.

*Moina paradoxa* var. *japonica* Ishikawa, 1896, p. 7-12, pl. IV.

*Moina macrocopa* Sars, 1903a, p. 178, pl 7, figs. 3,3a-c ; Goulden, 1968, p.22-28, figs. 5-7 (subspecies designated) ; Dussart, 1970, p. 665-666, fig. 1 ; Flössner, 1972, p. 204-206, Abb. 97 ; Smirnov, 1976, p. 213-216, figs. 196-201 (subspecies designated) ; Mamaril Sr. & Fernando, 1980, p. 136, figs. 123-127.

*Moina rectirostris* var. *casani* Arevalo, 1920, p. 166, figs. 1-3.

*Moina esau* Brehm, 1936, p. 289-290, figs. 1A-F.

*Moina* nov. sp. Brehm, 1937a, p. 22-23, figs. 1-3.

*Moina esau* var. *dschirofti* Hensen, 1952, p. 599-601, figs. 8-12 ;

*Moina ganapati* Brehm, 1963, p. 165-170, figs. 11-15.

*Moina irrasa* Chiang, 1963, figs. 4-18.

**MATERIAL EXAMINED :** *Reference material* : Description taken from literature, since no material was available. *Other material* : Sample 2, fish ponds of Central Institute of Fishery Education, Versova, Bombay, sent by Dr. B. S. Bhimachar, 20.10.70 (material identified as *M. macrocopa*, but sample returned.).

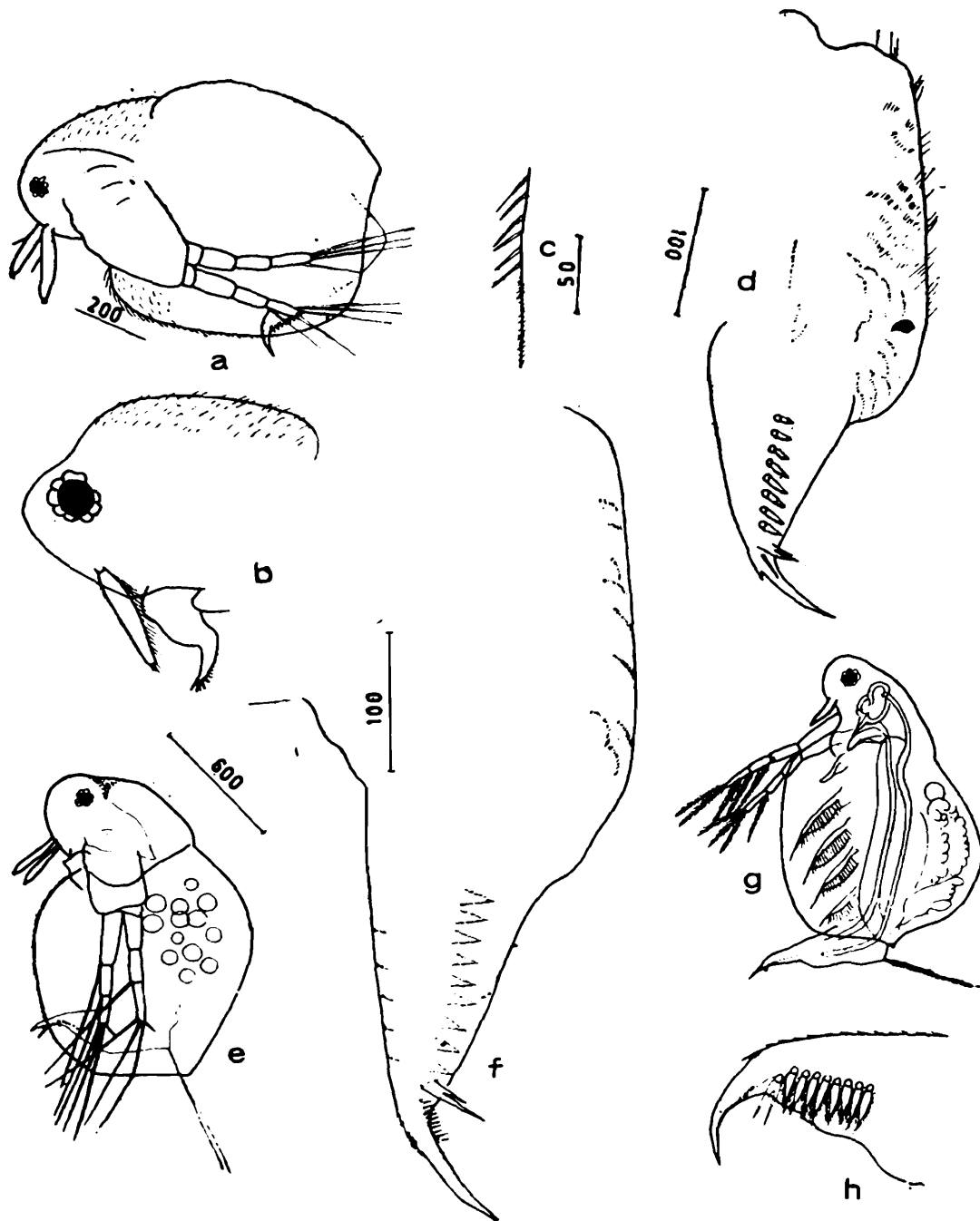
*Female* : Head and valves generally covered with long setules. Head broadly rounded, without any distinct supraocular depression. Eye of moderate size. Antennules large, robust and armed with rings of setae ; sensory seta very long and origination on lateral margin at the mid-point of antennule. Valves with granular appearance and distinct reticulations formed by parallel lines ; fine setules on the valves arranged along these lines. Ventral margin of valves with a row of 45-64 setae, followed by a row of shorter setae along the posterior margin. Postabdomen very broad and long, with 7-10 lateral feathered teeth and one short bident tooth ; dorsal margin with rows of thin setae. Claw with one or two teeth on ventral surface and with row of fine setae on its concave margin. Ehippial females generally smaller ; without setules on head and valves or atleast setules not present on ehippium. Ehippium reticulated and with flattened cells, more trapezoidal than square in cross-section.

*Length* : 1.3 mm

*Male* : Body dorsally covered with hairs. Antennules originating below eye and bent in middle ; with 5 or 6 short, recurved hooks on distal end. First leg with very large hook on endopod and long seta on exopod. Postabdomen similar to that of female ; vas deferens opening ventral to claws.

*Length* : 0.70 mm

*Remarks* : The described Indian specimens are identical with nominate subspecies i.e. *M. macrocopa macrocopa* (Straus) as has



Text-fig. 27, a-d : *Moina macrocopa* (Straus) (After Goulden 1968) : a. female ; b. head (enlarged) ; c. ventral margin of valve (enlarged) ; d. postabdomen.

Text-fig. 27, e-f : *Moina brachiata* (Jurine) (After Goulden, 1968) : a. female ; and f. postabdomen.

Text-fig. 27, g-h : *Moina weismanni* Ishikawa (After Goulden, 1968) : g. female ; and h. postabdomen.

been designated in the works of Goulden (1968) and Smirnov (1976).

*Distribution* : INDIA—Nilgiri Hills (Brehm, 1936), Yamuna river, Delhi (Brehm, 1963) and Rajasthan (Biswas, 1971). Elsewhere—Tropics and sub-tropics.

## 26. *Moina brachiata* (Jurine, 1820) (Text-fig. 27 e-f)

*Monoculus brachiatus* Jurine, 1820, p. 131-132, pl. 12, figs. 3-4.

*Daphnia brachiata* Liéven, 1848, p. 29-30, pl. 17, figs. 7-9 ; Lilljeborg, 1853, p. 37-40, pl. 2, figs. 4-5 ; Leydig, 1860, p. 166-174, pl. 4, fig. 39, pl. 5, figs. 40-43.

*Moina rectirostris* Baird, 1850, p. 101, pl. 11, figs. 1-2 ; Hellich, 1877, p. 54-55, fig. 21 ; Gruber & Weismann, 1880, p. 52-81, pl. 3, figs. 3-4, pl. 4, figs. 5,7,10, pl. 5, figs. 17, 19,21, pl. 6, figs. 22-24 ; Eylmann, 1887, p. 74-76, pl. 5, fig. 2 ; Lilljeborg, 1900, p. 216-222, pl. 29, figs. 29-30, pl. 30, figs. 1-12 ; Sars, 1903a, p. 179, pl. 7, fig. 5 ; Wagler, 1937, p. 36, figs. 115-116 a-c ; Bening, 1941, p. 556-560, figs. 62, a-d, 63 ; Stephanides, 1948, p. 19-20, pl. 7, figs. 57-60, Gauthier, 1954, p. 15-26, pl. 1, figs. A-C, pl. 2, figs. A-D, pl. 3, figs. A-C, pl. 4 ; figs. A-C, pl. 5, figs. A-F, pl. 6, figs. A-D, pl. 7, figs. A-E, pl. 8, figs. A-B, pl. 9 ; figs. A-B, pl. 10, figs. A-C, pl. 11, figs. A-B, figs. 2 A-C, Scourfield & Harding, 1958, p. 25, fig. 7 ; Srámek-Husek et. al., 1962, p. 247-249, figs. 89 a-g ; Biswas, 1971, p. 122, figs. 9A-D.

*Moina brachiata* Baird, 1850, p. 102, pl. 9, figs. 1-2 ; P.E. Müller, 1867, p. 133-134, pl. 2, fig. 22 ; Hellich, 1877, p. 53-54, fig. 20 ; Sars, 1916, p. 321-322, pl. 35, fig. 3,3a-b ; Goulden, 1968, p. 15-22, figs. 2-3 ; Nayar, 1971, p. 512, figs. 12-16 ; Biswas, 1971, p. 120-121, figs. 8D-E ; Flössner, 1972, p. 207-209, abb. 98 ; Smirnov, 1976, p. 191-194, figs. 168-170 ; Mamaril Sr. & Fernando, 1980, p.136, figs. 120-122.

*Moina lilljeborgi* Schoedler, 1877, p. 5, figs. 9a-c, 10 ; Keilhack, 1914, p. 150-151.

*Moina lilljeborgi* var. *salinarum* Ruhe, 1914, p. 16-19, fig. 4e-f.

*Moina* n.sp. (?) Srámek-Husek, 1940, p. 212, figs. 2a-f.

**MATERIAL EXAMINED** : *Reference material* : Description taken from literature, since no material was available.

*Female* : Head rather broad ; supraocular depression located above eye, not much marked. Eye of moderate size, situated near the dorsal margin of head. Antennules long and thin, with setae arranged in rings ; sensory seta located on lateral anterior margin of antennules at point 1/3 of the distance from head. Valves rotund

or rectangular ; with granular surface and distinct reticulations. Ventral margin of valves with 35-41 long setae on anterior two-thirds of valve margin, followed by about 25 groups of shorter setae, each group consisting of 5-8 setae increasing in size posteriorly ; setae at posterior margin not arranged in groups. Postabdomen large and rather long, its dorsal margin with long bident tooth and 9-14 feathered teeth. Claw with large pecten of 11-14 teeth, its distal half with short setae ; ventral base of claw with 5-8 thin teeth.

*Length* : 1.3 mm

*Male* : Not known from India.

*Distribution* : INDIA—Kashmir (Brehm, 1936), Rajasthan (Biswas, 1971, Nayar, 1971), Meghalaya (Patil, 1976). Elsewhere—Europe, England, Russia, Mongolia, Italy, Greece, Africa, Philippines, and throughout most of the Old World.

27. *Moina weismanni* Ishikawa, 1896  
(Text-fig. 27, g-h)

*Moina weismanni* Ishikawa, 1896, p. 1-6, pl. 2, figs. 1-9 ; Uéno, 1927, p. 284, pl. 25, figs. 14, 14a-b, pl. 26, figs. 14, c-f ; Brehm, 1951, p. 112-113, p. 31-34 ; Goulden, 1968, p. 53-55, figs. 23, 25A-B ; Smirnov, 1976, p. 200-203, figs. 180-181.

*Moina brevicornis* Sars, 1903c, p. 10-12, pl. 1, figs. 3, 3a-b.

*Moina vom Mandvi-flouve* Brehm, 1953, p. 331, figs. 95a-b.

**MATERIAL EXAMINED** : *Reference material* : Description taken from literature, since no material was available.

*Female* : Head broadly rounded and with a well developed supraocular depression above eye. Eye moderately large and located near frontal margin of head. Antennules short and spaced widely apart on ventral margin of head. Valves rounded ; with about 17 long setae on ventral margin followed posteriorly by short setae arranged in groups. Postabdomen with 5-9 lateral feathered teeth ; bident tooth with two longer arms, its proximal arms much longer than normally found in *Moina*. Claw with the ventral base having 5-7 teeth and with setae on its concave margin.

*Length* : 1.0 mm

*Male* : Not known from India.

*Distribution* : INDIA—Mandvi (Brehm, 1953). Elsewhere—Japan, China, Cambodia.

### Genus 11. *Moinodaphnia* Herrick, 1887

*Moinodaphnia* Herrick, 1887, p. 35 ; Sars, 1916, p. 15-16 ; Goulden. 1968, 83-84 ; Smirnov, 1976, p. 186.

*Paramoina* Sars, 1888, p. 68.

Body compressed. Head strongly arched above, angled in front and with almost a beak behind. Antennules long and movable. Antennae with long, unjointed spines on apical joint of four segmented ramus. Ocellus present, Valves quadrate, crested dorsally, very slightly angled above. One large abdominal process. Postabdomen with slender post-anal projection and bearing bident distally.

Type Species : *Moinodaphnia macleayi* (King, 1853)

Represented by one species from this country.

#### 28. *Moinodaphnia macleayi* (King, 1853) (Text-fig. 28, a-e)

*Moina macleayii* King, 1853. p. 251-252. pl. 5.

*Moina submucronata* Brady, 1886, p. 294, pl. 37, figs. 4-5.

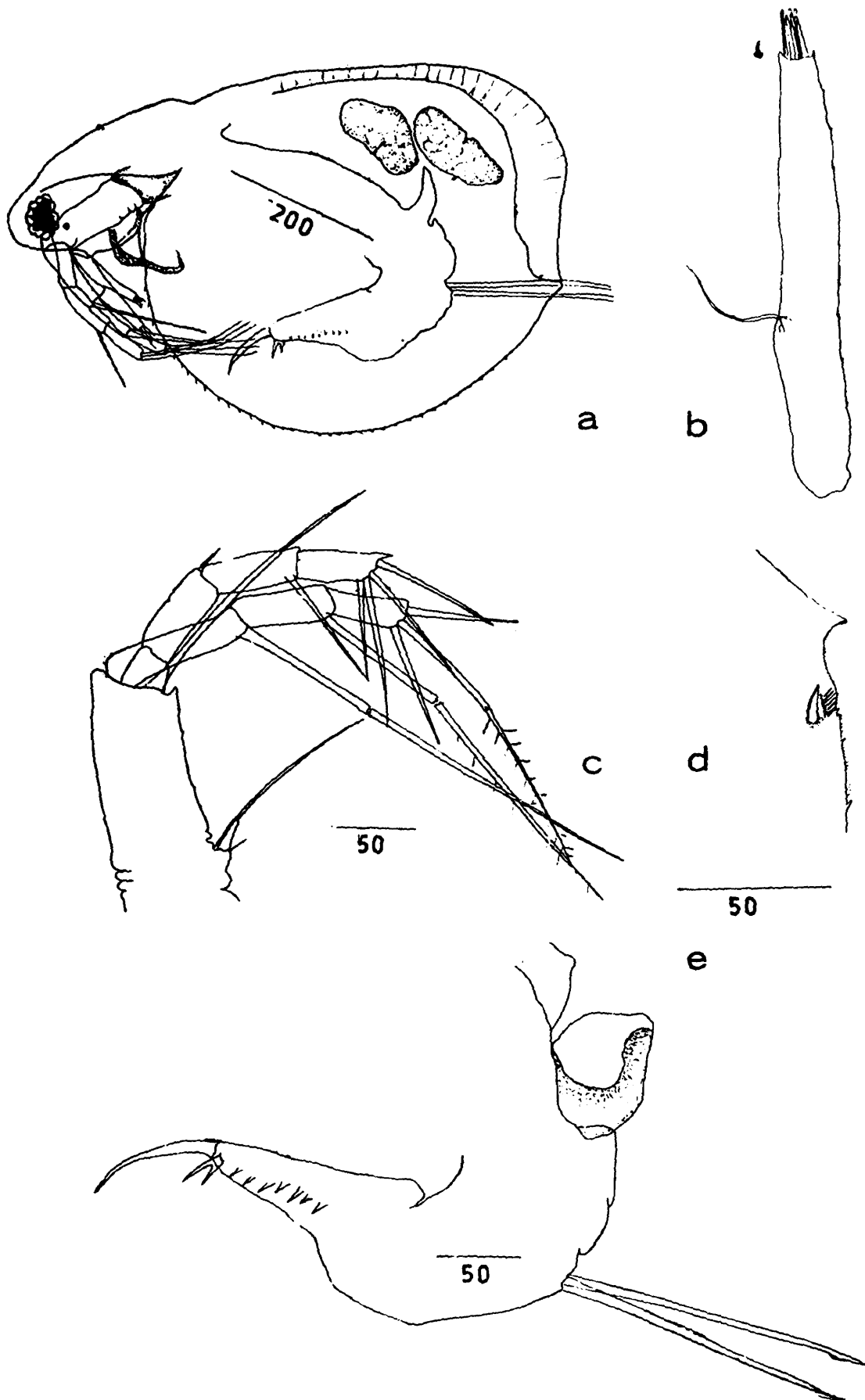
*Moinodaphnia alabamaensis* Herrick, 1887, p. 35-36, pl. 35-36, pl. 3, figs. 13-16; 1895, p. 166-167. pl. 36, figs. 7-10.

*Moinodaphnia macquerysi* Richard. 1892. p. 222-226, figs. 7-8.

*Moinodaphnia submucronata* Daday, 1898, p. 57-59, fig. 28.

*Moinodaphnia macleayii* Sars, 1901, p. 16-19, pl. 3, figs. 1-10. Daday, 1910. p. 143-144, pl. 8. fig. 7 ; Birge, 1918, p. 703, fig. 1009 ; Henry. 1922, p. 34. pl. 4. fig. 6 ; Brehm, 1933a, p. 669-670, fig. 10 ; Ueno, 1936. p. 515. fig. 2A, D ; Brehm, 1953. p. 324-325, fig. 92. Brooks. 1959. p. 621, fig. 27-44 ; Goulden 1968, p. 84-87. figs. 45-46 ; Smirnov, 1976. p. 187-189, figs. 165-167 ; Sharma, 1978. p. 149.

MATERIAL EXAMINED : *Reference material* : DGF 1524, Jagady Pond, Trivandrum, 11.1.65. *Other materials* : BKS—West Bengal: Bon-Hooghly (24-Parganas) 29.3.75.



Text-fig. 28, a-e : *Moinodaphnia macleayi* (King) : a. female ; b. antennule ; c. antenna ; d. posterior margin of valve (enlarged) ; e. postabdomen.

*Female* : Head small, rounded and trigonal in shape. Eye large, filling up anterior part of head. Very slight supraocular depression. Ocellus situated above point of origin of antennules. Antennules long and thin and arising from the ventral margin just behind eye. Labral keel with few setules on ventral margin. Distal segment of exopod of antennae with 4 setae. Valves tumid in posterior region, crested and marked with oblique striae, usually invisible in preserved specimens ; with minute spinules on the ventral margin. No spine present at junction of dorsal and ventral margin of valves. Abdominal process large, horse-shoe shaped. Postabdomen with an elongated distal end, with 7-11 feathered teeth and one bident tooth. Claw with fine setae on concave margin.

*Length* : 0.66 mm

*Male* : Not known from India.

*Distribution* : INDIA—South India (Brehm, 1953) and West Bengal (Sharma, 1978). Elsewhere—Widely distributed in tropics.

#### Family IV. BOSMINIDAE Sars, 1865

Body form short and high, usually oval or rounded in outline. Antennules of female large and immovably fixed to head. No ocellus or abdominal process. Intestine without loops or hepatic caeca. Six pairs of legs.

The family Bosminidae is represented by two genera in the material examined.

#### *Key to the Indian genera of family BOSMINIDAE*

Antennules of female not united at the base, almost parallel to each other.....*Bosmina* Baird, 1845

Antennules united at base and diverging at apex.....*Bosminopsis* Richard, 1895c

#### Genus 12. *Bosmina* Baird, 1845

Body usually transparent ; valves thin and posteroventral margin of each valve sometimes with a spine (mucro). Antennules of female

almost parallel to each other, curving backward and fixed to head ; olfactory setae lateral and usually near base of each antennule. Antenna with 3- and 4-segmented rami. Postabdomen almost quadrate ; anus terminal, anal denticles small and inconspicuous.

*Type species* : *Bosmina longirostris* (O.F. Müller, 1776).

Only one species belonging to this genus is recorded in India.

29. ***Bosmina longirostris*** (O.F. Müller, (1776)  
(Text-fig. 29, a-h)

*Lynceus longirostris* O. F. Müller, 1776, p. 76, tab. 10, figs. 7-8.

*Eunica longirostris* Koch, 1841, Heft. 35.

*Bosmina curvirostris* Fischer, 1854, p. 426 ; Leydig, 1860, p. 208.

*Bosmina longirostris* Sars, 1862a, p. 162 ; Uëno, 1927, p. 285-287, pl. 26, figs. 15, 15a-f ; Uëno, 1932, p. 239-241 ; Uëno, 1937, p. 204, figs. 4, 19-38a, p. 14-15, figs. 13-19 ; Uëno, 1938b, p. 129, figs. 6a-c, 7, 8a-d ; Yousuf & Qadri, 1975, p. 88 ; Sharma, 1978, p. 149 ; Swar & Fernando, 1980, p. 133, figs. 94-95.

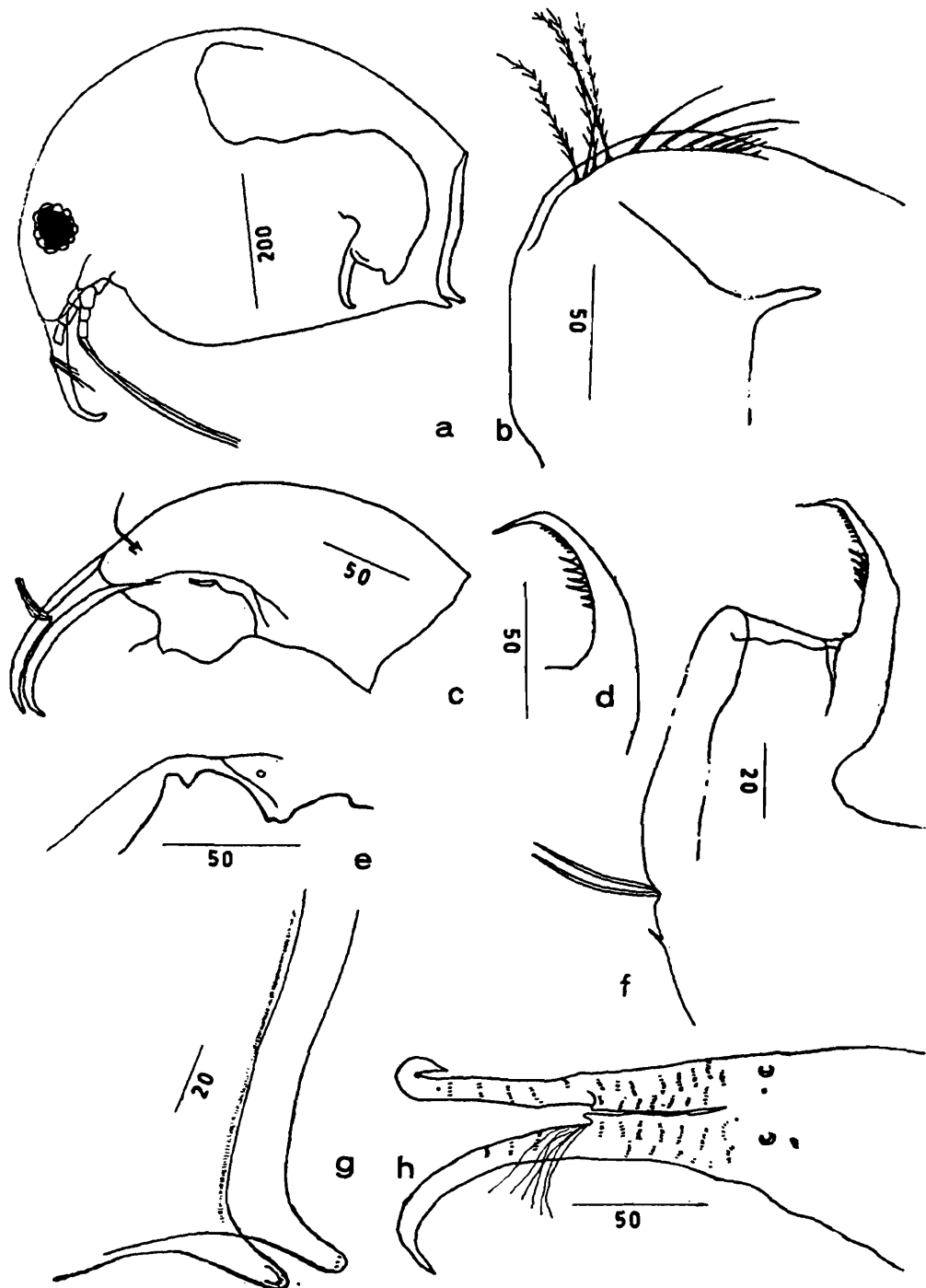
**MATERIAL EXAMINED** : *Reference material* : RGM 24, Shillong, 10.4.78. *Other materials* : RGM 5, 68, 71, 87, 89, 91, 92, 94, 96 ; Sample 9, (Govindsagar, Rewa), Sample 18 (Tripura lake) sent by Dr. B.S. Bhimachar, 20.10.70 ; BKS—West Bengal : Tank in maidan opposite Birla Planetarium (Calcutta) 15.6.76 ; Barisha (24-Parganas) 3.2.77.

*Female* : Body almost oval in outline. Posterodorsal corner of valves distinctly angular, posteroventral corner produced into backwardly directed spine (mucro). Markings on head and valves not distinct. Head large, more or less arched in front of eye. Eye usually large. A small sensory hair situated nearer to eye than to base of antennule. Antennules almost parallel to each other, delicate and curved ; olfactory setae on side, inserted near base of antennule. Antenna small, with 3- and 4-segmented rami. Postabdomen almost quadrate. Claw with proximal pecten of 3-6 spinules and distal pecten of 7-10 spines continued distally into minute spinules.

*Length* : 0.64 mm

*Male* : Not known in India.

*Distribution* : INDIA—Kashmir (Brehm, 1936), Meghalaya (Patil, 1976) and West Bengal (Sharma, 1978). Elsewhere-Cosmopolitan.



Text-fig. 29, a-h : *Bosmina longirostris* (O.F. Müller) : a. female ; b. posterior margin of valve and the mucrone ; c. head shield ; d. claw ; e. head-pore ; f. postabdomen ; g. posterior margin of valves (enlarged) ; h. antennules.

Genus 13. **Bosminopsis** Richard, 1895

*Bosminopsis* Richard, 1895, p. 96 ; Burckhardt, 1924, p. 220 ; Uèno, 1927, p. 288.

*Bosminella* Daday, 1903, p. 594.

General form much like *Bosmina*. Carapace usually oval or oblong. Head very large. Ocellus absent. Antennules 2-jointed, united at base and diverging at apex, with several sensory setae on the ventral side, of diverging portion. Antennae with both rami 3-segmented. Postabdomen comparatively large and rounded, tapering at the base of claws. Claw large and with a large spine near base. Intestine straight, remarkably broadened at anterior portion.

*Type species* : *Bosminopsis deitersi* Richard, 1895.

Of the two known species of this genus, only one is present in India.

30. **Bosminopsis deitersi** Richard, 1895  
(Text-fig. 30, a-e)

*Bosminopsis deitersi* Richard, 1895, p. 96, figs. 1-4 ; Klocke, 1902, p. 123, figs. 1-4, Tab. IV, fig. 1 ; Kawamura, 1918, p. 224, fig. 339 ; Uèno, 1927, p. 288, pl. XXVI, figs. 17, 17a-c ; Uèno, 1932, p. 241, fig. 1 ; Uèno, 1937, p. 205 ; Fryer, 1957, p. 229, Uèno, 1966c, p. 203-204, figs. 31-40 ; Mamaril Sr. & Fernando, 1980, p. 133, figs. 98-99.

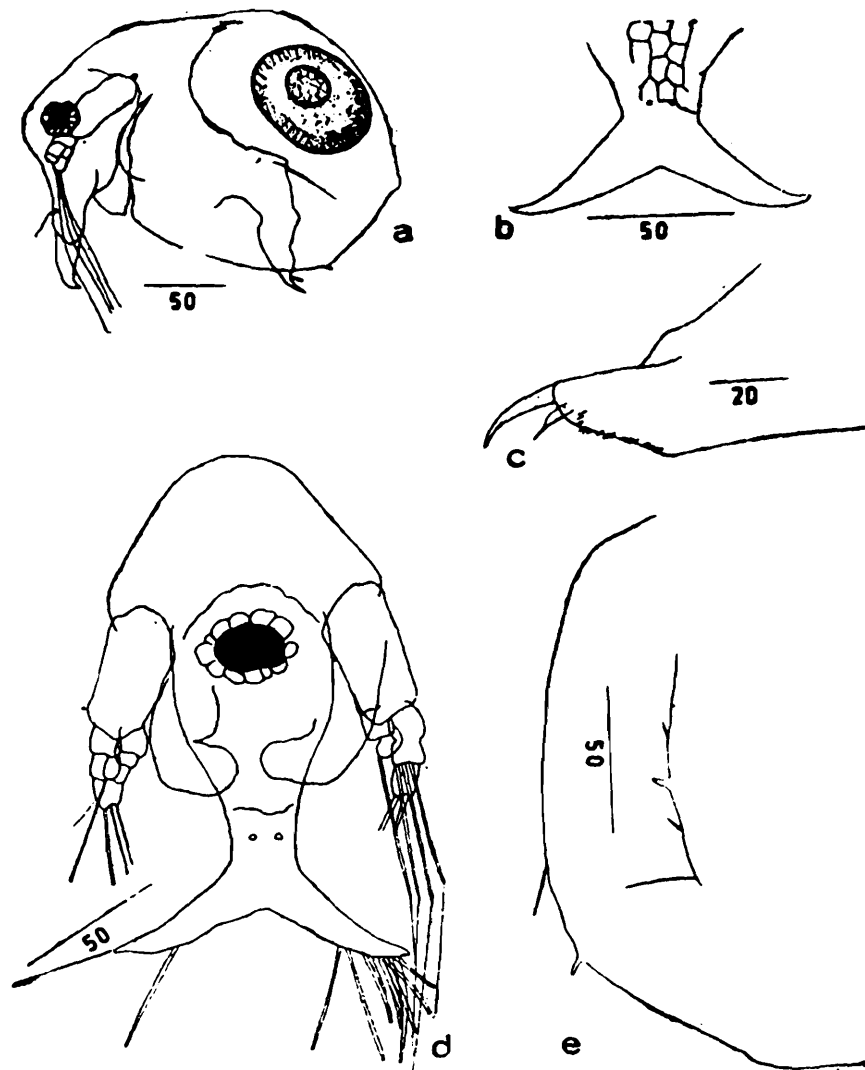
**MATERIAL EXAMINED** : *Reference material* : Sample 1, Irinjalkuda, Kerala, collected by Dr. C.K.G. Nayar, 8.12.77.

*Female* : Body almost oval in outline. Posterodorsal corner of valves distinct ; posteroventral corner with a small mucro-like process and with a few (1 or 2) spinules before it. Head very large, with a long rostrum ; head with supraocular depression. Antennules long, united with each other at basal part and with about 5-6 sensory setae on the ventral side near apex. Postabdomen broad and tapering distally ; with about 7 small spines on the postanal edge followed by a row of setae proximally. Claw large and with one large basal spine.

*Length* : 0.23 mm

*Male* : Not known from India.

*Distribution* : INDIA—Yamuna river, Delhi (Brehm, 1963).  
Elsewhere—Asia, Africa, North and South America.



Text-fig. 30, a-e : *Bosminopsis deitersi* Richard : a. female ; b. antennules ; c. postabdomen ; d. anterior and (enlarged) ; and e. posterior margins of right and left valves (enlarged).

Family V MACROTHRICIDAE Norman & Brady, 1867

Head well marked, valves often crested. Antennules of female long, freely movable and usually inserted at anterior end of ventral surface of head. Fornix well developed. Labrum usually with a keel or marked projection. Abdominal process usually absent,

except in *Ilyocryptus*. Intestine simple or convoluted. Hepatic caeca usually wanting. Postabdomen marked off from body, usually large, often bilobed ; anus terminal or lateral. Five or six pairs of legs present ; first two for grasping and sixth, if present, rudimentary.

*Type genus* : *Macrothrix* Baird, 1843.

This family is represented by five genera in the Indian material.

*Key to the Indian genera of MACROTHRICIDAE*

1. Postabdomen very large with long spines **Ilyocryptus** Sars, 1862a  
     Postabdomen of medium size with small spines.....2
2. Gut with loops.....**Streblocerus** Sars, 1862a  
     Gut without loops.....3
3. Antennule widening distally. Exopodite of leg IV with  
     three bristles.....**Macrothrix** Baird, 1843  
     Antennule not widening distally. Exopodite of leg IV with  
     two bristles.....**Echinisca** Lièvin, 1848

**Genus 14. *Macrothrix* Baird, 1843**

*Macrothrix* (subgenus) Baird, 1943, p. 87.

*Macrothrix* Baird, 1850, p. 103 ; Lilljeborg, 1853, p. 47 ; P.E. Müller, 1867, p. 135 ; Hellich, 1877, p. 63-64 ; Herrick, 1882, p. 244 ; Herrick, 1884, p. 68 ; Daday, 1880, p. 105 ; Lilljeborg, 1900, p. 336-337 ; Keilhack, 1909, p. 65 ; Sars, 1909, p. 13 ; Brehm, 1933a, p. 689-691, 693-694 ; Manuilova, 1964, p. 171 ; Smirnov, 1976, p. 69-70.

*Drepanomacrothrix* Brehm, 1936, p. 292-293 ; Bening, 1941, p. 227-228.

*Macrothrix* (part) Bening, 1941, p. 209-210 ; Srámek-Husek *et al.*, 1962, p. 295-296.

Body slightly compressed, with a dorsal crest. Head large, ordinarily not depressed ; rostrum short. Antennules large and located at the tip of rostrum. Antennal setae : 0-0-1-3/1-1-3 ; basal seta of 3-segmented ramus stout and stiff. Ventral margin of valves

with long, stout and movable bristles. Postabdomen small, often bilobed. Claws small. Intestine without loops and caeca. Five pairs of legs, exopodite of leg IV with three bristles.

*Type species* : *Macrothrix laticornis* (Jurine, 1820) Represented by four species in Indian material.

*Key to the Indian species of genus Macrothrix*

1. A lateral ridge starting from compound eye, arch ed at level of base of antenna, running downwards towards ventral edge of head shield ; post abdomen short, bilobed.....*M. spinosa* King, 1853
2. Lateral ridge starts from tip of rostrum distal to level of ocellus and run towards base of headshield in a continuous concave arch. Headpore large Postabdomen broad, not bilobed.....*M laticornis* (Jurine, 1820.)
3. Postabdomen with a small notch on dorsal margin in the proximal side of anal opening. Anal region with sharp teeth and groups of bristles.....*M. goeldi* Richard, 1897
4. Postabdomen has 6-7 teeth on anal region ; preanal margin also has teeth. An exopodite of leg I with a long bristle, feathered on one side only.....*M. gronlandica* Lilljeborg, 1900.

**31. *Macrothrix spinosa* King, 1853**  
(Text-fig. 31, a-e)

*Macrothrix spinosa* King, 1853, p. 256, pl. Vi F (not Daday, 1901) ; Sars, 1888, p. 2532, pl. 3 ; Sars, 1916, p. 326-327, pl. 36, figs. 3, 3a-b ; Henry, 1922, p. 36 ; Gurney, 1927, p. 67-68, fig. 5 ; Bening, 1941, p. 213-215, fig. 92 ; Manuilova, 1964, p. 190-191, fig. 5 ; Biswas, 1971, p. 24-25, figs. 7E-F ; Petkovski, 1973, p. 179-182, figs. 35-43, 61 ; Smirnov, 1976, p. 73-76, figs. 40-44 ; Mamaril Sr. & Fernando, 1980, p. 137, figs. 73, 130.

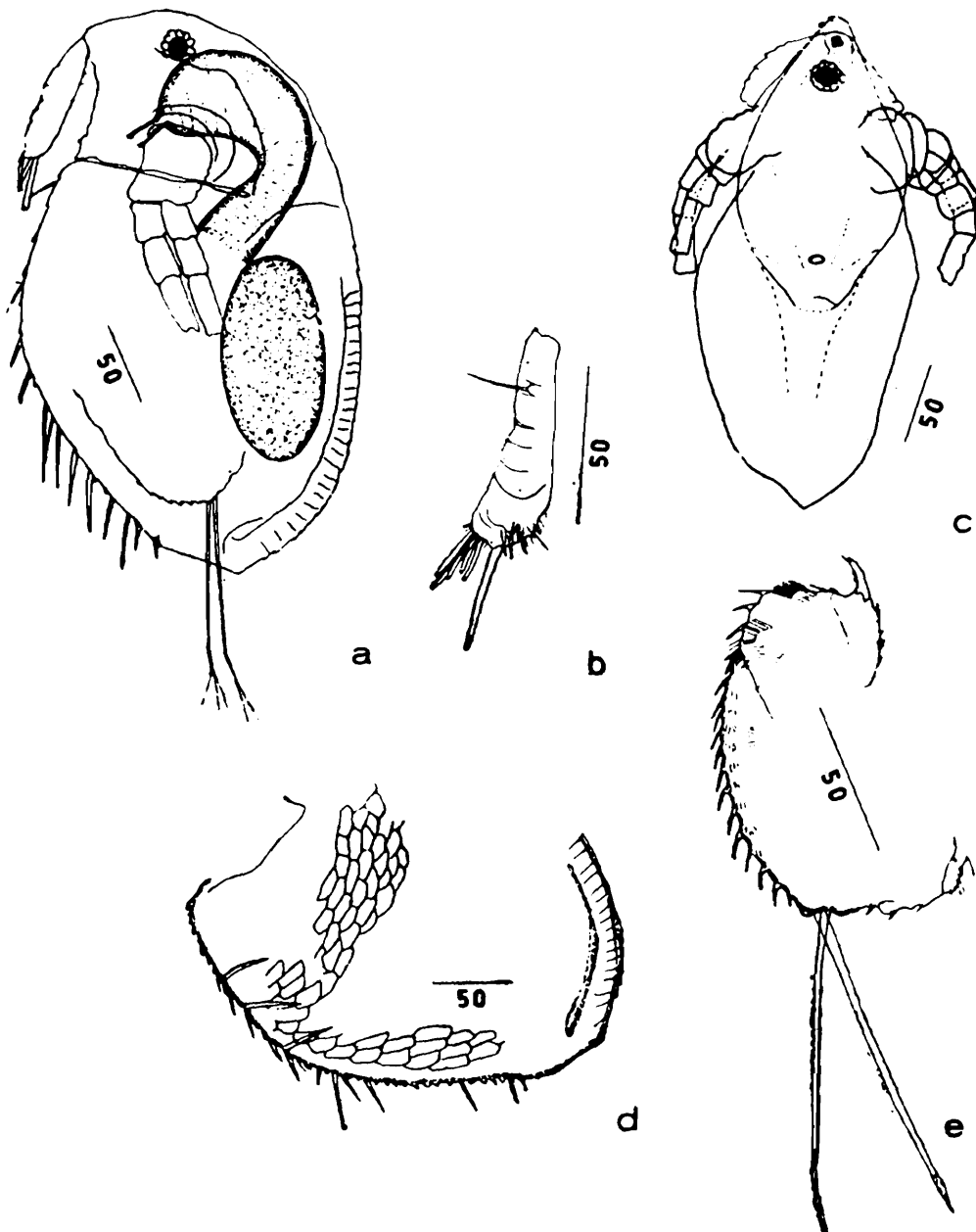
*Macrothrix squamosa* Sars, 1901, p. 36-37, pl. VI, figs. 10-12.

*Macrothrix spinosa dentata* Playfair, 1915, p. 140-141, pl. 8, figs. 1-2.

MATERIAL EXAMINED : *Reference material* : DGF 1512, Chetpet fish farm, Madras, 6.1.65. *Other materials* : ZSI C 1934/2, rain-

water pool, Sambhar lake, Rajasthan, collected by Mr. S. Biswas, 28.9.58.

*Female* : Carapace broadly rounded oval in outline. Dorsal margin almost evenly arched, ventral margin subangulated in middle and obliquely ascending posteriorly ; posterior end with well-marked though short protuberance occurring about in line of axis of body. Head moderately large, subtriangular and with slightly prominent rostral projection. Head shield widening abruptly



Text-fig. 31, a-e : *Macrothrix spinosa* King : a. female ; b. antennule ; c. female (dorsal view) ; d. left valve ; and e. postabdomen.

tly at level of the compound eye. In lateral view, a ridge departing from compound eye, arched at level of the base of antenna and running downwards towards ventral edge of head shield. Antennules enlarged at apex ; anterior margin with several fine incisions and clusters or rows of setules and with ventral angulation. Shell obscurely reticulate and dorsal surface with more or less distinct squamous sculpturing, giving dorsal edge a minute serrulate appearance. Ventral edge of valves serrate and armed with slender spines. Eye large, ocellus small and located near the tip of rostrum. Post-abdomen short, bilobed and with a row of small but strong anal denticles along dorsal edge and row of minute lateral spines. Claw very short and with setae on concave margin.

*Length* : 0.31 mm

*Male* : Not known from India.

*Distribution* : INDIA—Rajasthan (Biswas, 1971), Manipur (Patil, 1976). Elsewhere—Cosmopolitan.

### 32. *Macrothrix goeldi* Richard, 1897 (Text-fig. 32, a-d)

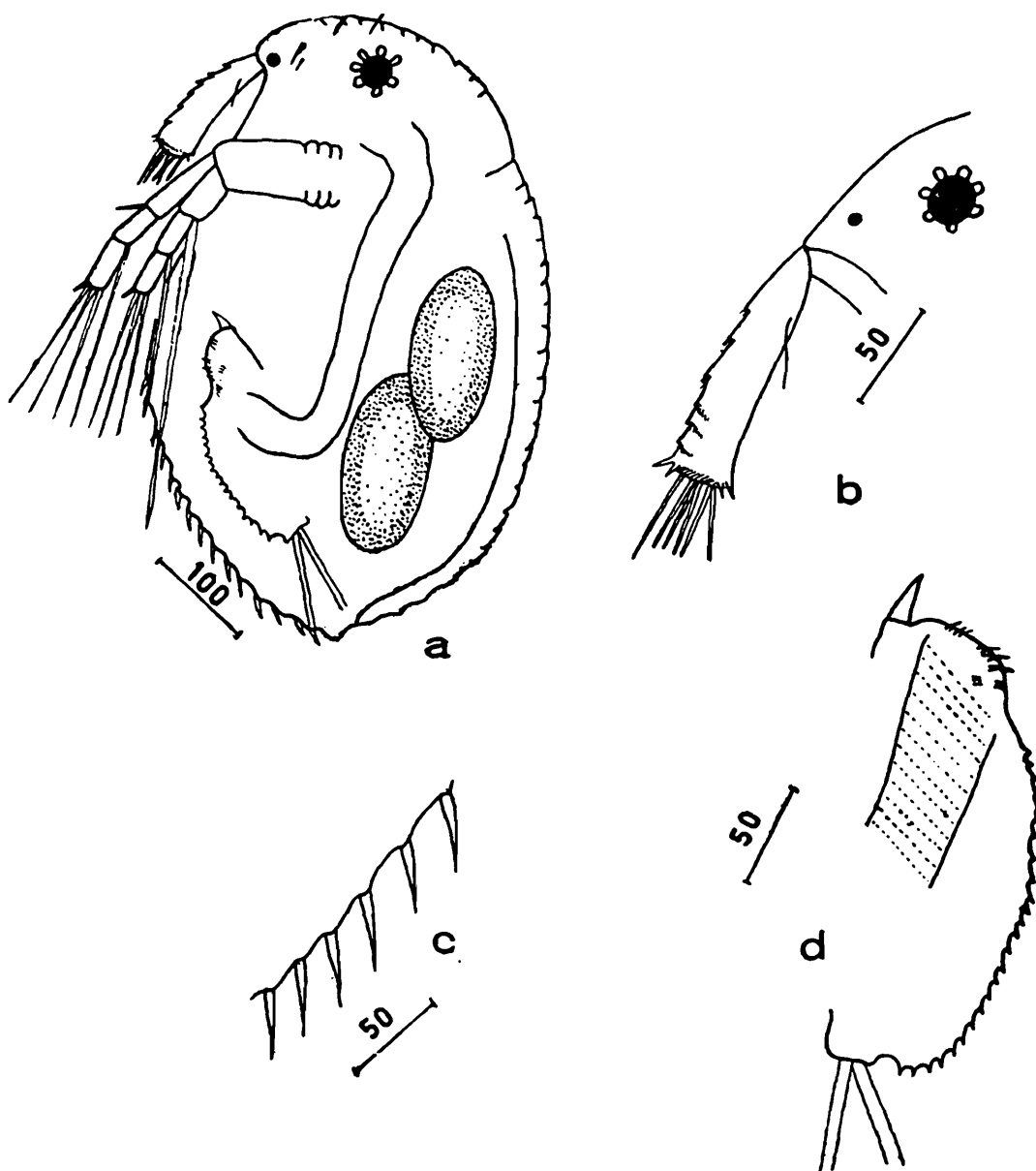
*Macrothrix goeldi* Richard, 1897, p. 287-289, figs. 32,33,43 ; Harding, 1957, p. 69, figs. 11-14 ; Thomas, 1961a, p. 119 ; Green, 1962, p. 41, figs. 11-14 ; Rey & Saint-Jean, 1968, p. 95-96, fig. 12 ; Nayar, 1971, p. 512, figs. 17-20 ; Smirnov, 1976, p. 76-79, figs. 45-47 ; Sharma, 1978, p. 150.

*Macrothrix goeldi* f. *murati* Gauthier, 1939, p. 162-168, figs. 7-8 ; Rahm, 1956, p. 248, fig. 68.

**MATERIAL EXAMINED** : *Reference material* : BKS 11, Indian Museum tank (Calcutta) 1.6.75. *Other materials* : BKS—West Bengal : Baruipur (24-parganas) 1.9.75 ; Shirakole (24-Parganas) 6.5.76 ; Tank opposite Lindsay Street, (Calcutta) 1.1.76 ; ZSI 5397/10, Museum tank, Calcutta, collected by Dr. N. Annandale, 26.2.1903 (vial contains no specimens).

*Female* : Body almost oval in outline, with maximum width slightly before middle ; dorsal margin almost evenly arched, ventral margin arched anteriorly and ascending posteriorly. Shell

markings reticulate and cause minute serrations on dorsal margin of head and body ; ventral margin of shell with a few long setae and serrations between setae become inconspicuous. Head sub-triangular and almost evenly arched. Antennules broadened distally, with row of bristles at distal end and anterior margin with 6 notches, distal 3 with a row of setae ; olfactory setae of different length, with sensory seta near base of antennules. Ocellus small, situated nearer to the base of antennules than to eye. Postabdomen with small notch on dorsal margin in the proximal side of anal opening.



Text-fig. 32, a-d : *Macrothrix goeldii* Richard ; a. female ; b. head and antennules (enlarged) ; c. portion of ventral margin of valve (enlarged) ; and d. postabdomen.

Anal region with sharp teeth and groups of bristles. Claw with setae on concave margin.

*Length* : 0.56 mm

*Male* : Not recorded from India.

*Distribution* : INDIA—West Bengal (Gurney, 1907 ; Sharma, 1978) ; Rajasthan (Nayar, 1971). Elsewhere—Chile, Nigeria, Uganda.

### 33. *Macrothrix laticornis* (Jurine, 1820) (Text-fig. 33, a-f)

*Monoculus laticornis* Jurine, 1820, p. 151.

*Lynceus laticornis* Desmarest, 1825, p. 376-377.

*Daphnia curvirostris* Fischer, 1848, p. 184-185, pl. 7, figs. 7-10.

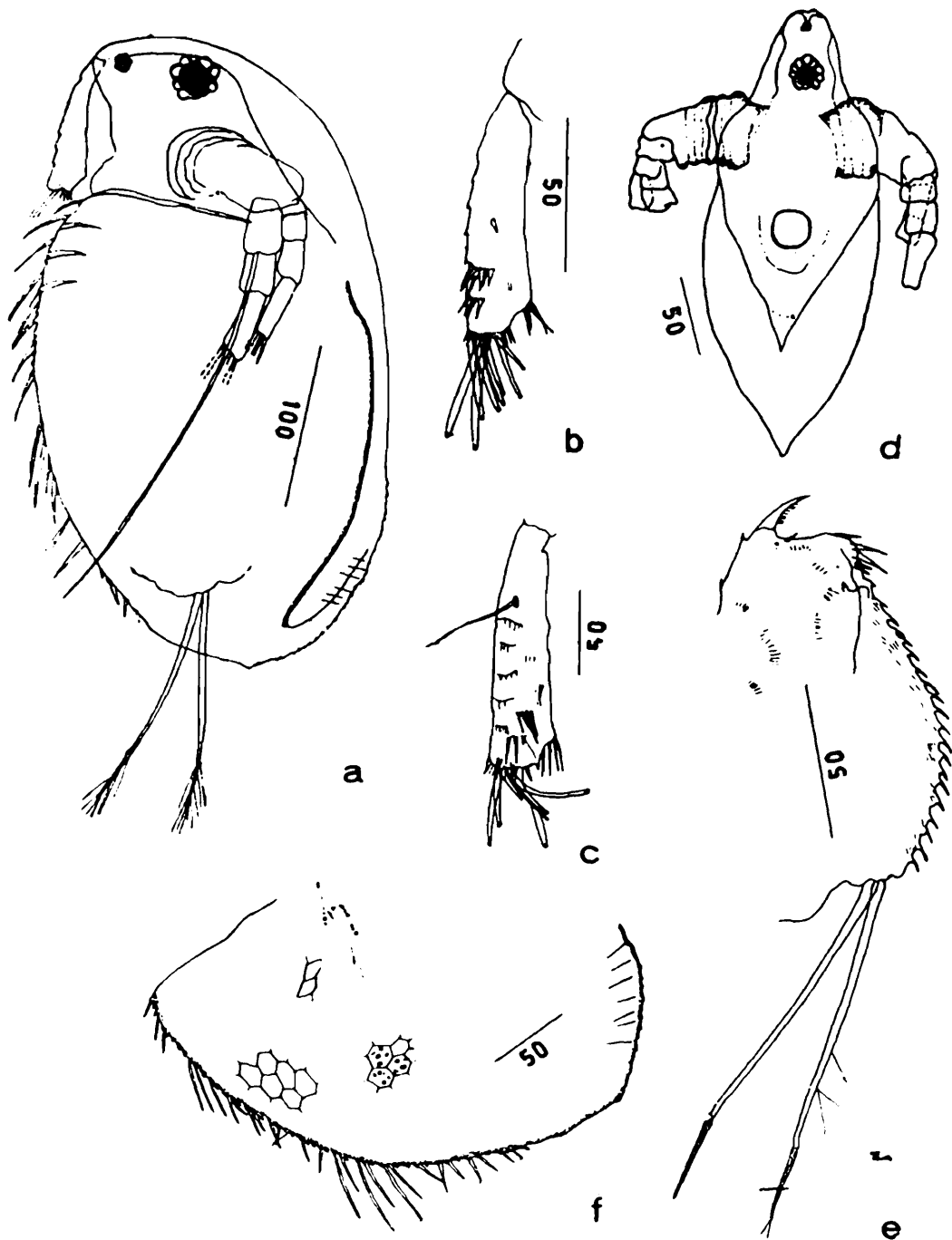
*Macrothrix laticornis* Lilljeborg, 1853, p. 50-51, Tab. 3, figs. 8-9 ; Leydig, 1860, p. 193-195 ; P.E. Müller, 1867, p. 137, pl. 3, fig. 5 ; Norman & Brady, 1867, p. 9-10, pl. 23, figs. 4-5 ; Hellich 1877, p. 64-65 ; Herrick, 1884, p. 68-69, pl. C, figs. 8-9 ; Daday, 1888, p. 105, Tab. II, figs. 40-41 ; Lilljeborg, 1900, p. 338-341, Tab. LIV, figs. 6-13 ; Daday, 1905, p. 194-195 ; Birge, 1918, p. 714, fig. 112 ; Harding, 1955, p. 339, figs. 40-44 ; Scourfield & Harding, 1958, p. 32, fig. 68 ; Brooks, 1959, p. 633, fig. 27-31 ; Herbst, 1962, p. 72, Abb. 46a-c ; Srámek-Husek *et al.*, 1962, p. 296-299, fig. 108 ; Flössner, 1972, p. 248-250, Abb. 117 ; Fryer, 1974, p. 191-194, figs. 56-58 ; Smirnov, 1976, p. 72-73, figs. 8, 38-40.

