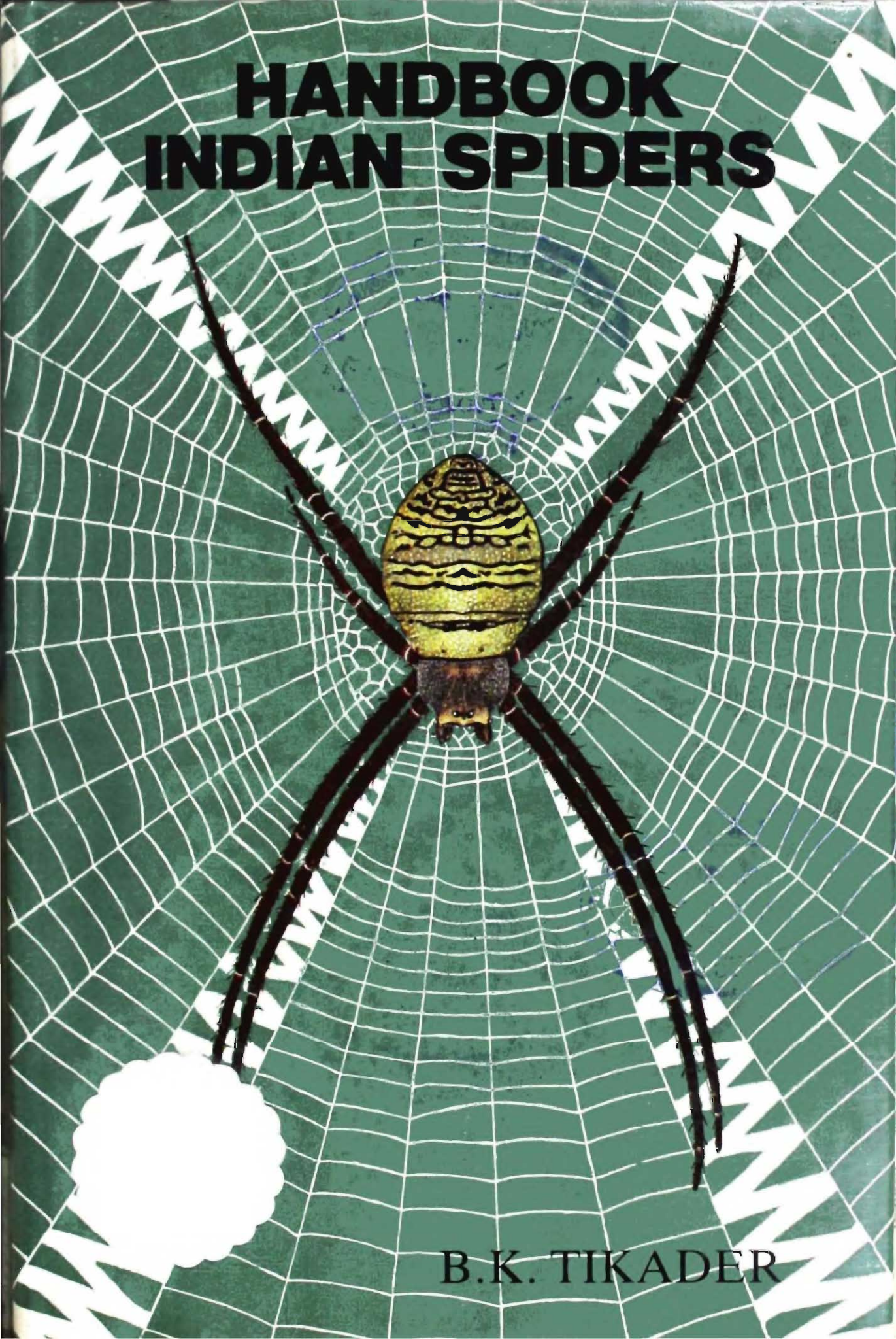
HANDBOOK INDIAN SPIDERS



B.K. TIKADER

Spiders, though ubquitous, have remained a neglected group and about eighty five years ago a consolidated volume on entire Arachnida was published by Pocock (1900) in the *Fauna of British India.* During the last 30 years, mainly through the work of the author, enormous amount of information on Indian spiders has been gathered. The first (1980) and second volume (1982), and the third volume on scorpions (1983) were published by the author. The present Handbook on spiders deals with and gives complete information about Arachnida and especially the spiders of India.