*Macrothrix singalensis* Daday, 1898, p. 53-54, fig. 25.

**MATERIAL EXAMINED** : *Reference material* : DGF 1512, Chetpet fish farm, Madras, 6.1.65. *Other materials* : Sample 4, Irinjalakuda, Kerala, collected by Dr. C.K.G. Nayar, 8.12.77.

*Female* : Body almost oval in outline, with very small protuberance at the posterior end. Valves crested, reticulated ; serrations on the dorsal edge distinct only in posterodorsal region. Head evenly arched. Head shield widening gently from tip of rostrum onwards ; headpore large. In lateral view, a ridge departs from tip of rostrum, distal to level of ocellus and runs towards base of

head shield in continuous concave arch. Antennules broadening apically with distinct ventral angulation, anterior margin with several fine incisions and clusters or rows of setules ; olfactory setae conspicuously unequal. Labrum with large triangular process. Eye very near margin of the head. Postabdomen broad, not bilobed, with numerous fine spines and setules ; the latter setules terminal. Claw small, with setae on the concave margin.



Text-fig. 33, a-f : *Macrothrix laticornis* (Fischer) : a. female ; b. and c. antennules ; d. female (dorsal view) ; e. postabdomen ; and f. left valve.

*Length* : 0.38 mm

*Male* : Not known from India.

*Distribution* : INDIA—Ladakh and Nilgiri Hills (Brehm, 1936).  
Elsewhere—Holarctic, Neotropical and Oriental.

#### 34. *Macrothrix grönlandica* Lilljeborg, 1900

*Macrothrix grönlandica* Lilljeborg, 1900, p. 351-352 ; Bening, 1941, p. 219,  
229-231, fig. 98 ; Smirnov, 1976, p. 101-103, figs. 74-75.

*Macrothrix hirsuticornis* var. *grönlandica* Minkiewicz, 1916, p. 58-60, pl. 6,  
fig. 4-6 ; Fox, 1962, p. 69-77.

*Drepanomacrothrix stschelkanowzewi* Brehm, 1936, p. 293-295.

**MATERIAL EXAMINED** : *Reference material* : Description taken  
from literature, since no material was available.

*Female* : Body generally rounded and oval with no distinct  
posterior prominence or point. Dorsal margin smooth. Antennu-  
les have 6-7 groups of spinules on the anterior margin. Antenna  
has a spine formula of 0-2-1-1/0-0-1, and setal formula of 0-0-1-3/  
1-1-3. Ocellus is closer to eye than to base of antennule. Head  
shield meets the shell on dorsal margin. Postabdomen has 6-7  
teeth on anal margin ; it is further characterised by a large postanal  
extension that bears a row of lateral feathered setae and one distal  
bident tooth. Leg I has an exopodite with a long bristle, feathered  
on one side.

*Length* : 2.00 mm

*Male* : Not known from India.

*Distribution* : INDIA—Ladakh (Brehm, 1936).

#### Genus 15. *Echinisca* Lievin, 1848

*Echinisca* Lièvin, 1848, p. 31-32 ; Sars, 1916, p. 232-325 ; Gauthier, 1930, p.  
97-98.

*Iheringula* Sars, 1900, p. 4-5.

*Gurneyella* Brehm, 1930, p. 683.

*Macrothrix* (part) Bening, 1941, p. 209-210 ; Srámek-Husek *et al*, 1962, p. 295-296.

Antennal setae 0-0-1-3/1-1-3. Antennules cylindrical, but widened distally. Fornix located along rim of head. Postabdomen of female wide. Claw small. Intestine without loops. Five pairs of legs, exopodite of leg IV with two bristles.

*Type species* : *Echinisca odiosa* (Gurney, 1907)

This genus is represented by two species in India.

*Keys to the Indian species of Genus ECHINISCA*

Posteroventral margin of valves with serrations arranged in groups of 3.....*E. triserialis* (Brady, 1886)

Posteroventral margin of valves with irregularly disposed serrations.....*E. odiosa* (Gurney, 1907)

**35. *Echinisca triserialis* (Brady, 1886)**  
(Text-fig. 34, a-e)

*Macrothrix triserialis* Brady, 1886, p. 295, pl. 37, figs. 16-20 ; Gurney, 1907, p. 25, figs. 21, 21a ; Henry, 1922, p. 36-37 ; Rey & Saint-Jean, 1968, p. 93-94, fig. 11 ; Biswas, 1971, p. 125, figs. 7A-D ; Fryer, 1974, p. 199-203, figs. 69-76 ; Mamaril Sr. & Fernando, 1980, p. 137, fig. 129.

*Macrothrix chevreuxi* Guerne et Richard, 1892, p. 530-533, figs. 3-6 ; Sars, 1909, p. 13-14 ; Brehm, 1954, p. 341-342, fig. 5 ; Manuilova 1964, 1964, p. 191-192, p. 86 ; Biswas, 1971, p. 125-126.

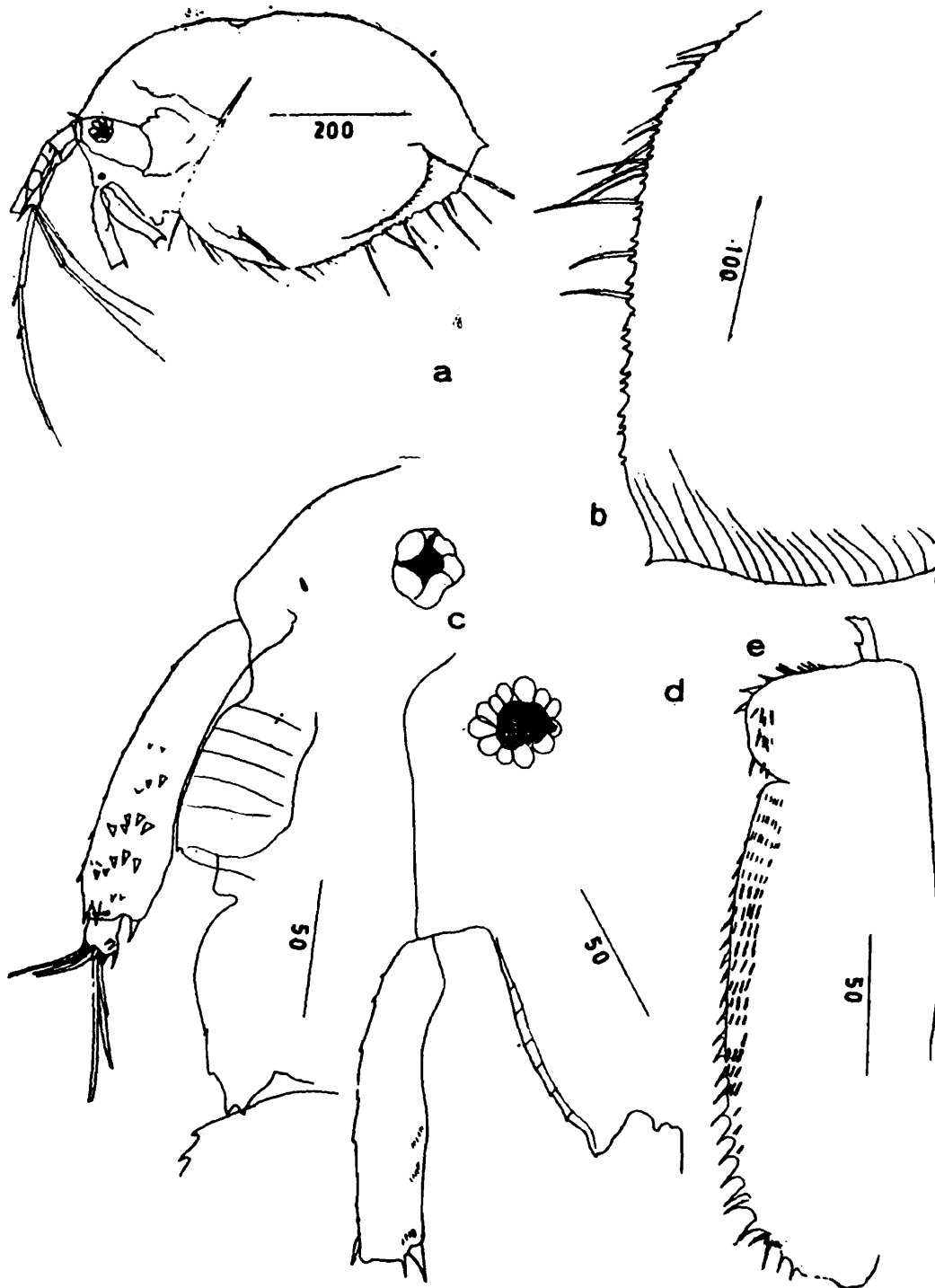
*Macrothrix elegans* Sars, 1901, p. 33-36, pl. VI, figs. 1-9.

*Macrothrix triserialis* var. *chevreuxi* Stingelin, 1913, p. 615-616, figs. 18-19.

*Echinisca triserialis* Smirnov, 1976, p. 109-110, figs. 81-83.

**MATERIAL EXAMINED** : *Reference material* : Sample 3, Irinjalkuda, Kerala, collected by Dr. C.K.G. Nayar, 8.12.77. *Other material* : ZSI 5398/10, Chakradharpur, Chotanagpur, collected by Dr. N. Annandale (*Macrothrix triserialis*) ; ZSI C 1939/2,

Biprasar, Jaisalmer district, Rajasthan, collected by Dr. K. K. Tiwari and Dr. B. Biswas, 4.1.58 (*Macrothrix triserialis*) ; ZSI C 1932/2, rainwater pool, adjacent Nagaur lake, Rajasthan, collected by Mr. S. Biswas, (*Macrothrix chevreuxi*) 17.9.58 ; BKS—West



Text-fig. 34, a-e : *Echinisca triserialis* (Brady) : a. female ; b. left valve enlarged) ; c. and d. anterior end of head (enlarged) ; and e. postabdomen.

Bengal : Amtala (24-Parganas) 8.1.78 ; Baranagar (24-Parganas), 16.5.75 ; Bon-Hooghly (24-Parganas), 29.3.75 ; Sarisha (24-Parganas), 8.5.75.

*Female* : Body almost oval in outline ; dorsal margin slightly arched, ventral more strongly arched and protuberant in the middle, forming a sharp angle and a produced point posteriorly. Valves reticulate, dorsal margin with serrations particularly in posterior region ; ventral margin with serrations and bristles, and serrations on posteroventral margin arranged in groups of three. Head large, moderately arched and with conspicuous ridge over its edges ; produced below into a small rostrum. Eye large ; ocellus small and located near tip of rostrum. Antennules slender, cylindrical and olfactory setae (esthetes) unequal in length ; antennules with notches on anterior margin, sensory seta situated near the base. Postabdomen large, moderately broad, bilobed, with anal spines on both lobes, lateral setae present in transverse rows. Claw short and curved.

*Length* : 0.52 mm

*Male* : Not known from India.

*Distribution* : INDIA—West Bengal (Gurney, 1907 ; Sharma, 1978), Rajasthan (Biswas, 1971). Elsewhere—Cosmotropical.

### 36. *Echinisca odiosa* (Gurney, 1907) (Text-fig. 35, a-c)

*Macrothrix tenuicornis* Gurney, 1907, p. 25, pl. I, figs. 1-2, pl. II, fig. 22.

*Gurneyella odiosa* Brehm, 1930, p. 683 ; Biswas, 1971, p. 127, fig. 7G-I.

*Macrothrix tenuicornis* var. *maxima* Brehm, 1938a, p. 26-27, Abb. 1-3.

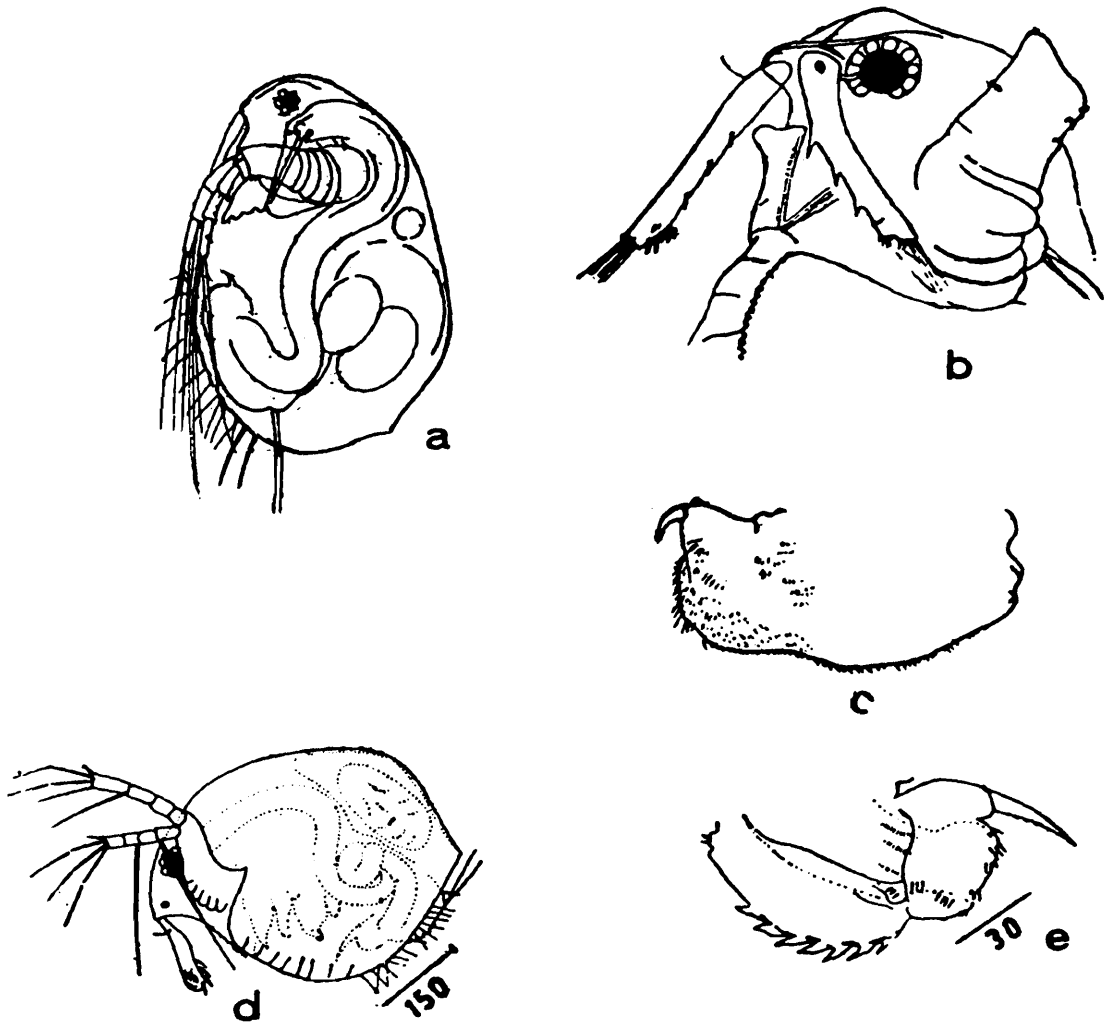
*Macrothrix odiosa* Bening, 1941, p. 225-227, fig. 97 ; Manuilova 1964, p. 185-186, fig. 80.

*Echinisca odiosa* Smirnov, 1976, p. 118-119, figs. 94-95.

**MATERIAL EXAMINED** : *Reference material* : Description taken from literature, since no material was available. *Other material* :

ZSI C 1927, Godisar near Ramgarh, Rajasthan, collected by Dr. K. K. Tiwari and Mr. S. Biswas, 7.1.58 (*Gurneyella odiosa*).

*Female* : Body almost rounded-oval in outline ; dorsal and ventral margins evenly arched, posterior end with very small protuberance above the axis of body. Shell marked with faint hexagonal or pentagonal reticulations ; dorsal margin of body smooth, ventral margin slightly serrated anteriorly but with irregularly disposed minute, blunt teeth posteriorly, fringed with long setae. Head almost evenly rounded, with a conspicuous ridge over the eye ; produced into small rostrum. Plate of labrum marked with transverse ridges. Eye moderately large, near vertex of head ;



Text-fig. 35, a-c : *Echinisca odiosa* (Gurney) (After Gurney, 1907) : a. female ; b. head (enlarged) ; and c. postabdomen.

Text-fig. 35, d-e : *Streblocerus serricaudatus* (Fischer) : d. female and e. postabdomen.

ocellus small, located near tip of rostrum. Antennules long and nearly straight, with three spines at tip ; sensory seta located near base of antennule. Postabdomen moderately large, bilobed ; preanal part densely setiferous, postanal part with row of anal spines. Claw short and curved.

*Length* : 0.44 mm

*Male* : Not known from India.

*Distribution* : INDIA—Chakradharpur, Bihar (Gurney, 1907) ; Rajasthan (Biswas, 1971). Elsewhere—Russia, Madagascar.

#### Genus 16. *Streblocerus* Sars, 1862a

*Streblocerus* Sars, 1862a, p. 284 ; Hellich, 1877, p. 66-67 ; Herrick, 1884, p. 72 ; Daday, 1888, p. 104 ; Lilljeborg, 1900, p. 360-362 ; Keilhack, 1909, p. 68-69 ; Bening, 1941, p. 236-237 ; Herbst, 1962, p. 63 ; Srámek-Husek *et al.*, 1962, p. 303-304 ; Manuilova 1964, p. 200 ; Flössner, 1972, p. 259-260 ; Smirnov, 1976, p. 166.

Small, not crested or compressed. Labrum with large, serrate, acute process. Antennules large, bent or twisted at distal end. Antennal setae : 0-0-1-3/1-1-3. Postabdomen with preanal spines or hairs. Intestine convoluted, with small hepatic caeca. Five pairs of legs.

*Type species* : *Streblocerus serricaudatus* (Fischer, 1849). Only two species of this genus have been so far described. Of these, *S. serricaudatus* has been reported from India.

#### 37. *Streblocerus serricaudatus* (Fischer, 1849) (Text-fig. 35, d-e)

*Daphnia serricaudata* Fischer, 1849, p. 45-50, tab. IV, figs. 2-3.

*Streblocerus minutus* Sars, 1862b, p. 284-285 ; Sars, 1891, p. 12.

*Streblocerus serricaudatus* Hudendorff, 1876, p. 41-43, Tab. II. 2, a-c ; Hellich, 1877, p. 67-68, figs. 27-29 ; Daday, 1888, p. 105, pl. 2, figs. 37-39 ; Herrick, 1895, p. 216-217, pl. 66, fig. 1 ; Lilljeborg, 1900, p. 362-366, pl. 56, figs. 15-27, pl. 57, fig. 1 ; Keilhack, 1909, p. 69, figs. 163-164 ; Stingelin, 1913, p. 619-620 ; Birge, 1910, p. 709, fig. 1102 ; Bening, 1941, p. 237-239, fig. 101 ; Scourfield & Harding, 1958, p. 30, fig. 64 ; Brooks, 1959, p. 627, figs. 25-28 ;

Löffler, 1961, p. 157, Abb. 18-20 ; Herbst, 1962, p. 73, Abb. 50, a-b ; Srámek-Husek *et al.*, 1962, p. 304-306, figs. 111 & 112A; Scourfield & Harding 1966, p. 30, fig. 64 ; Fryer, 1972, p. 87-89, figs. 14-17 ; Flössner, 1972, p. 260-262, Abb. 123 ; Fryer, 1974, p. 175-183, figs. 32-39 ; Smirnov, 1976, p. 166-171, figs. 153-158

**MATERIAL EXAMINED :** *Reference material* : Description taken from literature, since no material was available. *Other materials* : ZSI 1940/2, Asalpura Bund, Phulera, Jaipur, Rajasthan, collected by Mr. S. Biswas, 5.12.58 (no specimen in the tube).

*Female* : Body almost rounded-oval in outline ; dorsal surface evenly arched, ventral surface produced in the middle, posterior end with indistinct protuberance. Valves reticulate, dorsal margin of valves smooth, ventral margin with setae. Antennules bent, with lateral sensory seta near base and several setules on inner edge ; olfactory setae unequal. Postabdomen with the anal part rounded and with spines, preanal part serrate and bearing rows of fine setules ; claw small, curved and with denticles or setae on its concave margin.

*Length* : 0.91 mm

*Male* : Not known from India.

*Distribution* : INDIA—Rajasthan, (Biswas, 1971), Manipur (Patil, 1976). Elsewhere—Europe and North America.

### Genus 17. *Ilyocryptus* Sars, 1862a

*Acanthocercus* part Liévin, 1848, p. 32.

*Ilyocryptus* Sars, 1862a, p. 154 ; Sars. 1862b, p. 281-282 ; P.E. Müller, 1867, p. 154 ; Norman & Brady, 1867, p. 17 ; Hellich 1877, p. 70 ; Herrick, 1884, p. 76 ; Herrick, 1895, p. 200 ; Lilljeborg, 1900, p. 324-325 ; Keilhack, 1909, p. 60-61 ; Bening, 1941 p. 200-201 ; Smirnov, 1976, p. 42-44.

*Ilyocryptus* Herbst, 1962, p. 70 ; Srámek-Husek *et al.*, 1962, p. 285-286 ; Manuilova, 1964, p. 203 ; Flössner, 1972, p. 236.

Head with keel ; dorsal crest on valves absent or small. Vertex of head forming a sharp angle in front of insertion of antennules.

Antennules long and biarticulated. Antennal setae : 0-0-0-3/1-1-3. Abdominal process long, tongue-shaped. Intestine without loops, enlarged near the rectum ; hepatic caeca present. Postabdomen large, broad and compressed ; with numerous long spines.

Type species: *Ilyocryptus sordidus* (Liévin, 1848).

So far, only one species of *Ilyocryptus* is known from India.

38. *Ilyocryptus spinifer* Herrick, 1882  
(Text-fig. 36, a-d)

*Ilyocryptus spinifer* Herrick, 1882, p. 39-41, 246, pl. 8. figs. 1-5 ; pl. 9, figs. 1-3 ; Herrick, 1884, p. 77, pl. C, figs. 18-19 ; Herrick, 1895, p. 221-223, pl. IV, figs. 1-4 ; pl. LVI, figs. 18, 19, 21 ; Birge, 1918, p. 713, fig. 110 ; Henry, 1922, p. 37-38 ; Harding, 1957, p. 68, fig. 10 ; Loffier, 1961, p. 157 ; fig. 17 ; Thomas, 1961a, p. 117-118 ; Rey & Saint-Jean, 1969, p. 31, fig. 9 ; Orghidan & Nigrea, 1973, p. 107, fig. 2 ; Smirnov, 1976, p. 53-56, figs. 20, 22, 23 ; Sharma, 1978, p. 150 ; Mamaril Sr. & Fernando, 1980, p. 138, fig. 133.

*Ilyocryptus halyi* Brady, 1886, p. 294-295, pl. 37, figs. 6-9 ; Daday, 1910, p. 138, pl. 7, fig. 25 ; Rahm, 1956, p. 246-247, fig. 5 ; Biswas, 1971, p. 127, figs. 12, 130.

*Ilyocryptus longiremis* Sars, 1888, p. 33-41, pl. 4 ; Sars, 1901, p. 40-42, pl. VII figs. 1-10 ; Vavra, 1900, p. 15-16.

*Thyocryptus longiremis* Gurney, 1907, p. 26.

*Ilyocryptus halyi* var. *longiremis* Stingelin, 1913, p. 618-619, fig. 20.

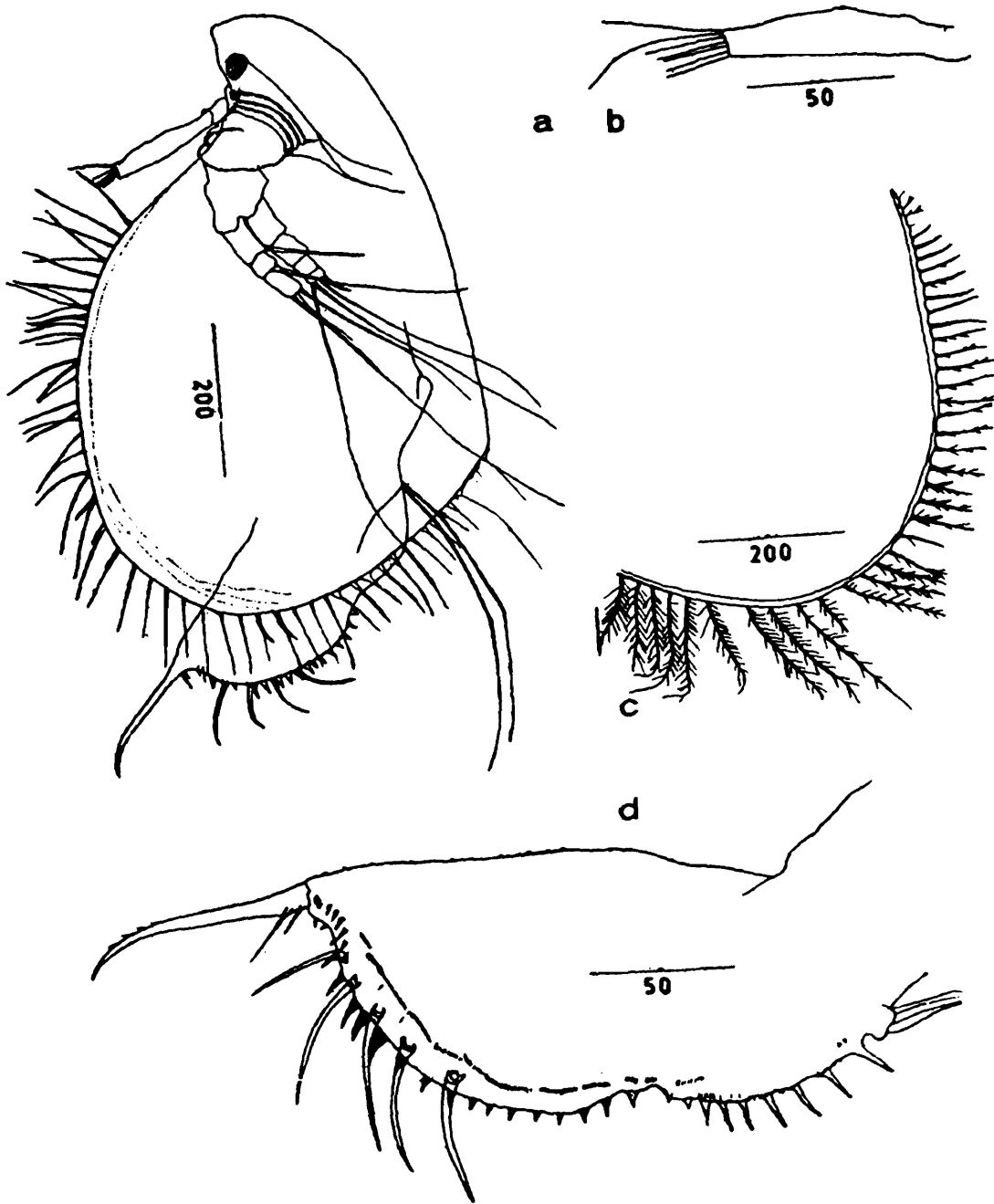
**MATERIAL EXAMINED:** *Reference material* : DGF 1524, Jagady Pond, Trivandrum, 11.1.76. *Other materials* : ZSI C 1930/2, Julga lake, Rajasthan, collected by Mr. S. Biswas, 24.11.58 (*Ilyocryptus halyi*).

*Female* : Body form oval-triangular in outline. Posterior and ventral edge of valves rounded into each other and bearing long, usually branched and feathered setae. Head keel starting from anterior rim of head and extending upto back of head. Antennules long, biarticulated and attached to the ventral side of head behind vertex. Antennary setae usually long. Postabdomen large, broad and anus opening in the depression on the dorsal margin of post-

abdomen ; with 5-7 preanal spines and 4-8 postanal lateral spines situated in a row. Claw long, slightly curved and with two basal spines of unequal length.

*Length* : 0.76 mm

*Male* : Not known from India.



Text-fig. 36, a-d : *Ilyocryptus spinifer* Herrick : a. female ; b. antennule ; c. posteroventral part of right valve ; and d. postabdomen.

*Distribution* : INDIA—West Bengal (Gurney, 1907, Sharma, 1978) ; Rajasthan (Biswas, 1971), Meghalaya (Patil, 1976). Elsewhere—Pantropical, also recorded from North America, China, Australia and Cuba.

Additional Genus and Species : *Guernella ceylonica* Daday, 1898 (= *raphaelis* Richard, 1892) : reported by Brehm (1953).

#### Family VI. CHYDORIDAE Stebbing, 1902

Body generally oval in outline, sometimes almost rounded ; completely enclosed by a carapace and head shield. Head shield with head pores, with some rare exceptions. Antennule one-segmented, mobile and generally not extending beyond tip of rostrum. Antennae short, rami 3-segmented ; antennal setae : 0-0-3/0-1-3 or 0-0-3/1-1-3. Labrum with expanded flattened plate projecting ventrally ; differs in shape in different species. Midgut forming loops. Ocellus present. Postabdomen of female with anal spines and with lateral setae or fascicles in some species.

Five sometimes six, pairs of legs. Leg I with small exopodite with 1-2 setae ; endite tripartite, its outer ramus with robust setae serving for movement on the substrate. Leg II with small exopodite with 1-2 setae ; endite with 8 thick setae, without sensory papilla. Gnathobase of leg II with a row of feathered setae. Legs III-V having large exopodites with 4-9 setae ; with small endite and gnathobase bearing rows of feathered setae. Leg IV when present, vestigial and in the form of a small lobe.

Male smaller than female ; with larger antennules, modified postabdomen and hook on first pair of legs. Anal spines and lateral setae on postabdomen comparatively reduced.

The Chydoridae is the largest family of the order Cladocera and is clearly defined morphologically and ecologically. Frey (1967) examined the phylogenetic relationships amongst its members and established four subfamilies *i.e.*, Euryercinae, Sayciinae, Chydorinae and Aloninae. This treatment, also accepted by Smirnov (1971), has been followed in the present account. However, Indian representatives of Chydoridae belong to three subfamilies—Eury-

cercinae, Chydorinae and Aloninae. Furthermore, the recorded 46 chydorid species are spread over 17 genera of the three mentioned subfamilies.

*Key to the Indian subfamilies of family CHYDORIDAE*

1. Head shield with one main head pore with small lateral pores.....2  
  
Head shield with 2 or 3 main head pores ; when a single pore is present, without small pores.....3
2. Main head pore situated near posterior margin of head shield ; small pores adjacent, lateral to main pore.....Subfamily : EURYCERCINAE  
Kurz, 1875
3. Two separate main head pores situated in median line of head shield, two small pores situated between the main pores ; if there is a single main pore, then situated far from posterior margin of head shield... ..Subfamily : CHYDORINAE  
Stebbing, 1902  
  
Two or three united main pores in median line of head shield, two small pores situated lateral to main pores ; sometimes two main pores in median line of head shield, with two small pores between them and a small pore on each side ; if main pore is single, is situated near posterior margin of head shield.....Subfamily : ALONINAE  
Frey, 1967

**Subfamily 1. Eurycercinae Kurz, 1875**

Series generum *Eurycercus* P. E. Müller, 1867, p. 92, 161.

*Eurycercinae* Kurz, 1875, p. 30 ; Bening, 1941, p. 241 ; Smirnov, p. 202.

Body almost oval in outline. Main head pore large, rounded and situated near posterior margin of head shield, small lateral pores adjacent to main pore ; canals extending from main pores. Mandibles articulated between head shield and valve. Midgut with two hepatic caecae ; a short caecum present. Postabdomen flattened with more than 80 preanal spines in a single series ; anus situated

on distal end of postabdomen. Claws with two basal spines. Six pairs of legs ; Leg VI with epipodite.

*Type genus* : *Eurycercus* Baird, 1843

Represented by the sole genus *Eurycercus*. This genus has now been (Frey, 1975) split up into three subgenera. However, in this work, only the nominate subgenus is represented.

### Genus 18. *Eurycercus* Baird, 1843

*Lynceus partim* O F. Müller, 1785

*Eurycercus* Baird, 1843, p. 88 ; Schoedler, 1862, p. 6-9 ; Lilljeborg, 1900, p. 384-385 ; Bening, 1841, p. 241 ; Sramék-Husek *et al.*, 1962, p. 311-312 ; Herbst, 1962, p. 78 ; Smirnov, 1971, p. 203.

*Eurycercus (Eurycercus)* Frey, 1975, p. 292-293.

Carapace with prominent and sharp median dorsal keel, which actually begins on the head behind median pore. Median pore projecting from head and directed posteriorly, with transverse fold or indentation immediately behind it ; head shield more or less pointed to adapt to keel on shell. Antennules and antennae with numerous transverse rows of spinules. Labral keel large, expanded and sharply angled at posterior edge. Midgut with a single loop ; posterior intestinal caecum present. Postabdomen with numerous anal spines in a single row ; with lateral groups of small spinules. Claw with two basal teeth. Six pairs of legs.

*Type species* : *Eurycercus lamellatus* (O.F. Müller, 1776). Only one species known of this genus was present in the examined material.

### 39. *Eurycercus lamellatus* (O.F. Müller, 1776)

*Lynceus lamellatus* O. F. Müller, 1776, p. 73-74, pl. IX, figs. 4-6 ; Zaddach, 1844, p. 28-29 ; Leydig, 1860, p. 209-215, pl. VII, figs. 25-26, pl. X, fig. 72,

*Monoculus lamellatus* Linne, 1788, p. 3008.

*Eurycercus lamellatus* Baird, 1843, p. 88-89, pl. II, figs. 1-8 ; Baird, 1850, p. 124, pl. XV, figs. 1, 1a-b; Schoedler, 1862, p. 9 ; Lilljeborg, 1900, p. 385-393, pl. LIX, figs. 1-10 ; Bening, 1941, p. 241-244, fig. 102 ; Sramék-Husek *et al.*, 1962, p. 312-324, figs. 5-6 ; Herbst, 1962, p. 78-80, fig. 53 ; Fryer, 1963, p. 335-380, figs. 1-56 ; Chiang, 1964, p. 78, figs. 10-13 ; Negrea, 1966, p. 138-139 ; Smirnov, 1971, p. 203-208, figs. 183-188.

*Lynceus laticaudatus* Fischer, 1851, p. 187-188, pl. VIII, figs. 4-7.

*Eurycercus lamellatus* var. *minutus* Biraben, 1939, p. 652-654, figs. 1-3.

*Eurycercus (Eurycercus) lamellatus* Frey, 1975, p. 292-294.

**MATERIAL EXAMINED :** *Reference material* : Only 2 specimens from littoral zone, Manasbal lake, Kashmir, 1978 (specimen distorted and badly preserved)

*Female* : Body somewhat oval in outline ; with almost straight ventral margin and rounded posterodorsal and posteroventral corners of valves. Valves with row of setae on ventral margin and row of spinules at end of ventral margin and on part of posterior margin. Valves marked with indistinct pattern of pentagons or polygons. Dorsal keel present ; head keel absent. A large transverse oval main head pore bordered by a small lateral pore on each side. Antennules with sharp incisions ; sensory seta situated in middle of anterior margin. Antennal seta 0-0-3/1-1-3. Plate of labrum triangular. Eye with 28 facets ; Ocellus small, situated at base of antennule. Midgut with single loop ; caecum short. Post-abdomen with concave distal margin. Distal preanal spine much larger and spines decrease in size proximally. Natatory setae 2-segmented. Claws with setae on concave margin and with two basal spines, of which distal being is the larger.

*Length* : 2.5mm

*Male* : Not known from India.

*Distribution* : INDIA—New record. Elsewhere—Holarctic region also Argentina, South Africa. Ubiquitous in USSR.

Subfamily 2. CHYDORINAE Stebbing, 1902

*Chydorinae* Frey, 1967, p. 36 ; Smirnov, 1971, p. 215-216 ; Sharma, 1978, p. 195 ; Mamaril Sr. & Fernando, 1980, p. 138.

Height of body generally greater than length. Horizontal keel present in some species. Mandibles articulated with head shield some distance from its margin. Head pores separated, situated in median line of head shield ; two small pores between main pores, small pores without canals. In some genera (*Chydorus*, *Dunhevedia*, *Anchistropus* and *Dadaya*), setae of ventral margin of valves situated on the inner side of valve in posterior part of the margin. In others (*Pleuroxus* and *Alonella*), all setae situated on margin. Anus situated in proximal part of postabdomen. Claws of female with two basal spines in most species ; but only one in some. Hepatic processes absent. Five to six pairs of legs. Leg VI, if present, without epidodite.

*Type genus* : *Chydorus* Leach, 1816

This subfamily is represented by six genera in India.

*Key to the Indian genera of subfamily CHYDORINAE*

1. Valves with setae on the entire posteroventral margin.....2  
 Valves with setae situated on ventral margin in anterior half and on inner side of ventral margin of posterior half.....3
2. Rostrum long.....*Pleuroxus* Baird, 1843  
 Rostrum short and blunt.....*Alonella* Sars, 1862a
3. Labrum with plate-shaped process.....4  
 Labrum without plate-shaped process.....*Pseudochydorus* Fryer, 1968
4. Body spherical. Postabdomen long, anus situated on its functionally ventral side.....*Chydorus* Leach, 1816  
 Body oval. Postabdomen rounded, anus situated on its functional posterior side.....*Dunhevedia* King, 1853

Genus 19. **Pleuroxus** Baird, 1843

*Lynceus* part O. F. Müller, 1785, p. 74-76.

*Monoculus* part Linné. 1788.

Subgenus *Pleuroxus* Baird, 1843, p. 93.

Subgenus *Peracantha* Baird, 1843, p. 94.

*Pleuroxus* Baird, 1850, p. 134 ; Lilljeborg, 1900, p. 527-528 ; Sars, 1901, p. 78 ; Sars, 1916, p. 342 ; Bening, 1941, p. 276 ; Srámek-Husek *et al.*, 1962, p. 369 ; Herbst, 1962, p. 96 ; Smirnov, 1964, p. 305-318 ; Smirnov 1966, p. 161-194 ; Smirnov, 1971, p. 217-219.

*Peracantha* Baird, 1850, p. 136 ; Schoedler, 1863, p. 39-40 ; Kurz, 1875, p. 68 ; Bening 1941, p. 266 ; Herbst, 1962, p. 94-96 ; Sramek-Husek *et al.*, 1962, p. 367-368.

*Rhypphilus* Schoedler, 1863, p. 54.

Section *Pleuroxus* *verus* Herrick, 1884, p. 206-208.

*Paratacantha* Lilljeborg, 1900, p. 520-521.

*Cornuella* Vereshchagin, 1923, p. 32-33.

Rostrum long and pointed, rarely bent forward. Dorsal margin of body convex ; posterodorsal corner much lower than highest point of dorsal side. Posterior margin short, rarely toothed along entire length ; posteroventral angle rarely rounded, usually with one or more number of denticles. Setae on the ventral margin situated on outer margin of valve. Plate of labrum large, usually tongue-shaped, with rounded posterior angle. The distance from the posterior head pore to posterior margin of head shield more than distance between main pores. Ocellus usually smaller than eye. Intestine forming loops ; and with a caecum. Claws of female with two basal spines. Bergamin (1940) and Smirnov (1971) arranged all the known species of this genus into four broad groups according to their form of body and postabdomen.

*Type species* : *Pleuroxus trigonellus* (O.F. Müller, 1776).  
Represented by four species in Indian material.

*Key to the Indian species of genus PLEUROXUS*

1. Postabdomen with rounded distal end.....2  
Postabdomen with truncate distal end.....3
2. Anal denticles irregularly distributed.....*P. aduncus* (Jurine, 1820)  
Anal denticles regularly distributed.....*P. trigonellus* (O.F. Müller, 1776)
3. Valves without striae.....*P. similis* Vavra, 1900  
Valves with striae.....4
4. Maximum height of valves about 3—5 times  
that of posterior margin.....*P. denticulatus* Birge, 1879  
  
Maximum height of valves about 2—3 times  
that of posterior margin.....*P. laevis* Sars, 1862a

**40. *Pleuroxus aduncus* (Jurine, 1820)**  
(Text-fig. 37, a-d)

*Monoculus aduncus* Jurine, 1820, p. 152-153, pl. 15, figs. 7-8.

*Monoculus hamatus* Baird, 1834.

*Lynceus aduncus* Milne-Edwards, 1840, pl. 3 : 387.

*Lynceus trigonellus* Lilljeborg, 1853, p. 80, pl. IX, fig. 1.

*Chydorus aduncus* Schoedler, 1858, p. 27 ; Schoedler, 1862, p. 25 ; Schoedler, 1863, p. 46, pl. 3, fig. 59.

*Chydorus inermis* Sars, 1896, p. 31-35, pl. 5, figs. 8-9.

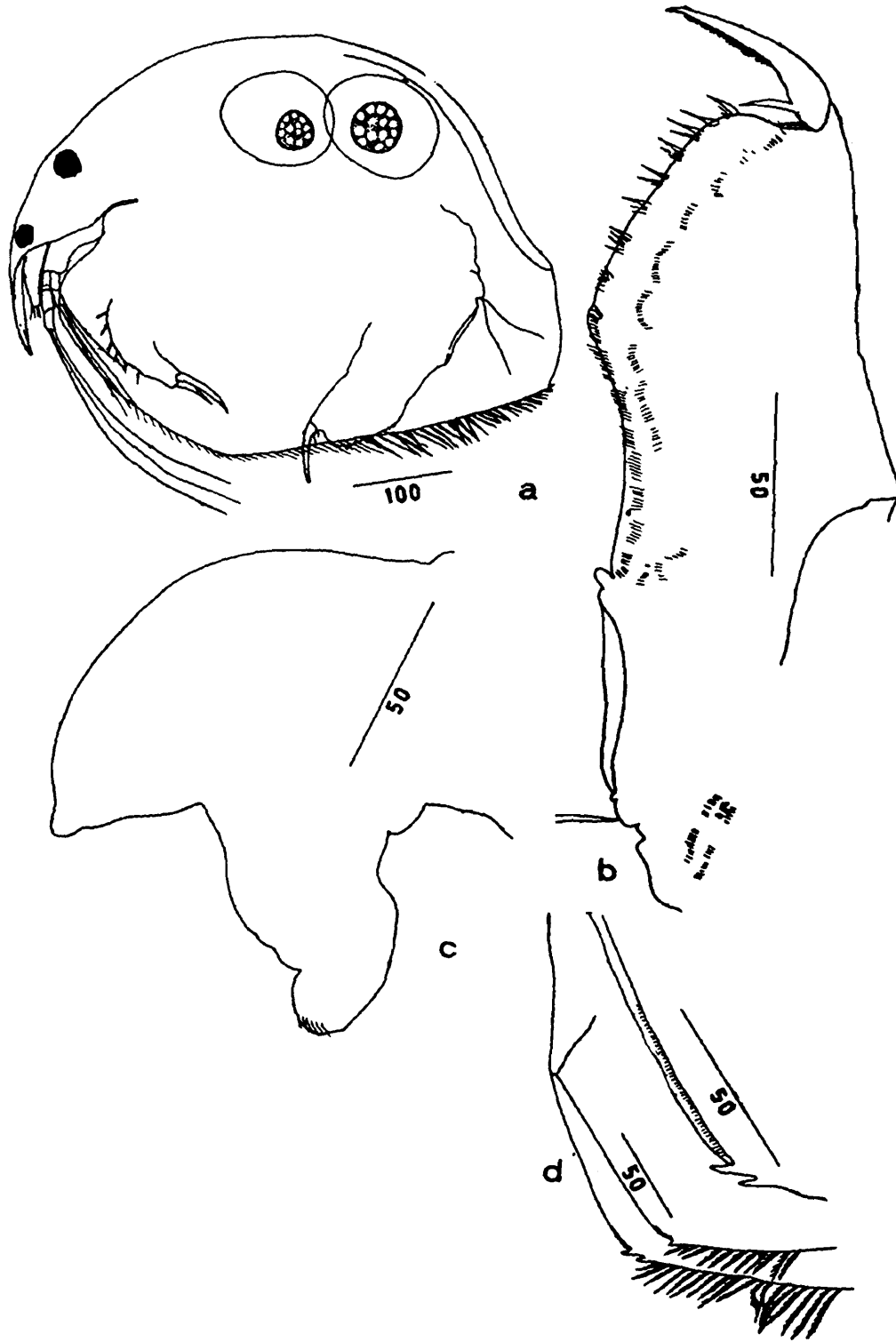
*Pleuroxus scopuliferus* Ekman, 1900, p. 78-81, pl. 4, figs. 25-29.

*Pleuroxus aduncus* Lilljeborg, 1900, p. 541-545, pl. LXXV, figs. 11-17 ; Gauthier, 1929, p. 153-155, fig. 7 ; Harding, 1955, p. 348-350, figs. 83-92 ; Frey, 1960, p. 696, figs. 20-25 ; Srámek-Husek *et al.*, 1962, p. 381-383, fig. 143 ; Smirnov, 1964, p. 305-318 ; Smirnov, 1966, fig. 7, 23 ; Negrea, 1966, p. 147-148 ; Biswas, 1971, p. 132 ; figs. 14C, D ; Smirnov, 1971, p. 220-226, figs. 201-206 (subspecies differentiated) ; Nayar, 1971, p. 516, figs. 41-45 ; Mamaril Sr. & Fernando, 1980, p. 140, figs. 134-135.

**MATERIAL EXAMINED :** *Reference material :* CHF 6, eutrophic pond, Srinagar, Kashmir, 1977. *Other materials :* Sample 8, Collairu

lake (Manguluru Stn.), collected by Dr. Y Radhakrishna, 15.10.73  
Sample 12, Nainital, collected by Mr. P.C. Sharma, 30.8.77.

*Female* : Posteroventral corner of valves with 1-3 posteriorly



Text-fig. 37, a-d : *Pleuroxus aduncus* (Jurine) : a. female ; b. postabdomen ;  
c. plate of labrum ; and d. posteroventral margin of valves.

directed denticle. Height of posterior margin of valve about 1/3 maximum height. Dorsal margin strongly convex. Ventral margin convex in middle and with feathered setae. Rostrum long, pointed and directed downwards. Antennules reaching to about middle of rostrum ; with sensory setae in middle of anterior margin. Antennal setae : 0-0-3/1-1-3. Plate of labrum convex anteriorly and with slightly pointed apex. Ocellus smaller than eye situated nearer to eye than to apex of rostrum. Postabdomen short, tapering distally, preanal corner not distinctly projecting, anus with slightly concave margin. Anal spines small, arranged in 8-10 groups. Lateral setae present. Claw with two spines at base.

*Length* : 0.55 mm

*Male* : Not known from India.

*Remarks* : Harding (1955) noticed a great diversity of form in this species, of which Smirnov (1971) designated four subspecies.

*Distribution* : INDIA—Punjab (Brehm, 1936), Rajasthan (Biswas, 1971). Elsewhere—Cosmopolitan.

41. **Pleuroxus trigonellus** (O.F. Müller, 1776)  
(Text-fig. 38, a-e)

*Lynceus trigonellus* O.F. Müller, 1776, p. 74-75, pl. X, figs. 5-6 ; Schoedler, 1862, p. 25, pl. 2, figs. 33-36.

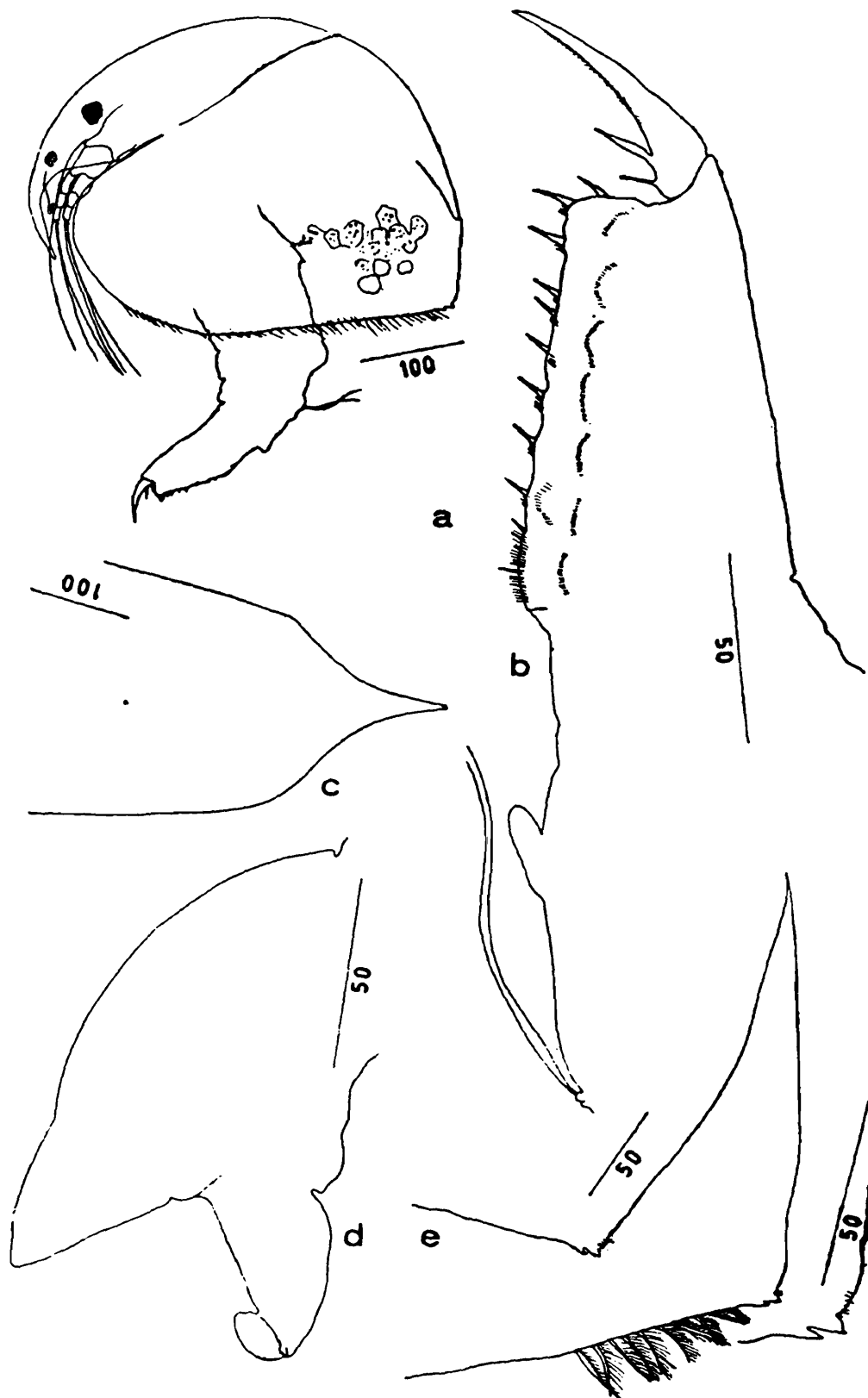
*Monoculus trigonellus* Linné, 1788, p. 3008.

*Lynceus trigonellus* Zaddach, 1844, p. 28.

*Lynceus ornatus* Schoedler, 1858, p. 28, 1862, fig. 32 ; Schoedler, 1863, p. 44-46, pl. II, figs. 33-36, 47, pl. II, fig. 32.

*Pleuroxus trigonellus* Bening, 1941, p. 280-282, fig. 116 ; Frey, 1962, figs. 58-59 ; Srámek-Husek *et al.*, 1962, p. 376-377, fig. 141 ; Herbst, 1962, p. 98, fig. 82 ; Smirnov, 1971, p. 225-231, figs. 208-215 (subspecies differentiated) ; Nayar, 1971, p. 516, figs. 37-40.

**MATERIAL EXAMINED** : *Reference material* : CHF 9, Srinagar, Kashmir, collected by Dr. M.A. Khan, 1976.



Text-fig. 38, a-e : *Pleuroxus trigonellus* (O.F. Müller) : a. female ; b. postabdomen ; c. head shield (part) ; d. plate of labrum ; and e. postero-ventral margin of valves.

*Female* : Body with strongly convex dorsal margin. Postero-ventral corner of valves with 1-3 denticles ; small spinules sometimes present above denticles which are pointed posteriorly and downward. Valve marked with pattern of polygons. Head shield pointed posteriorly ; rostrum long, pointed and directed ventrally. Antennules reaching middle of rostrum ; each with sensory seta in middle of anterior margin. Antennal setae : 0-0-3/1-1-3. Plate of labrum with convex anterior margin and slightly pointed apex. Ocellus nearer to eye than to apex of rostrum. Postabdomen tapering distally, anal spines 10-14 ; lateral setae in groups. Claws with setae on concave margin and with two basal spines.

*Length* : 0.43 mm

*Male* : Not known from India.

*Distribution* : INDIA—Kashmir (Brehm, 1936). Elsewhere—Holarctic region, Java, ubiquitous in the european USSR.

42. ***Pleuroxus similis*** Vavra, 1900  
(Text-fig. 39, a-e ; Text-fig. 40)

*Pleuroxus similis* Vavra, 1900, p. 23-24, fig. 6 ; Sars, 1901, p. 79-80, pl. XI, fig. 7 7a-b ; Manuilova, 1964, p. 267, fig. 128 ; Smirnov, 1971, p. 230-231, figs. 218-219 ; Yousuf & Qadri, 1977, p. 89 ; Qadri & Yousuf, 1978, p. 859-860, fig. 2 ; Sharma, 1978, p. 150 ; Mamaril Sr. & Fernando, 1980, p. 140, figs. 136-137.

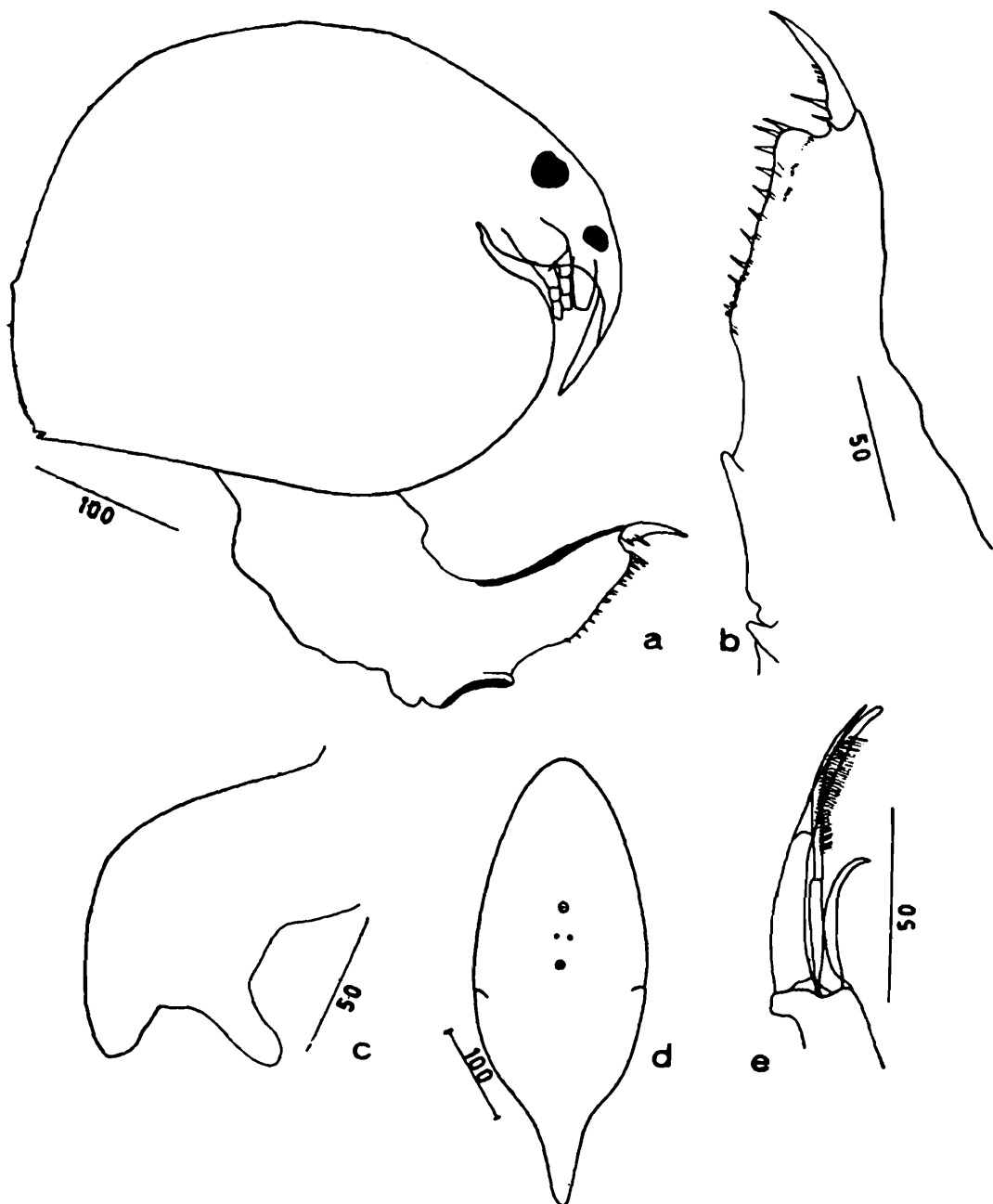
*Pleuroxus australis* Henry, 1922, p. 45, pl. VII, fig. 3.

*Pleuroxus similis* var. *fuhmanni* Stingelin, 1913, p. 624-625, figs. 24-25.

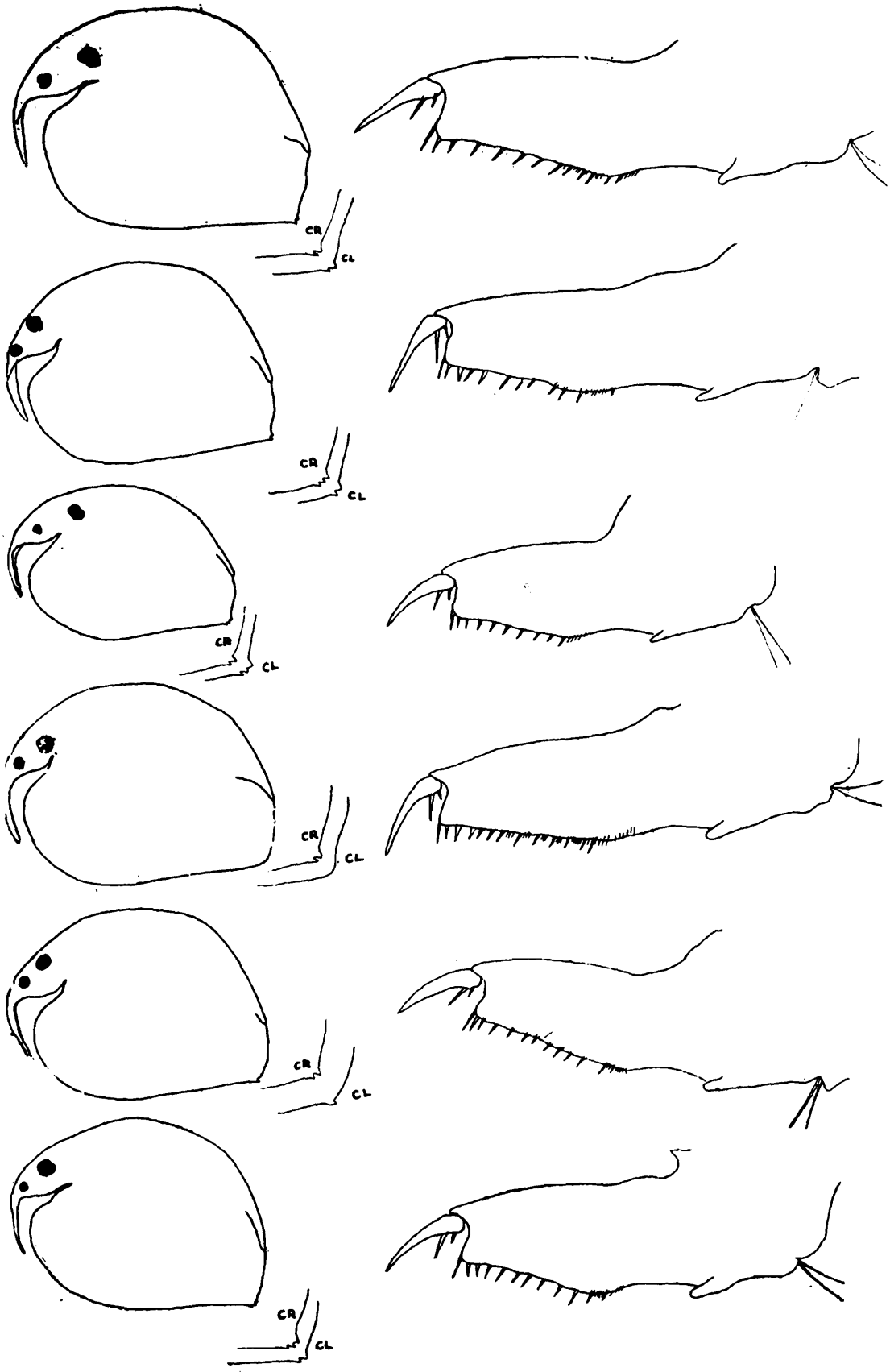
MATERIAL EXAMINED : *Reference material* : RGM 7, Shillong, collected by Dr. B. Bhattacharya, 10.4.78. *Other materials* : RGM 1, 7, 15, 19, 23, 31, 41, 51, 77, 80, 98 Shillong collected by Dr. B. Bhattacharya, 10.4.78 ; BKS—West Bengal : Achipur, (24-Parganas) 30.11.77 ; Baruipur (24-Parganas) 1.9.75 ; Memanpur (24-Parganas) 9.9.77 ; Thakurpukur (24-Parganas) 3.2.77.

*Female* : Body with uniformly curved dorsal margin. Postero-ventral corner of valves with 1-3 denticles ; variation noticed even

on valves of same animal. Valves without pattern, ventral margin with feathered setae. Rostrum long and pointed downwards, reaching level of ventral margin of valve. Antennules terminating far from apex of rostrum. Plate of labrum with convex anterior margin. Distance of ocellus to eye half distance to apex of rostrum. Postabdomen elongated, tapering slightly to distal end ; dorsal distal corner of postabdomen situated slightly behind base of claws. Preanal corner moderately distinct. Anal spines 10-13 and increase gradually in size distally. Claw with two basal spines.



Text-fig. 39, a-e : *Pleuroxus similis* Vavra : a. female ; b. postabdomen ; c. plate of labrum ; d. head shield ; and e. outer ramus of endite of leg I.



Text-fig. 40 : *Pleuroxus similis* Vavra : showing variations in the number of anal spines in the postabdomen of different animals as well as differing number of denticles even in the same animal between the right (CR) and left (CL) valves.

*Length* : 0.40 mm

*Male* : Not known from India.

*Distribution* : INDIA—Kashmir (Quadri & Yousuf, 1978 ; Yousuf & Quadri, 1977), West Bengal (Sharma, 1978). Elsewhere—Australia, Sri Lanka, Chile, Northern Caucasus.

43. **Pleuroxus laevis** Sars, 1862a  
(Text-fig. 41, a-d)

*Pleuroxus laevis* Sars, 1862a, p. 164-165 ; Lilljeborg, 1900, p. 528-531, pl. LXXIII, figs. 21-22 ; Bening, 1941, 277-278, fig. 114 ; Frey, 1959, p. 39, fig. 55 ; Frey, 1962, fig. 55 ; Sramek-Husek *et al.*, 1962, p. 370-372, fig. 139 ; Herbst, 1962, p. 96, fig. 79 ; Negrea, 1966, p. 147 ; Smirnov, 1971, p. 233-238, figs. 225-228 (subspecies differentiated).

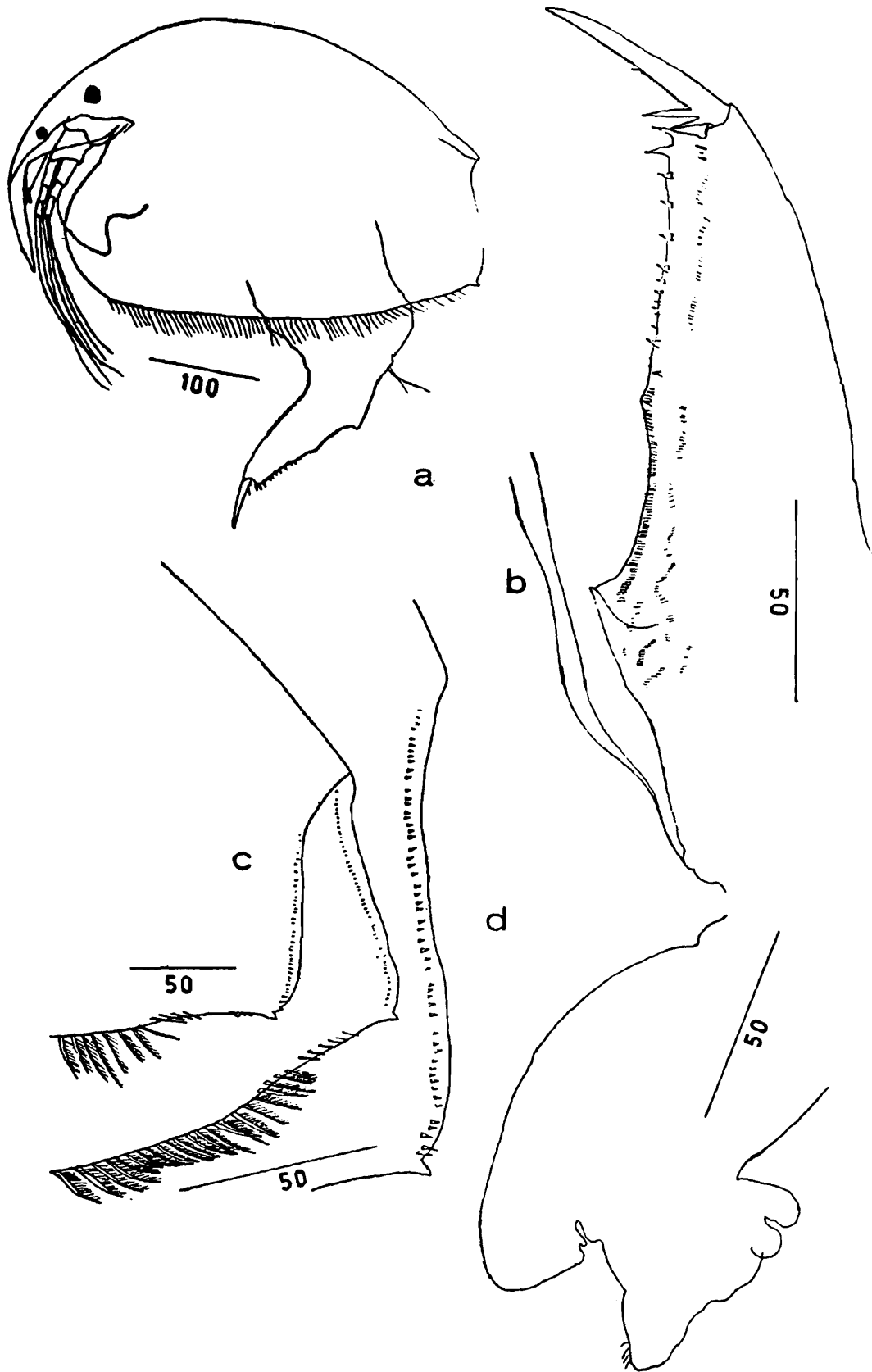
*Pleuroxus hastatus* Sars, 1862a, p. 300 ; Birge, 1893, p. 306-307, pl. XII, fig. 11.

*Lynceus laevis* Norman & Brady, 1867, p. 389-391, pl. XVII, fig. 5, pl. XXI, fig. 14.

*Pleuroxus sinkiangensis* Chiang, 1964, p. 84-85, figs. 29-31.

**MATERIAL EXAMINED** : *Reference material* : CHF 9, Srinagar, Kashmir, collected by Dr. M.A. Khan, 1976.

*Female* : Dorsal margin of body uniformly convex, ventral margin of valves only slightly convex. Posterodorsal corner distinct, and slightly projecting. Posteroventral corner rounded, with a denticle. Small setae present all along the inner side of the posterior margin. Rostrum long, directed posteroventrally. Antennules ending slightly before middle of rostrum, anterior margin of antennule with sensory seta on distal end. Antennae not reaching apex of rostrum. Antennal setae : 0-0-3/1-1-3. Plate of labrum with convex anterior margin and somewhat broad apex. Ocellus situated nearer to eye than to apex of rostrum. Postabdomen tapering distally. Preanal corner distinct. Ventral margin of postabdomen with incisions. Dorsal margin of postabdomen slightly concave, anal spines irregularly distributed. Distal margin of anus with fine



Text-fig. 41, a-d : *Pleuroxus laevis* Sars : a. female ; b. postabdomen ; c. posteroventral margin of valves ; and d. plate of labrum.

rows of setae. Claw with setae on concave margin and with two basal spines.

*Length* : 0.43 mm

*Male* : Not known from India.

*Distribution* : INDIA—New record. Elsewhere—Holarctic region, Africa, Sri Lanka, European USSR.

44. ***Pleuroxus denticulatus* Birge, 1879**  
(Text-fig. 42, a-d)

*Pleuroxus denticulatus* Birge, 1879, p. 20-21, pl. 1, fig. 21 ; Scourfield, 1907, p. 73-75, pl. 8, figs. 5-10 ; Bergamin, 1940, p. 49, fig. 2 ; Frey, 1959, p. 39, fig. 53 ; Frey, 1960, p. 696, figs. 17-18 ; Frey, 1962, fig. 53 ; Scourfield & Harding, 1966, p. 45, fig. 103 ; Shan & Frey, 1968, p. 203-205 ; Shan, 1969, p. 513-523 ; Smirnov, 1971, p. 231-233, figs. 216, 220-222 ; Sharma, 1978, p. 150.

**MATERIAL EXAMINED** : *Reference material* : BKS 12, Barisha, (24-Parganas), West Bengal, 4.6.76. *Other material* : BKS—West Bengal : Thakurpukur (24-Parganas) 4.6.76.

*Female* : Body broadly oval in outline ; dorsal margin arched, posterior margin almost straight. Valves striated, ventral margin denticulate anteriorly ; posteroventral corner of valves with 2-4 denticles. Rostrum long and pointed. Posterior margin of head shield rounded ; Antennules ending far from apex of rostrum. Ocellus situated nearer to eye than to apex of rostrum. Postabdomen tapering distally, apex truncate ; with 3-4 large distal anal denticles and 8-12 denticles anterior to them, groups of lateral setae also present. Preanal corner slightly projecting. Claws with two basal spines, distal much longer than proximal.

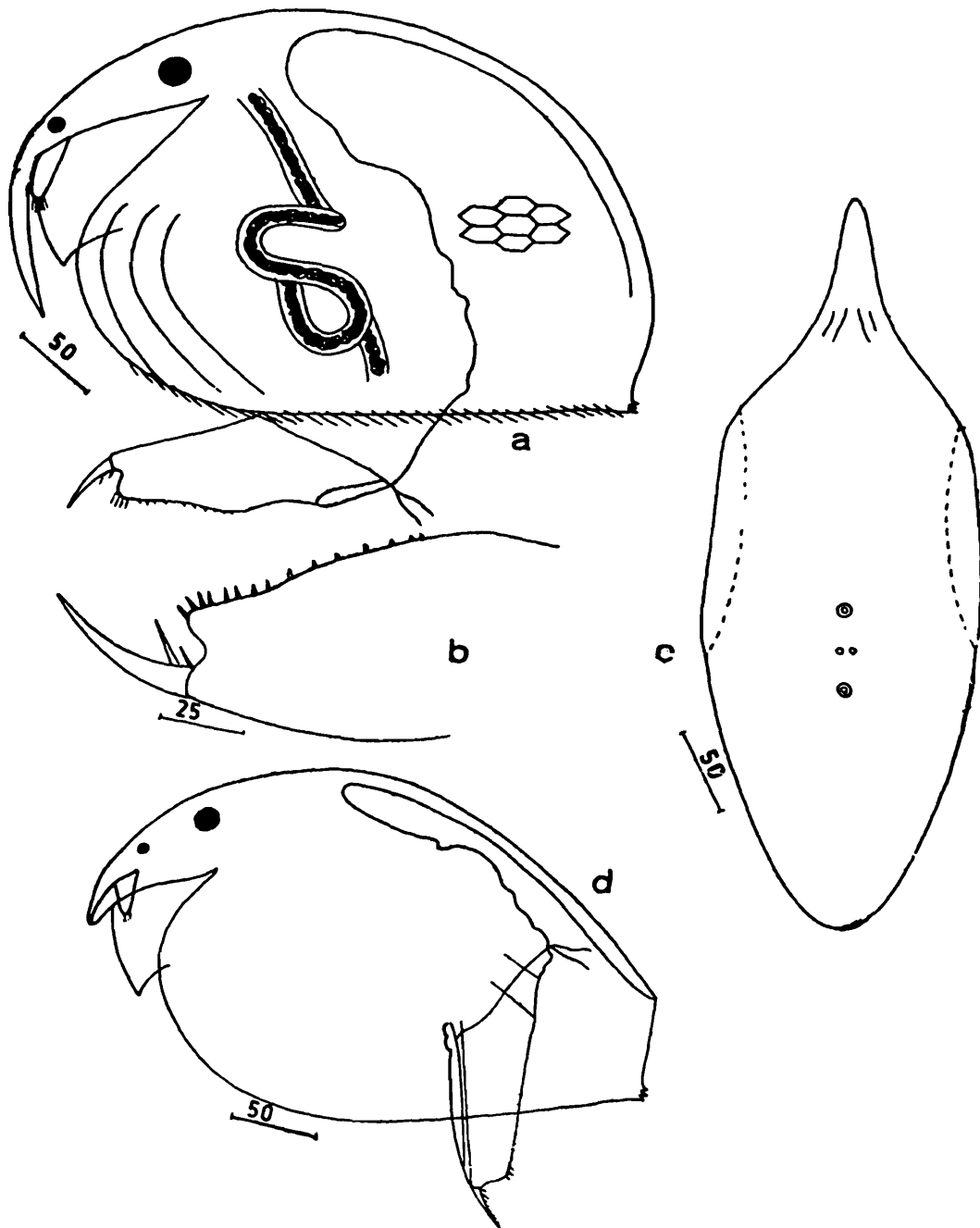
*Length* : 0.46 mm

*Male* : Smaller than female. Rostrum short. Postabdomen scarcely tapering distally ; distal anal denticles distinct and followed by small setae upto anus. Claws with setae on concave margin and

with two basal spines, distal spine the larger. Vas deferens opening at base of claws, ventral to them.

*Length* : 0.35 mm

*Distribution* :INDIA—West Bengal (Sharma, 1978). Elsewhere—North and South America, Africa, United Kingdom, Eastern China and France.



Text-fig. 42, a-d : *Pleuroxus denticulatus* Birge : a. female ; b. postabdomen (part) ; c. head shield ; and d. male.

Genus 20. **Alonella** Sars, 1862a

*Acroperus* part Baird, 1843, p. 92.

*Alonella* : *Alona* part Sars, 1862a, p. 40.

*Lynceus*, *Pleuroxus*, *Acroperus* Kurz, 1875, p. 62-64.

Section *Alonella* Herrick, 1884, p. 101-102 ; Lilljeborg, 1900, p. 509-510.

*Alonella* Birge, 1910, p. 1048-1051 ; Sars, 1916, p. 338 ; Bening, 1941, p. 318 ; Herbst, 1962, p. 92 ; Sramek-Husek *et al.*, 1962, p. 360-361 ; Smirnov, 1971, p. 258-259.

Body almost oval in outline. Reticulations of valves in form of polygons or lines. Setae situated on ventral margin of valve but not on inner side. Antennules ending behind apex of rostrum or projecting beyond it. Setae on antennae : 0-0-3/0-1-3. Head pores situated near posterior margin of head shield ; distance of head pores to posterior margin of head shield less than that between main pores. Five pairs of legs.

Males smaller than females. Postabdomen narrow, without denticles ; vas deferens opening at base of claws.

*Type species* : *Alonella excisa* (Fischer, 1854).

This genus is represented by two species in India.

*Alonella* differs from *Pleuroxus* in that the distance from the head pores to the posterior margin of head shield is less than the distance between the main pores. The other differences between these two genera were referred to by Sars (1862b : 288-289). For a long time there was confusion because of resemblances between some species of *Alonella* and *Alona*. However, it can now be distinguished from *Alona* by the structure of head pores and legs (Frey, 1959).

*Key to the Indian species of genus ALONELLA*

Valves with longitudinal striations inside the polygons. Postabdomen with truncate apex.....*A. excisa* (Fischer, 1854)

Valves with lines extending anteroventrally posterodorsally. Postabdomen with rounded tapering apex.....*A. nana* (Baird, 1850)

45. *Alonella excisa* (Fischer, 1854)  
(Text-fig. 43, a-d)

*Lynceus nanus* Lilljeborg, 1853, p. 206.

*Lynceus excisus* Fischer, 1854, p. 428-429, pl. 3, figs. 11-13.

*Pleuroxus excisus* Schoedler, 1862, p. 26, pl. II, fig. 38 ; Schoedler, 1863, p. 49, pl. 2, fig. 38 ; Stingelin, 1895, p. 253, pl. VII, figs. 38-39.

*Lynceus exiguus* Fric, 1872.

*Pleuroxus exiguus* Wesenberg-Lund, 1894, p. 127, pl. IV, fig. 16.

*Alonella excisa* Lilljeborg, 1900, p. 510-513, pl. LXXXI, figs. 9.19 ; Gurney, 1907, p. 26 ; Benning, 1941, p. 320-323, fig. 133 ; Frey, 1959, p. 38, fig. 41 ; Sramek-Husek *et al.*, 1962 p. 361-363, fig. 135 ; Frey, 1962, fig. 41 ; Herbst, 1962, p. 94, fig. 76 ; Negrea, 1966, p. 146 ; Fryer, 1968, p. 180-182, fig. 53 ; Rey & Saint-Jean, 1968, p. 113, fig. 27 ; Yousuf & Qadri, 1977, p. 89 ; Mamaril Sr. & Fernando, 1980, p. 140, figs. 138-140.

*Alonella setosa* Vereshchagin, 1913, p. 204-205, figs. 26-27.

*Alonella excisa excisa* Smirnov, 1971. p. 260-262, figs. 262-264.

**MATERIAL EXAMINED :** *Reference material :* DGF 1524, Jagady Pond, Trivandrum, 11.1.65. *Other materials :* ZSI C 5407/10, Chakradharpur, Chotanagpur, collected by Dr. N. Annandale, (no specimen in the vial) ; Sample 17, Nainital, collected by Mr. P.C. Sharma, 30.8.77.

*Female :* Body oval in outline ; posterior margin of valve straight. Posterodorsal corner distinct ; posteroventral corner with one blunt denticle. Reticulation of valves in form of parallel lines, the lines being fused in some places to form a honeycomb pattern and fine longitudinal lines and dots inside each polygon. Rostrum blunt and directed downwards. Head shield with rounded posterior margin. Antennules with sensory seta distal to middle of margin. Antennal setae : 0-0-3/1-1-3 ; spines : 1-0-1/0-0-1. Plate of labrum with convex anterior margin and blunt apex. Ocellus slightly nearer to eye than to apex of rostrum. Postabdomen short. Preanal corner blunt. With about 10 anal spines. Anal margin with setules. Claw with two basal spines.

*Length* : 0.31 mm

*Male* : Not known from India.

*Distribution* : INDIA—Madhya Pradesh (Gurney, 1907), Kashmir (Brehm, 1936 ; Yousuf & Qadri, 1977). Elsewhere—Cosmopolitan.

46. *Alonella nana* (Baird, 1843)  
(Text-fig. 43 e)

*Acroperus nanus* Baird, 1843, p. 92, pl. III. fig. 8 ; Baird, 1850, p. 130, pl. XVI, fig. 6 ; Schoedler, 1863, p. 33.

*Lynceus nanus* Lilljeborg, 1853.

*Alona pygmaea* Sars, 1862a, p. 162-163 ; Sars. 1862b, p. 288-301.

*Pleuroxus transversus* Schoedler, 1862, p. 26 ; Schoedler, 1863, p. 50, pl. 3, figs. 52-53.

*Alona transversa* P. E. Müller, 1867, p. 181-182, pl. IV, figs. 10-11. Kurz, 1875, p. 67-68, pl. III, fig. 7.

*Pleuroxus nanus* Hellich, 1877, p. 100.

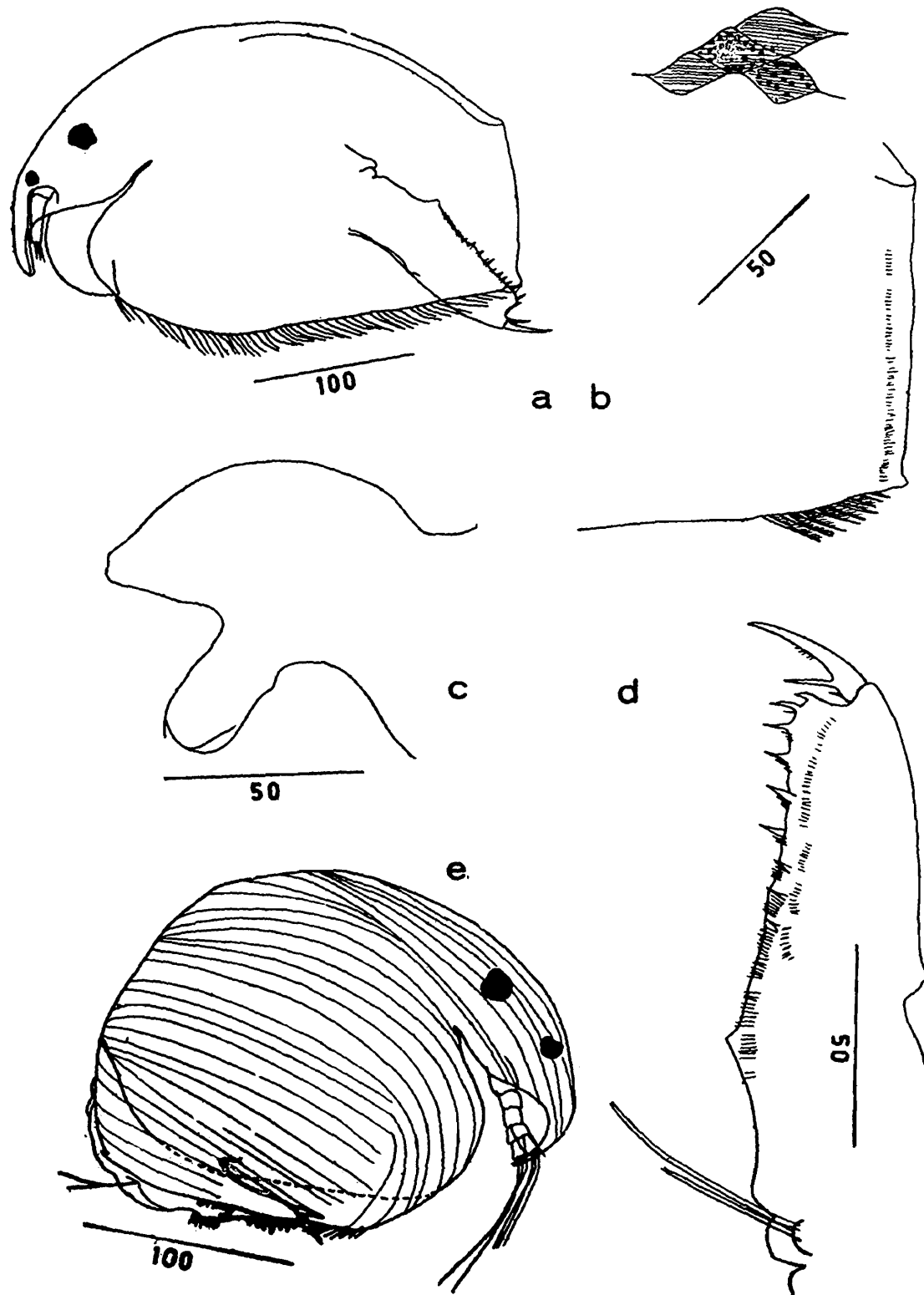
*Pleuroxus tusnadiensis* Daday, 1883, p. 9-11, pl. I, figs. 2,5 ; Daday, 1888, p. 90, pl. I, figs. 27-29.

*Pleuroxus griseus* Daday, 1888, p. 92, pl. I, figs. 22-23.

*Alonella nana* Sars, 1891, p. 48 ; Lilljeborg, 1900, p. 519-520, pl. LXXII, figs. 27-31 ; Bening, 1941, p. 319-320, fig. 132 ; Frey, 1959, p. 38, fig. 43 ; Frey, 1962, p. 43 ; Sramek-Husek *et al.*, 1962, p. 365-366, fig. 137 ; Herbst, 1962, p. 94, fig. 74 ; Negrea, 1966, p. 146 ; Fryer, 1968, p. 283-286, figs. 54-55 ; Smirnov, 1971, p. 266-268, figs. 272-274 ; Swar & Fernando, 1979, p. 120-121, figs. 28-31.

**MATERIAL EXAMINED** : *Reference material* : RGM 74, Shillong, collected by Dr. B. Bhattacharya, 10.4.78.

*Female* : Body almost oval in outline. Dorsal margin convex. Posterior margin almost straight. Posteroventral corner of valve with one, sometimes two denticles. Lines on valves directed antero-ventrally-posterodorsally. Rostrum pointed. Antennules with sen-



Text-fig. 43, a-d : *Alonella excisa* (Fischer) : a. female ; b. posteroventral margin of valve ; c. plate of labrum ; and d. postabdomen.

Text-fig. 43, e : *Alonella nana* (Baird), female.

sory seta distal to middle of posterior margin. Antennal setae : 0-0-3/1-1-3. Plate of labrum with pointed apex. Ocellus nearer to eye than to apex of rostrum. Postabdomen short, with about 6 anal spines ; proximal corner of arms distinct. Claws with two basal spines. Proximal spine small, its concave margin with setae.

*Length* : 0.22 mm

*Male* : Not known from India.

*Distribution* : INDIA—Kashmir (Brehm, 1936). Elsewhere—Holarctic region, European USSR to Baikal area.

An ADDITIONAL SPECIES *Alonella exigua* (Lilljeborg, 1853) was reported from Kashmir (Brehm, 1936 ; Yousuf & Qadri, 1975 ; Qadri & Yousuf, 1977). No specimen found in present Indian material.

## Genus 21. *Chydorus* Leach, 1816

*Monoculus* (part) Schrank, 1781, p. 536.

*Lynceus* (part) O.F. Müller, 1785, p. 71 ; Leach, 1816, p. 406.

Subgenus *Chydorus* Baird, 1843, p. 89.

*Chydorus* Leach, 1816, p. 406 ; Schoedler, 1862, p. 11-12 ; Schoedler, 1863, p. 11-12 ; Kurz, 1875, p. 76-77 ; Hellich, 1877, p. 107-108 ; Herrick, 1884, p. 115 ; Lilljeborg, 1900, p. 545-547 ; Sars, 1901, p. 66-67 ; Daday, 1910, p. 121 ; Sars, 1916, p. 339 ; Bergamin, 1939, p. 89-90 ; Bening, 1941, p. 325 ; Herbst, 1962, p. 100 ; Smirnov, 1971, p. 277-279.

Body spherical or ovate in outline. Posterior part of ventral margin of valves with setae on inner surface. Antennules not reaching apex of rostrum. Antennal setae : 0-0-3/0-1-3. Head shield with two separate main head pores and two small pores between them ; head pores absent in some species. Ocellus usually smaller than eye. Postabdomen usually broad, rarely long and narrow ; with anal spines only, or rarely with very fine lateral setae. Claw with two basal spines, proximal often minute, rarely absent. Male smaller in size than females.

*Type species* : *Chydorus sphaericus* (O.F. Müller, 1776).

This genus *Chydorus* is represented by nine species in the Indian collections.

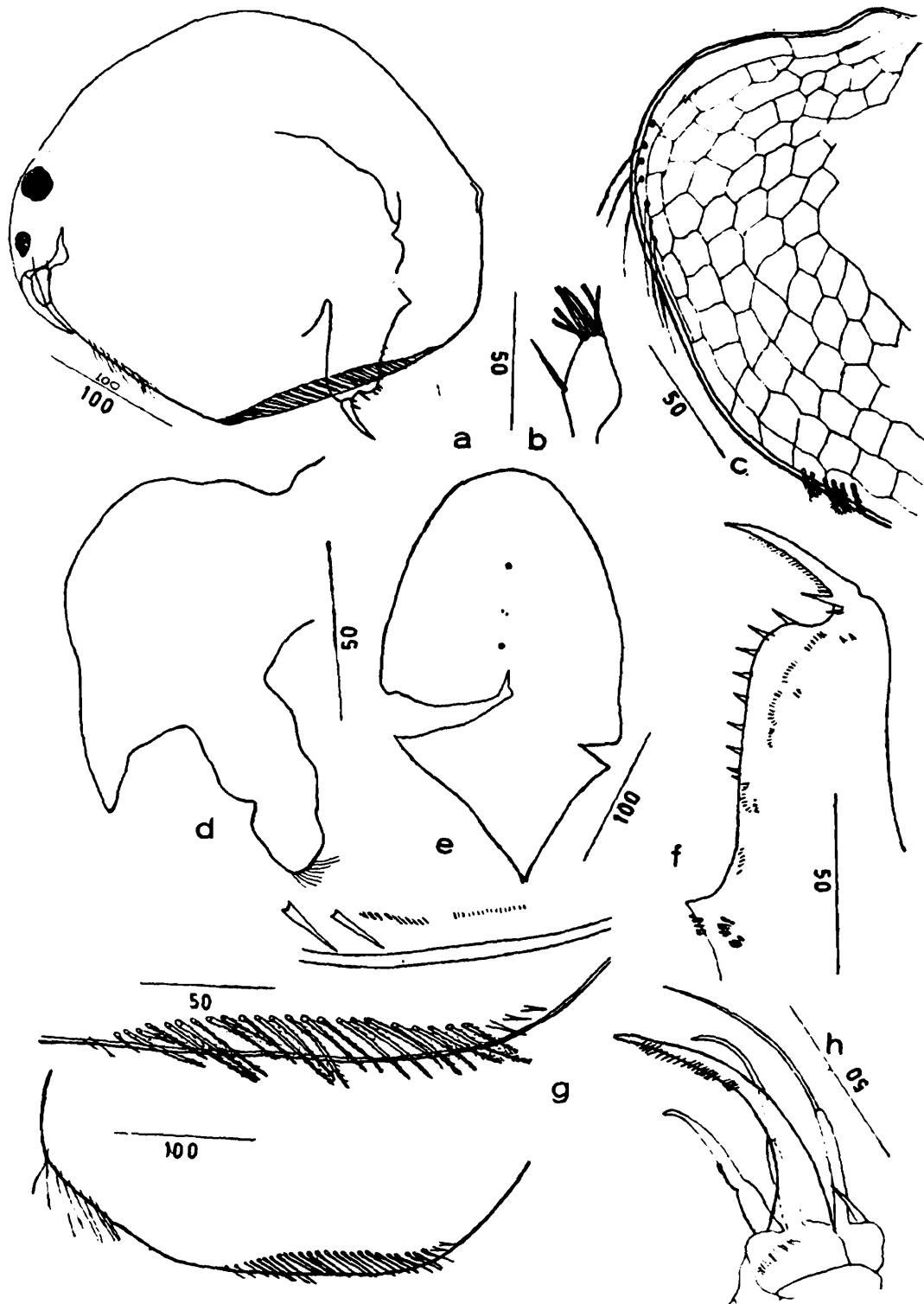
*Key to the Indian species of genus CHYDORUS*

1. Valves without deep polygons.....2  
Valves with deep polygons.....*C. faviformis* Birge, 1893
2. Plate of labrum with denticles.....*C. barroisi* (Richard, 1894b)  
Plate of labrum without denticles.....3
3. Plate of labrum with pointed apex.....4  
Plate of labrum with rounded apex.....7
4. Reticulations of valves without dots.....5  
Reticulations of valves with dots.....6
5. Valves with pattern of polygons with  
straight borders or without poly-  
gons.....*C. sphaericus* (O.F. Müller, 1776)  
Valves with pattern of polygons with  
undulating borders.....*C. herrmanni* Brehm, 1933
6. Valves with faint polygons with wavy  
margins, enclosing pigment patches  
and dots. size : 0.26-0.50 mm.....*C. ventricosus* Daday, 1898  
Valves strongly reticulated, with con-  
centration of dots within each cell.  
Size 0.17-0.27 mm.....*C. reticulatus* Daday, 1898
7. Dorsal side not pubescent.....8  
Dorsal side pubescent.....*C. pubescens* Sars, 1901
8. Valves without chitinous knobs on inner  
side of anterior margin.....*C. kallipygos* Brehm, 1934  
Valves with 1-3 chitinous knobs on  
inner side of anterior margin.....*C. parvus* (Daday, 1898)

47. ***Chydorus sphaericus*** (O.F Müller, 1776)  
(Text-fig. 44, a-h)

*Lynceus sphaericus* O.F. Müller, 1776, p. 119 ; Milne-Edwards, 1840, p. 386-387,  
pl. 3 ; Zaddach, 1844, p. 29 ; Bening, 1941, p. 192, pl. IX, figs. 13-15.

*Monoculus sphaericus* Linné. 1788, p. 3008 ; Jurine, 1820, p. 157-158, pl. 16,  
figs. 31, m.



Text-fig. 44, a-h : *Chydorus sphaericus* (O.F. Müller) : a. female ; b. antennule ; c. valve showing surface pattern ; d. plate of labrum ; e. head shield ; f. postabdomen ; g. ventral margin of valves (enlarged) and h. outer ramus of endite of leg I.

*Chydorus leonardi* King, 1853, p. 258, pl. VII, fig. C ; Stingelin, 1895, p. 262-265, pl. 8, figs. 46-48 ; Sewell, 1935, p. 218.

*Chydorus sphaericus* Lilljeborg, 1900, p. 561-567, pl. 77, figs. 8-25 ; Sars, 1901, p. 69 ; Brooks, 1959, p. 651, fig. 27-111 ; Scourfield & Harding, 1966, p. 48, 74 ; Yousuf & Qadri, 1975, p. 89 ; Qadri & Yousuf, 1977, p. 859 ; Sharma, 1978, p. 150 ; Swar & Fernando, 1979, p. 122, figs. 32-34.

*Chydorus sphaericus* var. *sphaericus* Srámek-Husek *et al.*, 1962, p. 394.

*Chydorus sphaericus sphaericus* Smirnov, 1971, p. 281-282, figs. 291-293, 300.

*Chydorus sphaericus* (O.F. Müller, 1776) Frey, 1980b, p. 99-108, pl. 1-3.

**MATERIAL EXAMINED :** *Reference material* : RGM 72, Shillong, collected by Dr. B. Bhattacharya, 10.4.78. *Other materials* : RGM 1, 3, 5, 9, 15, 18, 20, 21, 22, 25, 28, 31, 37, 41, 43, 46, 50, 51, 58, 62, 64, 69, 71, 79, 84, 87, 88, 90, 92, 94 ; collected from Shillong by Dr. B. Bhattacharya, 18.4.78. to 20.4.78 ; ZSI C 5580/10, 5595/10, Rhamtso, Tibet, Gyang-Tse (13120 ft. ) collected by Capt. F.H. Stewart, I.M.S., Samples 2,7, 15, 17 ; Nainital, collected by Mr. P.C. Sharma, 30.8.77 ; BKS—West Bengal : Amtala (24-Parganas), 8.1.78 ; Behala (Calcutta) 1.9.75 ; Baranagar (Calcutta) 29.5.75 ; Maheshtala (24-Parganas) 30.11.77 ; Dhakuria lake (Calcutta), 4.7.76 ; Thakurpukur (24-Parganas) 4.6.76.

*Female* : Body almost sphaerical in outline, length slightly more than height. Posterodorsal corner of valves distinct. Posteroventral corner rounded, without denticles. Valves usually reticulated with pentagonal or hexagonal cells ; without dots or pits. Rostrum pointed and emarginate. Posterior margin of head shield rounded, head pores typical for this subfamily. Antennules with sensory seta near middle of anterior margin ; all esthetascs situated on apex of antennule. Setae on antennae : 0-0-3/0-1-3. Plate of labrum with smooth, convex anterior margin and with produced, pointed apex. Ocellus nearer to eye than to apex of rostrum. Postabdomen short, with 7-10 anal denticles. Preanal corner projecting. Lateral setae in several groups and arranged in single row. Claw with two basal spines and setae on the concave margin. Endite of Leg 1 with 3 setae, two of them of about equal length, the third hook shaped.

*Length* : 0.32 mm

*Male* : Not known from India.

*Distribution* : INDIA—West Bengal (Gurney, 1906 ; Sharma, 1978), Bihar (Gurney, 1907), Kashmir, Ladakh & Nilgiri Hills (Brehm, 1936), Meghalaya (Patil, 1976). Elsewhere—Cosmopolitan.

48. ***Chydorus parvus*** (Daday, 1898)  
(Text-fig. 45, a-g)

*Chydorus sphaericus* var. *parvus* Daday, 1898, p. 25-26, fig. 7.

*Chydorus robustus* Stingelin, 1904, p. 350-361, pl. 13, figs. 35-38 ; Brehm, 1933a, p. 756-757, figs. 42-44.

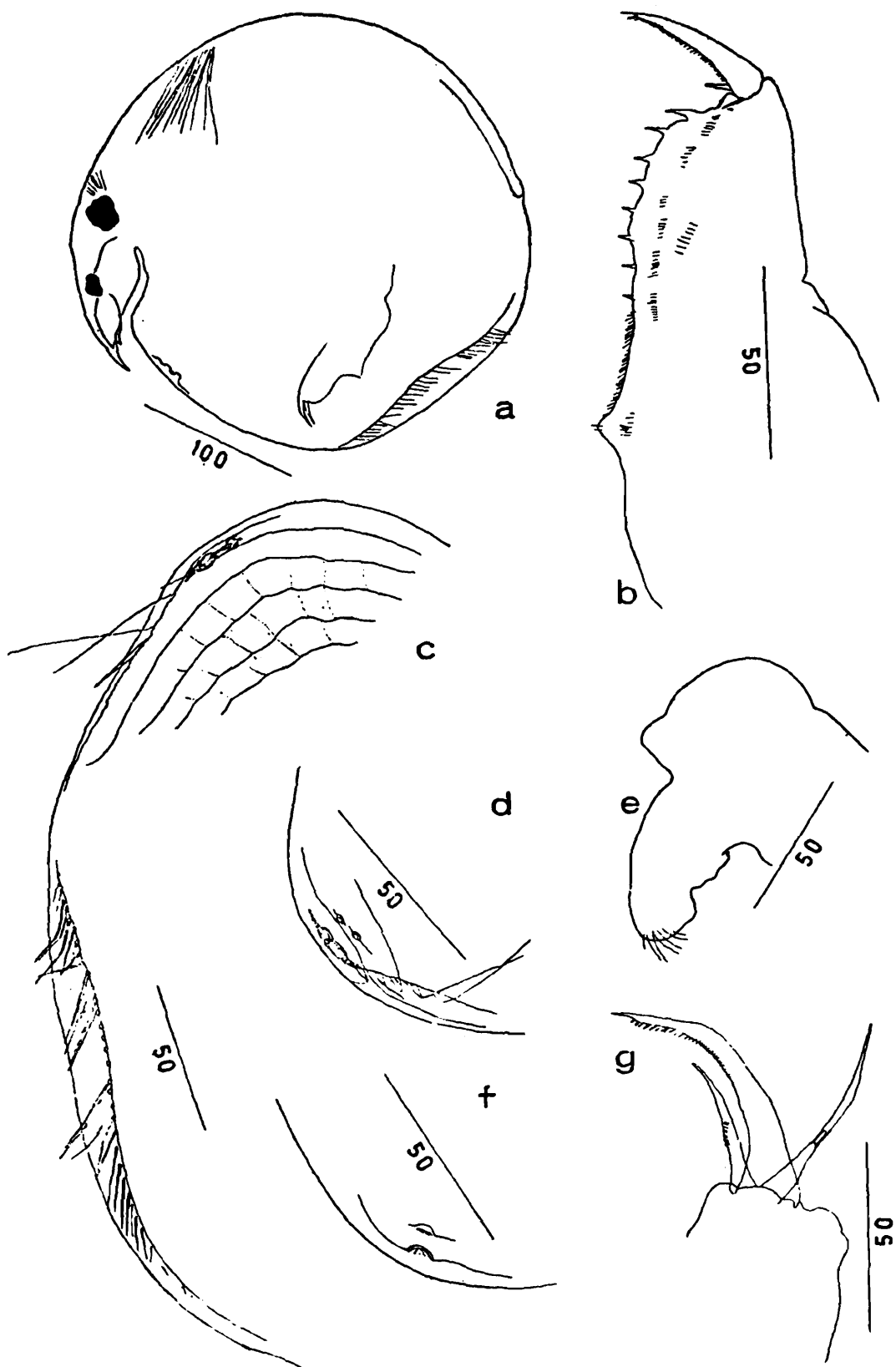
*Chydorus parvus* Mamaril Sr. & Fernando, 1980, p. 142, figs. 154-156.

*Chydorus parvus parvus* Smirnov, 1971, p. 311, fig. 344.

**MATERIAL EXAMINED** : *Reference material* : Sample 4, Irinjalkuda, Kerala, collected by Dr. C.K.G. Nayar, 8.12.77. *Other materials* : DGF 1516, Swamp near Godavilas Tank near Madras, 7.1.65 ; DGF 1517, Buderu tank near Poondi Reservoir, near Madras, 7.1.65 ; Sample 8, 9, Collairu lake, collected by Prof. Y Radhakrishna, 15.10.73.

*Female* : Body almost rounded in outline ; maximum height about in middle. Posterodorsal corner of valves rounded, without denticles. Anterior margin of valves with tubercles on inner side. Number and form of tubercles may differ on right and left valves. Rostrum pointed. Antennules slightly tapering distally and not reaching apex of rostrum. Distal segments of antennae not reaching apex of antennules. Plate of labrum broadly rounded, slightly depressed anteroventrally. Ocellus smaller than eye, situated half-way between eye and apex of rostrum. Postabdomen with 8-10 anal spines. Preanal corner distinctly with projecting groups of lateral setae present. Setae also present distal to the rows of anal spines. Claw with setae on its concave margin and with two basal spines. Tip of claw with two spines of differing length.

*Length* : 0.28 mm



Text-fig. 45, a-g : *Chydorus parvus* Daday : a. female ; b. postabdomen ; c. ventral margin of shell (enlarged) ; d and f. anteroventral margin of valves ; e. plate of labrum ; and g. outer ramus of endite of leg I.

*Male* : Not recorded from India.

*Remarks* : As reported by Jenkin (1934), the postabdomen of the examined material bears lateral groups of setae.

*Distribution* : INDIA—New record. Elsewhere—Ethiopian and Indo-Malayan region.

49. ***Chydorus faviformis* Birge, 1893**  
(Text-fig. 46, a-g)

*Chydorus faviformis* Birge, 1893, p. 307-308, pl. XIII, figs. 7-8 ; Frey, 1959, p. 40, fig. 60; Frey, 1962, fig. 60; Smirnov, 1971, p. 313, fig. 350; Jiang, 1979, p. 258-259, figs. 183 a-d ; Khan *et al.*, 1978.