Apart from systematic studies on spiders belonging to 43 families, the author has given a detailed general account of external and internal anatomy, characters of taxonomic importance, habitat, food and feeding habits and other phenomenon of their life. Keys of the families and list of higher categories, and other informations related to each family of spiders are given along with the orb-weaving mechanism of spiders in the family Araneidae (= Argiopidae).

It is earnestly hoped that the present Handbook will provide a handy tool to specialists, research students and naturalists in India and elsewhere interested in the study of Indian Arachnida, especially the spiders.

Front Cover : Typical Orb-weaving spider *Argiope aemula* (Walckenaer) on the web.

Back Cover : Animals alpana, Peacock in the centre, then fishes and elephants at the outer circle.

Cover theme and design by :
Dr. B. K. Tikader.

HANDBOOK
INDIAN SPIDERS

A Manual for the study of the Spiders and their relatives—The Scorpions, Pseudoscorpions, Whip scorpions, Harvestmen and all members of the Class Arachnida found in India with analytical keys for their classification and biology.

By

B. K. TIKADER

Zoological Survey of India, Calcutta

Edited by the Director

ZOOLOGICAL SURVEY OF INDIA, CALCUTTA

1987

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FOREWORD

One of the objectives of the Zoological Survey of India (ZSI) is to provide comprehensive systematic accounts on various groups of the Indian fauna. To achieve this objective, the ZSI undertakes faunistic survey programmes and publishes the results in the form of research papers and reports under the series "Fauna of India", "The Handbooks" and "Technical Monographs" The present contribution on the spiders is the sixth in the series of "Handbooks" This is a very primitive group of animals which has a role in the conservation of Nature.

The present "Handbook" gives a comprehensive taxonomic account of 43 families and detailed general account of external and internal anatomy, characters of taxonomic importance, habitat, food and feeding habits and other phenomenon of their life. Keys to the identification of families and list of higher categories, and other information related to each family of spiders is given along with orbweaving mechanism of spiders in the family Araneidae (=Argiopidae).

I congratulate the author for undertaking this work which I am sure will prove useful to students and researchers in the field of Arachnology both in India and abroad. I would also like to put on record my appreciation of Dr. B. K. Tikader (former Director, ZSI) for his dedication, devotion to duty and for initiating a number of programmes on the Fauna of India as also in building up public awareness about wildlife conservation.

T. N. Khoshoo
(former Secretary, Department of Environment)
Distinguished Scientist (CSIR)
New Delhi 110 003.

EDITOR'S PREFACE

After independence the responsibility for publication of "Fauna of British India" was passed on from the Secretary of State for India (to the British Government) to the Government of India and consequently the Director, Zoological Survey of India was entrusted with the task of editing the series. In keeping with the changed political set up after August, 1947, the title of the series was also changed as "Fauna of India"

Spiders, though ubiquitous, have remained a neglected group and about eighty five years ago a consolidated volume on entire Arachnida was published by Pocock (1900) in the *Fauna of British India.* During last 30 years, mainly through the work of Dr. B. K. Tikader, former Director, Zoological Survey of India, enormous amount of information on Indian spiders has been gathered. The first (1980) and second volume on spiders (1982) and the third volume on scorpions (1983) were published by Dr. Tikader. The present Handbook on spiders deals with and gives complete information about Arachnida and especially the spiders of India.