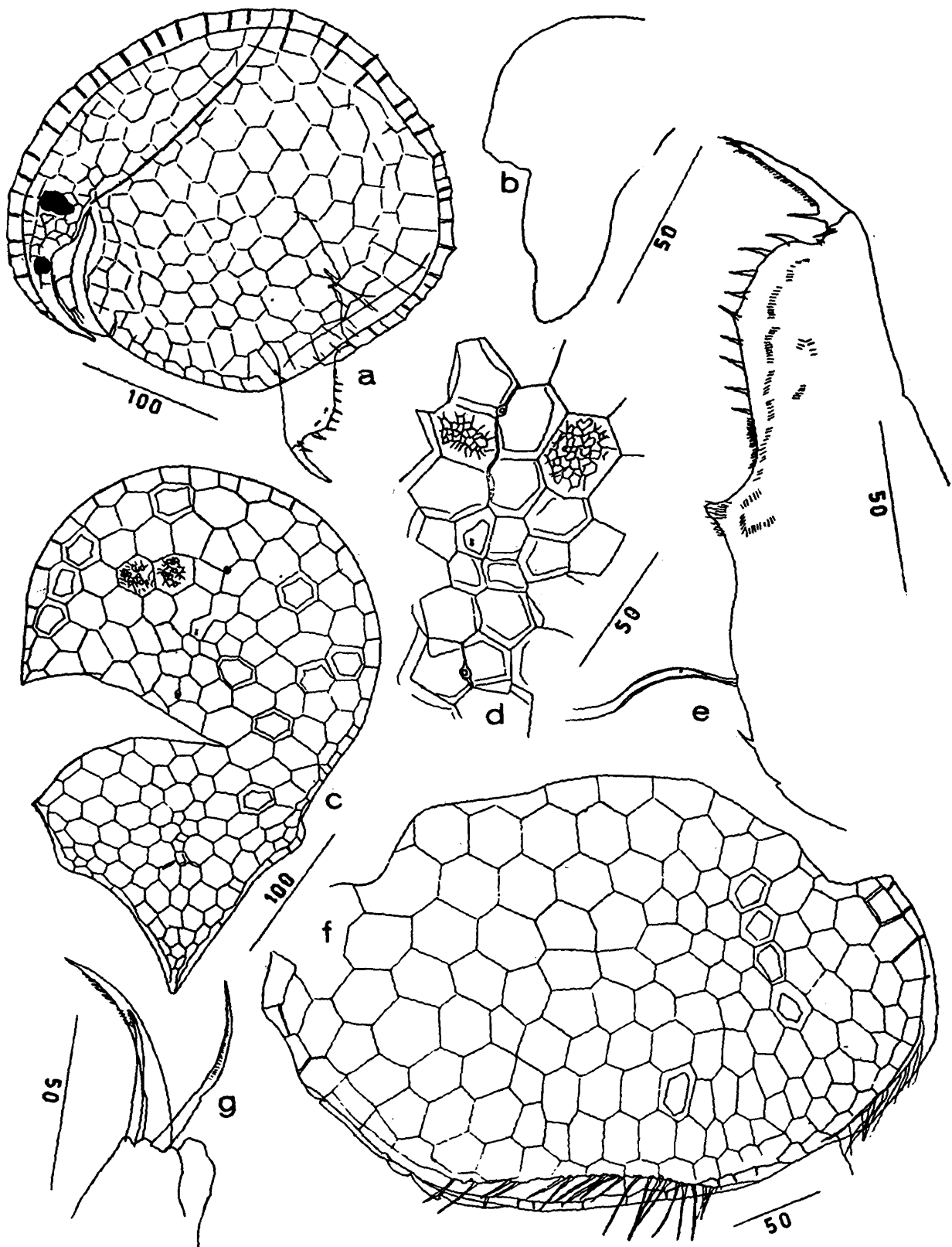
**MATERIAL EXAMINED** : *Reference material* : CHF 6, Srinagar, Kashmir, collected by Dr. M.A. Khan and Dr. D.P. Zutshi, 1976. *Other material* : RGM 14, Shillong, collected by Dr. B. Bhattacharya, 10.4.78.

*Female* : Body rounded in outline. Posterodorsal and posteroventral corners of valves not distinct. Valves and shield with deep polygonal cells. Rostrum pointed and ventrally directed. Head shield with rounded posterior margin. Antennules not reaching apex of rostrum. Antennae extending beyond apex of antennules. Plate of labrum with convex anterior margin and with slightly pointed apex. Ocellus situated almost midway between eye and apex of rostrum. Postabdomen wide, with rounded apex. Preanal corner distinctly projecting. Anal spines 9-10. Groups of lateral setae present. Claw with setae on its concave margin and with two basal spines. Tip of claw provided with two spines of unequal length. Outer branch of endite in I leg with three setae ; two setae thin and almost equally long, 3rd seta longest, short and sickle-shaped.

*Length* : 0.46 mm

*Male* : Not known from India.

*Distribution* : INDIA—Kashmir (Khan *et al.*, 1978). Elsewhere—Northeast of North America, Sri Lanka, China, Malaysia, Australia.



Text-fig. 46, a-g : *Chydorus faviformis* Birge : a. female ; b. plate of labrum ; c. head shield ; d. polygonal cells of shell surface (enlarged) ; e. postabdomen ; f. right valve (enlarged) ; g. outer ramus of endite of leg I.

50. **Chydorus cf. herrmanni** Brehm, 1933a  
(Text-fig. 47, a-e)

*Chydorus herrmanni* Brehm, 1933a, p. 754-761, figs. 48-53 ; Brehm, 1934, p. 73-74, figs. 25-26 ; Smirnov, 1971, p. 292-294, figs. 313-314.

*Chydorus rylovi* Mukhamediev, 1963, p. 80-81, fig. 2.

**MATERIAL EXAMINED :** *Reference material* : DGF 1524, Jagady Pond, Trivandrum, 11.1.65. *Other materials* : CHF 15, Cinchona I.B. Pond, Anamalai Ranges, Tamil Nadu, collected by Dr. M. Rajendran, 30.11.76 ; Sample 4, Madurai, collected by Mr. Anthony Basil, 11.12.77.

*Female* : Body almost oval in outline, maximum height in middle. Posterodorsal corner of valve projecting. Posteroventral corner rounded, without any denticle. Valves marked with reticulation of tetragonal or pentagonal cells with undulate borders. Rostrum pointed and ventrally directed. Head shield with rounded posterior end. Antennules not reaching apex of rostrum. Keel of labrum with convex anterior margin and pointed apex. Ocellus nearer to eye than to apex of rostrum ; almost as large as eye. Postabdomen with 8-10 anal spines. Lateral setae present. Preanal corner projecting. Claw with two basal spines, proximal distinctly the smaller. Tip of claw with two spines and with setae on concave margin.

*Length* : 0.28 mm

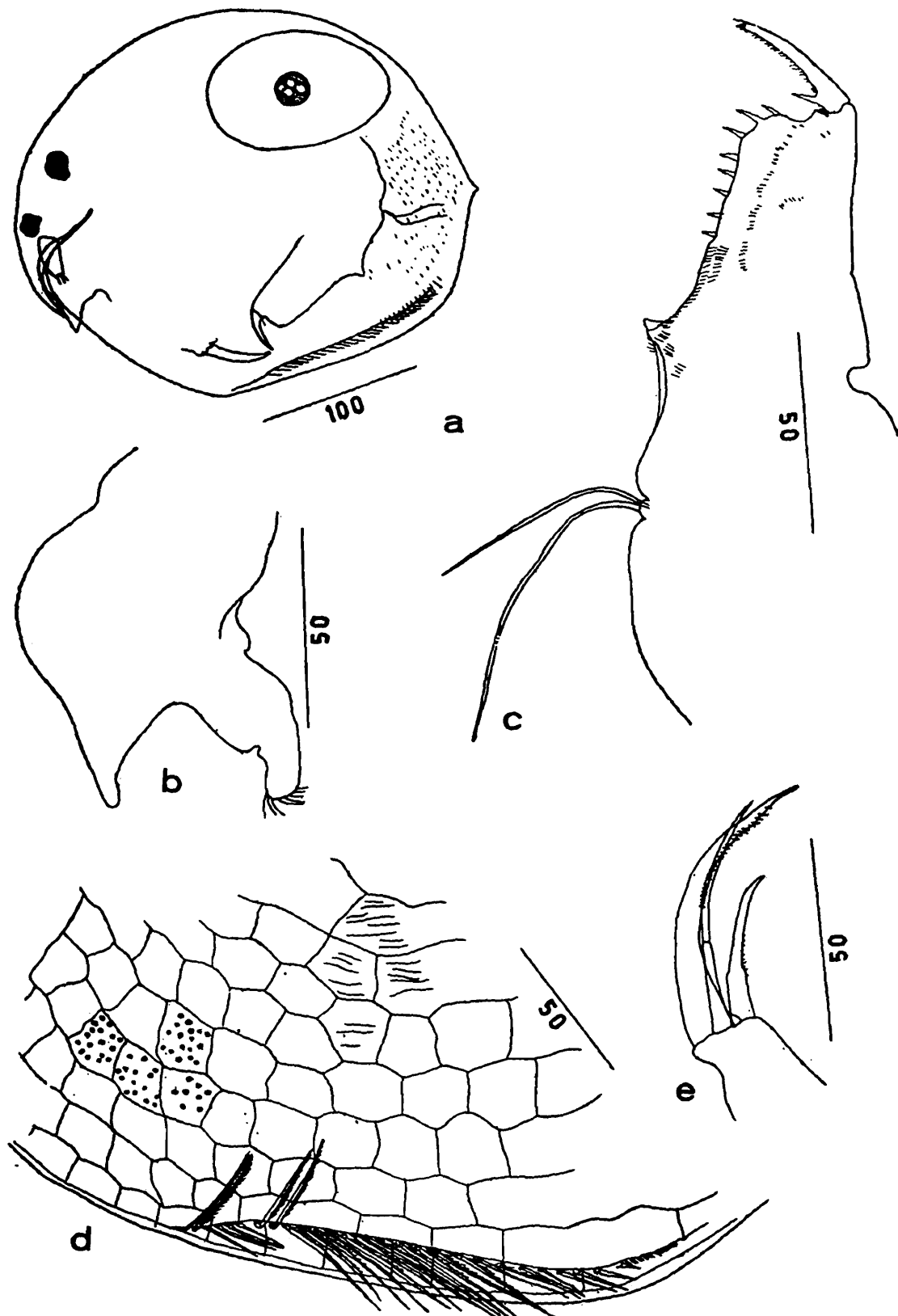
*Male* : Not known from India.

*Distribution* : INDIA— new record. Elsewhere—Java, Philippines, West Africa, USSR.

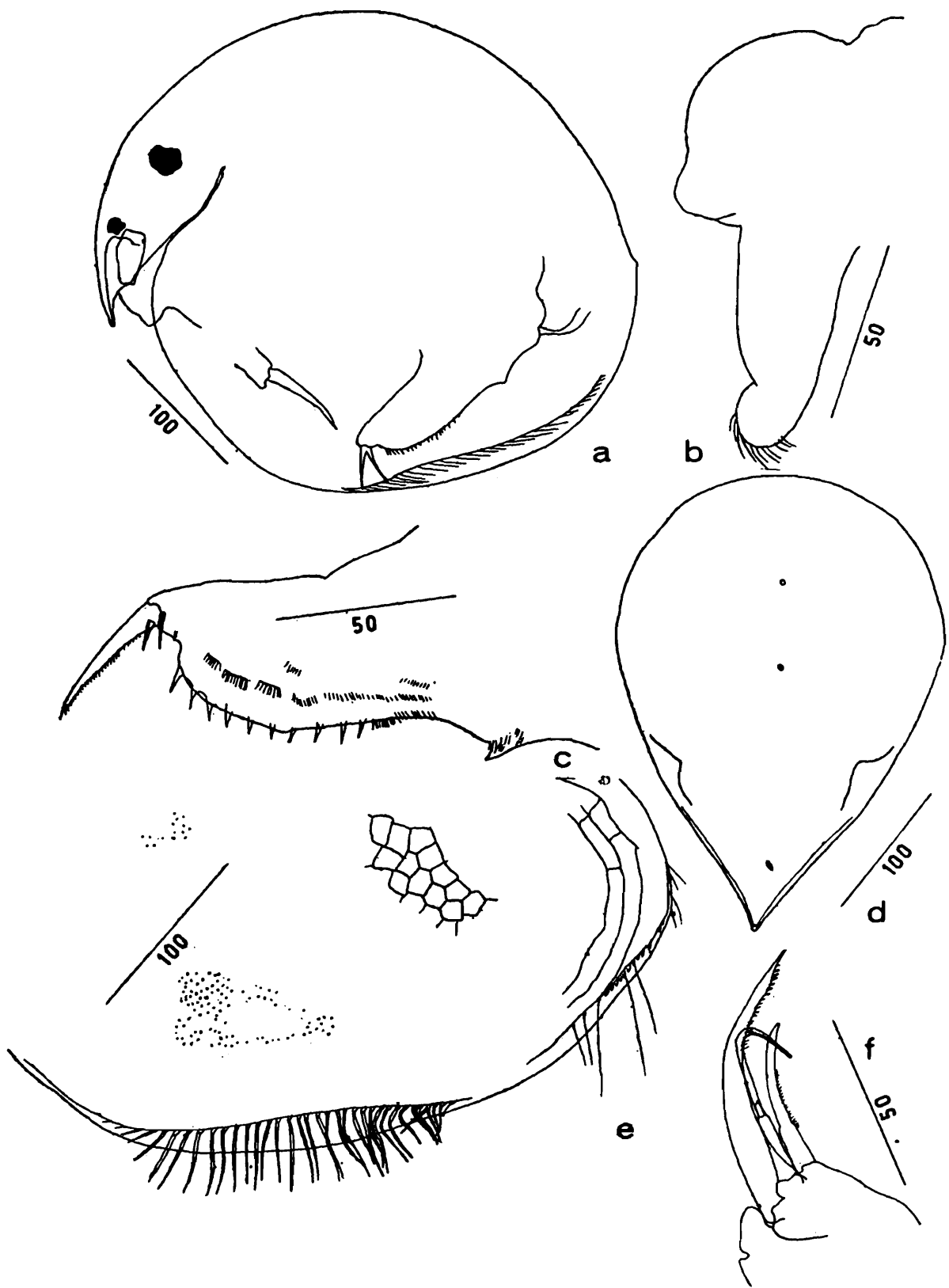
51. **Chydorus kallipygos** Brehm, 1934  
(Text-fig. 48, a-f)

*Chydorus kallipygos* Brehm, 1934, p. 74-75, figs. 27-29 ; Harding, 1955, p. 352, figs. 100-103 ; Smirnov, 1971, p. 309-310, fig. 343 ; Petkovski, 1973, p. 146-148, figs. 28-30.

**MATERIAL EXAMINED :** *Reference material* : DGF 1517, Buderu tank, near Poondi Reservoir, Madras, 7.1.75.



Text-fig. 47, a-e : *Chydorus* cf. *herrmanni* Brehm : a. female ; b. plate of labrum ; c. postabdomen ; d. head shield ; left valve (enlarged) and e. outer ramus of endite of leg I.



Text-fig. 48, a-f : *Chydorus kallipygos* Brehm : a. female ; b. plate of labrum ; c. postabdomen ; d. head shield ; e. right valve (enlarged) ; and f. outer ramus of leg I (enlarged).

*Female* : Body almost oval in outline, with maximum height around middle. Posterodorsal corner of valves distinct and with projecting corner. Posteroventral corner rounded, without spine. Valves with pattern of polygons, head shield with broadly rounded posterior margin. Rostrum short and pointed. Antennules ending far before apex of rostrum. Plate of labrum broadly rounded, with anterior depression in distal part. Ocellus situated almost midway between eye and apex of rostrum. Postabdomen with 10 anal spines. Preanal corner strongly projecting. Margin of anus with setae. Claw with setae on concave margin and two basal spines. Leg I with outer branch of endite with 3 setae ; two setae thin, third thick and hook-shaped.

*Length* : 0.57 mm

*Male* : Not recorded from India.

*Distribution* : INDIA—new record. Elsewhere—Ethiopian region.

52. *Chydorus barroisi* Richard, 1894b  
(Text-fig. 49, a-d)

*Pleuroxus barroisi* Richard, 1894b. p. 375-377, figs. 9-12.

*Chydorus barroisi* Sars, 1895, p. 25-28, pl. 4, figs. 9-13 ; Sars, 1901, p. 67, pl. X, fig. 1, 1a-b ; Sars, 1916, p. 339-340, pl. XL, figs. 6, 6a-b ; Delachaux, 1917, p. 87, figs. 17-18 ; Green, 1962, p. 480 ; Petkovski, 1966, p. 163 ; Rey & Saint-Jean, 1968, p. 113, fig. 29 ; Fernando, 1974, figs. 125-128, 171A ; Swar & Fernando, 1979, p. 122, figs. 35-37 ; Mamaril Sr. & Fernando, 1980, p. 141, figs. 84, 149-151

*Alonella barroisi* Schiklejew, 1930, p. 344-346, figs. 14-18.

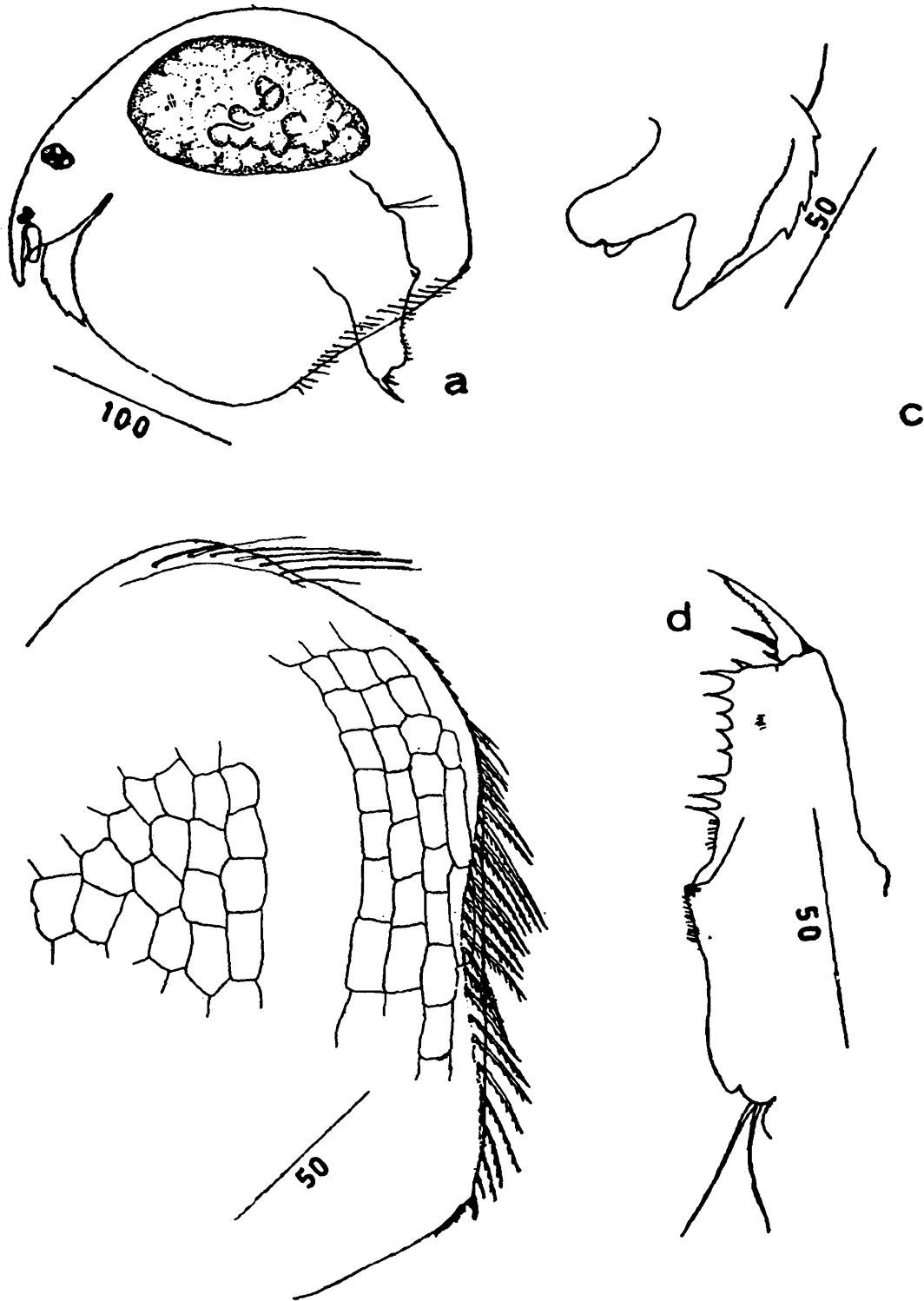
*Chydorus tridentatus* Bergamin, 1939, p. 90-91, fig. 12.

*Chydorus barroisi barroisi* Smirnov, 1971 p. 301-306. figs. 328-333 ; Sharma, 1978, p. 150.

*Ephemevoporus barroisi* (Richard, 1894) = nomen dubius. Frey, 1982, p. 233-237. pl. 1.

MATERIAL EXAMINED : *Reference material* : DGF 1517, Buderu tank near Poondi Reservoir, Madras, 7.1.65. *Other materials* : Sample 8, Collairu lake, collected by Prof. Y Radhakrishna, 15.10.73 ; DGF 1516, Swamp near Madras, 7.1.65, DGF 1521, shallow tank, Narasingam village, near Madurai, 9.1.65 ; DGF

1524, Jagady Pond, Trivandrum, 11.1.65 ; BKS—West Bengal :  
Baranagar (Calcutta) 29.5.75 ; Bon-Hooghly (24-Parganas) 16.5.75 ;  
Dhakuria lake (Calcutta) 4.7.76, 3.8.77 ; Sarisha (24-Parganas)  
8.5.76.



Text-fig. 49, a-d : *Chydorus barroisi* Richard : a. female ; b. right valve (enlarged) ; c. plate of labrum ; d. postabdomen.

*Female* : Body broadly elliptical in outline, maximum height in middle. Dorsal and ventral margins similarly convex, posterior margin almost straight. Posterodorsal corner of valves rounded. Posteroventral corner of each valve with denticle. Rostrum with apical notch. Head shield with rounded posterior margin ; antennules short, conical and not reaching apex of rostrum. Antennal setae : 0-0-3/0-1-3. Plate of labrum with produced apex and with 3-5 denticles on anterior margin. Ocellus smaller than eye, situated halfway between eye and apex of rostrum. Postabdomen short, with 9 unequal anal spines. Preanal corner projecting. Claw with two basal spines and setae on concave margin.

*Length* : 0.36 mm

*Male* : Not known from India.

*Distribution* : INDIA—Gujerat (Petkovski, 1966), West Bengal (Sharma, 1978). Elsewhere—Cosmotropical.

53. ***Chydorus ventricosus*** Daday, 1898  
(Text-fig. 50, a-d)

*Chydorus ventricosus* Daday, 1898, p. 28-29, figs. 10, a-d ; Daday, 1910, p. 121, pl. 6, figs. 1-4 ; ? Grochamlicki, 1915, p. 225 ; ? Delachaux, 1917, p. 91 fig. 21 ; Bar, 1924, p. 118 ; Biswas, 1971, p. 136, fig. 12K ; Smirnov, 1971, p. 298, fig. 323 ; ? Petkovski, 1973, p. 150-151, figs. 31,32,36,38 ; Fernando, 1974, p. 51, figs. 144-147, 171Q ; Mamaril Sr. & Fernando, 1980, p. 141-142, figs. 152-153 ; Michael & Hann, 1979, p. 225-229, fig. 1, a-i.

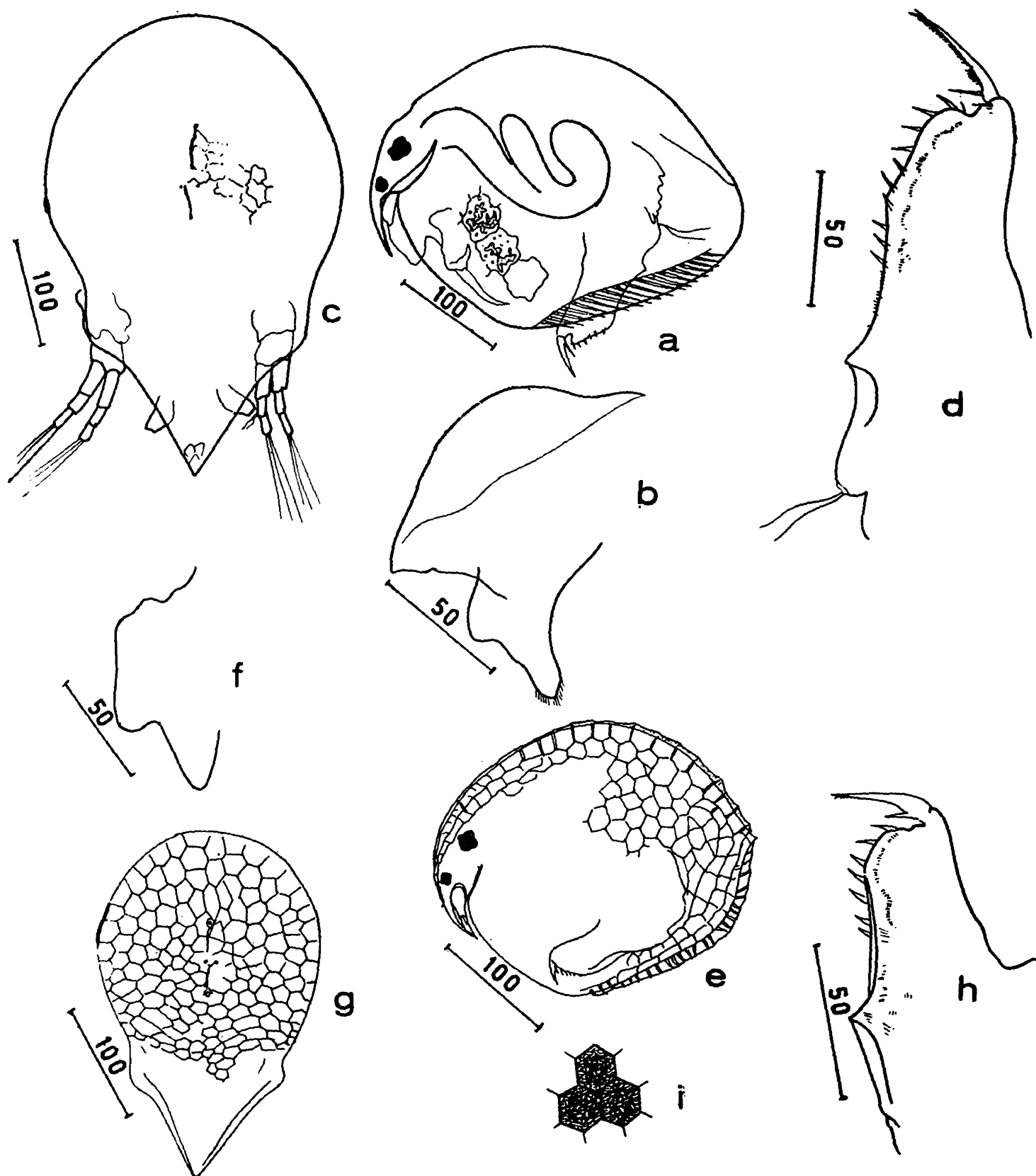
*Chydorus ventricosus* Daday ? ; Brehm, 1933c, p. 758 ; Fryer, 1957, p. 238.

*Chydorus* n.sp. ? Brehm, 1936, p. 297.

*Chydorus brehmi* Biswas, 1966, p. 113-114, fig. 1, a-c ; Biswas, 1971, p. 136.

*Chydorus eurynotus brehmi* comb.n. Smirnov, 1971, p. 309.

MATERIAL EXAMINED : *Reference material* : DGF 1524, Jagady Pond, Trivandrum, 11.1.65. *Other material* : ZSI C 1877/2, C 1879/2, Dudu, Jaipur, Rajasthan, collected by Mr. S. Biswas, 8.1.59 ; ZSI C 4578/1, (Holotype), C 4579/2 (Paratype) of *Chydorus brehmi* Biswas ; Dudu Talao ; Sample 3, pond near Vengalyapalan,



Text-fig. 50, a-d : *Chydorus ventricosus* Daday : a. female ; b. plate of labrum ; c. head shield ; and d. postabdomen.

Text-fig. 50, e-i : *Chydorus reticulatus* Daday : e. female ; f. plate of labrum ; g. head shield ; h. postabdomen ; and i. polygons (enlarged).

Sample 10, Collairu lake, collected by Prof. Y Radhakrishna, 28.1.74, 17.12.73 ; Sample 4, Irinjalakuda, Kerala collected by Dr. C.K.G. Nayar, 8.12.77 ; DGF 1513, Kovur village tank near Madras, 7.1.65 ; DGF 1521, 1529, Tulsi Dam near Bombay, 17.1.65.

*Female* : Body almost oval in outline. Posterodorsal and posteroventral corners of valves rounded, without denticles. Ventral margin strongly bulged in middle, with 11-15 long setae on anteroventral margin ; 27-35 submarginal setae posterior to bulge, placed well above margin in a sinuous curve. Posterior margin with double line, provided with thin rim of transverse setae. Valves having faint polygons with wavy margins, enclosing pigment patches and dots. Rostrum long, pointed and with V-shaped notch at tip. Head shield broadly rounded posteriorly, with faint reticulations in mid-region ; fornices expanded. Antennules thick, about half length of rostrum. Labral plate rather long, broadly rounded and slightly indented on the anterior margin near tip. Ocellus about half diameter the size of eye ; located closer to eye than to apex of rostrum. Postabdomen elongated, slightly tapering distally and preanal corner distinct, with 9-10 marginal spines and 4-7 lateral groups of setules. Claw with setae on concave margin ; bearing long slender basal spine and with seta attached subterminally on convex margin.

*Length* : 0.50 mm

*Male* : Not known from India.

*Distribution* : INDIA—Nilgiri Hills (Brehm, 1936), Gujarat, (Petkovski, 1966), Rajasthan (Biswas, 1971). Elsewhere—Sri Lanka, China, Java, East Africa.

#### 54. *Chydorus reticulatus* Daday, 1898 (Text-fig. 50, e-i)

*Chydorus reticulatus* Daday, 1898, p. 27, figs. 9, a-d ; Brehm, 1933c, p. 758-759, figs. 46-47 ; ? Biswas, 1971, p. 134, 136, fig. 12J.

*Chydorus sphaericus* var. *parvus* Daday, 1898, Stingelin, 1904, p. 33-34. pl. 3, fig. 34 ; Bar, 1924, p. 118-119.

*Chydorus reticulatus* Smirnov, 1971, p. 308 (in part). fig. 341 ; Michael & Hann, 1979, p.

MATERIAL EXAMINED : *Reference material* : DGF 1524, Jagady Pond, Trivandrum, 11.1.65. *Other material* : DGF 1501, roadside ditch, Anuradhapura, Sri Lanka, 2.1.65.

*Female* : Body somewhat sphaerical in outline. Posterodorsal corner of valves well-marked. Posteroventral corner rounded, without denticles. Ventral margin moderately bulged. Valves strongly reticulated, with concentration of dots within each cell. Shallow, chitinous epidermal outfoldings project from straight-sided polygonal cells on surface of valves. Rostrum long, sharply pointed and with notched tip. Head shield strongly reticulated ; posterior margin rounded. Antennules reaching middle of rostrum. Plate of labrum elongated and with rounded apex. Ocellus about half diameter of eye and situated somewhat closer to eye than to tip of rostrum. Postabdomen short with distinct preanal corner and several lateral groups of setae. Claw with two basal spines, setae on concave margin and long subterminal seta. Legs similar to those of *C. ventricosus* except for differences in size (Michael & Hann, 1979).

*Length* : 0.27 mm

*Male* : Not known from India.

*Distribution* : INDIA—Rajasthan (Biswas, 1971). Elsewhere—Sri Lanka, Java, Thailand.

### 55. *Chydorus pubescens* Sars, 1901

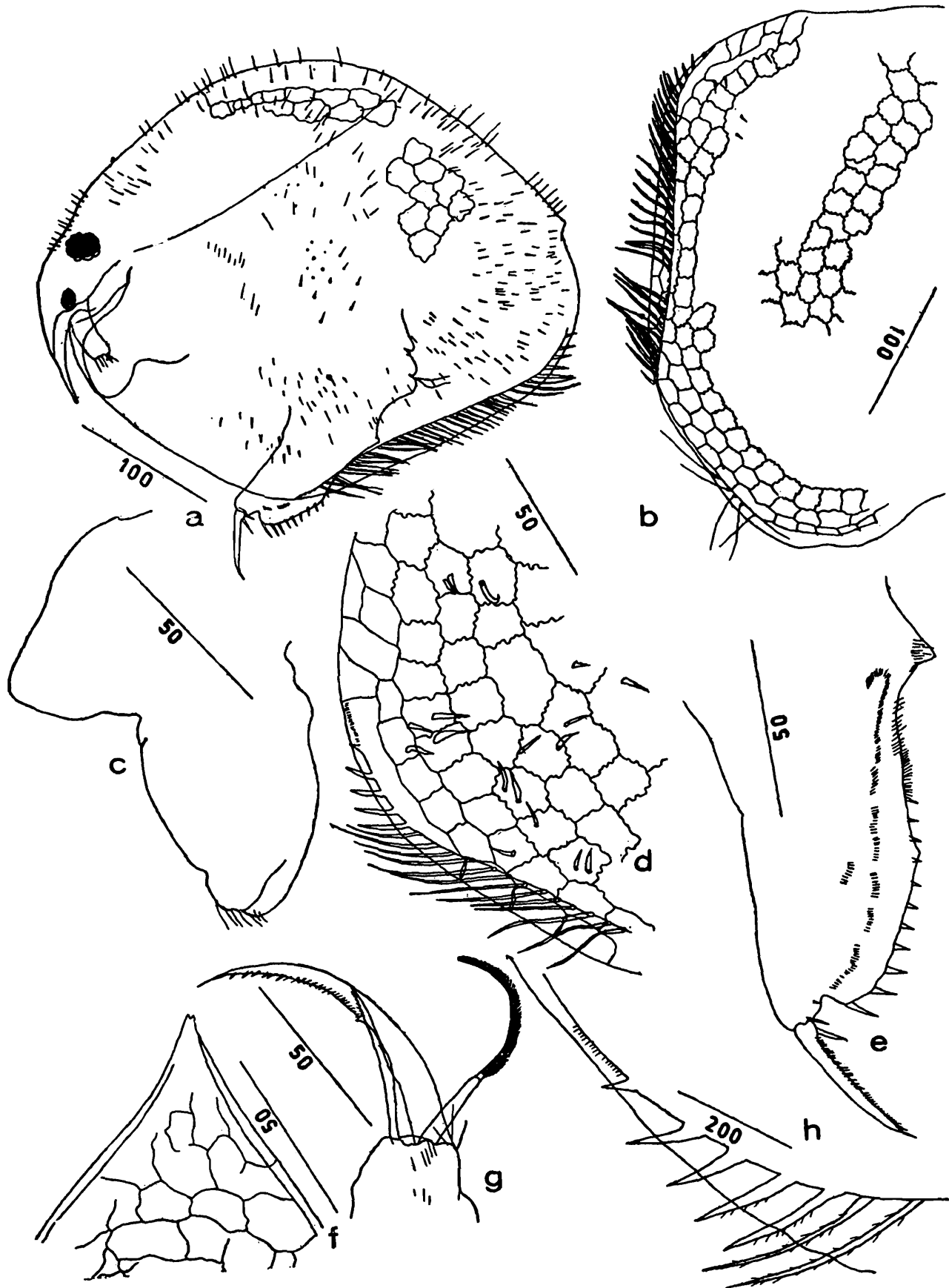
(Text-fig. 51, a-h)

*Chydorus pubescens* Sars, 1901, p. 71-73, pl. II, figs. 4a-c ; Stingelin 1913, p. 628 ; Bergamin, 1940, p. 99, fig. 17 ; Rahm, 1956, p. 260-261, fig. 21a ; Olivier, 1962, p. 254, lam 28, fig. 8, lam 29, fig. 1 ; Goulden, 1966b, p. 105, pl. 3, fig. 7 ; Paggi, 1972, p. 229-234, lam, figs. 25-41.

*Chydorus* cf. *eurynotus* Brehm, 1935, p. 157, figs. 10-12 ; Brehm, 1937b, p. 489 : Brehm, 1956, p. 219, 227.

? *Chydorus eurynotus* Gauthier, 1939, p. 183, fig. 11,a-c ; Harding 1957, p. 83-84, figs. 48-53 (part) ; Green, 1962, p. 430, figs. 36-38.

*Chydorus kallipygos* Harding, 1955, p. 353, figs. 100-103.



Text-fig. 51, a-h : *Chydorus pubescens* Sars : a. female ; b. right valve (enlarged) ; c. plate of labrum ; d. ventral portion of valve (enlarged) ; e. postabdomen ; f. anterior part of head shield ; g. outer ramus of endite of leg I ; and h. posteroventral part of right valve (highly magnified).

MATERIAL EXAMINED : *Reference material* : RGM 14, Kokrajhar, Assam, collected by Dr. B. Bhattacharya, 10.4.78.

*Female* : Body almost globular in outline. Posterodorsal corner rounded, without denticles. Valves somewhat truncate posteriorly ; dorsal and ventral margins greatly bulging. Valves reticulated, reticulations distinct in lower part of valves ; dorsal surface covered with short stiff setules forming a velvet like coating of the valves. Head broad, rostral projection less protruded, fornices strongly curved. Head shield with broadly rounded posterior margin ; Antennules with sensory seta on side ; not reaching apex of rostrum. Labral plate rounded at tip. Ocellus smaller than eye, situated nearer to eye than to tip of rostrum. Postabdomen moderately arched, slightly tapering distally ; with 8-11 anal spines and groups of lateral setae. Preanal corner distinct. Anal region marked with a number of setules. Claw long, with setae on concave margin ; and two basal spines.

*Length* : 0.75 mm

*Male* : Not known from India.

*Distribution* : INDIA—New record. Elsewhere—America, Asia, Africa, Australia.

## INCERTAE SEDIS

*Chydorus eurynotus* Sars, 1901 : reported from Pandharpur (Brehm, 1953), Rajasthan (Nayar, 1971). Also reported as *C. denticulatus* Henry from Rajasthan (Biswas, 1971) and Meghalaya (Patil, 1976).

### Genus 22. *Dunhevedia* King, 1853

*Dunhevedia* King, 1853, p. 261 ; Vavra, 1900, p. 21-22 ; Sars, 1901, p. 75-76 ; Daday, 1910, p. 126 ; Bening, 1941, p. 268-269 ; Herbst, 1962, p. 100 ; Sramek-Husek *et al.*, 1962, p. 383 ; Smirnov 1971, p. 319.

*Crepidocercus* Birge, 1879, p. 24-25 ; Herrick, 1884, p. 94 ; Stingelin, 1895, p. 259.

*Alona* Sovinski, 1891, p. 53-54, tab. II, figs. 33-36.

*Landea* Dybowski *et.* Grochowski, 1894, p. 382.

Body oval in outline. Posteroventral corner of valves with a distinct large denticle, sometimes without denticle, or with two as in *D. serrata*. Posterior part of ventral margin with setae on inner side of valves. Distance from head pores to posterior margin of head shield shorter than distance between head pores. Antennal setae : 0-0-3/0-1-3. Ocellus smaller than eye. Postabdomen wide, convex dorsal margin with anal spines. Claw with single basal spine. Five pairs of legs.

*Type species* : *Dunhevedia crassa* King, 1853.

This genus is represented by three taxa from India.

*Key to the Indian species of genus DUNHEVEDIA*

1. Plate of labrum without denticles.....2  
Plate of labrum with denticles.....*D. serrata* Daday, 1898
2. Anterior margin of labrum without  
tubercle shaped convexity.....*D. crassa crassa* King, 1853  
Anterior margin of labrum with a  
tubercle shaped convexity.....*D. crassa ciliocaudata* Sovinski, 1891

**56. *Dunhevedia crassa crassa* King, 1853**  
(Text-fig. 52, a-e)

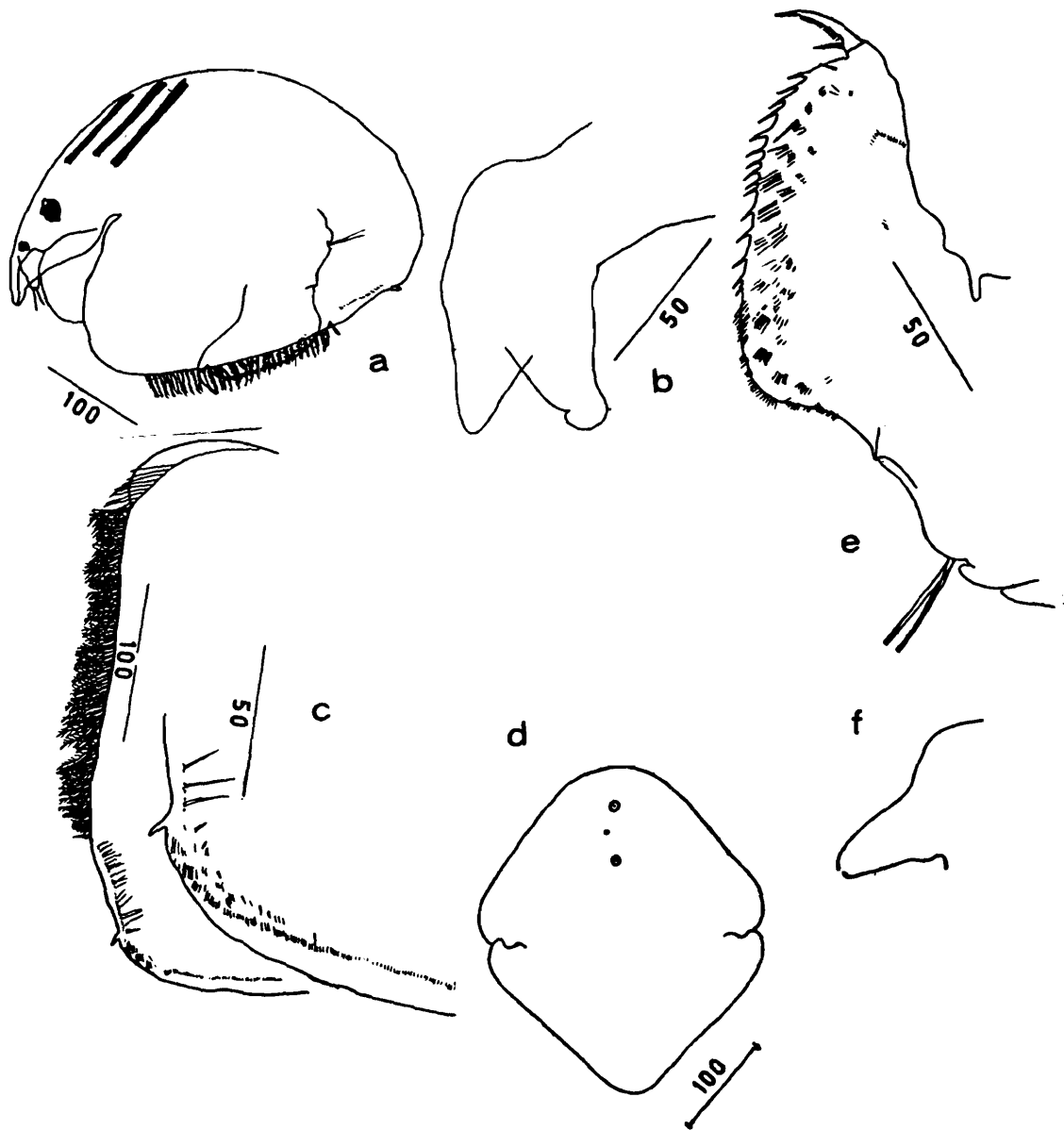
*Dunhevedia crassa* King, 1853, p. 261, pl. VII F ; Gurney, 1907, p. 27 ; Sars, 1916, p. 343-344. pl. XLI figs. 3, 3a-c ; Sewell, 1935, p. 218 ; Bening, 1941, p. 269-271, fig. 111 ; Einsle, 1959, p. 62-64 ; Frey, 1959, p. 38-39, fig. 49 ; Frey, 1962, fig. 49 ; Sraamek-Husek *et al.*, 1962, p. 283, fig. 144 ; Herbst, 1962, p. 100, fig. 84 ; Petkovski, 1966, p. 163 ; Biswas, 1971, p. 133, fig. 12A ; Sharma, 1978, p. 150 ; Mamaril Sr. & Fernando, 1980, p. 141, figs. 143-145.

*Crepidocercus setiger* Birge, 1879, p. 26, pl. I, fig. 18 ; Stingelin, 1895, p. 259-260, pl. VIII. fig. 42.

*Dunhevedia setiger*, Sars, 1903a, p. 185-186, pl. VIII, fig. 5 ; Birge, 1918, p. 725, fig. 1134.

*Dunhevedia siedlackii* Grochmalicki, 1915, p. 227-228, pl. E, fig. 9,a-b.

*Dunhevedia crassa crassa* Smirnov, 1971, p. 320-322, figs. 358-360.



Text-fig. 52, a-e : *Dunhevedia crassa crassa* King : a. female ; b. plate of labrum ; c. ventral margin of valves (enlarged) ; d. head shield ; and e. postabdomen.

Text-fig. 52, f : *Dunhevedia crassa ciliocaudata* (Sovinski) : f. plate of labrum.

**MATERIAL EXAMINED :** *Reference material* : DGF 1514, Chembarampakkam tank, near Madras, 7.1.65. *Other materials* : ZSI C 1924/2, (Julga lake) 24.11.58, C 1925/2 (Debdani temple tank) 5.10.58. C 1926/2 (Sambhar lake) 13.11.58, Rajasthan, collected by Mr. S. Biswas ; DGF 1519, Oothangudi tank, Madurai, 9.1.65, DGF 1523, water well, Yanamalai Hills, Madurai, 9.1.65, DGF 1527, fountain pool in front of aquarium at Kerala University,

Trivandrum, 11.1.65 ; Samples 9,11 ; Collairu lake, collected by Prof. Y Radhakrishna, 17.11.73 ; BKS—West Bengal : Achipur (24-Parganas) 4.12.77 ; Amtala (24-Parganas) 3.2.77 ; Behala (Calcutta) 3.2.77 ; Baranagar (Calcutta) 29.3.75 ; Budge-Budge (24-Parganas) 30.11.77 ; Shirakole (24-Parganas) 6.5.76 ; Mahes-tala (24-Parganas) 30.11.77 ; Thakurpukur (24-Parganas) 4.6.76 ; Indian Museum tank (Calcutta) 1.2.75 ; Tank opposite Park street (Calcutta) 1.6.75 ; Dhakuria lake (Calcutta) 4.7.76, 12.2.78.

*Female* : Body almost oval in outline, minimum height slightly before the middle. Posteroventral corner of valve with one denticle. Ventral margins of valve with feathered setae, which are longest in middle. Head shield with rounded anterior and posterior margins. Antennules ending slightly before apex of rostrum ; thick and tapering distally ; lateral sensory seta situated on a tubercle distal to middle of anterior margin of antennule and sensory papillae at most half as long as antennules. Antennal setae : 0-0-3/0-1-3. Plate of labrum without denticles, with produced apex. Ocellus situated nearer to eye than to apex of rostrum. Postabdomen oval with 15-18 anal spines and numerous lateral groups of setae.

*Length* : 0.35 mm

*Male* : Not known from India.

*Distribution* : INDIA—West Bengal (Gurney, 1906 ; Sharma, 1978), Baroda (Petkovski, 1966) ; Rajasthan (Biswas, 1971). Elsewhere—Holarctic region (South of 60°N), Ethiopian, Indo-Malayan and Australian regions. Also Southern part of european USSR.

57. ***Dunhevedia crassa ciliocaudata*** (Sovinski, 1891)  
(Text-fig. 52, f)

*Alona ciliocaudata* Sovinski, 1891, p. 159-160, pl. III, figs. 33-36.

*Dunhevedia neglecta* Daday, 1904b, p. 62-64, pl. 5, figs. 6-8.

*Dunhevedia crassa* var. *interrupta* Brehm, 1936, p. 290-291, fig. 2C.

*Dunhevedia crassa ciliocaudata* Smirnov, 1971, p. 322, fig. 363.

**MATERIAL EXAMINED :** *Reference material* : as reported by Brehm, 1936. Not found in the present study material.

*Female* : Posteroventral corner of valves with denticle, sometimes with accessory denticle above it. Anterior margin of labral plate with strong convexity and blunt apex. Ocellus smaller than eye and situated halfway between eye and apex of rostrum. Postabdomen with 11-12 anal spines and transverse row of setae almost on the whole surface.

*Length* : 0.50 mm

*Male* : Not known from India.

*Distribution* : INDIA—Kashmir (Brehm, 1936). Elsewhere—Poland, USSR.

58. **Dunhevedia serrata** Daday, 1898  
(Text-fig. 53, a-d)

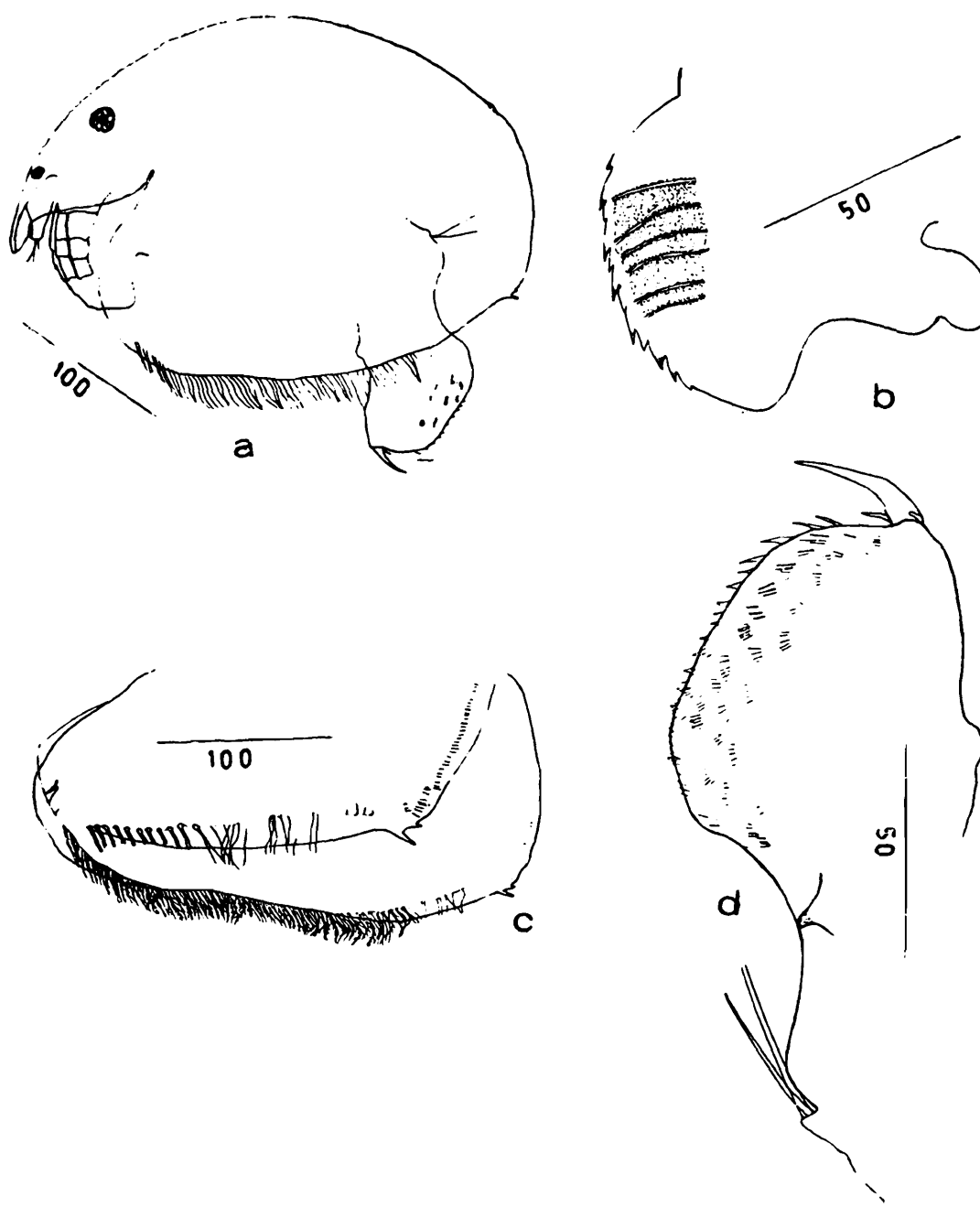
*Dunhevedia serrata* Daday. 1898, p. 32-33, fig. 13 ; Daday, 1910, p. 126-127, pl. 6, figs. 26-28 ; Rahm, 1956, p. 252-253, fig. 10 ; Harding, 1957, p. 81, figs. 39-42 ; Smirnov, 1971, p. 324-325, fig. 365.

**MATERIAL EXAMINED :** *Reference material* : DGF 1514, Chembarampakkam tank near Madras, 7.1.65.

*Female* : Body almost oval in outline ; maximum height just before middle. Posterodorsal corner of valves not very distinct. Posteroventral corner with two denticles ; dorsal denticle smaller than ventral. Valves with longitudinal lines and dots. Rostrum blunt. Plate of labrum with serrated anterior margin with 10-15 denticles, apical denticles directed downward. Ocellus smaller than eye and situated halfway between eye and apex of rostrum. Postabdomen oval ; with 13-15 anal denticles and numerous lateral groups of setae. Claw with basal spine and with setae on the concave margin.