This Handbook is the sixth volume in this series and seventh and eighth are in press. Assignments have been made to other specialists to write further volume on groups so far not covered or which require up-to-date information and these are expected to be published within a couple of years.

It is my privilege that I am able to write the preface to this popular series of publication of 'Handbook'. It is hoped that this illustrated book will serve as an important and handy tool to specialists, research students and naturalists in India and abroad interested in the fascinating study of this primitive animals which are very important for their role of biological control of insects fauna of our country.

B. S. LAMBA
Joint Director-in-Charge,
Zoological Survey of India

Zoological Survey of India,
Calcutta

AUTHOR'S PREFACE

The HANDBOOK OF SPIDERS will serve the needs of beginners and mature students of Arachnida, especially the spiders in India and elsewhere for the study of Indian spiders as well as spider fauna of the oriental regions. It brings together for the first time in a concise form the wealth of information on the structure, habits and classification of the Indian arachnids, mainly spiders. It emphasizes the interest and keen enjoyment in store for all who study these creatures. The need for this Handbook of Spiders is realised by the fact that there are at present more serious students and amateurs interested in spiders and this is unique in the history of Indian Arachnology.

In the course of my systematic and ecological studies on Indian spiders, since last three decades, I felt the necessity of a Handbook of spiders for the benefit of amateurs as well as students of Arachnology for an easy understanding of Indian spiders and to create interest in this subject.

The present handbook deals with the near relatives of spiders, of the other orders of the class Arachnida to which the spiders belong. A detailed account of morphology of spiders, characters of taxonomic importance, habitat, food and feeding habits and other phenomenon of their lives and keys to the families are given. List of higher categories and detailed characters and other informations of each family of spiders are also given with proper illustrations. The list of the species so far known from Indian subcontinent has been included for ready reference.

At the end I have included all available references on Indian spiders and their relatives.

It would be a great pleasure for me if this handbook serve the purpose to some extent and stimulate abundant interest among the spider lovers and be used as a stepping stone for the future advancement in arachnology in India.

"URNANABHA"
Salt Lake City, Cl-85, Sector-II,
CALCUTTA-700 091
Dol Purnima, 15th March, 1987.

B. K. TIKADER

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ACKNOWLEDGEMENTS

I express my deep sense of gratitude to Dr. T. N. Khoshoo, former Secretary, Department of Environment, Government of India, for his keen interest in this book and kindly write the foreword of this book. It is only due to his inspiration and support it has been possible for me to bring out many books including the present book.

This book would not have been completed without the generous help of numerous individuals and Arachnologists. I wish to take this opportunity to express my grateful thanks to my friend Dr. J. A. L. Cooke, Oxford University, Oxford, U.K., who has offered without reservation, his photographs of spiders for use in this book and my son, Shri Shyamal Tikader who assisted me in collecting live spiders as well as in photography. Thanks are also due to Prof. V A. Murthy, Loyola College, Madras; Prof. B. H. Patel, Sir P. P. Institute of Sciences, Bhavnagar, Gujarat; Dr. S. K. Bhattacharyya; Dr. S. K. Gupta; Dr. A. K. Sanyal, Scientists, Zoological Survey of India, Calcutta; Dr. R. H. Kamble, Scientist, Zoological Survey of India, Western Regional Station, Poona, for assisting me in various ways during the preparation of the manuscript.

I am thankful especially to Dr. Animesh Bal, scientist, Zoological Survey of India, Calcutta who worked tirelessly with me for the completion of this book and it would not have been possible for me to achieve this target in time without his assistance and help. I am also thankful to my students Dr. D. B. Bastawade, Dr. Bijan Biswas, Dr. U. A. Gajbe, Dr. M. S. Malhotra and Dr. Subhash Mazumdar who have assisted me in various ways during the preparation of the manuscript. This faunal work could not be completed without the help of many individuals and institutions. I take this opportunity to express my deepest gratitude for loans of literature and type-specimens and authenticated identified specimens of many araneid specimens and other help to: Mr. F R. Wanless, Arachnida section, British Museum (Natural History), London, Prof. M. Vachon, Museum National d'Historie Naturelle, Paris; Prof. H. W. Levi, Museum of Comparative Zoology, Harvard University, U.S.A., Dr. N. I. Platnick, Museum Natural History, New York, U.S.A. and Dr. M. Grasshoff, Forchungs Institute

Senckenberg, Frankfurt, West Germany.

My deepest appreciation for the invaluable aid and encouragement which were primarily responsible for initiating the detailed study on this interesting groups of animals goes especially to Prof. M. S. Mani, who has been kind enough to go through the manuscript and offer many valuable suggestions for improvement of this book.

I am thankful to Dr. B. S. Lamba, my old colleague and Joint Director-in-Charge, Zoological Survey of India and Shri G. Sivagurunathan, Publication Production Officer and the staff of the Publication Division, Zoological Survey of India, Calcutta for assisting in various ways for publication of this book.

I am also indebted to Shri Sitaram Mondal and Shri Sushil Mazumdar, Artists, Zoological Survey of India, Calcutta and Shri P. W. Garde, Artist, Zoological Survey of India, Western Regional Station, Poona for helping me to prepare many illustrations of this book. I am indebted to Shri Mrinal Sen, Photographer, Zoological Survey of India, Calcutta for preparation of some photographs and to Shri Anil Bhattacharyya, Senior Stenographer for typing the manuscript and to Shri Bhanu Sinha (Asst. Zoologist) for various assistance during the preparation of the manuscript.

I also thank Dr. M. P. Nayar, Director, Botanical Survey of India, Calcutta and Prof. Amalesh Chowdhury, Professor and Head of the Department of Marine Science, University of Calcutta for valuable suggestions.

Last but not the least, I would like to express my grateful thanks to the Department of Environment, Government of India for honouring me with the assignment of writing the fauna volumes on spiders, scorpions and other service of the hand books.

B. K. TIKADER

INTRODUCTION

Among all our little neighbours in the fields there are none that are more universally known and feared than spiders. There is a widespread belief that spiders are dangerous and their bites are very venomous. This may be true in black widow spiders or large spiders like tarantula that live in burrows; but other spiders are practically harmless.

It is true that spiders bite and inject venom to kill an insect into the wounds made by their fangs. But they are extremely shy creatures, fearing man more than they are to be feared. The spiders we are most familiar with are the dingy house spiders. They have, for ages, been the object of much superstition and fear. The poets are unkind to them and wrote of the cruel, false, envenomed spiders, and described them in other unfriendly phrases.

Spiders are a primitive group of animals occurring almost everywhere, on or near water, inside or on the ground; from the seashore to the tops of the high mountains and in various climates from deserts to snowlands. They are distributed extensively in the fields, thick forest floors as well as in the human habitations and deserted buildings, under stones and logs and on tree trunks and flowering shoots.

The spiders are perhaps one of the best friends of mankind, because they feed on insects which are generally harmful to man and their live stocks. The other animals like frogs, toads, lizards, birds, shrews, hedgehogs and bats also destroy our insects-enemies, but spiders kill far more insects than all the others put together. The abundance of the spiders can be summarized in the following few sentences of Gertsch (1949) "Spiders are among the dominant predators of any terrestrial community. When the fauna of the soil and its plants cover is analysed, they come to light in vast numbers, in such convincing abundance that it is evident that they play a significant part in the life of every habitats."

The first thing which strikes our mind of spider, is its spinning habit. They are of special attention to the naturalists because of their unique weaving capability to construct with geometrical precision and beauty the orb-webs. Some of these are true orb-web weavers, some make the irregular webs, and some are unable to make any

web. According to their web building ability, generally the spiders are considered as weavers or non-weavers. The weavers make the snares to trap insects for food, while the non-weavers hunt the prey by chasing or by stalking. The true orb-web weaving spiders of the family Araneidae (= Argiopidae), make the wheel-shaped web with spokes and a central hub. The spider waits at the centre or at the corner of the web for the prey. When any insect prey gets entangled in the web, the spider quickly rushes in and injects its poison through the cheliceral fangs into the prey to kill it, often biting it repeatedly, and ultimately it sucks the prey dry.