*Length* : 0.43 mm

*Male* : Not recorded from India.



Text-fig. 53, a-d : *Dunhevedia serrata* Daday : a. female ; b. plate of labrum ; c. ventral margin of valves (enlarged) ; and d. postabdomen.

*Distribution* : INDIA—New record. Elsewhere—Africa, Sri Lanka, New Guinea and North America.

### Genus 23. *Dadaya* Sars, 1901

*Alona* Daday, 1898, p. 38.

*Dadaya* Sars, 1901, p. 73 ; Daday, 1910, p. 126 ; Bergamin, 1940, p. 100 ; Smirnov, 1971, p. 326.

Body oval in outline. Posterior part of ventral margin of valves with setae on inner side of valve. Valves reticulated. Rostrum pointed. Head shield rounded posterior margin ; a single head pore present. Antennules projecting distinctly beyond apex of rostrum. Antennal setae : 0-0-3/0-1-3. Plate of labrum long and narrow. Ocellus and eye unusually large. Postabdomen without lateral setae, with anal spines. Claw with a single basal spine. Five pairs of legs present.

*Type species* : *Dadaya macrops* (Daday, 1898).

This genus is represented by only one species *D. macrops* (Daday, 1898).

59. ***Dadaya macrops*** (Daday, 1898)  
(Text-fig. 54, a-f)

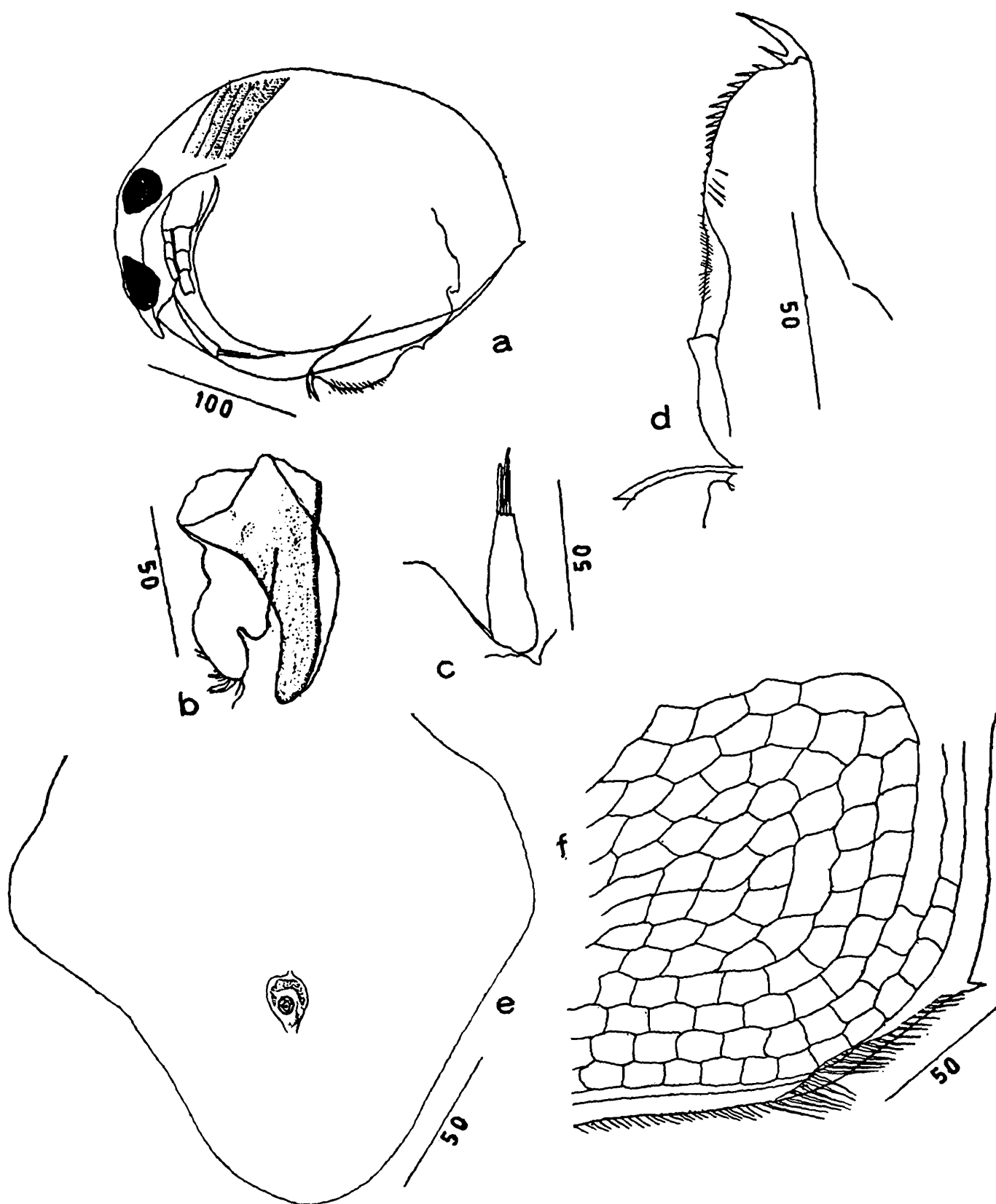
*Alona macrops* Daday, 1898, p. 38-39. fig. 17.

*Dadaya macrops* Sars, 1901, p. 73-74, pl. XI, figs. 5,a-b ; Daday, 1910, p. 126 ; Brehm, 1933a, p. 746-747, figs. 40-41 ; Bergamin, 1939, pl. II, fig. 1 ; Bergamin, 1940, p. 101, fig. 20 ; Brehm, 1953, p. 334-340, fig. 106 ; Rahm, 1956, p. 256, figs. 11-12 ; Fryer, 1956, p. 733-734, figs. 1-2 ; Smirnov, 1971, p. 326-327, figs. 368-369 ; Mamaril Sr. & Fernando, 1980, p. 141, figs. 141-142.

*Dadaya ocellata* Bergamin, 1940, p. 100, fig. 19.

**MATERIAL EXAMINED** : *Reference material* : DGF 1525, Jagady Pond, Trivandrum, 11.1.65. *Other materials* : Sample 4, Madurai, collected by Mr. Anthony Basil, 11.12.77.

*Female* : Body oval in outline. Dorsal and ventral margin of valves convex. Posteroventral corner of valve rounded, with a denticle. Valves marked with a pattern of hexagons. Ventral margin of valve with setae on inner side in posterior half. Rostrum long, directed backwards. Posterior margin of head shield round ; head pore single. Antennules distinctly projecting beyond apex of rostrum. Antennal setae : 0-0-3/0-1-3. Distal segments of antennae not reaching apex of rostrum. Labrum with a long, beaklike process. Ocellus and eye unusually large. Postabdomen with about 15 anal spines, proximal ones small. Postabdomen with a projecting preanal corner. Claw with a basal spine.



Text-fig. 54, a-f : *Daday macrops* (Daday) : a. female ; b. plate of labrum ; c. antennule ; d. postabdomen ; e. head shield ; f. posteroventral part of ventral margin of left valve (enlarged).

*Length* : 0.38 mm

*Male* : Not recorded in India.

*Remarks* : Posteroventral corner of valve in the female with a denticle as has also been illustrated by Daday (1898) and Sars (1901).

*Distribution* : INDIA—Southern region (Brehm, 1953). Elsewhere—Ethiopian, Indo-Malayan, Australian and Neotropical regions.

#### Genus 24. *Pseudochydorus* Fryer, 1968

*Chydorus* part Lilljeborg 1900, p. 549.

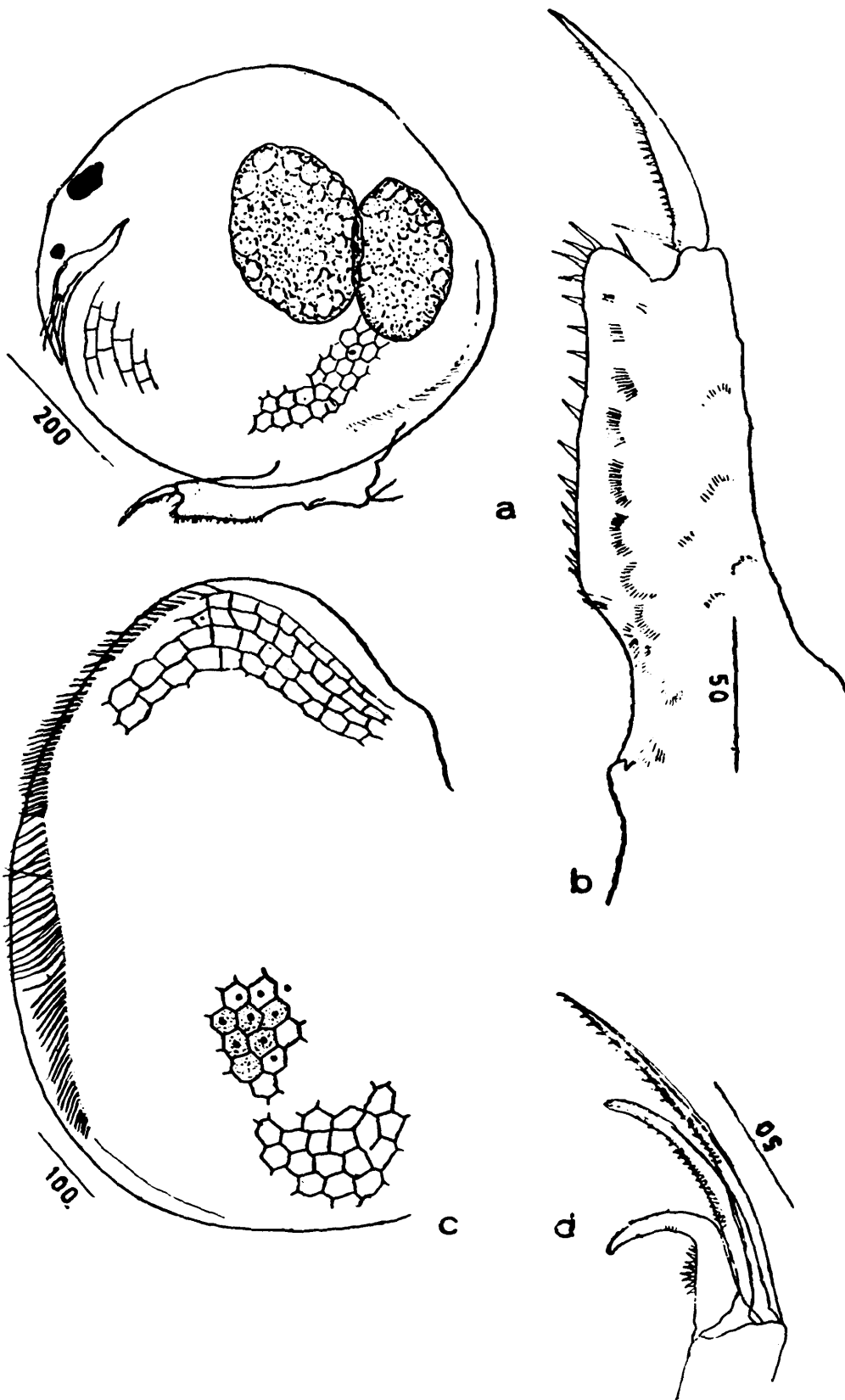
*Pseudochydorus* Fryer, 1968, p. 322-324 ; Smirnov, 1971, p. 328-329.

Body sphaerical in outline. Ventral setae of valve situated on inner surface along whole length those in posterior half at a distance from margin. Ventral margin of valves closed, without a gap. Rostrum pointed. Antennules not projecting beyond the tip of rostrum. Ocellus much smaller than eye, situated nearer to eye than to apex of rostrum. Postabdomen narrow, with anal spines and groups of lateral setae. Claws with 2 basal spines, distal spine stout and long. Leg II-IV with non-filtering setae. According to Fryer (1968), gnathobase of legs II and III with 5 setae, that of leg IV with 4 setae. Gnathobase of leg V with 3 setae.

*Type species* : *Pseudochydorus globosus* (Baird, 1843)

#### 60. *Pseudochydorus globosus* (Baird, 1843) (Text-fig. 55, a-d)

*Chydorus globosus* Baird, 1843, p. 90, pl. III, figs. 1-4 ; Schoedler, 1862, p. 13-14 ; P.E. Müller, 1867, p. 195, pl. IV, fig. 25 ; Singelin, 1895, p. 25 ; Lilljeborg, 1900, p. 547-592, pl. XXV, figs. 18-27, pl. XXVI, fig. 1 ; Gurney, 1907, p. 27 ; Bening, 1941, p. 326-328, fig. 135 ; Frey, 1959, p. 40, fig. 66 ; Frey, 1962, fig. 66 ; Srámek-Husek *et al.*, 1962, p. 386-388, fig. 145 ; Herbst, 1962, p. 100-102 85 ; Negrea, 1966, p. 148 ; Rey & Saint-Jean, 1968, p. 115, fig. 31 ; Nayar, 1971 p. 514, figs. 34-36.



Text-fig. 55, a-d : *Pseudochydorus globosus* (Baird) : a. female ; b. postabdomen ; c. left valve (enlarged) ; d. outer ramus of endite of leg. I

*Lynceus tenuirostris* Fischer, 1848, p. 193 pl. X, fig. 3.

*Chydorus angustus* King, 1853, p. 258, pl. VIIB.

*Lynceus globosus* Leydig, 1860, p. 230 ; Brady, 1868, p. 423, fig. 7.

*Chydorus paradoxus* Shiklee, 1930, p. 317-318, 320-321, fig. 5.

*Pseudochydorus globosus* Fryer, 1968, p. 324-328, figs. 92-111.

*Pseudochydorus globosus globosus* Smirnov, 1971, p. 328-329, figs. 371-376.

**MATERIAL EXAMINED :** *Reference material :* RGM 80, Shillong, collected by Dr. B. Bhattacharya, 10.4.78. *Other material :* DGF 1513, Kovur village tank, near Madras, 7.1.65.

*Female :* Body outline almost spherical, slightly longer than high ; posteroventral corner of valves rounded, without denticles. Valves with a pattern of polygons. Rostrum pointed and ventrally directed. Head shield with rounded posterior margin ; Antennules not reaching apex of rostrum. Setae on antennae : 0-0-3/1-1-3 ; spines 0-0-1/0-0-1. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen narrow, almost uniformly wide ; distal dorsal corners of postabdomen produced in examined specimens. Anal spines about 20, decreasing in size proximally. Groups of lateral setae present. Anal margins with setae. Claw with two basal spines and row of setae on concave margin.

*Length :* 0.82 mm

*Male :* Not known from India.

*Distribution :* INDIA—Calcutta (Gurney, 1907), Meghalaya (Patil, 1976). Elsewhere—Holarctic, Ethiopian, Indo-Malayan, and Australian regions, also from European USSR.

### Subfamily 3. ALONINAE Frey, 1967

*Aloninae* Frey, 1967, p. 36 ; Smirnov, 1971, p. 336-337.

With two or three main head pores, situated in median line of head shield and with two small pores located, one on either side

lateral to them ; mandibles articulated between head shield and valves. Claws usually with single basal spine ; sometimes without it. Hepatic processes absent. Anus situated in proximal part of postabdomen. Five or six pairs of legs present. Leg VI, if present, without epipodite.

*Type genus : Alona Baird, 1843.*

This subfamily shows a variety of pattern of head pores (Smirnov, 1971). The main patterns are as follows :

- (i) 3, with a narrow connection between them ;
- (ii) 2, with a small connection between them ;
- (iii) 2, with a broad connection between them ;
- (iv) 2, large main pores with two small pores between them ;  
two small pores situated laterally one on either side ;
- (v) A single main pore without small spores.

According to Smirnov (1971) the subfamily Aloninae contains 14 genera. Of these 10 genera are represented in India.

*Key to the Indian genera of subfamily ALONINAE*

- 1. Three main head pores.....2  
One or two main head pores.....7
- 2. Lateral setae of postabdomen large.....*Leydigia* Kurz 1875  
Lateral setae of postabdomen not large.....3
- 3. Postabdomen of varying form but not narrow or very long.....4  
Postabdomen long and narrow.....5
- 4. Head shield with broadly rounded  
anterior margin ; projecting in  
anteriorly lateral view.....*Graptoleberis* Sars, 1862b  
  
Anterior margin of head shield not  
broadly rounded ; not projecting  
in lateral view..... *Alona* Baird, 1843 emend.  
Smirnov, 1971

5. Postabdomen tapering distally .....6  
 Postabdomen straight, with parallel  
 dorsal and ventral margin ..... *Acroperus* Baird, 1843, emend.  
 Smirnov, 1971
6. Rostrum projecting.....*Kurzia* Dybowski & Grochowski 1894  
 Rostrum not projecting.....*Camptocercus* Baird, 1843
7. Two main head pores.....8  
 One main head pore.....9
8. Main head pores narrowly connected.....*Biapertura* Smirnov, 1971  
 Main head pores separate.....*Oxyurella* Dybowski & Grochowski, 1894
9. Body much longer than high.....*Euryalona* Sars, 1901  
 Body only slightly longer than high.....*Indialona* Petkovski 1966

#### Genus 25. *Alona* Baird, 1843 emend Smirnov, 1971

*Lynceus* part O.F. Müller, 1785, p. 72-78 ; Lilljeborg, 1900, p. 446-448.

Subgenus *Alona* Baird, 1843, p. 92 ; Baird, 1850, p. 131.

*Alona* part P. E. Müller, 1867, p. 171-173 ; Kurz, 1875, p. 47-50. (Section *Alona* Vera) Herrick, 1884, p. 91-93.

*Coronatella* Dybowski & Grochowski, 1894, p. 381.

*Alona* Sars, 1901, p. 48 ; Sars, 1916, p. 331 ; Bergamin, 1940, p. 49-50 ; Herbst, 1962, p. 84-86 ; Sramek-Husek *et al.*, 1962, p. 330 ; Smirnov, 1971, p. 337-340.

Body subquadrate in outline, compressed ; not crested. Valves rectangular, marked with lines. Posterodorsal corner of valves slightly below highest point of dorsal margin. Three main connected head pores, situated in median line of head shield ; two small pores located laterally at some distance from main pores. Rostrum short and blunt. Antennal setae : 0-0-3/1-1-3. Postabdomen with postanal spines and lateral setae. Anus situated in proximal part of the postabdomen. Five to six pairs of legs ; leg VI, if present, in form of small lobe without epipodite.

*Type species* : *Alona quadrangularis* (O.F. Müller, 1776).

This genus is represented by ten species and subspecies in India.

*Key to the Indian species of ALONA*

1. Plate of labrum with rounded apex. Main head pores connected.....2  
 Plate of labrum with pointed apex. Main head pores not connected.....*A. pulchella* King, 1853
2. Postabdomen tapering distally.....3  
 Postabdomen not tapering distally.....5
3. Dorsal margin of postabdomen broadly convex.....*A. taraporevae* Shirgur & Naik, 1977.  
 Dorsal margin of postabdomen not broadly convex.....4
4. Valves with pattern of polygons. Anal spines in 10-11 groups.....*A. davidi davidi* Richard, 1895a  
 Valves with dots. Anal spines in about 16 groups.....*A. davidi punctata* (Daday, 1898)
5. Distal end of postabdomen not projecting.....6  
 Distal end of postabdomen projecting.....9
6. Postabdomen widening distally.....*A. quadrangularis* (O.F. Müller, 1776)  
 Postabdomen not widening distally.....7
7. Plate of labrum with denticle on anterior margin.....*A. monocantha tridentata* (Stingelin, 1904).  
 Plate of labrum without denticle on anterior margin.....8
8. With 7 anal spines and 5 groups of lateral setae.....*A. rectangula rectangula* Sars, 1862a.  
 With 6-9 groups of lateral setae ; 2-3 spines and setae in each group.....*A. rectangula richardi* (Stingelin, 1894)
9. Distal end of postabdomen distinctly projecting beyond base of claws. Lateral pores without chitinous thickening.....*A. guttata* Sars, 1862b  
 Distal end of postabdomen slightly projecting beyond the base of claws. Lateral pores with chitinous thickenings.....*A. costata* Sars, 1862b

61. ***Alona quadrangularis*** (O.F. Müller, 1776)  
(Text-fig. 56, a-b)

*Lynceus quadrangularis* O. F. Müller, 1776, p. 72-73, pl. IX, figs. 1-3 ; Lilljeborg, 1900, p. 448-454, pl. LXVI, figs. 8-17.

*Monoculus quadrangularis* Linné, 1788, p. 3008 ; Fabricius, 1793, p. 498.

*Alona fulcata* Schoedler, 1858, p. 28.

*Alona sulcata* Schoedler, 1862, p. 21-24, pl. I, figs. 24-25 ; Schoedler, 1863, p. 21, pl. I, figs. 24-25.

*Alona quadrangularis* Baird, 1850, p. 131-132, pl. XVI, fig. 4 ; Stingelin, 1906, p. 324-325, pl. 13, fig. 19 ; Bening, 1941, pl. 309-312, fig. 128 ; Frey, 1959, p. 36, figs. 34-35 ; Frey, 1962, figs. 34-35 ; Sramek-Husek *et al.*, 1962, p. 343-344, fig. 127 ; Herbst, 1962, p. 89, figs. 68, a-c ; Negrea, 1966, p. 142-143 ; Smirnov, 1971, p. 340-342, figs. 382-383.

MATERIAL EXAMINED : *Reference material* : RGM 14, Kokrajhar, Assam, collected by Dr. B. Bhattacharya, 10.4.78.

*Female* : Body almost rectangular in outline with maximum height near posterior end. Posterodorsal and posteroventral corners of valves rounded. Posterior margin of valves with row of spinules on inner side. Valves marked with longitudinal lines, connected by transverse lines thus forming cells ; markings not distinct in examined specimens. Head shield with pointed posterior margin ; three main connected head pores, lateral pores at level of median main pore. Antennules distally with sensory setae and sensory papilla on posterior margin ; anterior margin with incisions. Antennal setae : 0-0-3/1-1-3. Plate of labrum with convex anterior margin. Ocellus slightly smaller than eye. Postabdomen broadened distally, with 14-16 anal spines and groups of lateral setae. Claw with basal spine and without row of setae on its concave margin.

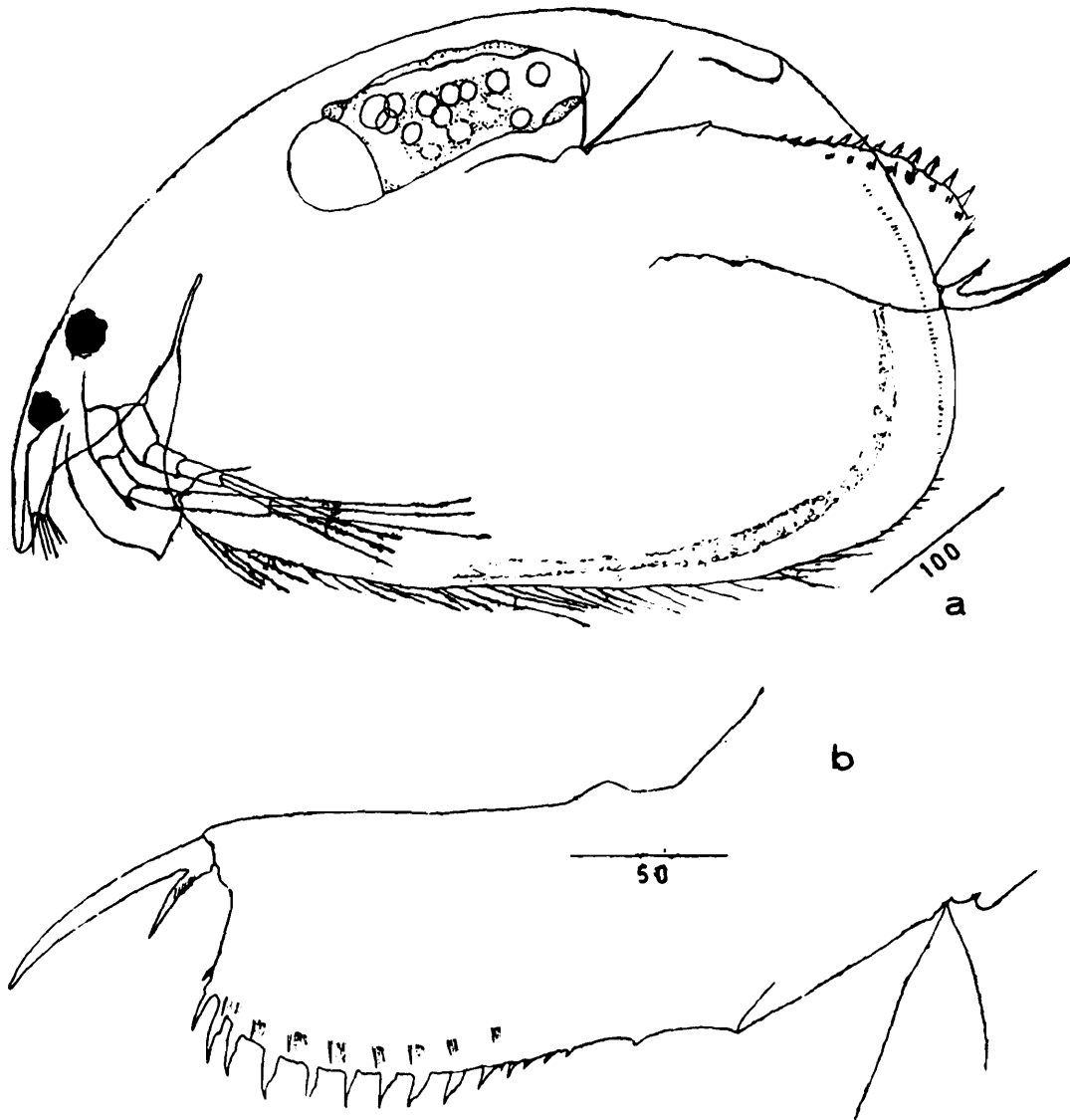
*Length* : 0.85 mm

*Male* : Not known from India.

*Distribution* : INDIA—Brehm (1953) Kali Pokhri, West Bengal, South India. Elsewhere—Holarctic, Ethiopian, Indo-Malayan and Neotropical regions.

62. *Alona rectangularis* Sars, 1862a

*Female* : Posterodorsal and posteroventral corners of valves rounded ; valves with longitudinal lines or rows of tubercles. Head shield with rounded posterior margin. Three main connected head pores. Setae on antennae : 0-0-3/1-1-3. Spines present on proximal segment of exopodite, on second segment of endopodite and on both distal segments. Plate of labrum with convex ventral margin. Ocellus almost as large as eye. Postabdomen wide, with rounded distal margin ; 7-9 anal spines, sometimes in groups. Anal margin slightly concave and with lateral row of setae. Claw with row of setae in proximal 3/4 of concave margin.



Text-fig. 56, a-b : *Alona quadrangularis* (O.F. Müller) : a. female ; and b. postabdomen.

*Male* : With rounded posteroventral corner of valves. Antennules ending slightly before apex of rostrum. Postabdomen wide, slightly tapering distally. Vas deferens opening ventrally at some distance from the claws.

This species is represented by two subspecies in the Indian examined material.

63. *Alona rectangula rectangula* Sars, 1862a  
(Text-fig. 57, a-d)

*Alona rectangula* Sars, 1862a, p. 160 ; Herbst, 1962, p. 88-89, fig. 67 ; Sramek-Husek *et al.*, 1962, p. 346-347 ; Manuilova, 1964, p. 251. figs. 134-135 ; Biswas, 1971, p. 130-131, figs. 13 C,D,H 14 E,F ; Nayar, 1971, p. 514, figs. 26-28 ; Yousuf & Qadri, 1975, p. 88.

*Alona lineata* P. E. Müller, 1867. p. 178, pl. 14, figs. 324 ; Hellich, 1877, p. 93-94 (*lineata* part).

*Alona lineata* P. E. Müller, 1867, p. 181, pl. 4, fig. 869.

*Alona inornata* Hudendorff, 1876, p. 53, pl. II. fig. 5.

*Alona rectangula* var. *rectangula* Vereshchagin, 1916, p. 17-18, fig. 11

*Alona rectangula pulchra* Being, 1941, p. 306-307. fig. 126a.

*Alona rectangula rectangula* Smirnov, 1971, p. 347-350. figs. 331-395 ; Sharma, 1978, p. 206, pl. XXV, figs. 1-5.

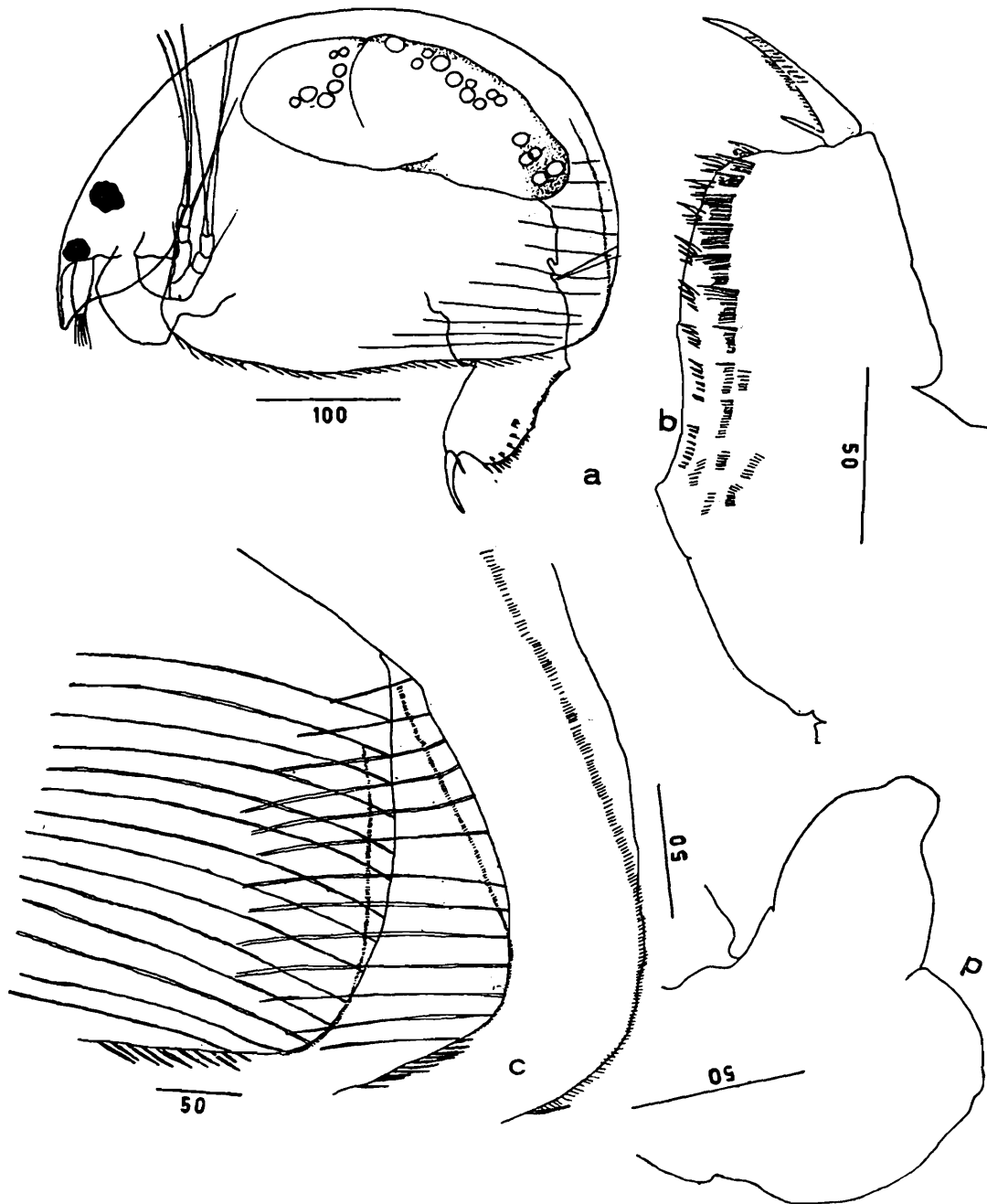
MATERIAL EXAMINED : *Reference material* : CHF 6, eutrophic pond, Srinagar, Kashmir, 1977. *Other materials* : CHF, 12, Dal lake, Srinagar, Kashmir, collected by Dr. M.A. Khan, 1976 ; ZSI C 1874/2, Asalpura bund, Phulera, Rajasthan, collected by Mr. S. Biswas, 5.12.58 ; DGF 2956 to 3039 (North European collections) ; BKS—West Bengal : Amtala (24-Parganas) 3.2.77 ; Bon-Hooghly (24-Parganas) 29.5.75 ; Shirakole (24-Parganas) 6.5.76 ; Thakurpukur (24-Parganas) 3.2.77 ; Sarisha (24-Parganas) 4.1.75.

*Female* : Valves with longitudinal lines, without pits. Ocellus slightly smaller than eye. Postabdomen with 7 anal spines accompanied by setae. Distal groups of lateral setae projecting beyond margin of postabdomen. Claw with basal spine ; with setae on

3/4 of its concave margin. Setae on antennae : 0-0-3/0-1-3 ; spines 1-0-1/0-0-1.

*Length* : 0.55 mm

*Male* : Not known from India.



Text-fig. 57, a-d : *Alona rectangulara rectangulara* Sars : a. female ; b. postabdomen ; c. posterior half of valves (enlarged) ; d. plate of labrum.

*Distribution* : INDIA—Ladakh (Brehm, 1936), Gujarat (Petkovski, 1966), Rajasthan (Biswas, 1971), Meghalaya (Patil, 1976), Kashmir (Yousuf & Qadri, 1975) and West Bengal (Sharma, 1978). Elsewhere—Africa, USSR.

64. *Alona rectangula richardi* (Stingelin, 1895)  
(Text-fig. 58, a-f)

*Alona richardi* Stingelin, 1895, p. 250, pl. 7, fig. 37 ; Bening, 1941, p. 307, fig. 126C.

*Alona intermedia* Stingelin, 1895, p. 248-249, pl. 7, figs. 34-35.

*Alona eucostata* Sars, 1895, p. 17-20, pl. 3, figs. 7-10.

*Alona rectangula* var. *richardi* Šrámek-Husék *et al.*, 1962, p. 347, fig. 128F.

*Alona rectangula rectangula* Smirnov, 1971, p. 350-352, figs. 397-398 ; Sharma, 1979, p. 206-207, pl. XXV, figs. 6-9.

MATERIAL EXAMINED : *Reference material* : BKS 13, Mahestala (24-Parganas), West Bengal, 4.12.77.

*Female* : Posteroventral corner of valves rounded, without denticles. Valves with 12 longitudinal lines in present specimens. Antennules almost reaching apex of rostrum. Plate of labrum rounded. Ocellus slightly smaller than eye. Postabdomen slightly widening distally ; with 6-9 lateral groups of setae, 2-3 spines and setae in each group. Claw with basal spine.

*Length* : 0.36 mm

*Male* : Posteroventral corner of valves rounded. Antennules projecting beyond apex of rostrum. Postabdomen slightly tapering, with small lateral setae and distinct preanal corner. Vas deferens opening near base of claws, ventral to it.

*Length* : 0.26 mm

*Distribution* : INDIA—West Bengal (Sharma, 1978). Elsewhere—New Zealand, USSR.

65. *Alona davidi* Richard, 1895a

Body almost oval in outline ; maximum height slightly before the middle region. Posterodorsal and posteroventral corners of valves rounded. Dorsal margin of head forming smooth curve with dorsal margin of valve. Ventral margin of valve projecting in middle, with feathered setae passing on the posteroventral corner into a row of short setules which continue on the posterior margin. Rostrum blunt. Posterior margin of head shield rounded ; with three main connected head pores and two small pores situated laterally. Plate of labrum rounded. Ocellus smaller than eye, slightly nearer to eye than to apex of rostrum. Postabdomen widest in middle, tapering distally ; with groups of spines dorsally and groups of setae laterally (Harding, 1955). Claws with one basal spine ; setae present on concave margin. Intestine without hepatic caecum (Brehm, 1933b).

Represented by two subspecies in the examined material.

66. *Alona davidi davidi* Richard, 1895a  
(Text-fig. 59, a-g)

*Alona davidi* Richard, 1895a, p. 192-195, figs. 5-8.

*Alona diaphana* Sars, 1901, p. 60-61, pl. 10, figs. 3, 3a-b.

*Alonella punctata* Daday, 1901, p. 122, pl. 6, figs. 6-8.

*Alona diaphana* Fryer, 1957, p. 231 ; Green, 1962, p. 421-422.

*Alona davidi davidi* Smirnov, 1971, p. 369-370, fig. 429 ; Sharma, 1979, p. 208-209 ; pl. XXV, figs. 10-14 and pl. XXVI, figs. 1-2 ; Mamaril Sr. & Fernando, 1980, p. 144, figs. 165-168.

MATERIAL EXAMINED : *Reference material* : BKS 14, Amtala (24-Parganas), West Bengal, 8.1.78. *Other materials* : BKS—West Bengal : Budge-Budge (24-Parganas) 4.12.77 ; Sarisha (24-Parganas) (8.5.75 ; Maheshtala (24-Parganas) 30.11.77 ; Memanpur (24-Parganas) 30.11.77.

*Female* : Valves with a pattern of polygons. Anal spines in 10-11 groups with 2-4 teeth. Richard (1895a) illustrated 25 spines. Post-abdomen with groups of setae laterally, distal setae longest in

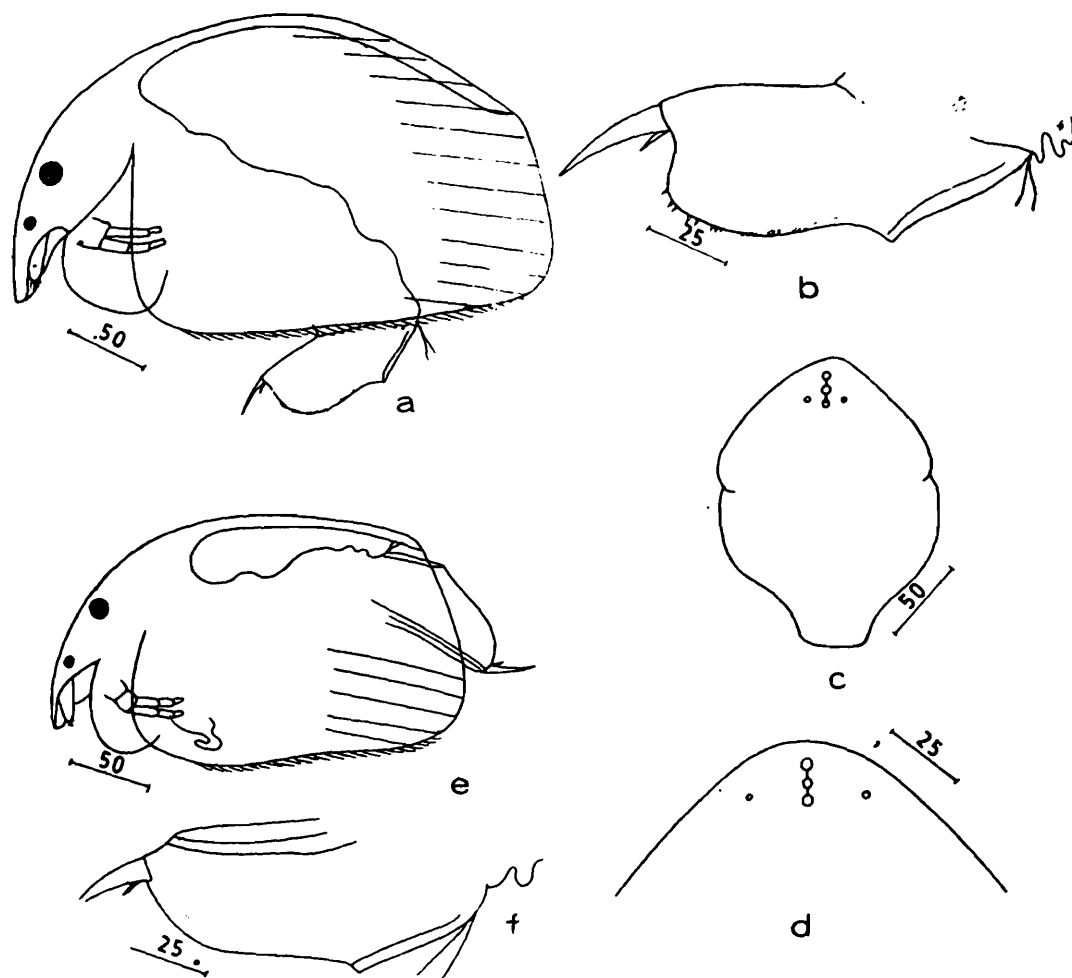
each group. Claws with setae in the proximal part of concave margin.

*Length* : 0.52 mm

*Male* : Maximum height slightly before middle. Antennules not reaching apex of rostrum. Postabdomen narrowing distally ; preanal margin slightly shorter than postanal margin. Vas deferens opening near base of claws ventral to it.

*Length* : 0.38 mm

*Distribution* : INDIA—West Bengal (Sharma, 1978). Elsewhere—Ethiopian region. Haiti.



Text-fig. 58, a-f : *Alona rectangularis richardi* (Stingelin) : a. female ; b. postabdomen ; c. head shield ; d. part of head shield (enlarged) showing head pores ; e. male ; and f. male postabdomen.

67. ***Alona davidi punctata*** (Daday, 1898)  
(Text-fig. 60, a-e)

*Alona punctata* Daday, 1898, p. 39-40, figs. 18, a-e.

*Alonella punctata* Daday, 1905, p. 163-164, pl. 10, figs. 12-17 ; Delachaux, 1917, p. 86-89, figs. 13-14.

*Alona davidi* var. *punctata* Gauthier, 1939, p. 176-182, fig. 10.

*Alona davidi punctata* Smirnov, 1971, p. 370-371, fig. 432 ; Sharma, 1979, p.209-210, pl. XXVI, figs. 3-4.

**MATERIAL EXAMINED :** *Reference material* : DGF 1512, Chetpet Fish farm, Madras, 6.1.65. *Other materials* : DGF 1513, Kovur village tank, near Madras, 7.1.65 ; DGF 1515, Godavilas tank near Madras, 7.1.65 ; DGF 1521, Shallow tank near Narasingam Village, Madurai, 9.1.65 ; Sample 10 (Kolletikota Stn.), Sample 11 (Manguluru Stn.), Collairu lake, collected by Prof. Y Radhakrishna 17.12.73 ; BKS—West Bengal : Achipur (24-Parganas) 4.12.77 ; Shirakole (24-Parganas) 6.5.76.

*Female* : Valves only punctate in studied material. Rostrum blunt. Postabdomen with 10-12 groups of lateral anal spines and groups of fine setae. Claws with setae on concave margin.

*Length* : 0.62 mm

*Male* : Not known from India.

*Distribution* : INDIA—West Bengal (Sharma, 1978). Elsewhere—Ethiopian & Australian regions, Argentina.

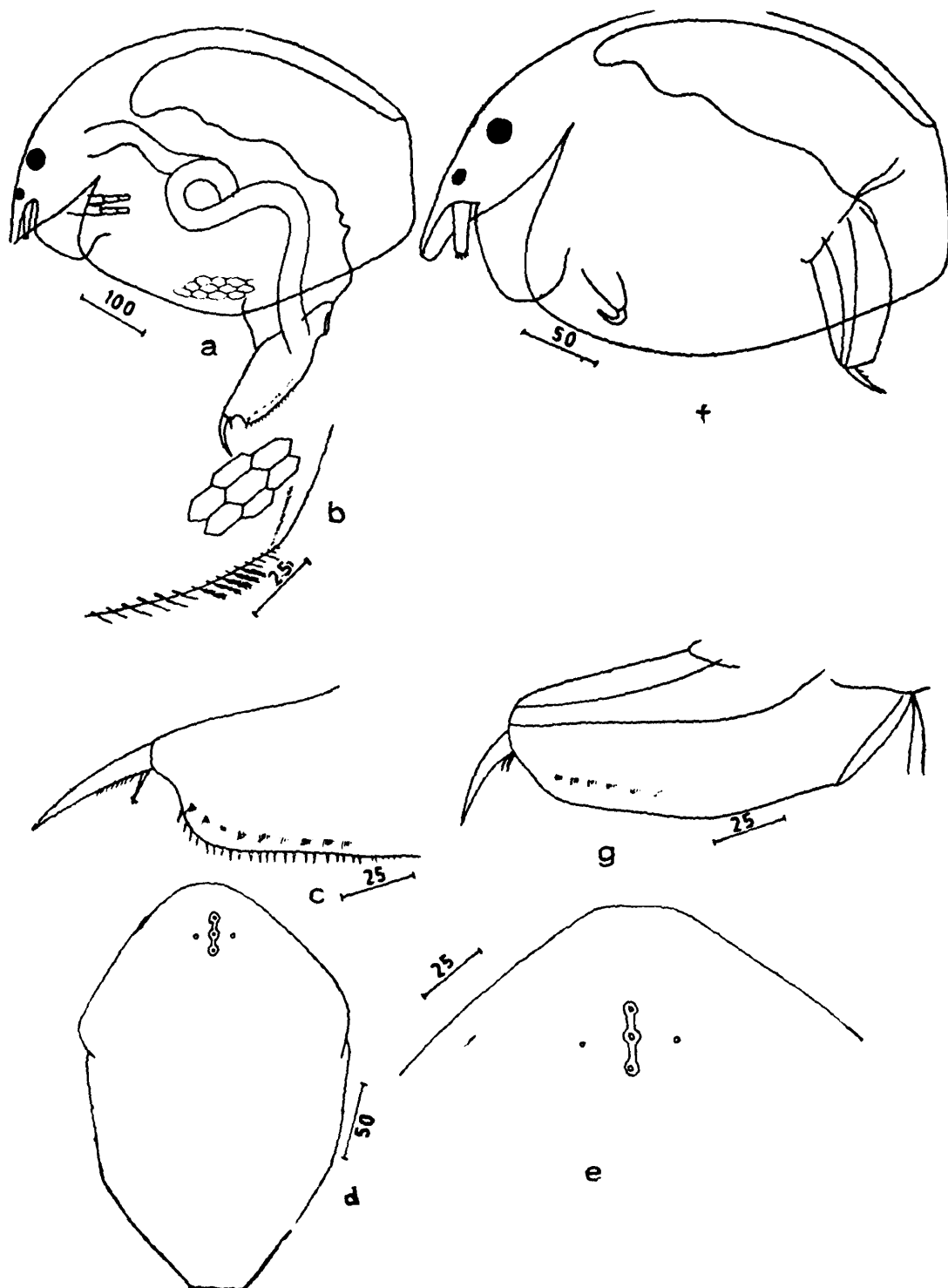
68. ***Alona costata*** Sars, 1862b  
(Text-fig. 61, a-c)

*Alona costata* Sars, 1862b. p. 286 ; Hellich, 1877, p. 90, figs. 47-48 ; Bening, 1941, p. 299-301, fig. 123 ; Frey, 1959, p. 35, fig. 28-29 ; Frey, 1962, figs. 28-29 ; Sramek-Husek *et al.*, 1962, p. 336-338, fig. 124 ; Herbst, 1962, p. 86, fig. 61 ; Biswas, 1964, p. 97-98, figs. 3a-b ; Chiang, 1964, p. 82 ; Shan *et al.*, 1964, figs. 6-8 ; Frey ; 1965, p. 159-162, figs. 1-6 ; Negrea, 1966, p. 141-142 ; Smirnov, 1971, p. 371-376, figs. 436-440 ; Swai & Fernando, 1979, O. 124, figs. 45-47.

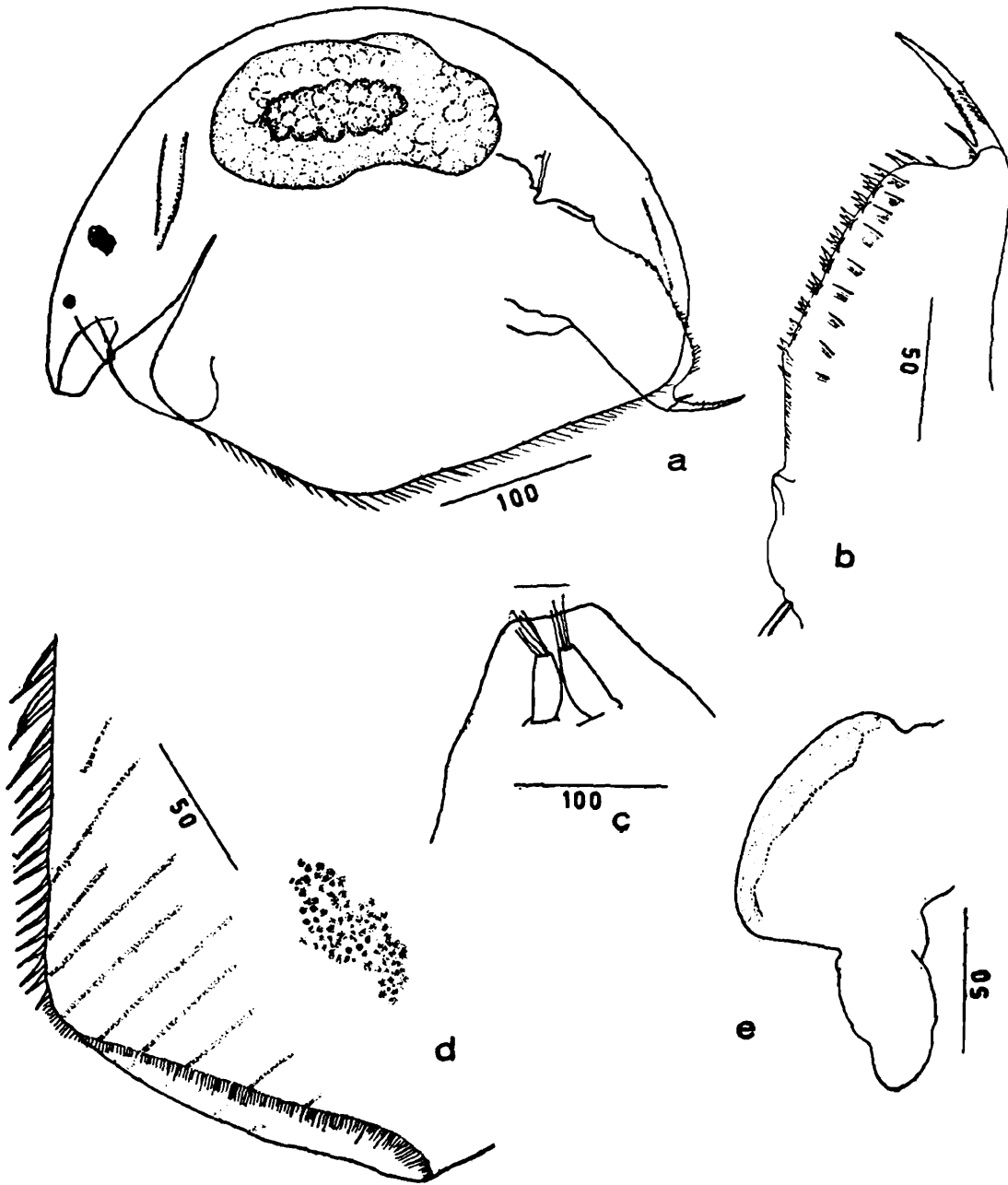
*Phryxura rectirostris* P. E. Müller, 1867, p. 184-185, pl. IV, fig. 15.

*Lynceus costata* Lilljeborg, 1900, p. 465-468, pl. LXVIII, figs. 9-15.

MATERIAL EXAMINED : *Reference material* : DGF, 1517, Buderu tank, near Poondi reservoir, near Madras, 7.1.65. *Other material* : Sample 1, Nainital, collected by Mr. P. C. Sharma, 30.8.77.



Text-fig. 59, a-g : *Alona davidi davidi* Richard : a. female ; b. posteroventral corner of valves (part) ; c. postabdomen ; d. head shield ; e. part of head shield (enlarged) showing head pores ; f. male ; and g. male postabdomen.



Text-fig. 60, a-e : *Alona davidi punctata* (Daday) : a. female ; b. postabdomen ; c. antennules ; d. posteroventral margin of left valve (enlarged) ; and e. plate of labrum.

*Female* : Body almost obovate in outline. Posterodorsal and posteroventral corners of valves rounded. Posterior margin of valves with a row of spinules on its inner margin. Valves marked with longitudinal lines with interconnections. Head shield with rounded posterior margin. Three main connected head pores, lateral pores with chitinous thickenings. Antennules not reaching apex of rostrum. Antennal setae : 0-0-3/1-1-3 ; spines on proximal segment of endopodite and on both distal segments. Plate of labrum rounded. Ocellus much smaller than eye and situated halfway between eye and apex of rostrum. Postabdomen short and tapering distally, dorsal margin almost straight and preanal corner only slightly projecting beyond base of claws. Anal spines 11-12, decreasing in size proximally. Groups of lateral setae present in a row, the distal setae being longest in each groups. Anal margin almost straight. Claw with basal spine.

*Length* : 0.60 mm

*Male* : Not know from India.

*Distribution* : INDIA—Simla Hills (Biswas, 1966), Manipur (Patil, 1976). Elsewhere—Holarctic, Ethiopian, Indo-Malayan and Neotropical regions. Also from European USSR.

69. *Alona monacantha tridentata* (Stingelin, 1904)  
(Text-fig. 61, d-g)

*Alona acuticostata* var. *tridentata* Stingelin, 1904, p. 349-350, pl. 12, figs. 18-19.

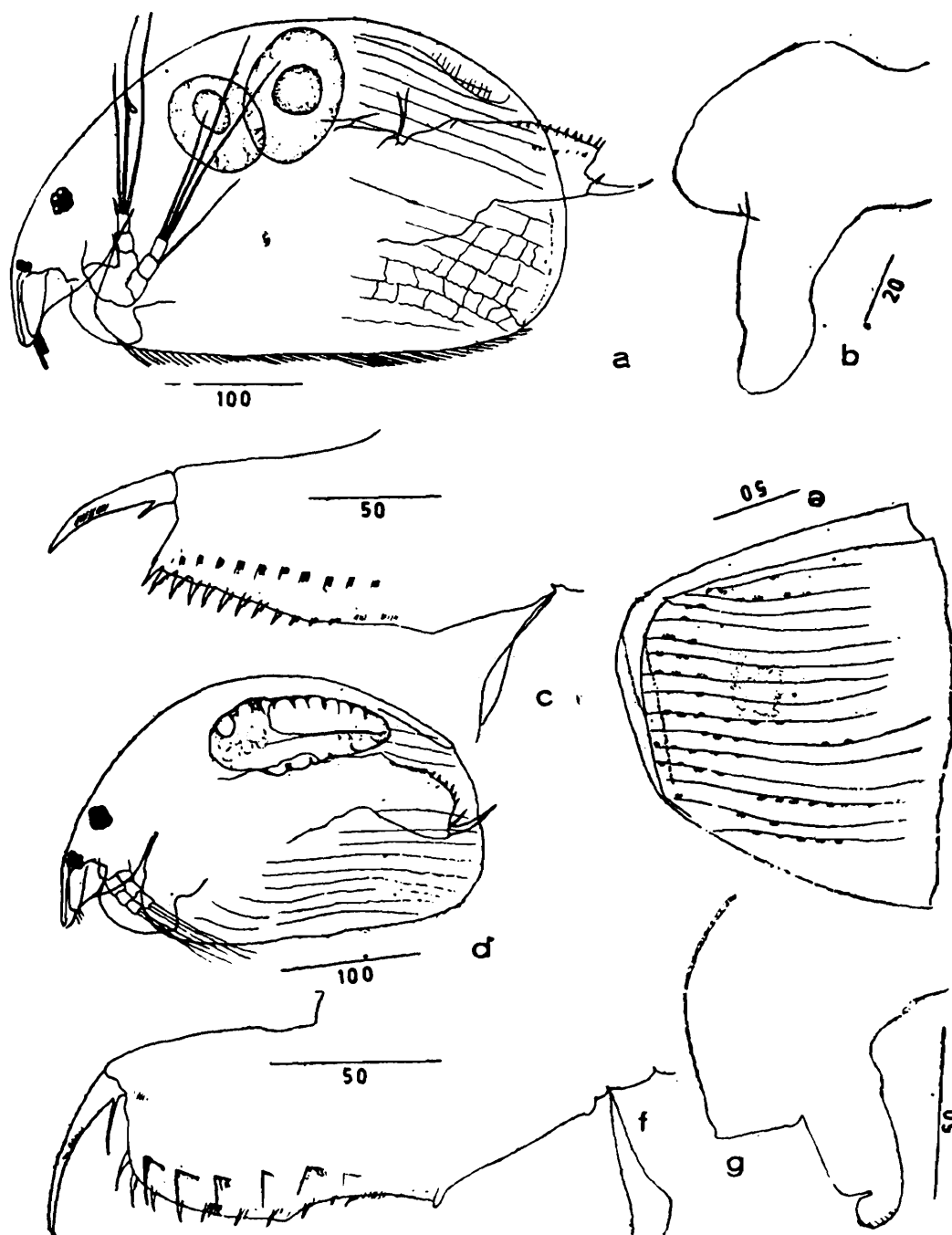
*Alona rectangula* var. *tridentata* Daday, 1910.

*Alona monacantha tridentata* Smirnov, 1971, p. 359-360, fig. 413.

MATERIAL EXAMINED : *Reference material* : CHF 13, astatic pond, Natham road, Madurai 8.11.73.

*Female* : Body almost oval in outline ; maximum height before middle. Posterodorsal corner not distinct ; posteroventral corner with 2-3 denticles (only two denticles in the examined specimens). Dorsal margin evenly arched, ventral margin almost straight. Valves marked with about 13 longitudinal lines. Rostrum long and blunt. Antennules not reaching apex of rostrum. Ocellus smaller than eye, situated nearer to eye than to apex of rostrum. Plate of labrum

with small denticle on anterior margin. Postabdomen with distinct preanal corner ; with 10 anal denticles. Groups of lateral setae present, distal seta in each group longest and a few distal setae of lateral groups of setae project beyond dorsal margin of postabdomen. Claw long and curved, with setae on concave margin and with basal spine.



Text-fig. 61, a-c : *Alona costata* Sars : a. female ; b. plate of labrum ; c. postabdomen. *Alona monocantha tridentata* : d-g : d. female ; e. Valve ; f. postabdomen ; g. labrum.

*Length* : 0.31 mm

*Distribution* : INDIA—new record. Elsewhere—Thailand.

70. *Alona pulchella* King, 1853  
(Text-fig. 62, a-h)

*Alona pulchella* King, 1853, p. 260, pl. VIII B, Sars, 1888, p. 59-62, pl. 6, figs. 5-6 ; Sars, 1896, p. 37-40, pl. 6, figs. 3-4 ; Sars, 1916, p. 335-336, pl. XL, figs. 2, 2a ; Petkovski, 1966, fig. 11 ; Nayar, 1971, p. 512, figs. 21-23 ; Smirnov, 1971, p. 375-376, figs. 441-442 ; Fernando, figs. 96-98 ; 171 C ; Mamaril Sr. & Fernando, 1980, p. 144-145, figs. 169. a-c.

*Alona cambouei* var. *pulchella* Richard, 1897, p. 289-290, figs. 35-36.

*Alona cambouei* var. *patagonica* Ekman, 1900, p. 74.

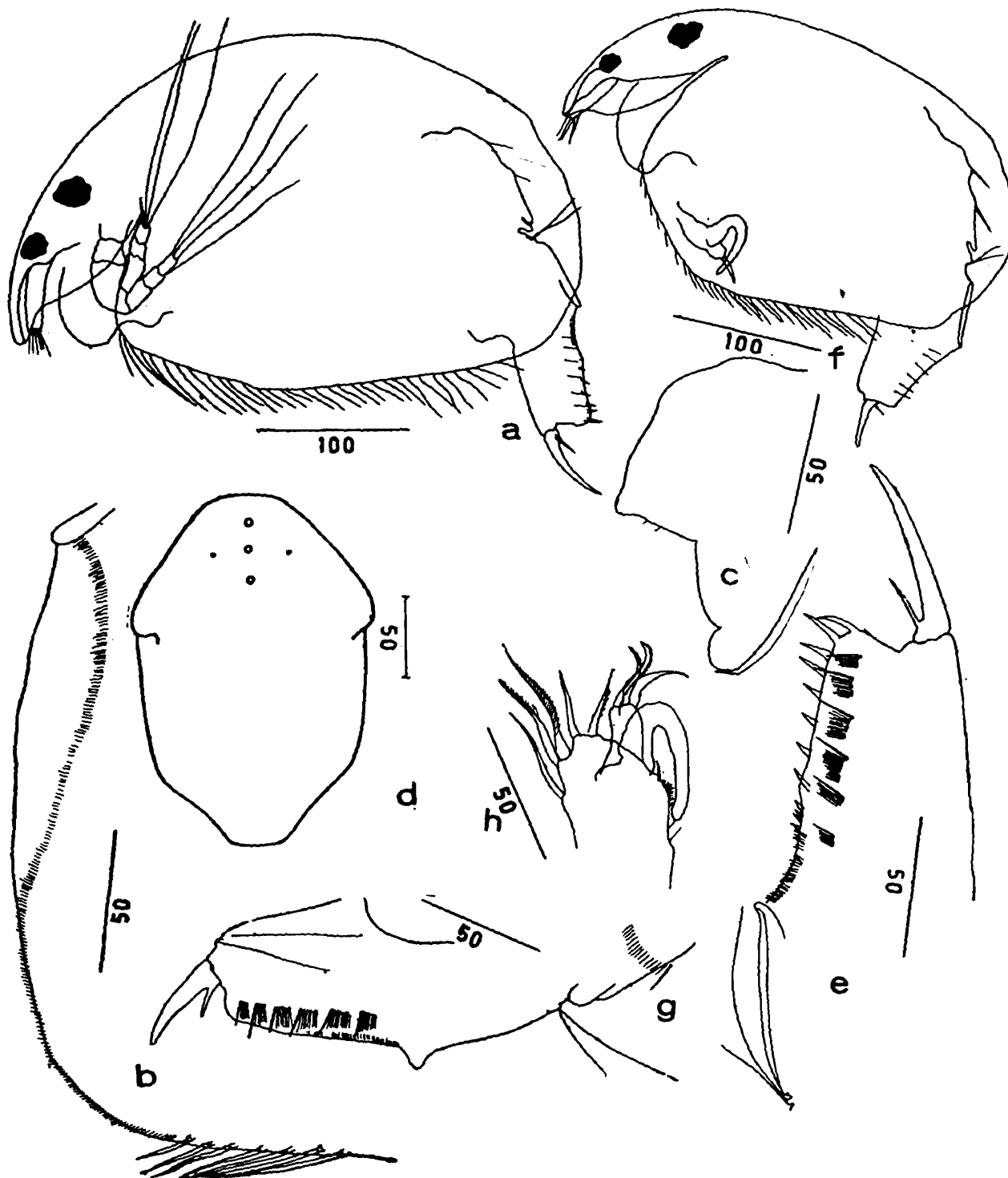
*Alona arenaria* Brehm, 1933a, p. 723-724, figs. 26-27.

**MATERIAL EXAMINED** : *Reference material* : DGF 1512, Chetpet Fish farm, Madras, 6.1.65. *Other materials* : DGF 1514, Chembar-rampakkam tank, Madras, 7.1.65, DGF 1516, swamp near Godavilas tank, near Madras, 7.1.65, DGF 1517, Buderu tank, near Poondi reservoir, near Madras, 7.1.65 ; BKS—West Bengal : Budge-Budge (24-Parganas) 30.11.77 ; Memanpur (24-Parganas) 4.12.77 ; Maheshtala (24-Parganas) 9.7.77.

*Female* : Body almost oval in outline. Posterodorsal and postero-ventral corner of valves rounded. Valves generally punctate or with reticulation. Head shield with almost rounded posterior margin. Three main head pores, not connected to one another. Rostrum blunt. Antennules not reaching apex of rostrum. Plate of labrum with convex anterior margin and slightly pointed apex. Ocellus situated halfway between eye and apex of rostrum. Post-abdomen with almost straight dorsal and ventral margins ; lateral setae in groups, distal seta longest in each groups. Preanal corner distinct but not projecting. Claws with basal spine.

*Length* : 0.53 mm

*Male* : Shorter and smaller than female. Valves with rounded posterodorsal and posteroventral corners. Antennules reaching beyond apex of rostrum. Ocellus situated halfway between eye and



Text-fig. 62, a-h : *Alona pulchella* King : a. female ; b. posterior part of valve (enlarged) ; c. plate of labrum ; d. head shield ; e. postabdomen ; f. male ; g. leg I of male ; and h. male postabdomen.

apex of rostrum. Leg I modified, with a hook. Postabdomen slightly narrowing distally, with groups of lateral setae ; distal seta in each group being longest. Preanal corner distinctly projecting. Vas deferens opening at base of claws, ventral to them. Claws with long basal spine.

*Length* : 0.41 mm

*Distribution* : INDIA—Females are recorded from Gujerat (Petkovski, 1966), West Bengal (Sharma, 1978). Males recorded for the first time in India with this description. Elsewhere—Cosmotropical.

71. *Alona guttata* Sars, 1862b  
(Text-fig. 63, a-d)

*Alona guttata* Sars, 1862b, p. 287-289 ; Sars, 1901, p. 51-52, pl. IX, figs. 3, 3a ; Frey, 1959, p. 35, figs. 22-23 ; Frey, 1962, figs. 22-23 ; Negrea, 1966, p. 140-141 ; Swar & Fernando, 1979, p. 124, figs. 48-51 ; Mamaril Sr. & Fernando, 1980, p. 145, figs. 171-172.

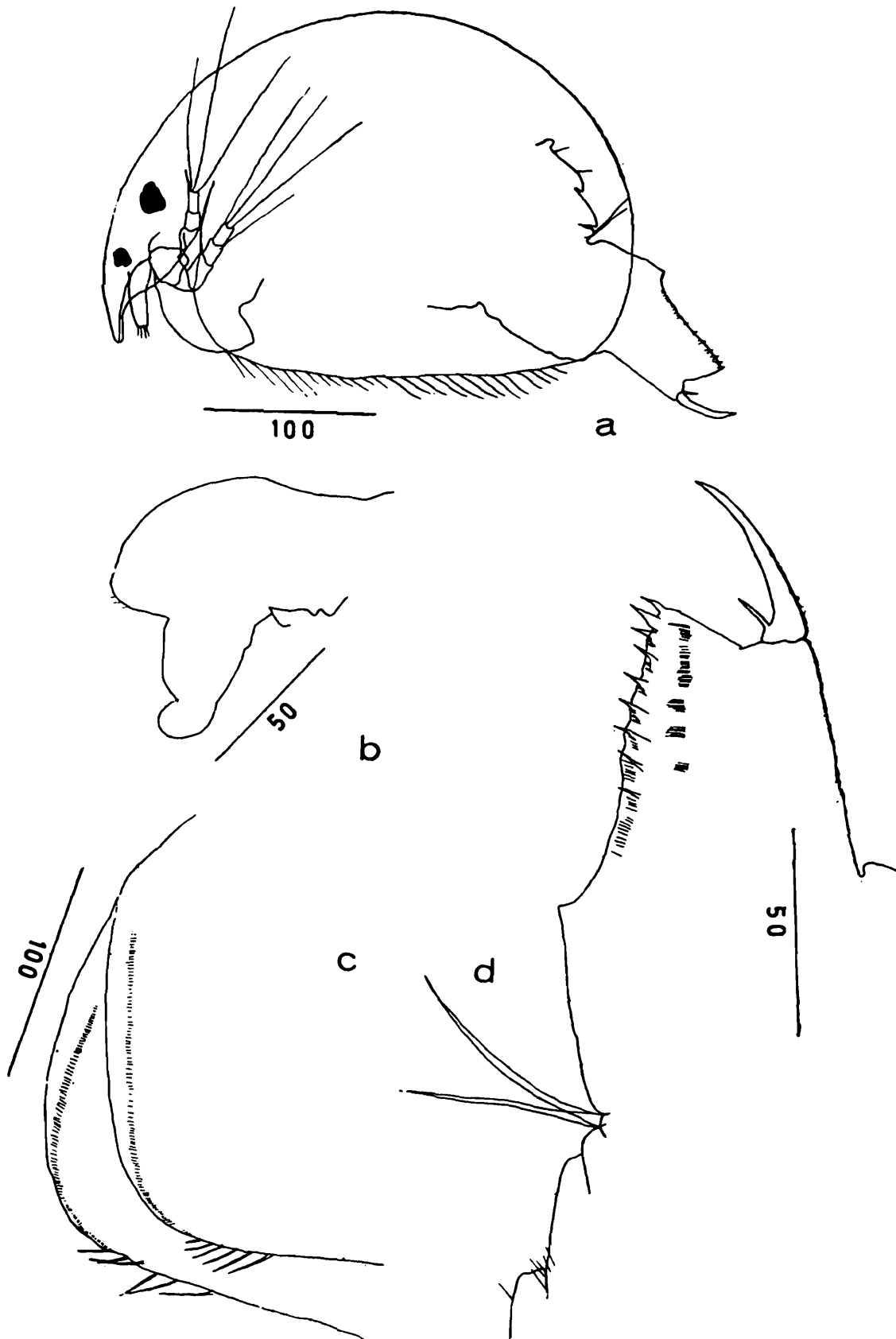
*Lynceus guttatus* Norman & Brady, 1867, p. 29, pl. XVIII, fig. 6, pl. XXI, fig. 10 ; Gurney, 1907, p. 26.

*Alona parvula* Hellich, 1877, p. 92-93, figs. 49-50.

*Alona guttata* var. *typica* Sramek-Husek *et. al.*, 1962, p. 333-335, figs. 123 A,B,C.

**MATERIAL EXAMINED** : *Reference material* : CHF 9, Srinagar, Kashmir, collected by Dr. M. A. Khan, 1976. *Other materials* : DGF 2955-3039 (North European collections).

*Female* : Body almost oval in outline, with rounded posterodorsal and posteroventral corners of valves. In some cases, valves with longitudinal lines, with patterns of polygons, posteriorly. Head shield with rounded posterior margin. Three main head pores, with narrow connection between them. Antennules not reaching apex of rostrum. Antennae with spine on proximal segment of exopodite and on both distal segments. Plate of labrum rounded. Ocellus smaller than eye, situated halfway between eye and apex of rostrum. Postabdomen wide, with 9 anal spines and lateral groups of setae. Distal dorsal end of postabdomen pointed and projecting beyond base of claws. Preanal corner projecting. Anal margin slightly concave. Claws with basal spine.



Text-fig. 63, a-d : *Alona guttata* Sars : a. female ; b. plate of labrum ; c. posterior half of valves (enlarged) and d. postabdomen.

*Length* : 0.47 mm

*Male* : Not recorded in India.

*Distribution* : INDIA—Ladakh and Nilgiri Hills (Brehm, 1936).  
Elsewhere—Cosmopolitan.

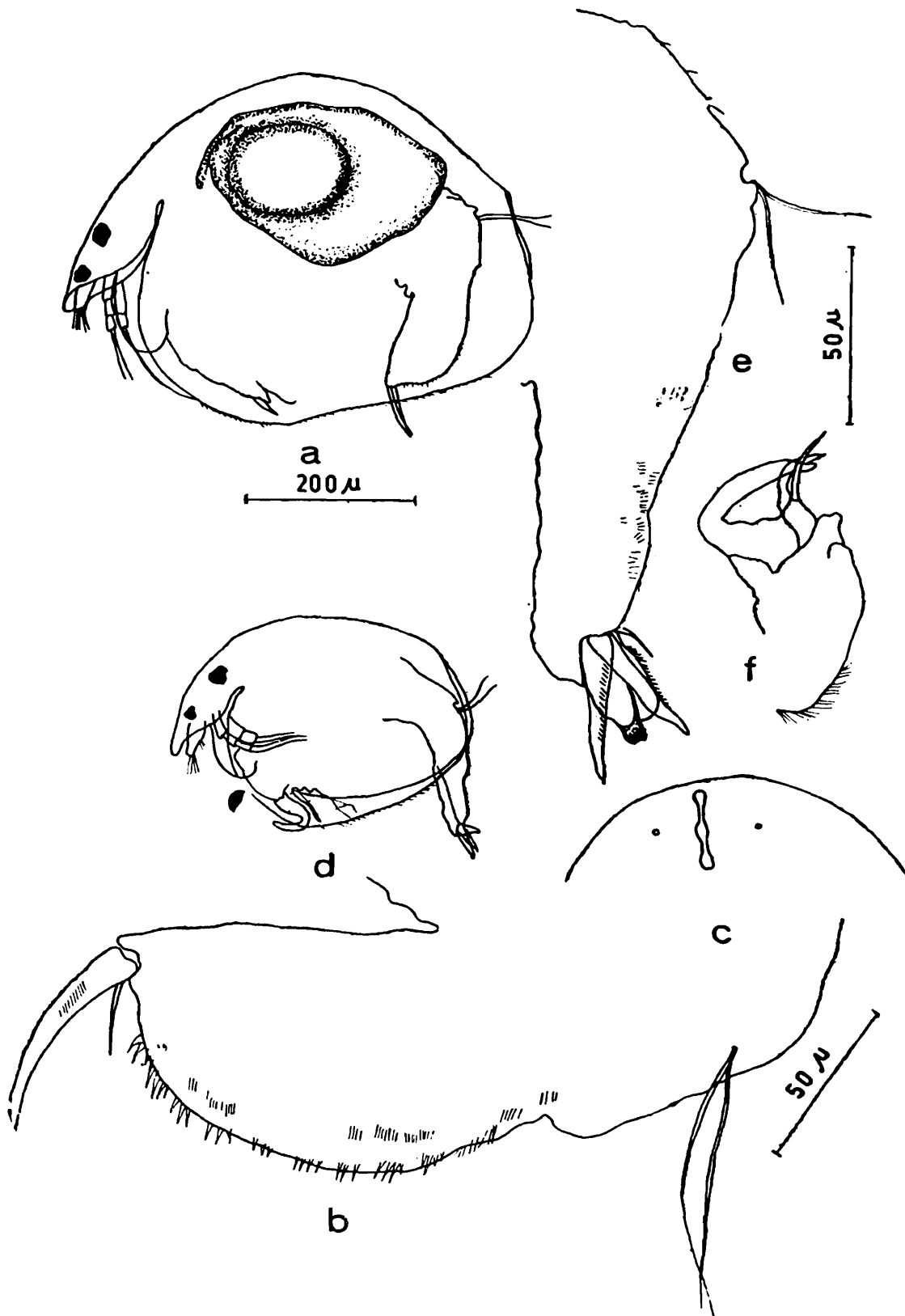
72. ***Alona taraporevalae*** Shirgur & Naik, 1977 ex Sharma and  
Michael, 1983  
(Text-fig. 64, a-f)

*Alona taraporevalae* Shirgur & Naik, 1977, p. 48-49, figs.1, i-viii, figs. 2. ix-xiii &  
figs. 3.xiv-xviii. Sharma & Michael, 1983, p. 35-38, fig.1, a-f. (redescription).

**MATERIAL EXAMINED** : *Reference material* : as per redescription  
of the species (Sharma and Michael, 1981).

*Female* : Body ovoid in outline ; maximum height just before  
the middle. Dorsal margin strongly arched ; ventral margin bulg-  
ing in middle and with slight concavity following it. Posterodorsal  
corner of valves distinct ; posteroventral corner broadly rounded,  
without denticles. Ventral margin of valves with short setae which  
continue to posteroventral corner and then to posterior margin as  
row of fine setules. Valves without markings. Rostrum blunt and  
directed anteriorly. Head shield with broadly rounded posterior  
margin ; with three main connected pores and two small pores  
lateral to median main pore. Eye moderately large ; ocellus slightly  
smaller than eye, located almost halfway between eye and tip of  
rostrum. Antennules reaching tip of rostrum , olfactory seta situa-  
ted in middle and aesthetes unequal. Setae on antennae : 0-0-3/  
1-1-3 ; plate of labrum with broadly convex anterior margin and  
rounded apex. Postabdomen broad, slightly tapering ; dorsal  
margin convex, distal end of dorsal margin not projecting. Preanal  
corner not distinct. 9 groups of anal denticles each with 3-4 denti-  
cles ; proximal 4 groups marginal, distal 5 lateral ; lateral fascicles  
in only few groups, not projecting beyond dorsal margin of post-  
abdomen. Claw long, stout and curved, with setae on proximal  
part of concave margin ; basal spine single, about 1/3 length of claw.

*Length* : 0.53 mm



Text-fig. 64,a-f : *Alona taraporevalae* Shirgur & Naik ex Sharma & Michael : a. female ; b. postabdomen ; c. part of head shield (enlarged) showing head pores ; d. male e. male postabdomen ; and f. leg I of male (after Sharma & Michael, 1981).

*Male* : Smaller than female. Posterodorsal corner of valves not distinct, posteroventral corner rounded, without denticles. Rostrum blunt. Plate of labrum with convex anterior margin and rounded apex. Antennules reaching apex of rostrum. Ocellus smaller than eye and located about halfway between eye and tip of rostrum. Postabdomen long and slender, with maximum width at preanal corner ; preanal corner slightly distinct. Dorsal margin of post-abdomen almost evenly tapering distally ; ventral margin produced above base of claws. Distinct and robust penis present between claws. Only few groups of lateral setae present. Claws long and stout, with setae on concave margin and single basal spine. Vas deferens opening near base of claw, ventral to it.

*Length* : 0.32 mm

*Remarks* : The original description (Shirgur & Naik, 1977) is not correct and the illustrations are too reduced to show distinct morphological details. While examining the original specimens, some differences from the original description also came to light. Hence this species has been redescribed by Sharma & Michael, 1981.

*Distribution* : INDIA—Bombay (Shirgur & Naik, 1977, Sharma & Michael, 1981).

#### INCERTAE SEDIS

*Alona bukobensis* Weltner 1896 : Reported from Punjab, part now in Pakistan (Brehm, 1936) and Rajasthan (Biswas, 1971).

*Alona cambouei* Guerne et. Richard 1893 : Reported from Chakradharpur (Gurney, 1907) and Rajasthan (Biswas, 1971).

*Alona glabra* Sars : Reported from Rajasthan (Biswas, 1971).

*Alona protzi* Hartwig, 1900 : Reported from Calcutta (Sewell, 1935).

Genus 26. *Acroperus* Baird, 1843 emend. Smirnov, 1966

*Monoculus* part Jurine, 1820.

*Lynceus* part Baird, 1834.

Subgenus *Acroperus* Baird, 1843. p. 91 ; Herrick, 1884, p. 81.

*Alonopsis* Sars, 1862b. p. 289 ; Kurz, 1875, p. 45 ; Hellich, 1877, p. 80-81 ; Herrick, 1884, p. 85 ; Stingelin, 1895, p. 241 ; Lilljeborg. 1900, p. 432-433 ; Bening, 1941, p. 255-256 ; Sramek-Husek *et al.*. 1962, p. 324.

*Acroperus* Kurz. 1875, p. 44 ; Hellich, 1877, p. 78 ; Stingelin, 1895, p. 239 ; Lilljeborg. 1900, p. 416-418 ; Bening, 1941, p. 251 ; Sramek-Husek *et al.*, 1962, p. 321 ; Smirnov, 1971, p. 400-403.

*Female* : Body oval and strongly compressed laterally. Valves marked with oblique lines. Three connected main head pores, small pores situated at considerable distance from them. Antennules almost reaching apex of rostrum. Antennal formula 0-0-3/0-1-3. Ocellus smaller than eye. Postabdomen with anal denticles, very small in some species. Lateral margins of postabdomen with a row of setae arranged in groups. Claw with tubercle with setae on dorsal side ; one basal spine. Intestine forming loops with a caecum. Six pairs of legs. Leg VI in form of small lobe.

*Type species* : *Acroperus harpae* Baird, 1834.

Two species belonging to this genus were recorded in the present material.

*Key to the Indian species of genus Acroperus*

- Posterodorsal corner of valves slightly lower than highest point of dorsal margin. Height at least 64% of length.....*A. harpae* (Baird, 1834)
- Posterodorsal corner of valves almost at level of maximum height. Height at most 56% of length.....*A. angustatus* Sars, 1863.

73. *Acroperus harpae* (Baird, 1834)  
(Text-fig. 65, a-f)

*Monoculus striatus* Jurine. 1820. p. 154-156. pl. 16, figs. 1-2.

*Lynceus harpae* Baird, 1834, p. 100, pl. II, fig. 17 ; Norman & Brady, 1867, p. 20. pl. XXI, fig. 1.

*Lynceus striatus* Milne-Edwards, 1840, p. 387-388 ; Leydig, 1860, p. 216-217, pl. VIII, fig. 58.

*Lynceus leucocephalus* Koch, 1841 p. 36, fig. 10 ; Leydig, 1860, p. 218-219, pl. IX, figs. 64-65.

*Acroperus harpae* Lilljeborg. 1900, p. 418-425, pl. LXIII, figs. 14-24, pl. LXIV, figs. 1-10 ; Stingelin, 1906, p. 326-327, pl. 13, figs. 1,2,6,11 ; Keilhack, 1907, p. 455-461 ; Frey, 1959, p. 34, figs. 5-7 ; Frey, 1962, figs. 5-7 ; Green, 1962, fig. 429 ; Sramek-Husek *et al.*, 1962, p. 322, fig. 118 ; Herbst, 1962, p. 82, fig. 57 ; Negrea, 1966, p. 139-140 ; Smirnov, 1971, p. 403-407, figs. 403-489 ; Yousuf & Qadri, 1975, p. 89 ; Sharma, 1978, p. 150.

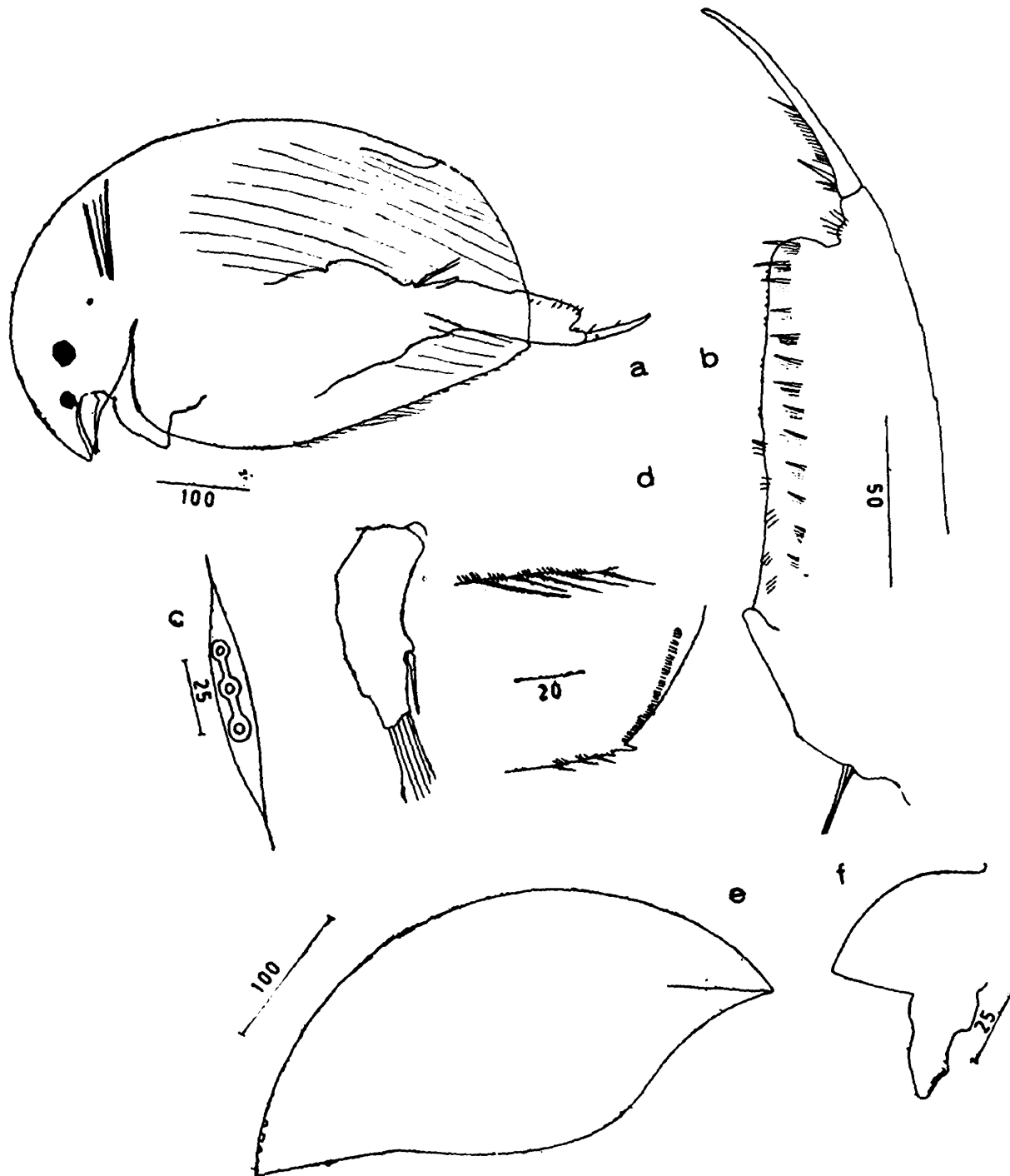
*Acroperus harpae harpae* Bening, 1941, p. 254.

**MATERIAL EXAMINED :** *Reference material :* RGM 96, Shillong, collected by Dr. B. Bhattacharya, 10.4.78. *Other materials :* RGM 46, 47, 53, 58, 77, 93, 94 Shillong, collected by Dr. B. Bhattacharya, 10.4.78 to 20.4.78 ; BKS—West Bengal : Achipur (24-Parganas) 30.11.77.

*Female :* Body almost oval in outline. Posterodorsal corner of valves slightly lower than highest point of dorsal margin, maximum height at least 64% of length. Posteroventral corner of valves with 2-5 denticles. Dorsal crest and head keel present. Head shield with 3 connected main head pores, lateral pores situated somewhat before anterior main pore. Main head pores situated in crest of head keel which becomes slightly wider here. Antennules not reaching apex of rostrum ; anterior margin of antennules with incisions and setae. Distal half of posterior margin with long papilla and small sensory seta, proximal half with small seta ; distal margin bearing other aesthetes, one longer than others. Proximal segment of exopodite of antennae and both distal segments with spines. Proximal segment of endopodite with a long spine ; second segment with short seta. Plate of labrum triangular, with convex anterior margin and blunt apex. Postabdomen with very small anal spines. Lateral setae in groups ; distal groups larger than others. Claws with basal spine and setae on proximal margin, distal most seta larger than others.

*Length :* 0.46 mm

*Male* : Small in size. Antennules reaching apex of rostrum. Postabdomen slightly tapering distally. Groups of lateral setae less developed than in female. Claws with basal spine. Vas deferens opening ventrally near base of claws.



Text-fig. 65, a-f : *Acroperus harpae* (Baird) : a. female ; b. postabdomen ; c. head pares ; d. posteroventral margin of valve (enlarged) ; e. head shield (lateral view) and f. plate of labrum.

*Length* : 0.42 mm

*Distribution* : INDIA—Kashmir (Brehm, 1936), West Bengal (Sharma, 1978). Males reported here for the first time from India. Elsewhere—Cosmopolitan.

74. *Acroperus angustatus* Sars, 1863  
(Text-fig. 66, a-e)

*Acroperus angustatus* Sars, 1863, p. 217 ; P. E. Müller, 1867, p. 169, pl. III, fig. 18, pl. IV, fig. 27 ; Stingelin, 1895, p. 240-241 ; pl. VII, fig. 29 ; Lilljeborg, 1900, p. 429-432, pl. LXIV, figs. 22-27, pl. LXV, figs. 1-4 ; Keilhack, 1907, p. 455-461 ; Uéno, 1937, p. 206, fig. 5 ; Smirnov, 1971, p. 407-409.

*Acroperus harpae angustatus* Bening, 1941, p. 254-255, fig. 105.

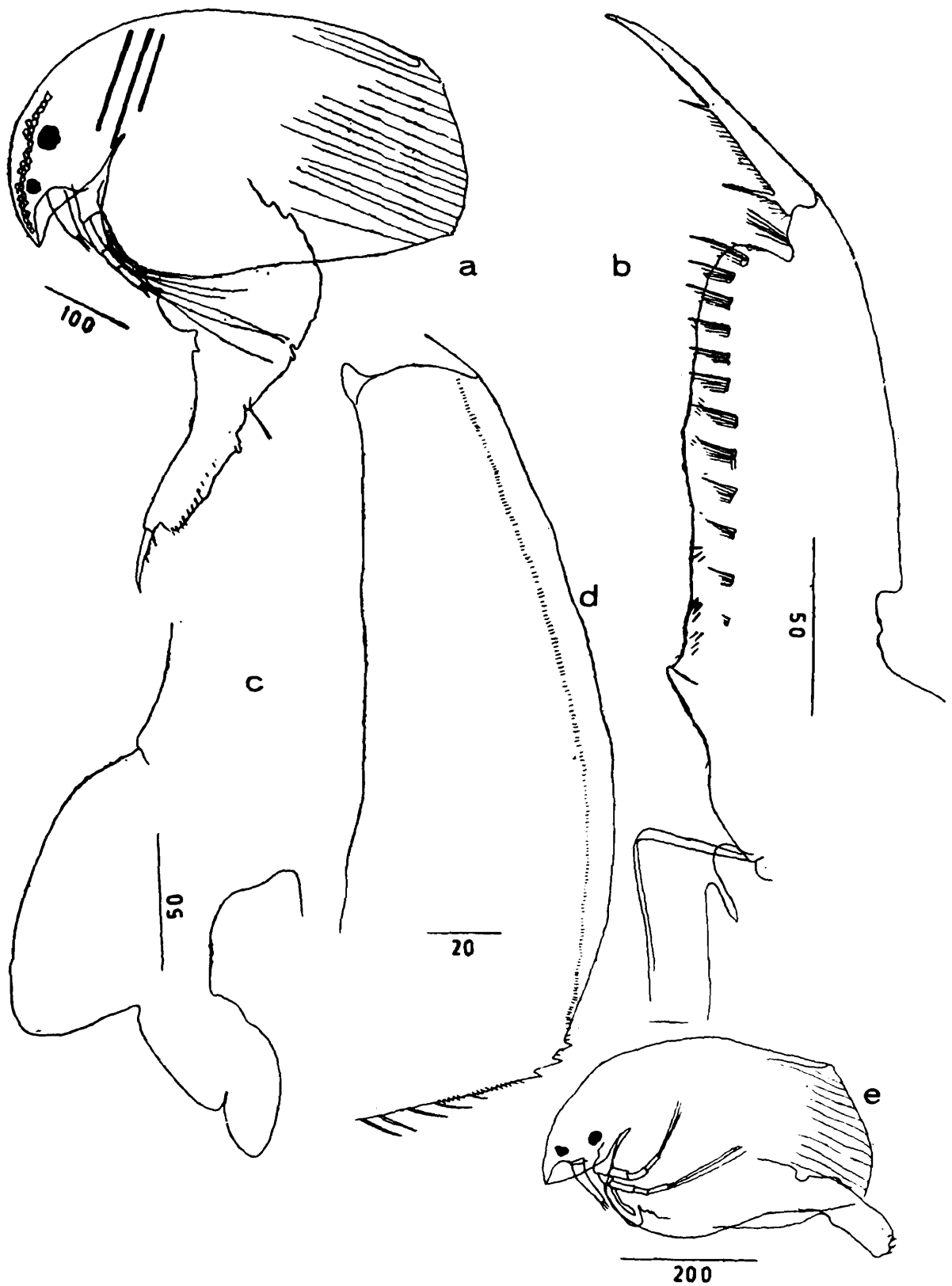
MATERIAL EXAMINED : *Reference material* : CHF 4, eutrophic pond, Srinagar, Kashmir, 1977.

*Female* : Body almost oval-oblong in outline ; maximum height at most 56% of length. Dorsal margin almost straight. Postero-dorsal corner of valves almost at level of maximum height ; postero-ventral corner with small denticles. Valves marked with diagonal lines. Antennules not reaching apex of rostrum. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Post-abdomen with almost parallel dorsal and ventral margins ; about 16 groups of lateral setae. Preanal corner distinct. Claws with setae on concave margin, distal seta increasing in size distally.

*Length* : 0.47 mm

*Male* : Smaller than female. Posterodorsal corner distinct, posteroventral corner with small denticles. Valves with longitudinal lines. Antennules projecting beyond apex of rostrum. Postabdomen with almost parallel dorsal and ventral margins ; with lateral groups of setae. Claws with setae on concave margin, increasing in length distally. Vas deferens opening ventrally in middle of claws.

*Length* : 0.42 mm



Text-fig. 66, a-e : *Acroperus angustatus* Sars : a. female ; b. postabdomen ; c. plate of labrum ; d. posteroventral margin of valve (enlarged) and e. male.

*Distribution* : INDIA—New record. Elsewhere—Palaeartic region.

**Genus 27. *Camptocercus* Baird, 1843**

Subgenus *Camptocercus* Baird, 1843, p. 91 ; Herrick, 1884, p. 81.

*Camptocercus* Schoedler, 1863, p. 3-35 ; Kurz, 1875, p. 40 ; Hellich, 1877, p.75 ; Lilljeborg, 1900, p. 399-401 ; Bening, 1941, p. 247, fig. 103 ; Sramek-Husek *et. al.*, 1962, p. 316 ; Herbst, 1962, p. 80 ; Manuilova, 1964, p. 210-211 ; Smirnov, 1971, p. 429.

*Acrokurzia* Brooks, 1953, p. 149-150.

*Female* : Body form oval greatly compressed and often with keel on head and back. Posterodorsal corner of valves only slightly below highest point of dorsal margin. Valves with longitudinal lines. Distance between head pores and posterior margin of head shield shorter than the distance between main pores. Antennules reaching apex of rostrum. Setae on antennae : 0-0-3/0-1-3. Ocellus smaller than eye. Postabdomen long, tapering distally and with anal spines and lateral setae. Claws long, with large basal spine and with setae on concave part. Intestine forming loops and with a caecum. Five to six pairs of legs.

*Male* : Vas deferens opening ventrally.

In the present material this genus is represented by only one species.

**75. *Camptocercus rectirostris* Schoedler, 1862  
(Text-fig. 67, a-e)**

*Lynceus macrurus* Fischer, 1851, p. 188-189, pl VIII, fig. 8, pl. IX, figs. 1-2.

*Camptocercus rectirostris* Schoedler, 1862, p. 25, pl. II, fig. 43 ; P. E. Müller; 1867, p. 165, pl. II, fig. 19, pl. III, fig. 13 ; Bening, 1941, p. 250, figs. 103, a-c ; Frey, 1959, p. 34, figs. 8-11 ; Frey, 1962, figs. 8-11 ; Herbst, 1962, p. 80, fig. 55 ; 1978, p. 150.

*Campharcus macrurus* P. E. Müller, 1867, P. 164-165, pl. III, fig. 12.

*Camptocercus rectirostris* s. str. var. Lilljeborg, 1900, p. 403-408 pl. XXI, fig. 14, pl. LXIII, figs. 1-15.

*Camptocercus adharens* Brehm, 1912, p. 170, figs. 122.

*Camptocercus atavas* Brehm, 1928, p. 318.

*Camptocercus caudatus* Brehm, 1930, p. 313-314, 320, fig. 2.

*Camptocercus rectirostris* var. *rectirostris* Srámek-Husek *et. al.*, 1962, p. 318, fig. 116.

*Camptocercus rectirostris rectirostris* Smirnov, 1971, p. 429-434, figs. 523-529.

**MATERIAL EXAMINED :** *Reference material :* BKS 15, tank opposite to Park Street (Calcutta), 3.1.75. *Other materials :* Sample 4 (Kolletikota Stn.), 17.11.73, Sample 10 (Kolletikota Stn.), 17.12.73, collected by Prof. Y Radhakrishna.

*Female :* Body oval in outline ; maximum height in front of middle. Posterodorsal corner of valves rounded ; posteroventral corner with 3-5 denticles. Valves marked with curved stripes. Head keel present, passing into dorsal keel. Head with generally sloping dorsal keel. Rostrum pointed and directed anteriorly. Head shield with three connected main head pores, lateral pores situated opposite to median main pore. Antennules not reaching apex of rostrum. Plate of labrum with rounded apex. Ocellus smaller than eye, situated nearer to eye than to apex of rostrum. Postabdomen long, narrow ; with 15-17 anal denticles, lateral setae small and in groups. Claw long, with basal spine and row of setae which become longer distally.

*Length :* 0.76 mm

*Male :* Not known from India.

*Distribution :* INDIA—Kashmir (Brehm, 1936 ; Yousuf & Qadri, 1975), Gujerat (Petkovski, 1966), Meghalaya (Patil, 1976) and West Bengal (Sharma, 1978). Elsewhere—Holarctic, Ethiopian, Indo-Malayan, New Zealand and European USSR regions.

#### INCERTAE SEDIS

*Camptocercus australis* Sars, 1896 ; Reported from Chakradharpur (Gurney, 1907). No details or illustrations are available to ascertain the validity of the reported species.

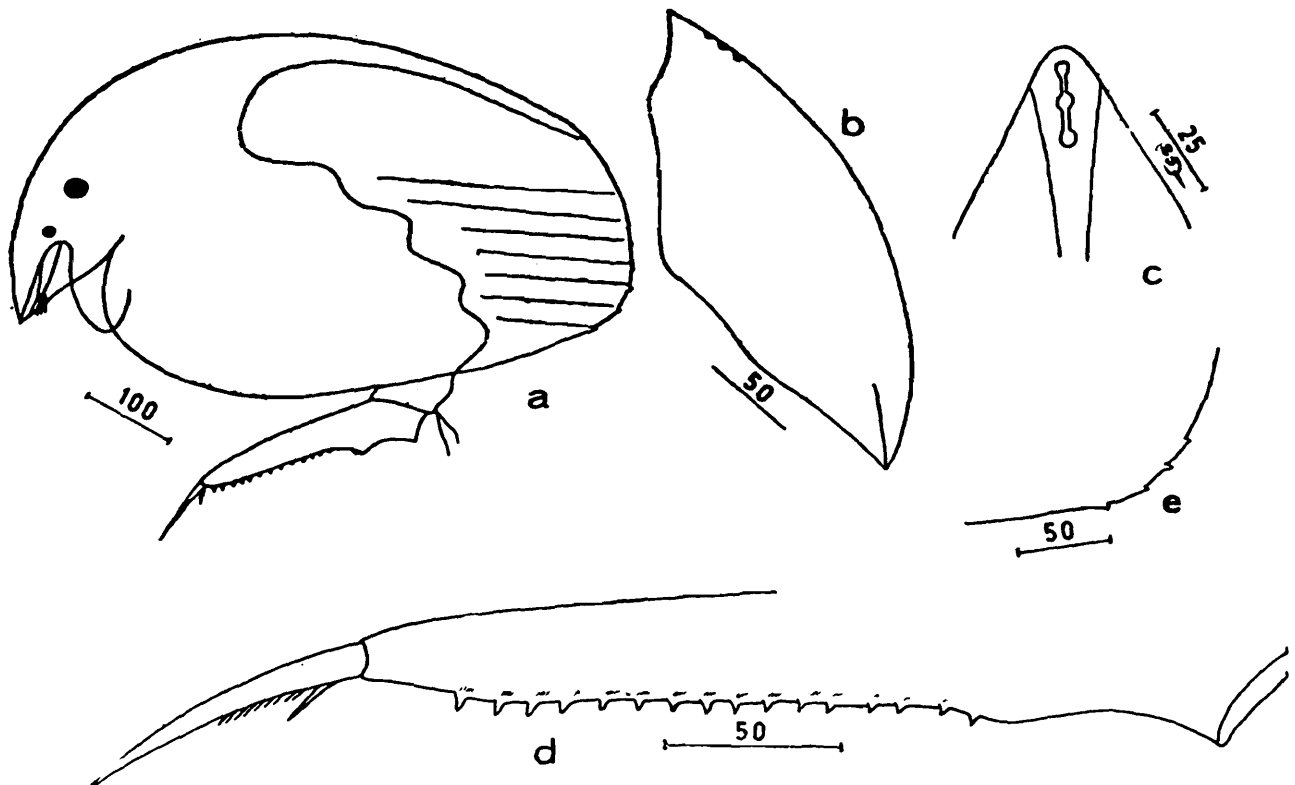
Genus 28. *Graptoleberis* Sars, 1862a

*Lynceus* part Fischer, 1851, p. 191.

*Alona* Schoedler, 1863.

*Graptoleberis* Sars, 1862a, p. 41 ; Kurz, 1875, p. 60 ; Herrick, 1884, p. 89 ; Lilljeborg, 1900, p. 502-504 ; Sars, 1901 p. 65-66 ; Daday, 1910, p. 127 ; Bening, 1941, p. 263 ; Sramek-Husek *et al.*, 1962, p. 358 ; Herbst, 1962, p. 90-92 ; Manuilova, 1964, p. 218 ; Smirnov, 1971, p. 443.

*Female* : Body almost semicircular in outline. Posteroventral corner of valves usually with denticles. Rostrum wide, spatula-shaped. Posterior margin of head shield pointed. Distance between main head pores larger than distance from pores to posterior margin of head shield. Reticulation of carapace consists of distinct large cells. Attenules not reaching apex of the broad rostrum. Setae on antennae : 0-0-3/0-1-3. Plate of labrum rounded. Ocellus smaller than eye. Postabdomen narrowing distally. Claws short,



Text-fig. 67, a-d : *Camptocercus rectirostris* Schoedler : a. female ; b. head shield (lateral view) ; c. part of head shield (enlarged) showing head pores ; d. postabdomen ; and e. posteroventral corner of valve.

with one basal spine. Vas deferens opening ventrally at base of claws. Six pairs of legs present. Leg VI in the form of a small process.

Type species : *Graptoleberis testudinaria* (Fischer, 1851).

76. ***Graptoleberis testudinaria*** (Fischer, 1851)  
(Text-fig. 68, a-b)

*Alona reticulata* Baird, 1843, p. 93, pl. III, fig. 12 ; Baird, 1850, p. 132-133, pl. XVI, fig. 3 ; Schoedler, 1862, p. 24.

*Lynceus testudinarius* Fischer, 1851, p. 191, pl. IX, fig. 12.

*Alona esocirostris* Schoedler, 1858, p. 28 ; Schoelder, 1862, p. 24, pl. I, figs. 26-27.

*Lynceus reticulatus* Leydig, 1860.

*Alona testudinaria* Hellich, 1877, p. 96, fig. 54.

*Graptoleberis testudinaria* Sars, 1891, p. 13 ; Stingelin, 1895, p. 252 ; Lilljeborg, 1900, p. 504-509, pl. LXXI, figs. 9-14, pl. LXXII, figs. 1-8 ; Henry, 1922, p. 43, pl. VI, figs. 5, 5A ; Bening, 1941, p. 263-266, fig. 109 ; Frey, 1959, p. 36, fig. 38-39 ; Frey, 1962, figs. 38-39 ; Herbst, 1962, p. 92, fig. 73.

*Graptoleberis testudinaria* var. *testudinaria* Srámek-Husek et al., 1962, p. 360, fig. 134A.