The main object of this Handbook is to furnish an introduction to the study of the structure, classification and habits of spiders, and it seemed wise to include some account of the near relatives of spiders, of the other orders of the class Arachnida to which the spiders belong. Some of these, as the scorpions, the harvestmen, the pseudoscorpions and the mites, are common in all parts of our country, and will be observed by all students of spiders. It is hoped that the present book will provide a handy tool to specialists and research students in India and elsewhere in the study of Indian spiders.

CHAPTER I
SPIDERS AND THEIR NEAR RELATIVES

CLASS–ARACHNIDA

1. THE SYSTEMATIC POSITION OF THE CLASS ARACHNIDA

The Phylum ARTHROPODA (Gr. *arthron*=joint+*podos*= foot) contains most of the known animals in the world. The Phylum Arthropoda is the largest of the Phyla of the Animal Kingdom, including many more species than all the other phyla taken together. The body of Arthropoda is segmented externally in varying degree, and the appendages are jointed. This is one of several classes of animals which are having the body composed of more or less similar rings or segments; some of these segments are provided with jointed legs i.e., *Arthropoda.* Similar body segments are also found in worms but these are separated from those of arthropods by the absence of legs.

Among the arthropoda the spiders, scorpions, pseudoscorpions, harvestmen, mites and certain other less popular forms constitude a group known to zoologists as the Class Arachnida (A-rach'ni-da).

The different classes of arthropoda are discussed here in brief just to show their relationships particularly with the Class Arachnida.

1. Class CRUSTACEA (Crus-tace-a)–The Crustacea (*L. crusta,* a hard shell) include the fairy-shrimps, waterfleas, barnacles, crayfishes, crabs and their kin. Most of them are marine but many live in fresh or brackish water, and a few, like the sow-bugs, live in moist places on land.

2. Class INSECTA. The class Hexapoda or Insecta comprises the various orders of insects. The members of this class are air-breathing arthropods, with distinct head, thorax and abdomen. They have one pair of antennae, three pairs of legs, and usually one or two pairs of wings in the adult. The grasshoppers, flies, lice, butterflies, bettles, bees are the most familiar examples of insects. They are the most abundant and widespread of all land animals,

MORPHOLOGICAL PECULIARITIES OF THE MAJOR GROUPS OF THE PHYLUM ARTHROPODA

		Onychophora	*Crustacea*	*Insecta*	*Arachnida*	*Chilopoda*	***Diplopoda***
Body divisions :		Head continuous with body	Usually cephalothorax and abdomen	Head, thorax and abdomen	Cephalothorax and abdomen	Head and long body	Head, short thorax, long abdomen
Paired appendages	**Antennae :**	1 pair	2 pairs	1 pair	None	1 pair	1 pair
	Mouthparts :	Jaws, oral papillae	Mandibles Maxillae, 2 pairs Maxillipeds	Mandibles Maxillae, 1 pair Labium	Chelicerae Padipalpi	Mandibles Maxillae, 2 pairs	Mandibles Maxillae, 1 pair
	Legs :	1 pair per somite	1 pair per somite, or less	3 pairs on thorax (+ wings)	4 pairs on cephalothorax	1 pair per somite	1 (or 2) pair per somite
	Respire by :	Tracheae	Gills or body surface	Trachae	Book lungs, or tracheae	Tracheae	Tracheae
Sex openings :		1, end of body	2, hind part of thorax	1, end of abdomen	1, second somite of abdomen	1, end of abdomen	1, third somite near head
Development :		Direct	Usually with larval stages	Usually with larval stages	Direct, except mites and ticks	Direct	Direct
Principal habitat :		All terrestrial	Salt or fresh water, few on land	Mainly terrestrial few aquatic	Mainly terrestrial, few aquatic	All terrestrial	All terrestrial

being the principal invertebrates that can live in dry environments and the only ones able to fly.