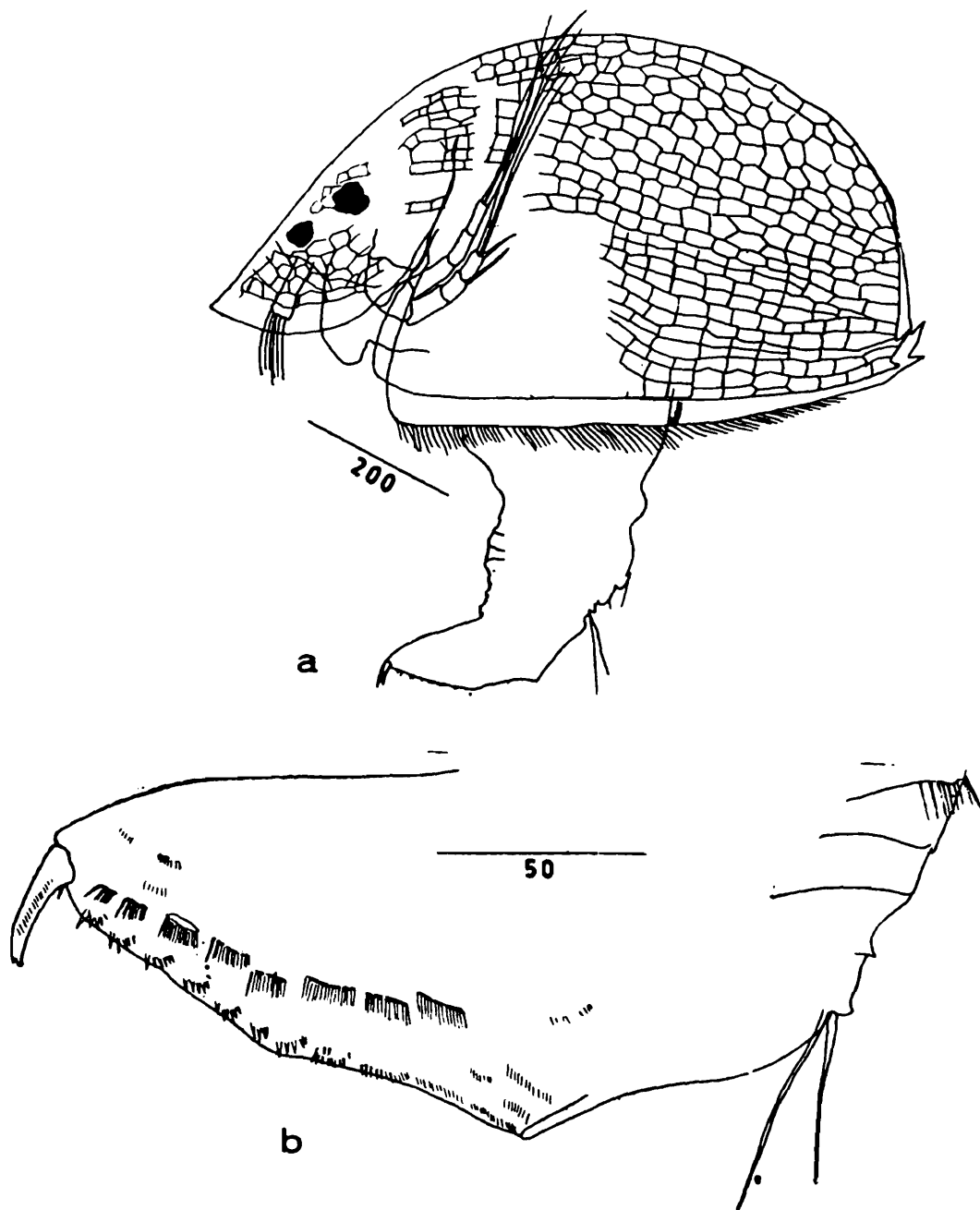
*Graptoleberis testudinaria typica* Goulden, 1966b, p. 94-96, pl. I, fig. 14.

*Graptoleberis testudinaria testudinaria* Sminnov, 1971, p. 444-447, figs. 545-549.

**MATERIAL EXAMINED** : *Reference material* : CHF 4, eutrophic pond, Srinagar, Kashmir, 1977. *Other materials* : Sample 9, Kelle-tikota Stn. Collairu lake, collected by Prof. Y Radhakrishna, 17.11.73.

*Female* : Dorsal margin of body convex ventral margin almost straight. Ventral margin of valves with setose setae decreasing in size towards posteroventral corner but not reaching it. Posteroventral corner of valves with variable number of denticles. Head shield and valves marked with tetragonal, pentagonal or hexagonal cells. Head shield with angular posterior margin. Three connected

main head pores, lateral pores at level of median main pore and surrounded by chitinous ring. Rostral margin very wide, its ventral margin almost at level of ventral margin of valve. Antennules with a sensory seta at the distal end of anterior margin ; distal end with esthetases of differing length. Plate of labrum with rounded apex. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen tapering distally and with distinct preanal corner. Anal margin with row of anal spines



Text-fig. 68, a-b : *Graptoleberis testudinaria* (Fischer) : a. female ; and b. postabdomen.

increasing in size distally. Eight groups of lateral setae. Claw with a small basal spine and with row of fine setae on the concave margin.

*Length* : 0.76 mm

*Male* : Not known from India.

*Distribution* : INDIA—Kashmir (Brehm, 1936) and Kumaon, Western Himalayas (Brehm, 1950). Elsewhere—Cosmopolitan.

### Genus 29. *Leydigia* Kurz, 1875

*Lynceus* part Fischer, 1854, p. 431.

*Alona* Schoedler, 1858.

*Eurycercus* Schoedler, 1862.

*Leydigia* Hellich, 1877, p. 88 ; Herrick, 1884, p. 88 ; Lilljeborg, 1900, p. 492-493 ; Dady, 1910, p. 136. Sars, 1916, p. 328 ; Bening, 1941, p. 287 ; Sramek-Husek *et al.*, 1962, p. 354 ; Herbst, 1962, p. 90 ; Smirnov, 1971, p. 449.

*Female* : Body almost oval in outline. Posterodorsal corner of valves near level of highest point of dorsal margin. Ventral margin of valves convex. Rostrum short and blunt. Posterior margin of head shield rounded. Three connected main head pores, small pores very close to main pores ; distance from posterior head pore to posterior margin of head shield longer than distance between main pores. Antennal setae : 0-0-3/1-1-3. Plate of labrum rounded. Postabdomen wide and flattened. Anal spines very small. Well developed groups of lateral setae present. Claws with or without basal spine. Five pairs of legs.

*Male* : Male smaller than female, with modified leg I and postabdomen. Vas deferens opening at the end of a distinct penis-like distal appendage of the postabdomen.

Type species : *Leydigia leydigi* (Schoedler, 1863)

Two species are known from India.

*Key to the Indian species of genus LEYDIGIA*

1. Postabdomen not narrowing distally, widest in distal part. Distal groups of lateral setae, each with 2 setae..... *L. acanthocercoides* (Fischer, 1854)
2. Postabdomen slightly narrowing distally, widest in the middle. Distal groups of lateral setae with three setae each.....*L. australis ceylonica* Daday, 1898

77. *Leydigia acanthocercoides* (Fischer, 1854)  
(Text-fig. 69, a-f)

*Lynceus acanthocercoides* Fischer, 1854, p. 431-433, pl. III, figs. 21-22.

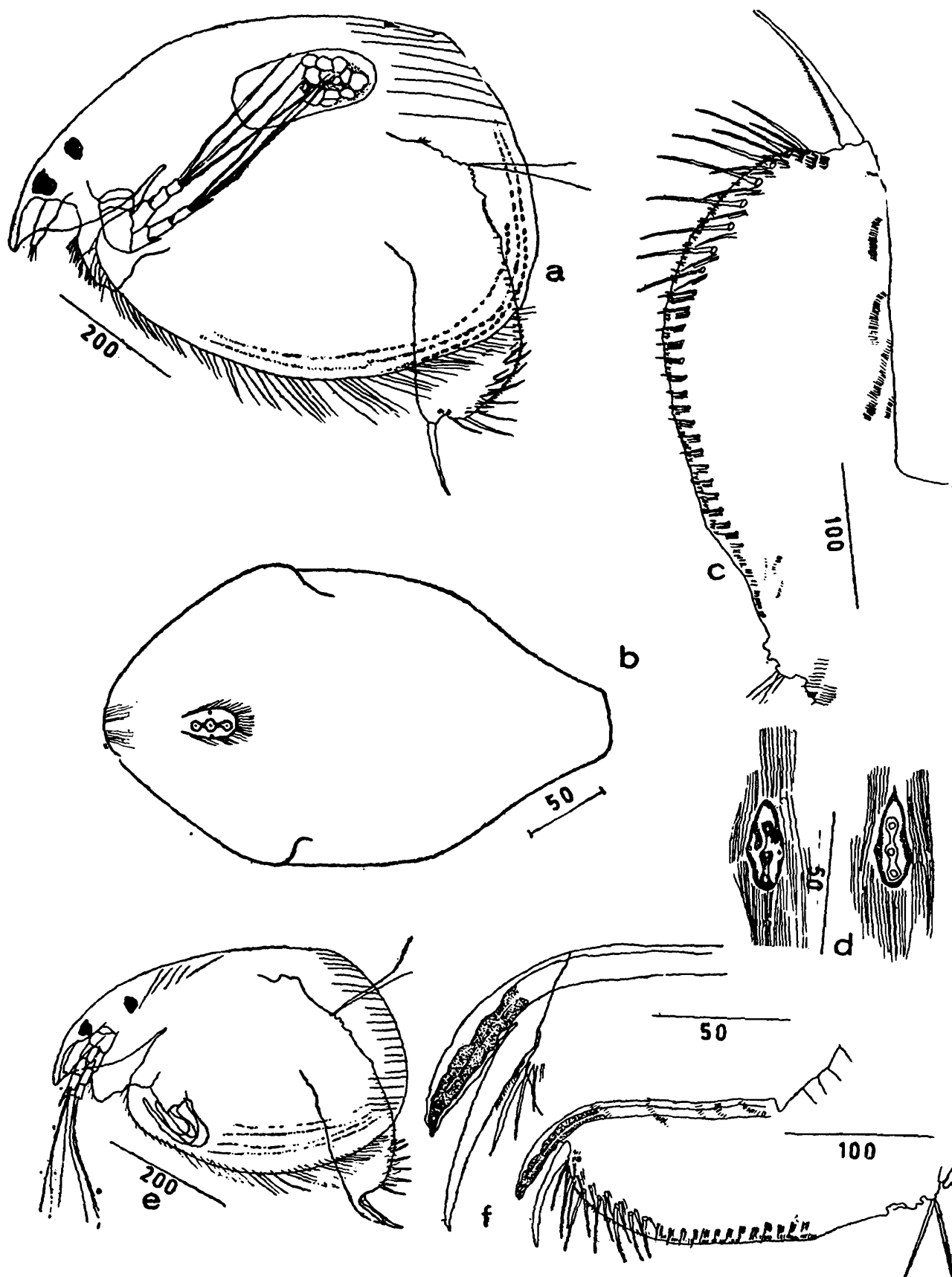
*Eurycercus acanthocercoides* Schoedler, 1862, p. II.

*Alona acanthocercoides* P. E. Müller, 1867, p. 174, pl. IV. fig. 5.

*Leydigia acanthocercoides* Kurz, 1875, p. 59-60 ; Sars, 1895, p. 18-22. pl. 4, figs. 1-4; Bening, 1941, p. 290-292, fig. 120; Frey, 1959, p. 37, figs. 19-20; Frey, 1962, figs. 19-20; Herbst, 1962, p. 90; Srámek-Husek *et al.*, 1962, p. 356-358, fig. 133; Negrea, 1966, p. 144; Biswas, 1971, p. 129, fig. 12F; Nayar, 1971, p. 516, figs. 46-48; Smirnov, 1971, p. 459-460, figs. 566, 569-590; Fernando, 1974, figs. 162, 171T; Sharma, 1978, p. 150; Mamaril Sr. & Fernando, 1980, p. 143, figs. 160-161.

MATERIAL EXAMINED : *Reference material* : CHF 9, Srinagar, Kashmir, collected by Dr. M. A. Khan, 1976. *Other materials* : DGF 2956 to 3039 (North-european collections) ; ZSI C 5400/10, Zoological gardens, Calcutta, collected by Dr. N. Annandale (sample missing) ; ZSI C 1948/2, (ditch adjacent to Sambhar lake) 17.11.58, C 1949/2 (Ganganagar, Suratgarh, Jaipur) 9.10.60, C 1950/2 (Dudu Talao, Dudu, Jaipur) 8.1.58, Rajasthan, collected by Dr. B. Biswas and Mr. S. Biswas ; BKS—West Bengal : Bon-Hooghly (24-Parganas) 16.3.75 ; Tank opposite Lindsay Street (Calcutta) 15.1.75, 1.2.75.

*Female* : Body roughly oblong and compressed. Valves with longitudinal lines, running parallel to the anterior margin. Head shield and intervals between lines with fine striations. Head shield



Text-fig. 69, a-f : *Leydigia acanthocercoides* (Fischer) : a. female ; b. head shield ; c. postabdomen ; d. head pores (enlarged) ; e. male ; and f. male postabdomen.

with rounded posterior margin. Three connected main head pores, lateral pores situated near median main pore. Distance from posterior main pore to posterior margin of head shield about four times longer than distance between marginal main pores. Rostrum short, blunt, directed anteriorly and slightly ventrally. Plate of labrum with setae on anterior margin. Ocellus larger than eye. Postabdomen broadly rounded and margin concave. Lateral part of anus with several rows of setae. Lateral groups consist of 2 setae each. Anal spines very small. Two small terminal groups near claws. Claws without basal spine.

*Length* : 0.80 mm

*Male* : Smaller than female. Valves marked with longitudinal lines. Antennules almost reaching apex of rostrum. Plate of labrum with pubescent anterior margins. Anal margin with setae. Vas deferens opening at an apex of penis-like process. Ocellus larger than eye.

*Length* : 0.46 mm

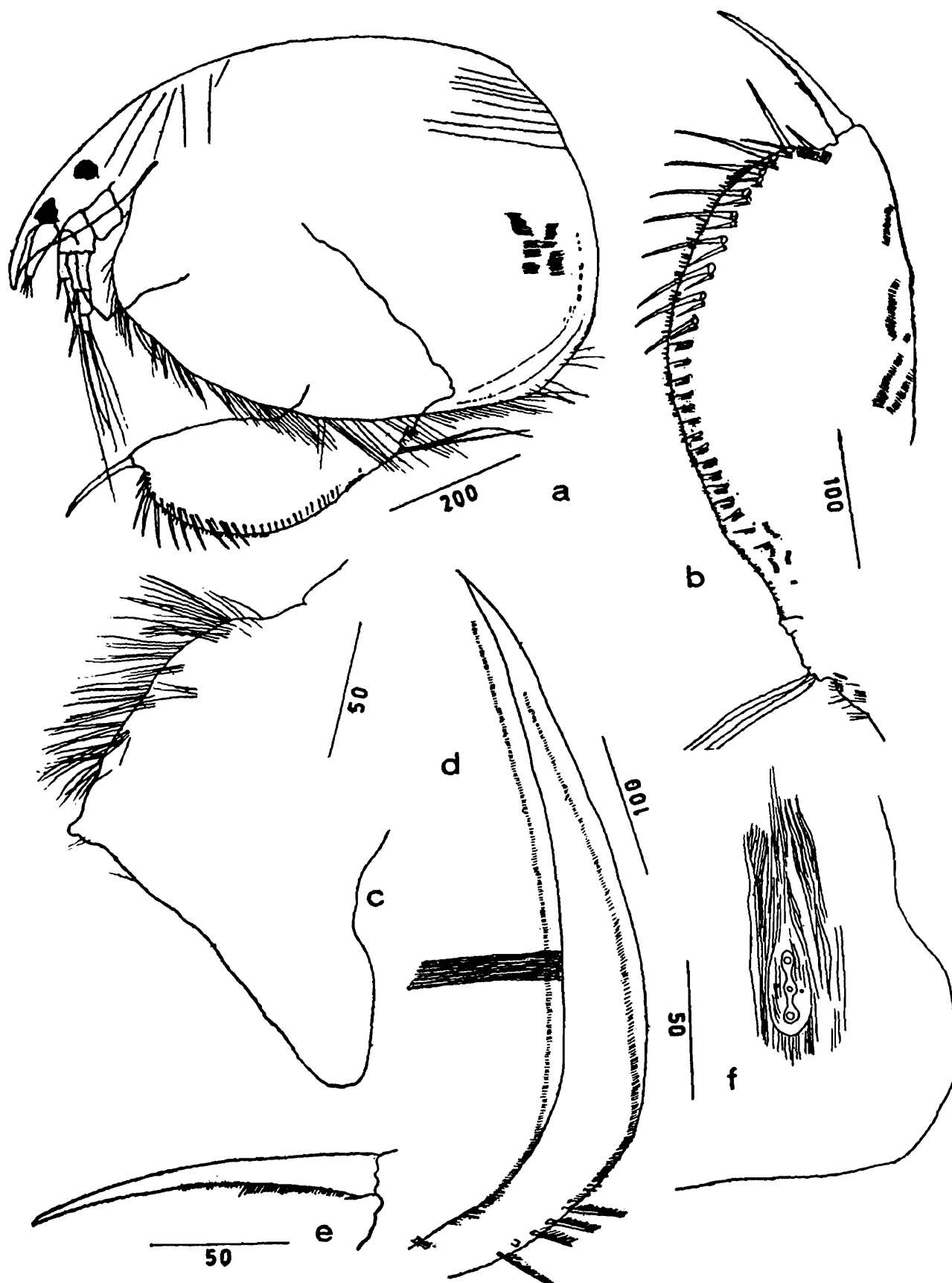
*Distribution* : INDIA—Calcutta (Gurney, 1907), Rajasthan (Biswas, 1965), Gujerat (Petkovski, 1966). Elsewhere—Holartic, Ethiopian, Indo-Malayan, Neotropical and European USSR regions.

78. *Leydigia australis ceylonica* (Daday, 1898)  
(Text-fig. 70, a-f)

*Leydigia australis* var. *ceylonica* Daday, 1898, p. 41-43, fig. 19.

*Leydigia australis ceylonica* Smirnov, 1971, p. 463-464, fig. 579.

**MATERIAL EXAMINED** : *Reference material* : DGF 1513, Kovur village tank, near Madras, 7.1.65. *Other materials* : RGM 24, Madurai, collected by Dr. N. Murugan, 3.12.77 ; Sample 6, Collairu lake, collected by Prof. Y Radhakrishna, Sample 1, Chirala specimens from rain pools, collected by Prof. Y Radhakrishna, 5.12.71.



Text-fig. 70, a-f : *Leydigia australis ceylonica* Daday : a. female ; b. postabdomen ; c. plate of labrum ; d. posteroventral margin of valves (enlarged) ; e. claw (enlarged) ; f. head pore.

*Female* : Body almost oblong. Posterodorsal corner blunt. Posteroventral corner rounded, without denticles. Valves with longitudinal lines and dots. Antennules almost reaching apex of rostrum. Setae on antennae : 0-0-3/1-1-3. Exopodite of antennae with 2 spines on first and second segment, third segment with a spine-shaped seta ; margin with setules and rounded apex. Ocellus much larger than eye, situated nearer to eye than to apex of rostrum. Postabdomen widest in middle, distal corner rounded ; lateral groups each with 3 setae, distal seta longest in each group, proximal seta shortest. In addition, 12-14 groups of spinules present. Claws without basal spine.

*Length* : 0.84 mm

*Male* : Not reported from India.

*Distribution* : INDIA—New record. Elsewhere—Sri Lanka.

#### INCERTAE SEDIS

*Leydigia laevis* Gurney, 1927 : Reported from Rajasthan (Biswas, 1971).

*Leydigia australis* Sars, 1885 : Reported from Chakradharpur (Gurney, 1907) and Calcutta (Sewell, 1935).

#### Genus 30. *Biapertura* Smirnov, 1971

*Biapertura* Smirnov, 1971, p. 466.

*Female* : Body generally oval in outline. Posterior margin of valves slightly shorter than maximum height. Posteroventral corner of valves sometimes with denticles. Head convex dorsally and without any keel. Head shield with rounded anterior margin. Two main head pores, connected by a narrow channel, situated in the median line of head shield and with two small lateral pores. Setae on antennae : 0-0-3/0-1-3, spines 1-0-1/0-0-1. Plate of labrum large. Postabdomen more or less wide laterally and anus situated near its base. Dorsal margin of postabdomen with anal spines and lateral surface with groups of fine spinules. Claw with basal spine. Five pairs of legs.

*Male* : Smaller than female in size ; no anal spines on the post-abdomen. Vas deferens opening at base of claws, ventral to them.

Types species : *Biapertura affinis* (Leydig, 1860).

The genus *Biapertura* is represented by three species in India.

*Key to the Indian species of genus BIAPERTURA*

1. Posteroventral corner of valves with denticles.....*B. karua* (King, 1853)  
Posteroventral corner of valves without denticles .....2
2. Plate of labrum with denticles. Valves tuberculated.....*B. verrucosa* (Sars, 1901)  
Plate of labrum without denticles. Valves not turberculated .....3
3. Postabdomen not widening distally. Anal spines large, lateral setae not projecting beyond margin of postabdomen.....*B. affinis* (Leydig, 1860)

**79. *Biapertura affinis* (Leydig, 1860)**  
(Text fig. 71, a-f)

*Lynceus affinis* Leydig, 1860, p. 223, pl. IX, figs. 68-69 ; Lilljeborg, 1900, p.454-461, pl. LXVI, figs. 18-21, pl. LXVII, figs. 1-7, pl. LXVIII, fig. 1.

*Lynceus quadrangularis* Lievin, 1848, p. 40, pl. X, figs. 6-7 ; Fischer, 1851, p. 189-190, pl. IX, figs. 3-6.

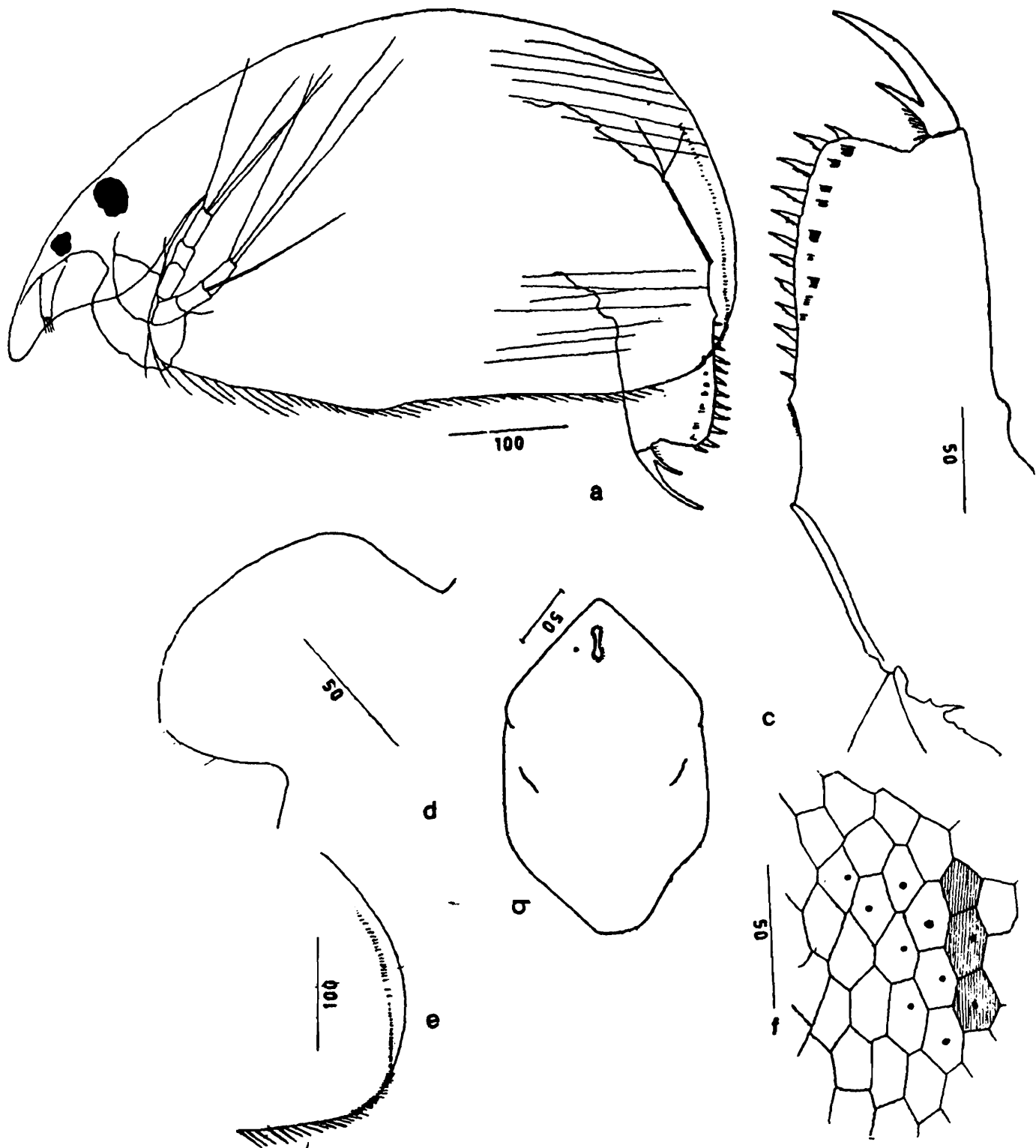
*Alona spinifera* Schoedler, 1858, p. 28 ; Schoedler, 1862, p. 18-19, pl. I, figs. 17-22 ; Schoedler, 1863, p. 18-19, pl. I, figs. 17-22.

*Alona oblonga* P. E. Müller, 1867, pl. 175-176, pl. III, figs. 22-23, pl. IV, figs. 1-2.

*Alona affinis* Stingelin, 1895, pl. 244-245, p. VII, fig. 33 ; Sars, 1901, p. 48-49, pl. IX, figs. 1, 1a-d ; Stingelin, 1906, 0. 324-325, 0l. 13,fig. 1 ; Sars, 1916, p. 331-332, pl. XXXIX, figs. 1, 1a ; Bening, 1941, p. 312-315, fig. 129 ; Frey, 1958, p. 249-252, pl. 38, figs. 49-56; Frey, 1959, 35-36, fig. 36-37; Frey, 1962, figs. 36-37 ; Herbst, 1962, p. 89, fig. 69 ; Manuilova, 1964, p. 246-247, fig. 130 ; Negrea 1966, p. 143.

*Alona whiteleggii* Sars, 1896, p. 35-37, pl. 6, figs. 1-2.

*Alona quadrangularis* var. *affinis* Levander, 1915, p. 25.



Text-fig. 71, a-f : *Biapertura affinis* (Leydig) : a. female ; b. head shield ; c. postabdomen ; d. plate of labrum ; e. posteroventral margin of right valve ; and f. surface polygons (enlarged).

*Alona longirostris* Henry, 1919, p. 475-476, pl. XLI, figs. 11-12.

*Alona affinis* var. *affinis* Sramek-Husek *et al.*, 1962, p. 342.

*Biapertura affinis affinis* Smirnov, 1971, p. 467-462, figs. 582-587.

**MATERIAL EXAMINED :** *Reference material :* RGM 55, Shillong, collected by Dr. B. Bhattacharya, 10.4.78. *Other materials :* RGM 43, 77, 97 Shillong, collected by Dr. B. Bhattacharya ; BKS—West Bengal : Thakurpukur (24-Parganas) 3.2.77 ; Baruipur (24-Parganas) 1.9.75.

*Female :* Body oblong in outline, maximum height in middle region. Posteroventral corner of valves with row of groups of setae continuing as a row of spinules on the inner side of the posterior margin. Valves marked with longitudinal lines. Under higher magnification these appear as distinct hexagons with enclosed fine structures. Head shield with pointed posterior margin. Two main head pores, with narrow connection between them. Lateral pores at level of anterior main pore. Antennules not reaching apex of rostrum. Setae on antennae : 0-0-3/1-1-3 ; with spines on proximal segment of exopodite and on both distal segments. Seta on proximal segment of exopodite not reaching apex. A spinule present at the joint of the segments of the distal setae. Plate of labrum with convex anterior margin. Ocellus smaller than eye, situated nearer to eye than to apex of rostrum. Postabdomen uniformly wide ; dorsal margin rounded with 12-16 anal spines. Lateral groups of setae on concave margin.

*Length :* 0.60 mm

*Distribution :* INDIA—Kashmir (Brehm, 1936), Gujerat (Petkovski, 1966) and West Bengal (Sharma, 1978). Elsewhere—Cosmopolitan between 40° latitude North and South. Also reported from USSR, Central Asia.

#### 80. *Biapertura karua* (King, 1853) (Text fig. 72, a-f)

*Alona karua* King, 1853, p. 260, pl. VIII ; Sars, 1916, p. 337-338, pl. XL, figs. 4, 4A ; Gauthier, 1959, p. 152-153, fig. 6 ; Frey, 1959, p. 35, figs. 30-31 ; Frey, 1962 figs. 30-31 ; Goulden, 1966b, p. 96 ; Petkovski, 1966, Abb. 10.

*Alonella karua* Sars, 1888, p. 50, pl. V, figs. 8-9 ; Sars, 1901, p. 59-60, pl. X, figs. 2, 2a-d ; Birge, 1910, p. 1050 ; Daday, 1910, p. 122-123, pl. 6, figs. 910 ; Brehm, 1936, p. 287.

*Alona kwangsiensis* Chiang, 1963, p. 258-259, 261-262, figs. 15-17.

*Biapertura karua* Smirnov, 1971, p. 479-481, figs. 600-604 ; Fernando, 1974, fig. 109-113, 171G ; Sharma, 1978, p. 150 ; Swar & Fernando, 1979, p. 126, figs. 60-62 ; Mamril Sr. & Fernando, 1980, p. 147, figs. 195-197.

**MATERIAL EXAMINED :** *Reference material* : DGF 1512, Chetpet Fish farm, Madras, 6.1.65. *Other materials* : Sample 2 (Manguluru Stn.) 19.11.73, Sample 8 (Manguluru Stn.) 15.10.73, Sample 9 (Kolletikota Stn.) 17.11.73, Sample 11 (Manguluru Stn.) 19.1.73 of Collairu lake, collected by Prof. Y Radhakrishna ; BKS—West Bengal : Amtala (24 Parganas) 3.2.77 ; Bon Hooghly (24-Parganas) 16.4.75 ; Budge-Budge (24-Parganas) 30.11.77 ; Sarisha (24-Parganas) 8.5.75 ; Maheshtala (24-Parganas) 4.12.77 ; Manikpur (24-Parganas) 9.7.77.

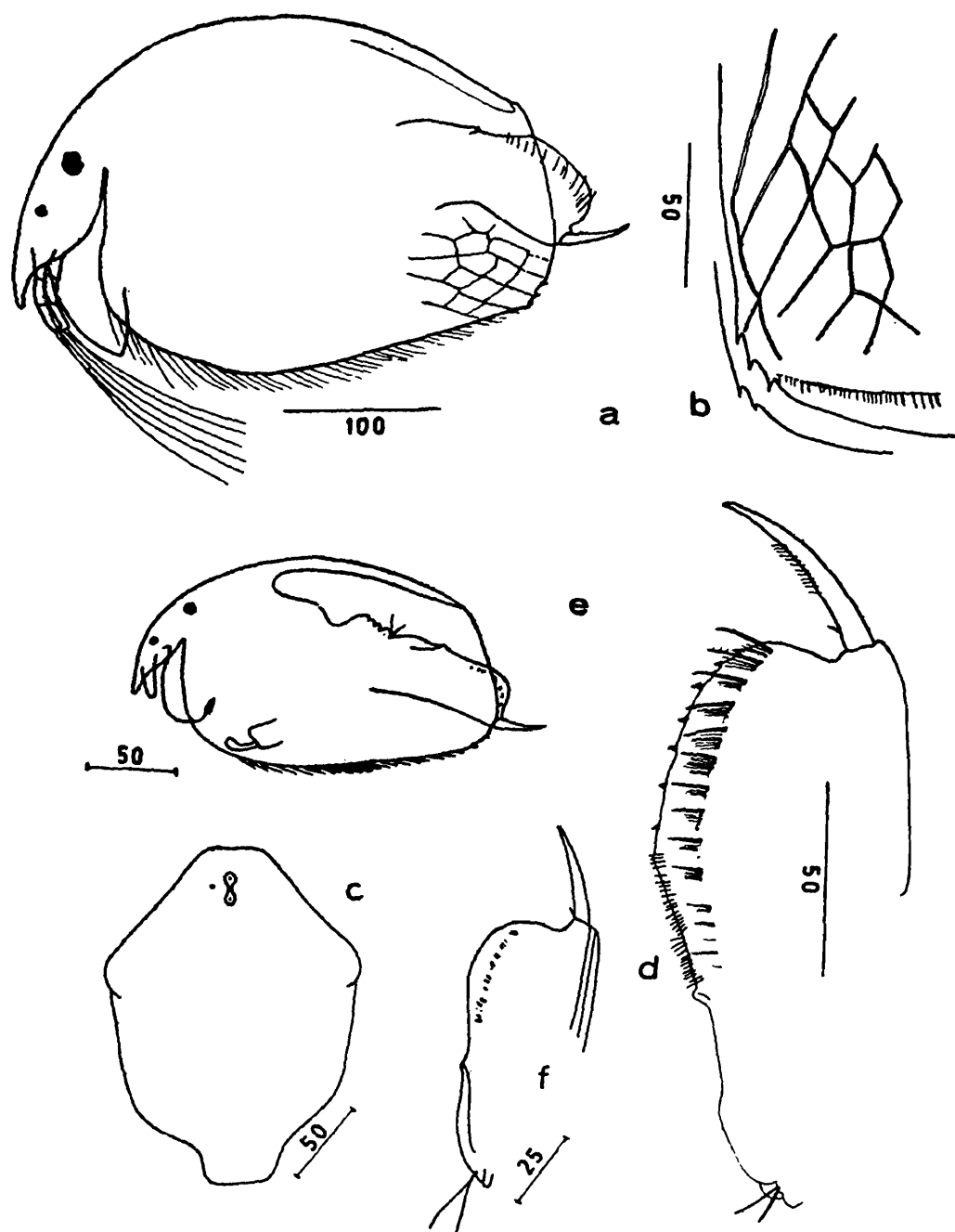
*Female* : Body oval in outline, maximum height slightly before middle. Posteroventral corner of valves with 3-5 denticles, separated from each other by margin of valve. Valves striated with occasional polygons. Head shield with rounded anterior and posterior margins. Two connected main head pores and two small lateral pores. Antennules almost reaching apex of rostrum. Setae on antennae : 0-0-3/0-1-3. Plate of labrum rounded. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. About 7-8 small anal spines present. Lateral setae in groups, first seta of some of the distal groups projecting beyond margin of postabdomen. Claw with very small basal spine.

*Length* : 0.35 mm

*Male* : Posteroventral corner of valves with denticles. Antennules not reaching apex of rostrum. Plate of labrum rounded. Postabdomen with distinct preanal corner. Vas deferens opening ventrally near base of claws. Claws with a basal spine.

*Length* : 0.23 mm

*Distribution* : INDIA—Meghalaya (Patil, 1976) and West Bengal (Sharma, 1978). Elsewhere—Cosmopolitan.



Text-fig. 72, a-f : *Biapertura karua* (King) : a. female ; b. posteroventral half of valves (enlarged) ; c. head shield ; d. postabdomen ; e. male ; f. male postabdomen.

81. ***Biapertura verrucosa*** (Sars, 1901)  
(Text-fig. 73, a-d)

*Alona verrucosa* Sars, 1901, p. 56-57, pl. IX, figs. 7, 7a ; Brehm, 1937b, p. 504-507 ; Brehm, 1938a, p. 100, pl. 6-7 ; Johnson, 1956a p. 200-204 ; Harding, 1957 p. 77-78, figs. 20-28 ; Goulden, 1966a, p. 377 ; Goulden, 1966b, p. 99, pl. 2, figs. 7-9 ; Paggi, 1975, p. 139-144, figs. 1-27.

*Alona alonopsiformis* Brehm, 1933b, p. 79, figs. 2-3.

*Biapertura pseudoverrucosa verrucosa* Smirnov, 1971, p. 480-481, fig. 606.

*Biapertura verrucosa* Fernando, 1974, figs. 114-115, 171H ; Swar & Fernando, 1979, p. 126, figs. 63-65.

**MATERIAL EXAMINED :** *Reference material* : DGF 1512, Chetpet Fish farm, Madras, 6.1.65. *Other materials* : Sample 2, Naini Tal, collected by Mr. P. C. Sharma, 30.8.77 ; DGF 1517, Buderu tank near Poondi reservoir, near Madras, 7.1.65 ; DGF 1519, Oothangudi tank, Madurai, 9.1.65 ; DGF 1524, Jagady Pond, Trivandrum, 11.1.65.

*Female* : Posterodorsal and posteroventral corners of valves rounded. Valves with large tubercles—apparently variable in different populations. Head shield with slightly produced posterior margin. Two main connected head pores, lateral pores elevated. Antennules almost reaching apex of rostrum. Setae on antennae : 0-0-3/0-1-3. Plate of labrum with denticles or incision in middle of anterior margin. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen short, with curved dorsal margin and rounded distal margin. Anal corner projecting and situated in about middle of dorsal margin of postabdomen. Postabdomen with 6-8 anal spines. Lateral setae large and present in groups. Claw with basal spine and setae on the concave margin.

*Length* : 0.32 mm

*Male* : Not recorded from India.

*Distribution* : INDIA—Gujarat (Petkovski, 1966). Elsewhere—Indo-Malayan, Ethiopian and Neotropical regions.

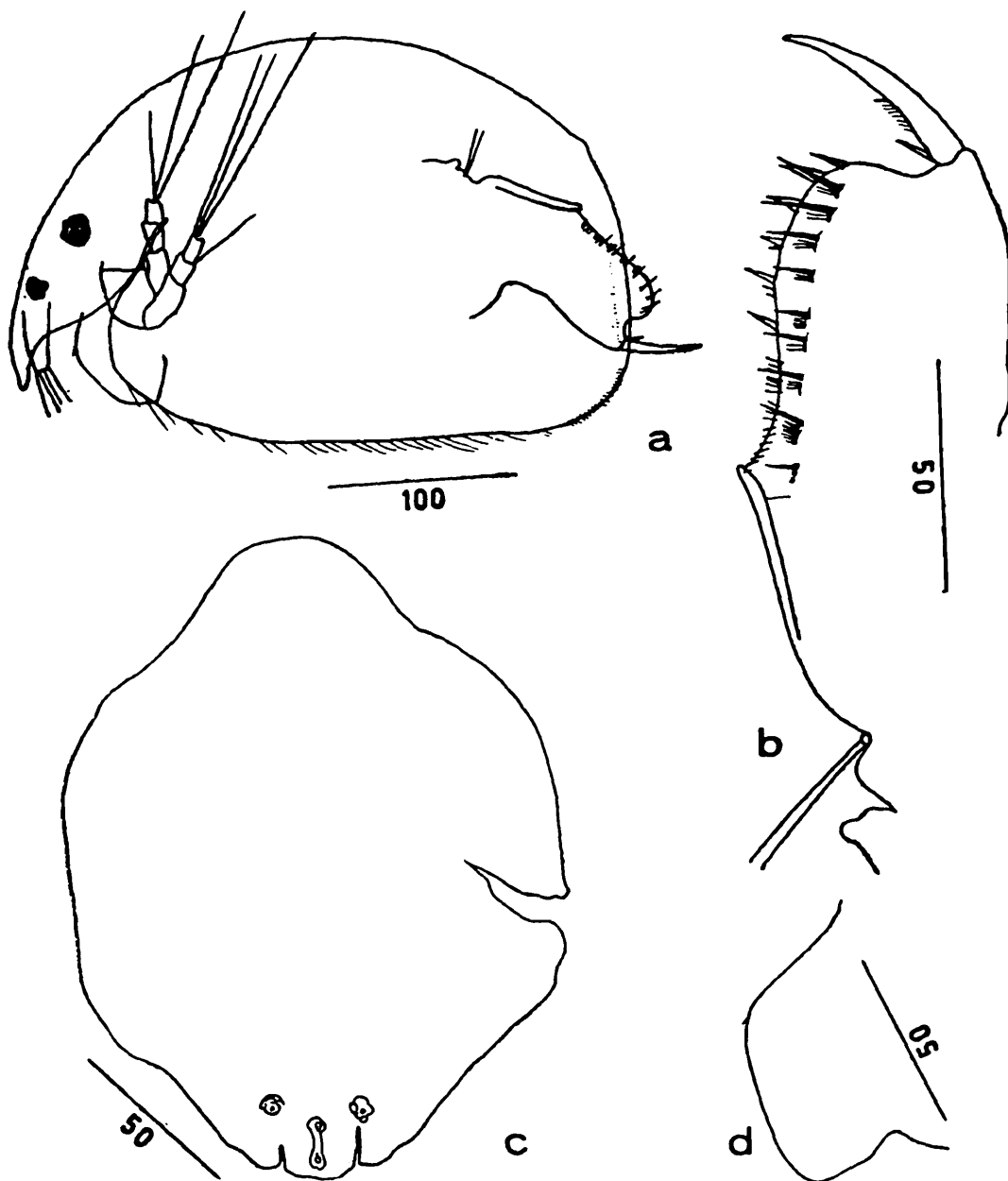
Genus 31. *Oxyurella* Dybowski & Grochowski, 1894

*Oxyurella* Dybowski & Grochowski, 1894, p. 381 ; Bening, 1941, p. 292-283 ;  
Smirnov, 1961, p. 491.

*Euryalona* part Daday, 1905, p. 178.

*Odontalona* Birge, p. 1045.

*Female* : Body oval in outline. Posteroventral corner of valves rounded, without denticles. Rostrum blunt. Two separated main



Text-fig. 73, a-d : *Biapertura verrucosa* (Sars) : a. female ; b. postabdomen ;  
c. head shield ; d. plate of labrum.

head pores, with two small pores, with two small pores between them and two small lateral pores. Antennules not reaching apex of rostrum. Setae on antennae : 0-0-3/1-1-3. Ocellus slightly smaller than eye. Postabdomen slender, slightly tapering distally ; with anal spines, 2-3 distal anal spines largest. Lateral setae present. Claw with one or more basal spines situated some distance from base. Five pairs of legs.

*Male* : Smaller than the female. Vas deferens opening ventrally at base of claws.

Type species : *Oxyurella tenuicaudis* (Sars, 1862b).

This genus is represented by two species.

*Key to the Indian species of genus Oxyurella*

Anal denticles abruptly increasing in size distally. Claw with one basal spine.....*O. tenuicaudis* (Sars, 1862b)

Anal denticles regularly increasing in size distally. Claw with one large and one small accessory basal spine.....*O. singalensis* (Daday, 1898)

82. *Oxyurella singalensis* (Daday, 1898)  
(Text-fig. 74, a-f)

*Alonopsis singalensis* Daday, 1898, p. 43-45, fig. 20, a-b ; Daday, 1910, p. 135-136, pl. 7, figs. 21-22.

*Alona gauthieri* Brehm, 1934, p. 66, figs. 12-13.

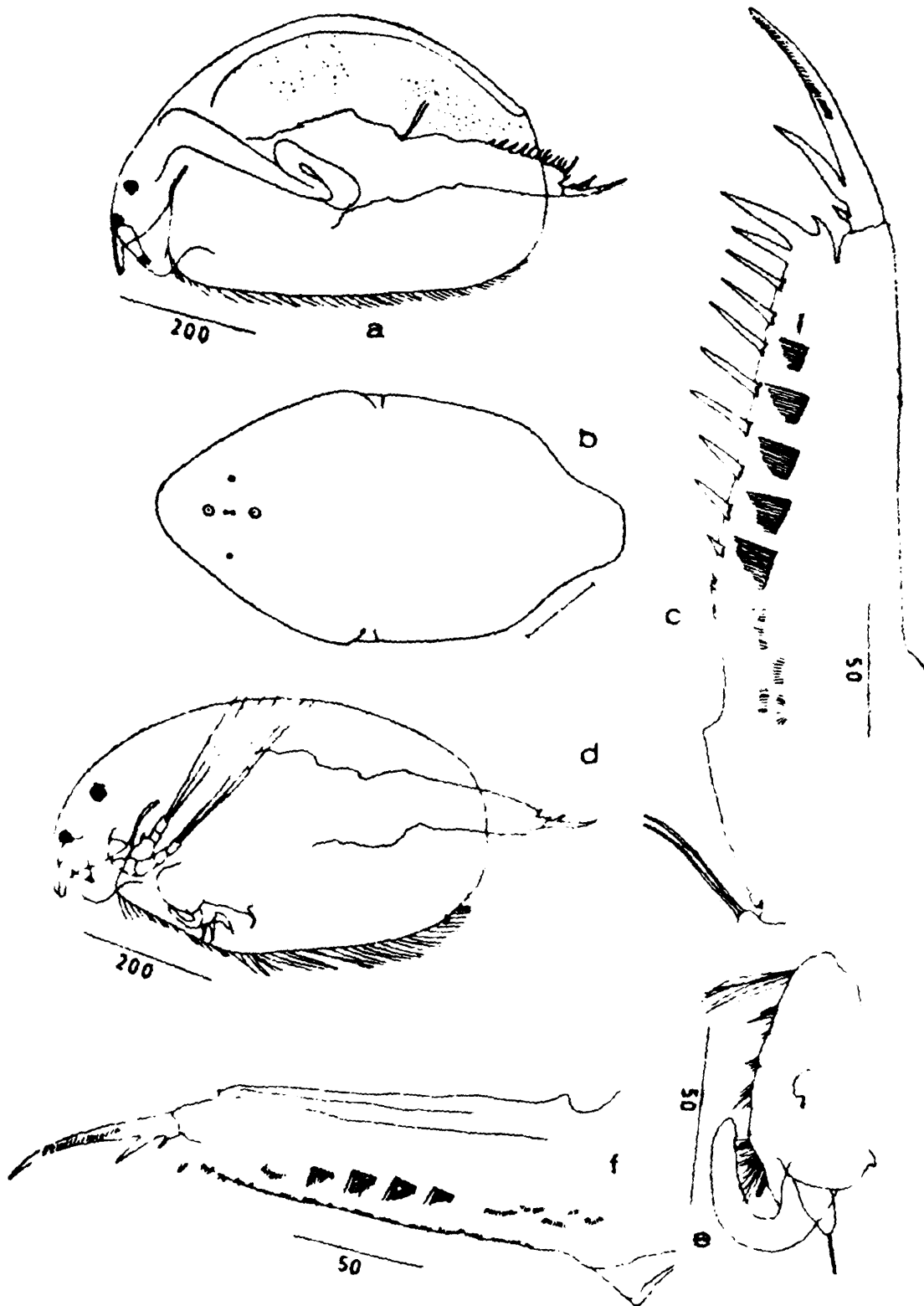
*Alona lindbergi* Brehm, 1953, p. 338-339, pl. 103-105.

*Oxyurlla singalensis* Fryer, 1957, p. 232 ; Green, 1962, p. 429, fig. 35 ; Smirnov, 1971, p. 497, figs. 625, 630-632 ; Fernando, 1974, figs. 156-157, 171 L ; Sharma, 1978, p. 150 ; Swar & Fernando, 1979, p. 126, figs. 66-69 ; Mamaril Sr. & Fernando, 1980, p. 148, figs. 203-204.

MATERIAL EXAMINED : *Reference material* : DGF 1524, Jagady pond, Trivandrum, 1.11.65. *Other materials* : BKS—West Bengal : Barisha (24-Parganas) 3.2.77 ; Maheshtala (24-Parganas) 4.2.77.

*Female* : Valves with dots and with lines parallel to the ventral margin. Antennules almost reaching apex of rostrum. Two separate main head pores, situated behind each other in median line

of head shield. Four small pores, two between the main pores, one behind the other and other two laterally about halfway between



Text-fig. 74, a-f : *Oxyurella siggalensis* (Daday) : a. female ; b. head shield ; c. postabdomen ; d. male ; e. leg I of male ; f. male postabdomen.

main pores. Distance between small lateral pores about equal to that between the main pores. Plate of labrum with blunt apex. Ocellus smaller than eye. Postabdomen slightly narrowing distally ; with 11-13 anal spines decreasing in size proximally. Distal anal spines longest, followed by short denticle at extreme distal end. Lateral setae in groups and arranged in a row. Claw large, with basal spine some distance from base and with one additional small spine at base of claw.

*Length* : 0.58 mm

*Male* : Posterodorsal and posteroventral corner of valves rounded. Ventral margin of valves with convexity in the middle ; shorter marginal setae before convexity and longer setae behind it. Valves indistinctly punctate. Postabdomen almost uniformly wide, but slightly tapering distally. Anal spines confined mostly to the rounded dorsal end of postabdomen. Ocellus smaller than eye. Leg I with well developed blunt hook.

*Length* : 0.56 mm

*Distribution* : INDIA—West Bengal (Sharma, 1978). Males recorded for the first time in India. Elsewhere—Ethiopian and Indo-Malayan regions, and from Northeast China.

83. **Oxyurella tenuicaudis** (Sars, 1862b)  
(Text-fig. 75, a-d)

*Camptocercus alonoides* Schoedler, 1858, p. 27 (no descriptions or drawing).

*Alona tenuicaudis* Sars, 1862b, p. 285-286 ; P. E. Müller, 1867, p. 179, p. 12, fig. 30, pl. fig. 24 ; Herrick, 1884, p. 95 ; Kurz, 1875, p. 52 ; Stingelin, 1906, p. 328 ; Scourfield & Harding, 1966, p. 41, fig. 91 ; Sramek-Husek *et al.*, 1962, p. 332-333, fig. 122 ; Herbst, 1962, p. 86-88, fig. 22.

*Alona camptocercoides* Schoedler, 1862, p. 24, pl. 1, figs. 8-10 ; Schoedler, 1862, p. 24-25, pl. 1, figs. 8-10.

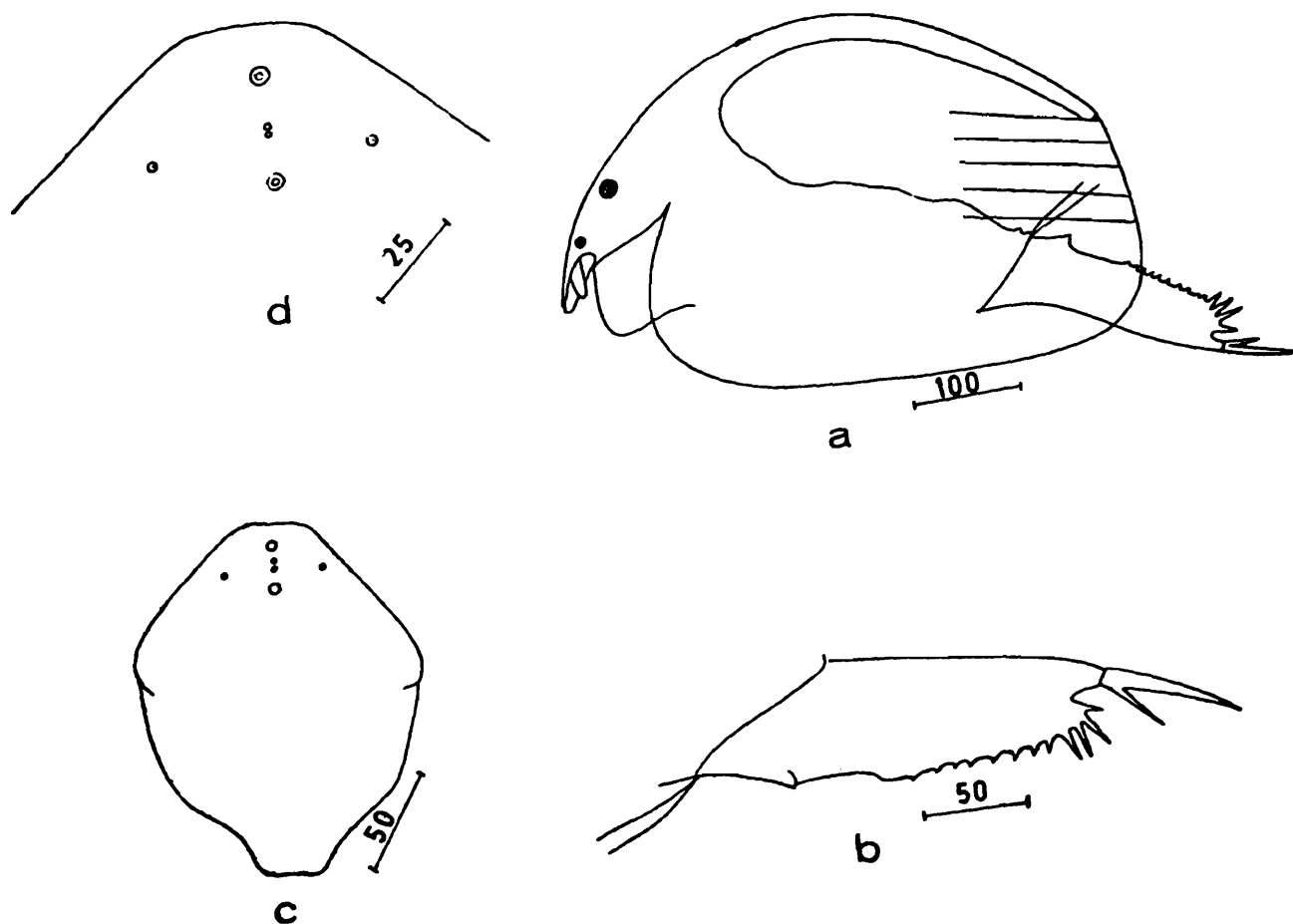
*Lynceus tenuicaudis* Norman & Brady, 1867, p. 25, 1, 9, fig. 3 ; Lilljeborg, 1900, p. 461-465, pl. 48, figs. 2-8.

*Euryalona tenuicaudis* Birge, 1910, p. 71, figs. 5-6.

*Oxyurella tenuicaudis* Dybowski & Grochowski, 1895, p. 151 ; Bening, 1941, p. 232 ; Brehm, 1959, p. 7 ; Frey, 1960, p. 695, fig.11 ; Goulden, 1966b, p.93, pl. 1, fig. 11 ; Smirnov, 1971, p. 492-494, figs. 622-624 ; Sharma, 1978, p. 150 ; Michael & Frey, 1983, p. 3-20, pl. 4, 5, 6, 7.

**MATERIAL EXAMINED :** *Reference material :* BKS 16, Sarisha, West Bengal, 8.5.75. *Other materials :* BKS—West Bengal : Thakurpukur (24-Parganas) 3.2.77.

*Female :* Body almost oval in outline. Posterodorsal corner of valves slightly below maximum height. Posteroventral corner rounded and with row of spinules on inner side. Valves marked with longitudinal lines. Rostrum short, slightly pointed and directed ventrally. Antennules not reaching apex of rostrum. Labral plate broadly rounded. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen narrowing distally,



Text-fig. 75,a-d : *Oxyurella tenuicaudis* (Sars) : a. female ; b. postabdomen ; c. head shield ; d. part of head shield (enlarged) showing head pores.

with 12-13 anal spines ; distal ones very large, last distal spine followed by a small spinule near the claws. Claws with long basal spine.

*Length* : 0.58 mm

*Male* : Not known from India.

*Distribution* : INDIA—West Bengal (Sharma, 1978). Elsewhere—Holarctic Region and European USSR.

### Genus 32. *Kurzia* Dybowski & Grochowski, 1894

*Alona* part Hellich, 1874. p. 219.

*Alonopsis* part Kurz, 1874, p. 40.

*Alonella* part Sars, 1891, p. 47.

*Kurzia* Dybowski & Grochowski, 1894, p. 380 ; Dybowski & Grochowski, 1895 p. 150 ; Bening, 1941. p. 261 ; Srámek-Husek *et al.*, 1962, p. 328 ; Herbst, 1962. p. 84 1 Sirnov. 1971. p. 396.

*Pseudalona* Sars, 1901, p. 85 ; Daday, 1910, p. 136.

*Female* : Body outline oval in shape. Dorsal margin of valves convex, ventral margin convex anteriorly concave in posterior half. Head shield with rounded posterior margin. Three main head pores situated in median line of head shield and small pores lateral to them ; distance from small pores to posterior margin of head shield shorter than distance between pores. Rostrum long and ventrally directed. Antennules narrow and elongate. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Intestine forming loops, with a caecum. Postabdomen long and narrow, with many anal spines. Claw with basal spine and row of small setae on concave margin. Vas deferens opening ventrally at base of claws. Five pairs of legs.

*Male* : Smaller than female. Posterodorsal and posteroventral corners of valves rounded.

Type species : *Kurzia latissima* (Kurz, 1875).

The genus *Kurzia* is represented in India by two species.

*Key to the Indian species of genus KURZIA*

Antennules almost reaching apex of rostrum.....*K. latissima* (Kurz. 1875)

Antennules reaching to middle of rostrum.....*K. longirostris* (Daday, 1898)

**84. *Kurzia longirostris* (Daday, 1898)**  
(Text fig. 76, a-d)

*Alona longirostris* Daday. 1898. p. 34, fig. 14, a-b.

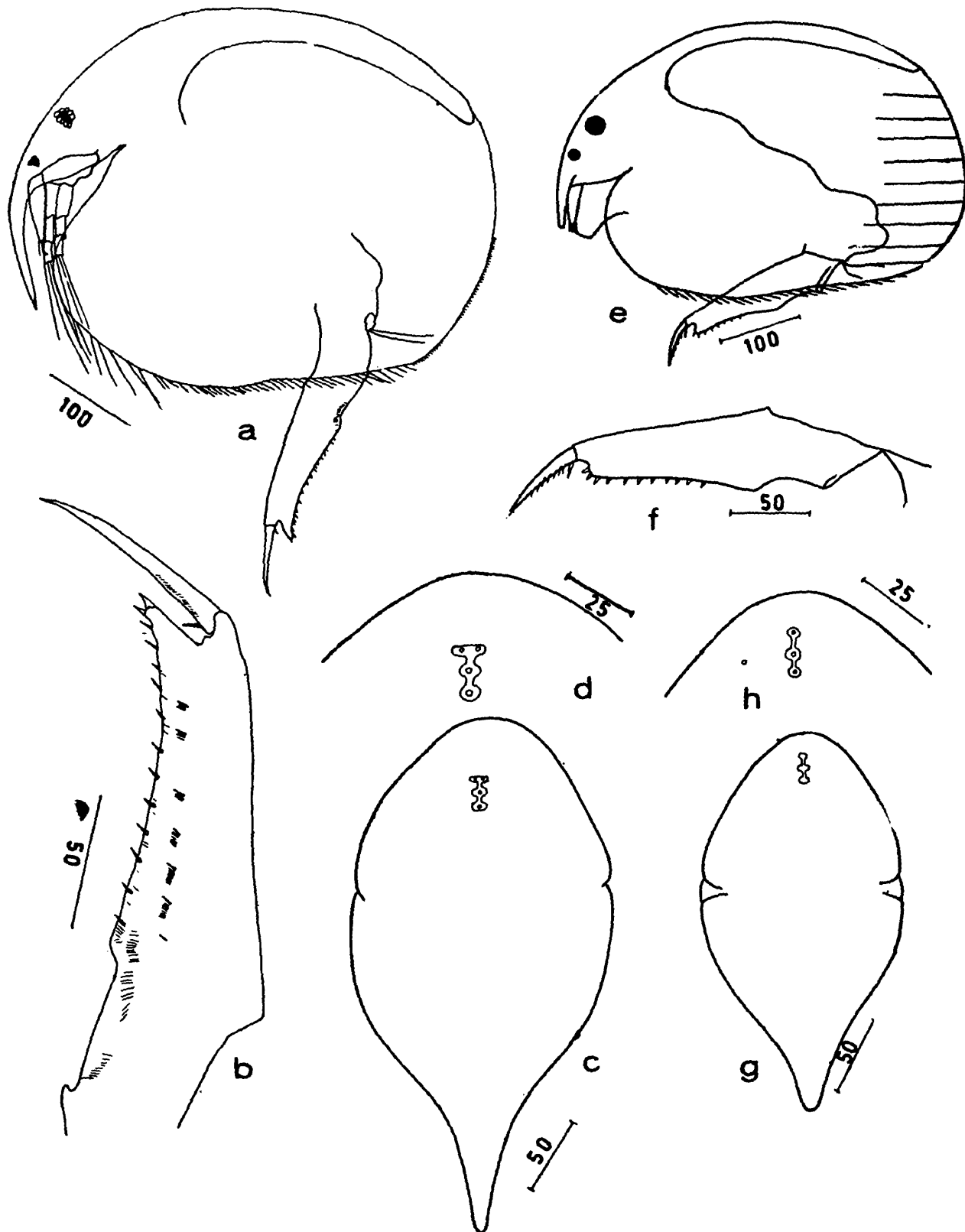
*Pseudalona longirostris* Sars. 1901, p. 87-88. pl. XXI, figs. 3, 3. a-b ; Daday, 1905. p. 184-185, pl. XI, fig. 18 ; Daday, 1910, p. 136, pl. 7, figs. 23-24 ; Bar, 1924, p. 111-112 ; Brehm, 1933b, p. 34-40. figs. 10-11 ; Sewell, 1935, p. 217 ; Gauthier 1937. p. 94-95, pl. VIIA ; Brehm, 1951b, pl 84-85. 91-92.

*Kurzia longirostris* Harding, 1956, p. 73, fig. 15 ; Smirnov, 1971, p. 399-400, figs, 479-482 ; Fernando, 1974, figs. 158-159, 171K ; Mamaril Sr. & Fernando. 1980, p. 145, figs. 173-177.

**MATERIAL EXAMINED :** *Reference material :* Sample 1, Madurai collected by Dr. N. Marugan, 1978. *Other materials :* Sample 9, Collairu Lake, collected by Prof. Y. Radhakrishna, 17.11.73 ; BKS—West Bengal : Sarisha (24-Parganas).

*Female :* Posterodorsal and posteroventral corners of valves rounded. Valves marked with longitudinal lines. Rostrum relatively long and slightly curved ventrally, apex or rostrum in line with median line of body. Head shield with rounded posterior margin. Three main head pores, connected by open channel transversely expanded at anterior region. Antennules reaching middle of rostrum. Antennae not reaching apex of rostrum. Plate of labrum with pointed apex. Ocellus smaller than eye, its distance from eye half as much as from rostrum. Postabdomen tapering distally distal corner produced. Preanal corner not projecting. Anal denticles 18-20. Claw with a basal spine and row of setae on concave margin.

*Length :* 0.50 mm



Text-fig. 76, a-d : *Kurzia longirostris* (Daday) : a. female ; b. postabdomen ; c. head shield ; d. part of head shield (enlarged) showing head pores.

Text-fig. 76, e-h : *Kurzia latissima* (Kurz) : a. female ; f. postabdomen ; g. head shield ; h. part of head shield (enlarged) showing head pores.

*Male* : Not known from India.

*Distribution* : INDIA—West Bengal (Sewell, 1935 ; Sharma, 1978).  
Elsewhere—Cosmotropical.

85. **Kurzia latissima** (Kurz, 1875)  
(Text-fig. 76, e-h)

*Alona tenuirostris* Hellich 1874, p. 129.

*Alona latissima* Kurz. 1875, p. 46-47, pl. 2. figs. 13-15 ; Herrick, 1884, p. 86,  
pl. E, fig. 8. pl. G. fig. 189 ; Stingelin, 1895, p. 242-243, pl. 7, fig. 31.

*Alona angusticaudata* Hudendorff, 1876, p. 5-56 pl. II, figs. 7. a-b.

*Alona latissima* Hellich, 1877. p. 84, fig. 46.

*Alonopsis media* Herrick, 1884, p. 86-87, pl. E, fig. 9.

*Alonella latissima* Sars. 1891, p. 47.

*Pseudalona latissima* Sars, 1901, p. 85-87, pl. 12, figs. 2, 2a-b ; Daday. 1905,  
p. 183-184, pl. 11, fig. 17.

*Kurzia latissima* Frey, 1959, p. 35. figs. 12-14 ; Frey, 1962, figs. 12-14 ; Herbst.  
1962, p. 84, fig. 59 ; Srámek-Husek *et al.*. 1962. p. 329, fig. 121 ; Smirnov.  
1971. p. 397-398. figs. 478-479.

**MATERIAL EXAMINED** : *Reference material* : BKS 17, Barisha  
(24-Parganas) West Bengal, 3.2.77.

*Female*: Posterodorsal corner rounded, situated slightly below level of the maximum height. Posteroventral corner rounded, without denticles. Valves marked with longitudinal lines. Head and valves forming semicircular dorsal arch. Dorsal keel present, head keel absent. Head shield with long rostrum and rounded posterior margin ; three connected head pores. Antennules not reaching apex of rostrum. Ocellus situated nearer to eye than to apex of rostrum. Postabdomen long, narrow, slightly tapering distally ; with 12 marginal anal spines. Claw with basal spine and row of setae on concave margin.

*Length* : 0.59 mm

*Male* : Not known from India.

*Distribution* : INDIA—West Bengal (Sharma, 1978). Elsewhere—Holarctic and Neotropical Regions and European USSR.

Genus 34. **Euryalona** Sars, 1901

*Alonopsis* Daday, 1898, p. 45.

*Euryalona* Sars, 1901, p. 80-81 ; Daday, 1910, p. 134 ; Sars, 1916, p. 341 ; Smirnov, 1971, p. 497-498.

*Female* : Body almost quadrangular in outline. Posterodorsal and posteroventral corners of valves rounded, without denticles. Valves with indistinct sculpture. Head shield with blunt rostrum and rounded posterior margin ; only one main head pore. Antennules almost reaching apex of rostrum. Setae on antennae 1-1-3/0-0-3. Plate of labrum with convex anterior margin. Ocellus smaller than eye. Postabdomen long, narrow with anal spines and lateral setae. Claw with basal spine and with setae on proximal part of concave margin. Anus situated in proximal part of postabdomen.

*Male* : Smaller than female. Vas deferens opening in middle of ventral side of postabdomen.

Type species : *Eurryalona orientalis* (Daday, 1898).

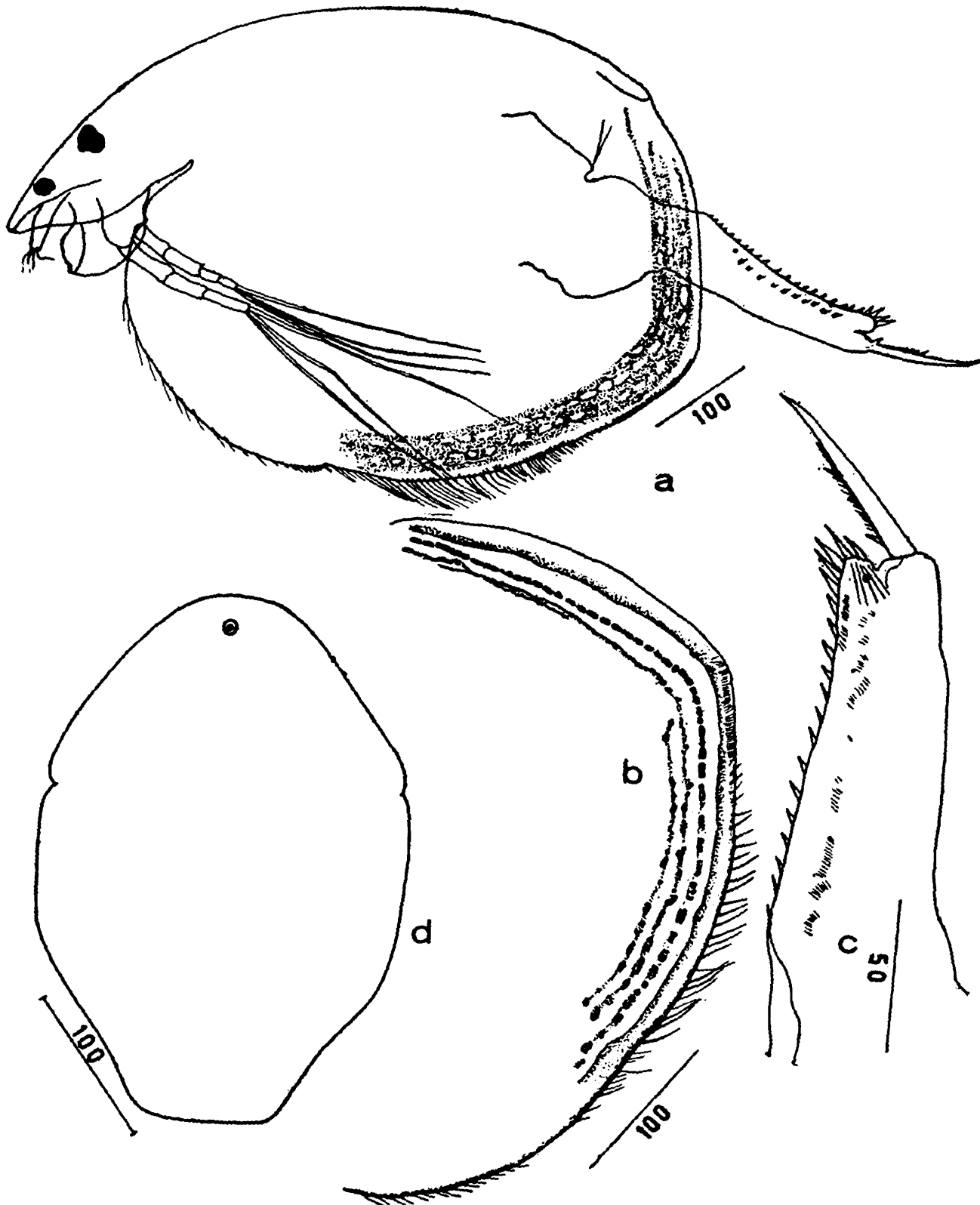
Of the three species (Smirnov, 1971) included in this genus, only one is represented in India.

86. **Euryalona orientalis** (Daday, 1898)  
(Text-fig. 77, a-d)

*Alonopsis orientalis* Daday, 1898, p. 45-48, figs. 21-22.

*Euryalona occidentalis* Sars, 1901, p. 81-84, pl. XII, figs. 1, 1,a-h ; Harding, 1957, p. 73-74, fig. 16 ; Brooks, 1959, p. 637, figs. 27.80 ; Green, 1962, p. 427, figs. 32-33.

*Euryalona orientalis* Daday, 1905, p. 180-181, pl. XI, figs. 14-15 ; Daday, 1910, p. 134-135, pl 7, figs. 18-20 ; Gauthier, 1930, p. 100-101, fig. 4 ; Brehm, 1939, p. 8-9 ; Brehm, 1951a, p. 85, fig. 1, e-f ; Brehm, 1953, p. 340—341 ;



Text-fig. 77, a-d : *Euryalona orientalis* (Daday) : a. female ; b. posteroventral margin (enlarged) ; c. postabdomen ; d. head shield.

Smirnov, 1971, p. 498-499, figs. 633-637 ; Fernando, 1974, figs. 152-153, 171 I ; Sharma, 1978, p. 150 ; Mamaril Sr. and Fernando, 1980, p. 146, figs. 182-185.

**MATERIAL EXAMINED :** *Reference material :* DGF 1513 ; Kovur village tank, near Madras, 7.1.65. *Other materials :* DGF 1715, Buderu tank, near Poondi Reservoir, near Madras, 7.1.65 ; DGF 1522, tank South of Yanamalai hill, Madurai, 9.1.65 ; Sample 10, Collairu lake, collected by Prof. Y Radhakrishna, 17.12.73 ; BKS—West Bengal : Baranagar (Calcutta) 16.3.77 ; Maheshtala (24-Parganas) 4.12.77.

*Female :* Posteroventral corner of valves rounded, without denticles. Ventral margin of valves with a blunt process before middle ; middle region of ventral margin with setae arising some distance from the margin. Margin of valves with several concentric rows of weak dots. Anterior margin of valves with fine setae. Head shield with blunt anterior and rounded posterior margin. A single median head pore. Antennules reaching apex of rostrum. Plate of labrum with convex anterior margin and blunt apex. Ocellus smaller than eye and situated halfway between eye and apex of rostrum. Postabdomen narrow and slightly curved ; with about 20 anal denticles, decreasing in size proximally. Claw with basal spine and with setae on proximal half of concave margin.

*Length :* 0.63 mm

*Male :* Not observed in the present material.

*Distribution :* INDIA—West Bengal (Sharma, 1978). Elsewhere—Indo-Malayan, Ethiopian and Neotropical regions.

#### Genus 34. **Indialona** Petkovski, 1966

*Indialona* Petkovski, 1966, p. 157-165 ; Smirnov, 1971, p. 501-502.

*Female :* Head shield with rounded anterior and posterior margins. A single main head pore. Mandibles articulated between head shield and valves. Postabdomen tapering towards base of claws without forming dorsal corner. Postabdominal armature consisting of 4-5 groups of setae from dorsal margin posteriorly

and upward (i.e., on lateral surface of postabdomen). Claw with one basal spine.

*Male* : Unknown.

*Key to the Indian species of genus Indialona*

Postabdomen tapering towards base of claws but forming a distal dorsal corner. Anal denticles absent.....*I. ganapati* Petkovski, 1966

Postabdomen with protruding distal dorsal corner. Anal denticles very small.....*I. globulosa* (Daday, 1898)

**87. *Indialona ganapati* Petkovski, 1966**  
(Text-fig. 78, a-b)

*Indialona ganapati* Petkovski, 1966, p. 157-165, pl. 1-9 ; Smirnov, 1971, p. 502, fig. 640.

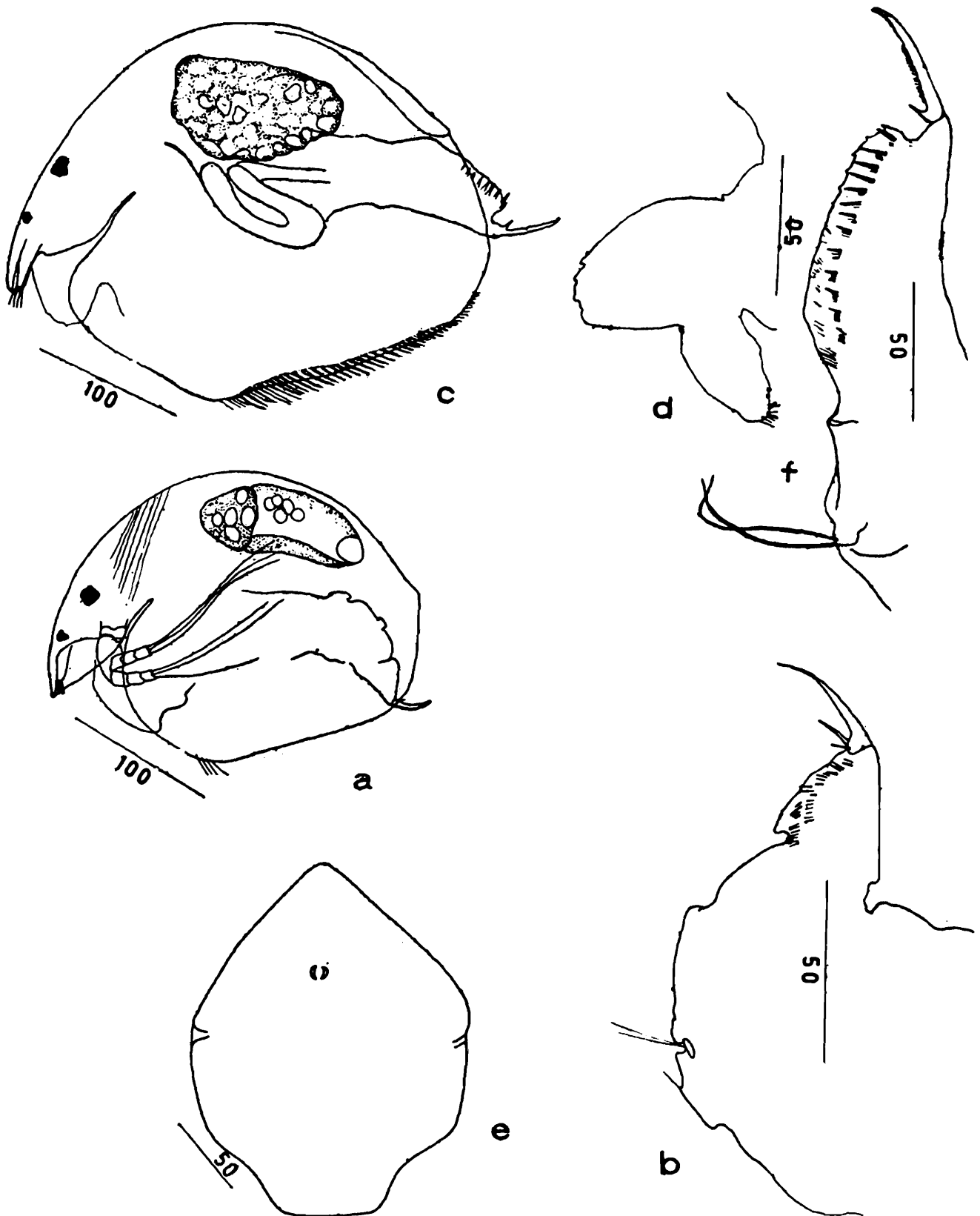
**MATERIAL EXAMINED** : *Reference material* : CHF 11, Bhopal lake, Bhopal, collected by Dr. Bhatnagar.

*Female* : Body almost oval in outline with maximum height anterior to middle region. Posterodorsal corner of valves distinct and posteroventral corner rounded, without spinules. Valves with sparse setae on ventral margin. Valves marked with pattern of small polygons. Head shield with rounded anterior and posterior margins. A single head pore. Antennules almost reaching apex of rostrum. Aesthetes of almost uniform length, as long as the rostrum. Setae on antennae : 0-0-3/1-1-3 ; seta of proximal segment small, reaching apex of third segment Ocellus smaller than eye and situated halfway between eye and apex of rostrum. Postabdomen tapering towards base of claw without forming a dorsal corner, with 4-5 groups of setae on lateral surface. Pre and postanal parts of postabdomen of almost equal size. Claw with one basal spine and setule.

*Length* : 0.25 mm

*Male* : Not reported from India.

*Distribution* : Ahmedabad, Bhopal (India).



Text-fig. 78, a-b : *Indialona ganapati* Petkovski : a. female ; b. postabdomen.

Text-fig. 78, c-e : *Indialona globulosa* (Daday) : c. female ; d. plate of labrum ; e. headshield ; f. postabdomen.

88. **Indialona globulosa** (Daday, 1898)  
(Text-fig. 78, c-f)

*Alona globulosa* Daday, 1898, p. 37-38, fig. 16.

*Alonella sculpta* Sars, 1901, p. 63-64, pl. X, fig. 6, 6a,

*Alonella globulosa* Daday, 1905, p. 165-166, pl. X, figs. 8-9.

*Alona sculpta* Stingelin, 1904, p. 353-354, pl. 12, figs. 24-25 ; Brehm, 1956, p. 225-226, fig. 4.

*Indialona globulosa globulosa* Smirnov, 1971, p. 503-504, figs. 642-643.

*Indialona globulosa* Fernando, 1974, figs. 116-118, 171 j ; Sharma, 1978, p. 150 ; Mamaril Sr. & Fernando, 1980, p. 146, figs. 186-190.

**MATERIAL EXAMINED :** *Reference material :* DGF 1524, Jagady Pond, Trivandrum, 11.1.65. *Other materials :* DGF 1525, pond in Jagady, Trivandrum, 11.1.65 ; Sample 4, Madurai, collected by Mr. Anthony Basil, 11.12.77 ; BKS—West Bengal : Achipur (24-Parganas) 30.1.77 ; Baruipur (24-Parganas) 1.9.75 ; Memanpur (24-Parganas) 4.12.77.

*Female :* Body oval and rounded in outline. Posterodorsal corner of valves distinct, posteroventral corner rounded and without denticles. Valves with distinct lines. Rostrum blunt. Posterior margin of head shield angular. A single head pore. Antennules not reaching apex of rostrum. Plate of labrum with bluntly denticulate pointed apex, though broad in some cases. Ocellus smaller than eye and situated slightly nearer to eye than to apex of rostrum. Postabdomen broadest near anus, with distinct preanal corner. Anal margin concave, with setae. Anal spines very small. About 11-13 lateral groups of setae. Claw with single basal spine.

*Length :* 0.32 mm

*Male :* Not reported from India.

*Distribution :* INDIA—West Bengal (Sharma, 1978). Elsewhere—Indo—Malayan, Neotropical and Nearctic regions.

Family VII. POLYPHEMIDAE Baird, 1845

Body and legs not covered with a carapace. Body short ; with four pairs of stout jointed legs, bearing branchial lobes.

*Type genus* : *Polyphemus* O.F. Müller, 1785.

Represented by only the genus *Polyphemus* in India.

Genus 35. **Polyphemus** O.F. Müller, 1785

Body very short. Carapace reduced into large globular broad sac. Caudal process long, slender and with 2 long caudal stylets. Antennae with 3- and 4-segmented rami. Labrum large. Eye very large, ocellus absent. Two small hepatic caecae.

*Type species* : *Polyphemus pediculus* (Linné, 1761).

89. **Polyphemus pediculus** (Linné, 1761)  
(Text-fig. 79, a)

*Polyphemus pediculus* Herrick & Turner, 1895, p. 266, pl. LVIII, figs. 4-6, LXIX, fig. 1 ; Lilljeborg, 1900, p. 594, tab. LXXIX, figs. 22-31 ; LXXX, figs. 1-9 ; Sars, 1903, p. 30 ; Keilhack, 1909, p. 107, figs. 260-261 ; Ueno, 1927, p. 297, pl. XXVIII, figs. 29, 29, a-g ; Ueno, 1933, p. 312 ; Ueno, 1937, p. 208 ; Pennak, 1953, p. 381, fig. 239H ; Brooks, 1959, p. 598-599 ; fig. 27.3 ; Scourfield & Harding, 1966, p. 49, fig. 15.

**MATERIAL EXAMINED** : *Reference material* : CHF 3, eutrophic pond, Srinagar, Kashmir, 1977. *Other materials* : CHF 4, eutrophic pond, Srinagar, Kashmir, 1977.

*Female* : Colourless or brownish. Head large, its frontal region filled by large movable eye. Antennules very small, situated on ventral surface of head. Antennae with 7 setae on each ramus. Legs stout, with strong claws and branchial lobes ; fourth pair of legs very small. Brood sac globular.

*Length* : 0.82 mm

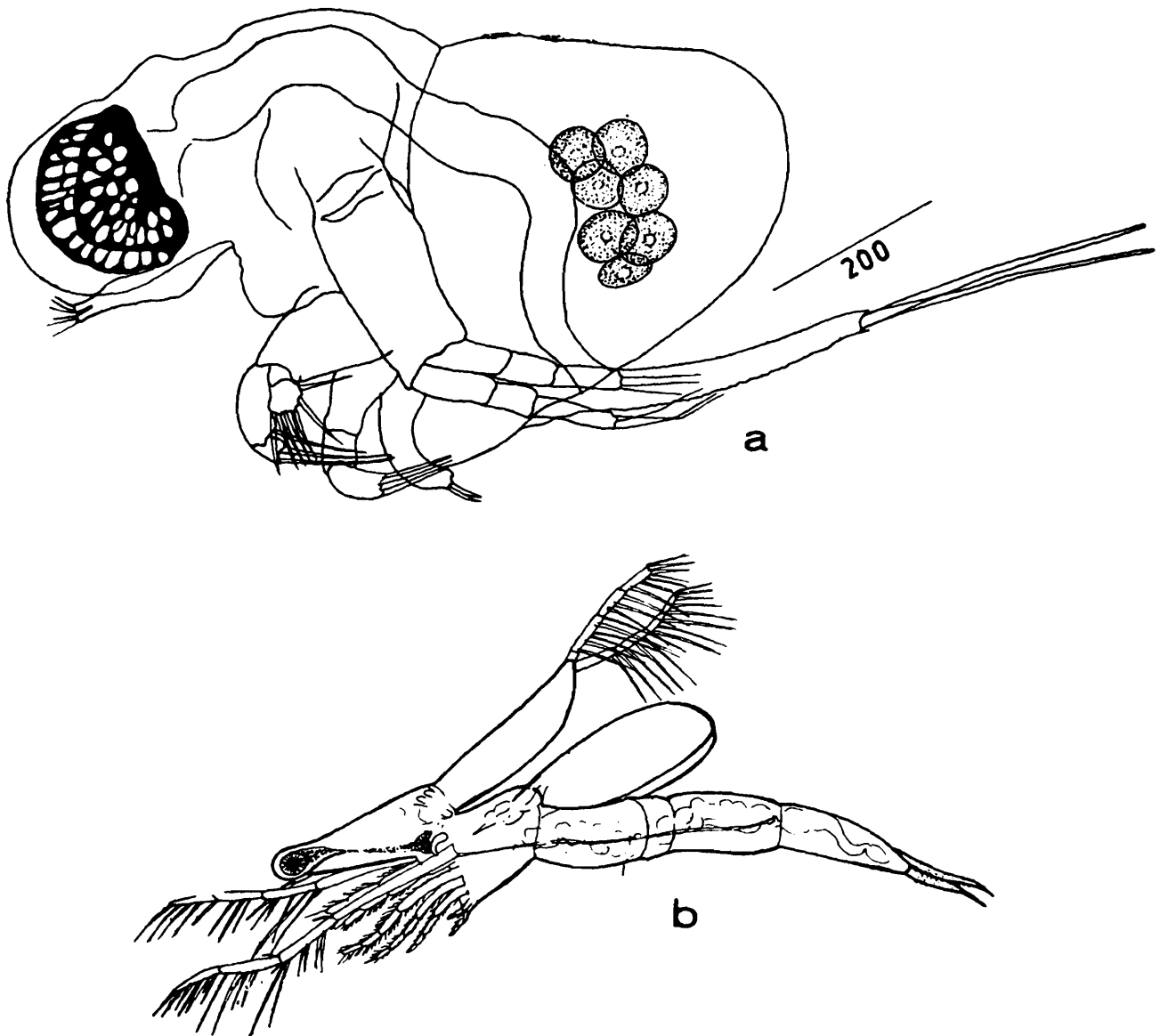
*Male* : Not reported from India.

*Distribution* : INDIA—Kashmir (Brehm, 1936). Elsewhere—Holarctic.

Family VIII. LEPTODORIDAE Lilljeborg, 1861

Body and legs not covered by carapace ; carapace reduced to small brood sac. Body long, with six pairs of legs ; branchial lobes absent. Only one genus *Leptodora* known.

Type genus : *Leptodora* Lilljeborg, 1861.



Text-fig. 79,a : *Polyphemus pediculus* (Linne) : female.

Text-fig. 79, b : *Leptodora kindti* (Focke) : female ; (after Pennak, 1953).

Genus 36. **Leptodora** Lilljeborg, 1861

*Leptodora* Lilljeborg, 1861 ; Ueno, 1927, p. 298 ; Brooks, 1959, p. 598.

Head slender and elongated ; eyes large and filling anterior end of head. Body divided into 4 parts. Thorax bearing six legs and dorsal brood sac. Abdomen clearly divided into 3 segments. Post-abdomen not reflexed, with 2 short stylets. Antennules small and freely movable. Antennae with very large basal segment ; rami 4-segmented, with numerous setae. Mandibles long, slender, pointed and with 2 spines near apex. First pair very long ; all legs prehensile and without branchial lobes. Winter eggs hatch into metanauplius.

Type species : *Leptodora kindti* (Focks, 1844)

90. **Leptodora kindti** (Focks, 1844)  
(Text-fig. 79, b)

*Leptodora kindti* Lilljeborg, 1900, p. 652, Tab. LXXXVII, figs. 4-13 ; Sars, 1903, p. 31 ; Keilhack, 1909, p. 109, figs. 264-265 ; Ueno, 1927, p. 298, pl. XXVIII, figs. 30, 30a ; Ueno, 1937, p. 208 ; Ueno, 1938a ; Brooks, 1959, p. 598, fig. 27.2 ; Scourfield & Harding, 1966, p. 49, fig. 16 ; Fernando, 1974, fig. 27.

*Leptodora kindti* Ueno, 1933 p. 312.

*Leptodora hyalina* Weismann, 1874, p. 349, tab, XXXIII-XXXVIII, Herrick & Turner, 1895. p. 268 ; Brehm, 1936, p. 286-287.

MATERIAL EXAMINED : *Reference material* : As per description in the literature. *Other material* : ZSI C 1717/2, Srinagar, Kashmir, collected by Dr. Raj Tilak, September, 1977 (only 3 specimens, but badly preserved and skewed)

*Female* : Largest known species in Cladocera. Transparent, predaceous, though its weak mandibles prevent it from devouring any tough plankters.

*Male* : Not reported from India.

*Distribution* : INDIA—Kashmir (reported as *L. hyalina* by Brehm, 1936). Elsewhere—Holarctic region.

## GENERAL REMARKS

With the completion of this study, 90 cladoceran species (93 taxa), belonging to 37 genera have now been reported from India. In addition, two marine species are also known from this country. The reported Indian taxa comprises about  $\frac{1}{4}$  of the world's cladoceran fauna. Of these, the freshwater species represent eight out of the 11 presently distinguished families of this Order. The marine forms belong to the families Sididae and Podonidae. Of these families, the former also includes a number of freshwater taxa. Hence, in all, nine cladoceran families are known from India.

As a result of the present study, eight species are reported for the first time from India. Further, the distribution of many species has been shown to extend to parts of this country from which they were previously unknown. While the descriptions of most of the reported species are based on the examination of parathenogenetic females, and in some cases also on ephippial females, the males of 11 taxa are also documented and described in the present account. This study also includes the first description of the male of *Alona pulchella* King, 1853. Another chydorid i.e., *Alona taraporevalae* Shirgur & Naik, 1977 has been redescribed (Sharma and Michael, 1981).

The cladoceran fauna of India shows a number of palaeartic and temperate elements such as *Leptodora kindti*, *Polyphemus pediculus*, *Diaphanosoma brachyurum*, *Sida crystallina*, *Daphniopsis tibetana*, *Daphnia magna*, *Daphnia longispina*, *Ceriodaphnia quadrangula*, *Macrothrix laticornis*, *Macrothrix grönlandica*, *Eurycercus lamellatus*, *Alonella exigua*, *Pleuroxus aduncus*, *P. denticulatus*, *P. trigonellus* and *Acroperus angustatus*. Only two species, *Indialona ganapati*, and *Alona taraporevalae* seem to be endemic. In addition, and not surprisingly, tropical, subtropical and cosmopolitan species are well represented in the Indian fauna.

A comparison of the reported cladoceran species from India with other South-Asian countries (TABLE : III) shows that the present account deals with more species than have so far been described from these countries. This is mostly due to the high

representation of chydorids in our collections, followed by the daphniids.

A list of taxa reported from India and adjacent countries, Sri Lanka, Nepal, Tibet, Bangladesh and Pakistan has been compiled and presented in TABLE. IV It is seen that the maximum number of species is reported from India, with fairly high number of species from Sri Lanka. In view of this resemblance between the two countries, the degree of percentage similarity expressed by Sorensen's Index was found to be 64.8% (Sorensen, 1948). It was not possible to work out such indices for other neighbouring countries, as it is opined that the species lists available for these are still incomplete as evidenced from published literature.

TABLE III : COMPOSITION (NUMBER OF SPECIES) OF CLADOCERAN FAUNA OF SOUTH-ASIAN COUNTRIES

Families	COUNTRIES				
	India	Sri Lanka	Malaysia	Nepal	Philippines
Sididae	7	6	6	2	5
Daphniidae	19	8	6	10	6
Moinidae	5	2	3	1	4
Bosminidae	2	3	1	2	3
Macrothricidae	9	8	10	2	6
Chydoridae	46	33	38	22	25
Polyphemidae	1	—	—	—	—
Leptodoridae	1	—	—	—	—
<b>Total</b>	<b>90</b>	<b>60</b>	<b>64</b>	<b>39</b>	<b>49</b>

The Chydoridae, the largest family of the Order Cladocera, exceeds all other reported families in its species diversity in the fauna. A valuable monograph of World Chydoridae by Smirnov (1971) is useful in the Indian context though with certain limitations. The taxonomic and phylogenetic significance of the study

of number and arrangement of head pores in chydorids has been duly emphasised by a number of workers (Werner, 1924 ; Frey, 1959, 1960, 1962, 1967 ; Smirnov, 1971). The head pores have also been effectively studied in the present work and are found to be useful to distinguish various subfamilies, genera and at times even in specific determination of the members of this family.

Of the reported subfamilies of the Chydoridae, the Euryercinae is represented solely by *Euryercus lamellatus*, which appears restricted to the northern latitudes of India. On the other hand, the Chydorinae and Aloninae are represented by six and ten genera respectively. Amongst the genera included under the two latter subfamilies, there is still much discrepancy regarding the correct placement of certain species of *Chydorus*, *Alona*, *Camptocercus* and *Leydigia*. There is immense need to find out the geographical equivalents of the various species described from different parts of the globe. A number of species have been included in the genus *Indialona* though these species have some basic differences from the type species, *Indialona ganapati* Petkovski, 1966. Detailed study of such species complex needs to be conducted to reexamine their inclusion under this genus.

The Daphniidae comes second in the order of importance as far as species diversity from India is concerned. As mentioned elsewhere, the identity of a number of species of the genus *Daphnia* is still uncertain, in spite of regional monographic treatments and revisions by Johnson (1952), Brooks (1957) and recently by Hebert (1977). Hebert's work provides an excellent base to resolve discrepancies in different species of *Daphnia* and to ascertain if a population is exclusively composed of a single species or of a number of distinct species. The authors have already initiated studies on the populations of *Daphnia carinata*, *Daphnia cephalata* and *Daphnia* sp. (unpublished).

Still another difficult daphniid genus appears to be *Simocephalus*, in which original descriptions of a number of species were not well defined. This led to the proposal of a number of synonyms in earlier works, thus making specific determination still more difficult. In the examined Indian collections, *Simocephalus* is represented by five species. Of these, *S. vetulus* poses difficulty because of inadequate descriptions available for the closely related taxa, *S. vetuloides*

and *S. elizabethae*. Though *S. elizabethae* has been designated as a distinct subspecies of *S. vetulus* (Dumont and Van de Velde, 1977), the reports of *S. elizabethae* from India give no adequate clue to warrant its correct identity. Hence these earlier reports of this species are presently included under *S. vetulus*, without any sub-specific designation.

Another genus that poses difficulty is *Diaphanosoma* (Family : Sididae). Although represented by only four species in this account, the authors feel that more species are likely to be present in India. A revision of the Indian species of *Diaphanosoma* based on population studies, needs to be undertaken. In this context, an excellent revision of the species of *Diaphanosoma* from Argentina has recently been given by Paggi (1978). However, a world review of the species of this genus is being worked out by Dr. V. Korinek, Charles University, Prague (personal communication), who is also currently involved in a world review of yet another difficult genus *Bosmina* (Family : Bosminidae).

Important monographs on the Moinidae (Goulden, 1968) and Moinidae and Macrothricidae (Smirnov, 1976) have been used to identify different reported species of genus *Moina* (Family : Moinidae). Of the family Macrothricidae, Indian species of the genus *Macrothrix* are in need of revision. When differentiating the various species under this genus, emphasis should be given to the study of head shields, head pores and also to the dorsal configuration and setulation of the postabdomen (Dumont and Van de Velde, 1977).

As a result of the present monographic treatment, it is indicated that the Cladoceran fauna of this country is rich and varied. This study presents interesting forms which inhabit a wide range of habitats. Though maximum efforts were made to collect and examine the material from various parts of India, further collections particularly from Northern latitudes and also from other parts of this country are essential. These may reveal many more cladoceran taxa. It is hoped that the present monograph will prove to be of value for future Indian systematists working on this group and as well be of use for hydrobiologists in general.

TABLE IV : A COMPARATIVE LIST OF FRESHWATER CLADOCERAN TAXA REPORTED FROM INDIA AND ADJACENT COUNTRIES OF THE SUB-CONTINENT

Taxa	Countries					
	India	Sri-Lanka	Nepal	Tibet	Bangladesh	Pakistan
<b>SIDIDAE</b>						
<i>Pseudosida bidentata</i> Herrick	+	+	—	—	—	—
<i>Sida crystallina</i> (O.F. Müller)	+	—	—	—	—	—
<i>Latonopsis australis</i> (Sars)	+	+	—	—	—	—
<i>Diaphanosoma sarsi</i> Richard	+	+	+	—	—	—
<i>D. excisum</i> Sars	+	+	+	—	—	—
<i>D. senegal</i> Gauthier	+	—	—	—	—	—
<i>D. brachyurum</i> (Lievin)	+	—	—	—	+	—
<i>D. leuctenbergianum</i> Fischer	—	—	—	—	+	—
<b>DAPHNIIDAE</b>						
<i>Ceriodaphnia cornuta</i> Sars	+	+	+	—	+	—
<i>C. reticulata</i> (Jurine)	+	—	+	—	+	—
<i>C. quadrangula</i> (O.F. Müller)	+	—	+	—	—	—
<i>C. laticaudata</i> P. E. Müller	+	—	—	—	+	—
<i>C. pulchella</i> Sars	+	—	+	+	—	—
<i>C. dubia</i> Richard	—	+	—	—	—	—
<i>Daphnia carinata</i> King	+	—	—	—	—	—
<i>D. lumholtzi</i> Sars	+	+	+	—	+	+
<i>D. cephalata</i> (King)	+	—	—	—	—	—
<i>D. pulex</i> Leydig emend. Scourfield	+	—	+	—	—	+
<i>D. obtusa</i> Kurz	+	—	—	—	—	—
<i>D. magna</i> Straus	+	—	—	—	+	+
<i>D. longispina</i> O.F. Müller	+	—	+	+	+	—
<i>D. hyalina</i> Leydig	—	—	—	—	—	+
<i>D. psittacea</i> Baird	—	—	—	—	—	+
<i>Daphniopsis tibetana</i> Sars	+	—	—	—	—	—
<i>Scapholeberis kingi</i> Sars	+	+	—	—	+	—
<i>S. mucronata</i> (O.F. Müller)	—	—	—	+	—	—
<i>S. sp.</i>	—	—	—	—	+	—
<i>Simocephalus vetulus</i> (O.F. Müller)	+	+	+	+	+	+
<i>S. exspinosus</i> (Koch)	+	—	—	—	+	—
<i>S. latirostris</i> Stingelin	+	—	—	—	—	—
<i>S. acutirostratus</i> (King)	+	+	—	—	—	—
<i>S. serrulatus</i> (Koch)	+	—	—	—	—	—
<i>S. sp.</i>	—	—	—	—	+	—

Taxa	Countries					
	India	Sri Lanka	Nepal	Tibet	Bangladesh	Pakistan
<b>MOINIDAE</b>						
<i>Moina micrura</i> Kurz	+	+	+	—	—	—
<i>M. weismanni</i> Ishikawa	+	—	—	—	—	—
<i>M. macrocopa</i> (Straus)	+	—	—	—	+	+
<i>M. brachiata</i> (Jurine)	+	—	—	+	—	+
<i>Moinodaphnia macleayi</i> (King)	+	+	—	—	—	—
<b>BOSMINIDAE</b>						
<i>Bosmina longirostris</i> (O.F. Müller)	+	+	+	—	+	—
<i>Bosmina</i> sp.	—	+	—	—	—	—
<i>Eubosmina coregoni</i> (Baird)	—	—	+	—	—	—
<i>Bosminopsis dietersi</i> Richard	+	+	—	—	+	—
<b>MACROTHRICIDAE</b>						
<i>Macrothrix spinosa</i> King	+	+	—	—	—	—
<i>M. goeldii</i> Richard	+	—	—	—	—	—
<i>M. laticornis</i> (Fischer)	+	—	+	—	+	+
<i>M. groenlandica</i> Lilljeborg	+	—	—	—	—	—
<i>M. hirsuticornis</i> Norman & Brady	?	—	—	+	—	—
<i>Echinisca rosea</i> (Lievin)	—	—	—	—	+	—
<i>E. triserialis</i> (Brady)	+	+	+	—	—	—
<i>E. odiosa</i> (Gurney)	+	+	—	—	—	—
<i>E. capensis</i> Sars	—	+	—	—	—	—
<i>E. shadini</i> (Mukhamediev)	—	+	—	—	—	—
<i>Streblocerus serricaudatus</i> (Fischer)	+	—	—	—	+	—
<i>Grimaldina brazzai</i> Richard	—	+	—	—	—	—
<i>Guernella raphaelis</i> Richard	+	+	—	—	—	—
<i>Ilyocryptus spinifer</i> Herrick	+	+	—	—	—	+
<b>CHYDORIDAE</b>						
Eurycercinae						
<i>Eurycercus lamellatus</i> (O.F. Müller)	+	—	—	—	—	—
<i>Eurycercus</i> sp.	—	—	+	—	—	—
Chydorinae and Aloninae						
<i>Plaeuroxus aduncus</i> (Jurine)	+	—	+	—	—	—
<i>P. trigonellus</i> (O.F. Müller)	+	—	—	—	—	—
<i>P. similis</i> Vavra	+	+	+	—	—	—
<i>P. denticulatus</i> Birge	+	—	—	—	—	—

Taxa	Countries					
	India	Sri Lanka	Nepal	Tibet	Bangladesh	Pakistan
<i>P. laevis</i> Sars	+	—	+	—	—	—
<i>Alonella excisa</i> (Fischer)	+	+	+	—	—	—
<i>A. nana</i> (Baird)	+	—	+	—	—	—
<i>A. exigua</i> (Lilljebord)	+	—	+	—	—	—
<i>Chydorus sphaericus</i> (O.F. Müller)	+	+	+	+	+	—
<i>C. faviformis</i> Birge	+	—	—	—	—	—
<i>C. parvus</i> Daday	+	+	+	—	—	—
<i>C. cf. herrmanni</i> Brehm	+	—	—	—	—	—
<i>C. kallipygos</i> Brehm	+	—	—	—	—	—
<i>C. reticulatus</i> Daday	+	+	—	—	—	—
<i>C. ventricosus</i> Daday	+	+	—	—	—	—
<i>C. barroisi</i> (Richard)	+	+	+	—	—	—
<i>C. pubescens</i> Sars	+	—	—	—	—	—
<i>C. eurynotus</i> Sars	?	+	+	—	—	—
<i>C. sp.</i>	—	—	—	—	+	—
<i>Dunhevedia crassa crassa</i> King	+	+	+	+	—	—
<i>D. crassa cilio-caudata</i> Sovinski	+	—	—	—	—	—
<i>D. serrata</i>	+	+	—	—	—	—
<i>Dadaya macrops</i> (Daday)	+	+	—	—	—	—
<i>Pseudochydorus globosus</i> (Baird)	+	+	—	—	—	—
<i>Alona quadrangularis</i> (O.F. Müller)	+	—	+	—	—	—
<i>A. rectangula rectangula</i> Sars	+	—	+	—	+	—
<i>A. rectangula richardi</i> (Stingelin)	+	—	—	—	—	—
<i>A. davidi davidi</i> Richard	+	+	—	—	—	—
<i>A. davidi punctata</i> (Daday)	+	—	—	—	—	—
<i>A. costata</i> Sars	+	+	+	—	—	—
<i>A. pulchella</i> King	+	+	—	—	—	—
<i>A. guttata</i> Sars	+	+	—	+	—	—
<i>A. taraporevalae</i> Shirgur & Naik	+	—	—	—	—	—
<i>A. harpularia</i> Sars	—	+	—	—	—	—
<i>A. monacantha</i> Sars	—	+	—	—	—	—
<i>A. monacantha tridentata</i> (Stingelin)	+	—	—	—	—	—
<i>A. setosa</i> Megard	—	+	—	—	—	—
<i>Acroperus harpae</i> (Baird)	+	—	—	—	—	—
<i>Acroperus angustatus</i> Sars	+	—	—	—	—	—
<i>Camptocercus rectirostris</i>	+	—	—	—	—	—

Taxa	Countries					
	India	Sri Lanka	Nepal	Tibet	Bangladesh	Pakistan
<b>Schoedler</b>						
<i>Camptocercus macrourus</i> Baird	—	—	—	—	+	—
<i>Leydigia acanthocercoides</i> (Fischer)	+	+	—	—	—	—
<i>L. australis</i> Sars	—	+	—	—	—	—
<i>L. australis ceylonica</i> (Daday)	+	+	—	—	—	—
<i>L. ciliata</i> Gauthier	—	—	+	—	—	—
<i>Graptoleberis testudinaria</i> (Fischer)	+	+	+	—	—	—
<i>Biapertura affinis</i> (Leydig)	+	+	+	—	—	—
<i>B. karua</i> (King)	+	+	+	—	—	—
<i>B. intermedia</i> (Sars)	—	+	+	—	+	—
<i>B. verrucosa</i> (Sars)	+	+	+	—	—	—
<i>Oxyurella singalensis</i> (Daday)	+	+	+	—	—	—
<i>O. tenuicaudis</i> (Sars)	+	—	—	—	+	+
<i>Kurzia longirostris</i> (Daday)	+	+	—	—	—	—
<i>K. latissima</i> (Kurz)	+	—	—	—	—	—
<i>Euryalona orientalis</i> (Daday)	+	+	—	—	—	—
<i>Indialona ganapati</i> Petkovski	+	—	—	—	—	—
<i>I. globulosa</i> (Daday)	+	+	—	—	—	—
<i>I. macronyx</i> (Daday)	—	+	—	—	—	—
<i>I. annandalei</i> (Daday)	—	—	—	+	—	—
<b>POLYPHEMIDAE</b>						
<i>Polyphemus pediculus</i> (Linné)	+	—	—	—	—	—
<b>LEPTODORIDAE</b>						
<i>Leptodora kindti</i> (Focke)	+	—	—	—	—	—

+ = Reported

— = not reported

? = doubtful report

\* = *Camptocercus macrourus* Baird = *Camptocercus lilljeborgi* Schoedler

The reports from various countries are based on the works of :

INDIA = Present study

SRI LANKA = Fernando (1980)

NEPAL = Brehm (1953), Uéno (1966b), Loffler (1969), Hickel (1973), Dumont &amp; Van de velde (1977) and Swar &amp; Fernando (1979).

TIBET = Daday (1908)

BANGLADESH = Das &amp; Bhuiyan (1974) and Khan et al., (1978)

PAKISTAN = Arora (1931).

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