3. Class DIPLOPODA (Di-plop'o-da). This class includes the millipedes. They are air-breathing arthropods in which the head is distinct, and the remaining segments of the body form a continuous region and most of the body segments bear each two pairs of legs. They live in damp places and feed on decaying vegetable matter.

4. Class CHILOPODA (Chi-lop'o-da). The chilopods include the centipedes. They, like the millipedes, are air-breathing and have an elongated body composed of similar segments and most of the body-segments bear each one pair of legs. They are predaceous and feed on insects. Many species are poisonous. The poison glands open through the claws of the first pair of legs ventrally which are curved forward so as to act with the mouthparts. These creatures are abundant in all parts of India.

5. Class PALAEOSTRACHA (Pa-lae-os'tra-cha). This class is composed almost entirely of extinct forms. The Xiphosura is only living representative, with only three genera, *viz., Limulus, Carcinoscorpius* and *Tachypleus.*

The members of this order are popularly known as king-crabs or horseshoe-crabs (Figs.1 & 2). The king-crabs are marine; they are found in shallow water from two to six fathoms deep on sandy and muddy shores and they burrow a short distance in the sand or mud and feed chiefly on worms. Two somewhat variable species of king-crabs, *Tachypleus gigas* (Muller) and *Carcinoscorpius rotundicauda* (Latreille) are common in Indian waters; but little information is available as regards their habits, which seem to differ considerably from those of the Japanese and American forms. It is observed that *Tachypleus gigas* is essentially a marine species, occurring on sandy and muddy bottoms from the tide-line to a depth of 20 fathoms and *C. rotundicauda* is mainly, if not entirely, estuarine. It ascends the river Hooghly at least as far Calcutta from the open sea, as and can live in water that is practically fresh. On the coast of Bengal *T. gigas* breeds at the end of the winter season, i.e., in March. The eggs, which are not very numerous, have a green colour and measure about 3 mm in diameter, are carried on the ventral surface of the

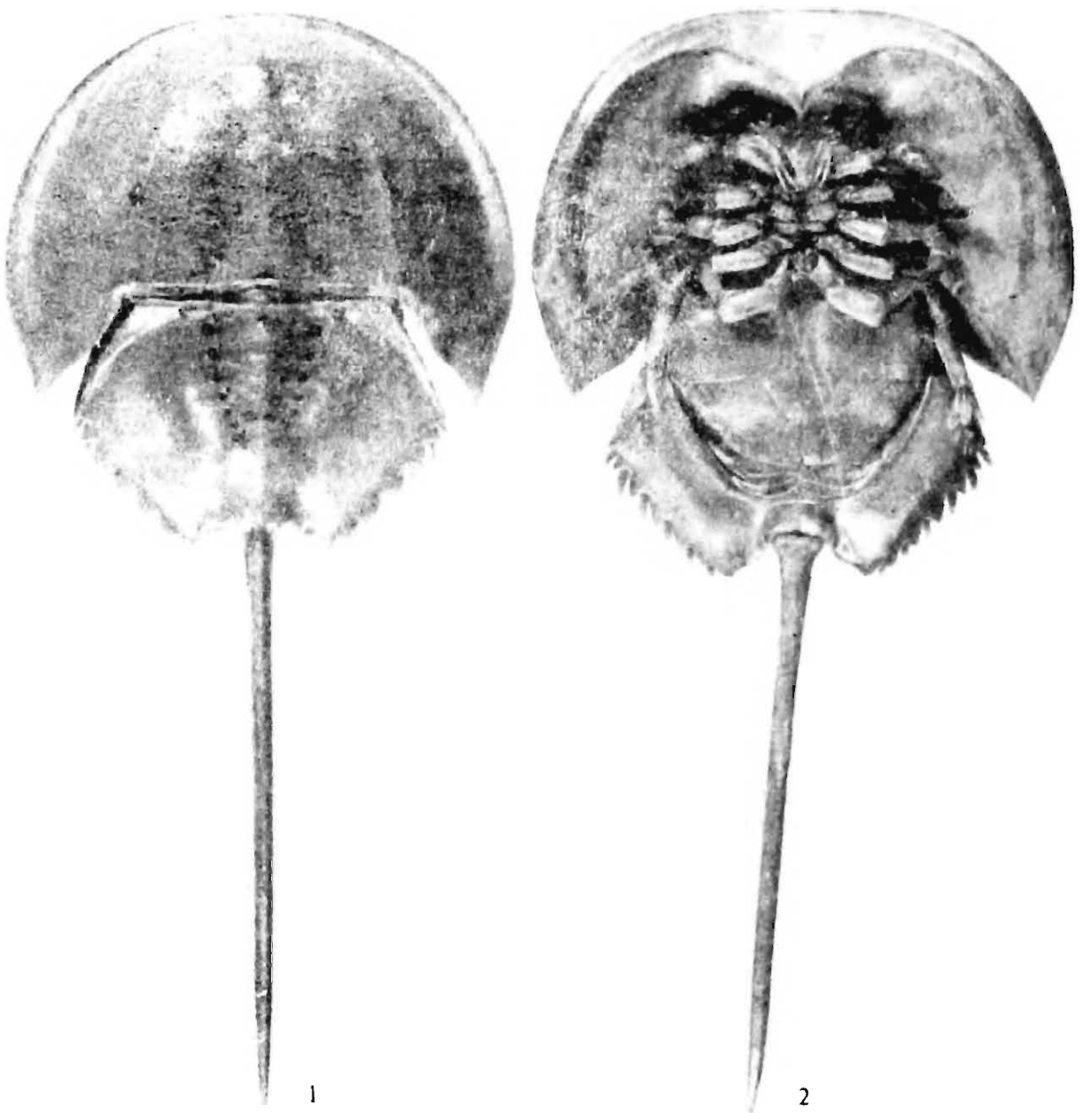


Fig. 1. Dorsal view of a Horse-shoe crab.

Fig. 2. Ventral view of a Horse-shoe crab.

abdominal appendages, to which they adhere tightly.

The most farmilier of the fossil representatives of the Palaeostracha are the Trilobites.

6. Class ARACHNIDA (A-rach'ni-da). The members of this class are air-breathing arthropoda and their head and thorax are usually fused together, forming a cephalothorax, provided with four

pairs of legs and apparently there are no antennae. The characters of Arachnida are discussed more details in the other part of this book.

The Arachnida are viviparous or oviparous. The young are born or hatched from the egg in a form substantially resembling their parents, and except in the case of the order Acari (mites and ticks), growth is not accompanied by metamorphosis, the characters of the adult being gradually assumed with each successive moult of the integument.

KEY TO THE CLASSES OF PHYLUM ARTHROPODA

1. With one or two pairs of antennae.....2
   With no antennae apparently.....5

2. With two pairs of antennae; at least five pairs of legs; adult with no wings.....CRUSTACEA
   With one pair of antennae; three or many pairs of legs; adult with or without wings.....3

3. Adult without wings and provided with pairs of legs.....4
   Adult generally with one or two pairs of wings and always provided with three pairs of legs.....INSECTA

4. Each of the body segment with one pair of legs.....CHILOPODA
   Some of the body segments with two pairs of legs.....DIPLOPODA

5. Six pairs of appendages but with chela; respiration always aquatic.....PALAEOSTRACHA
   Six pairs of appendages and generally without chela; respiration always aerial.....ARACHNIDA

2. THE ORDERS OF THE ARACHNIDA

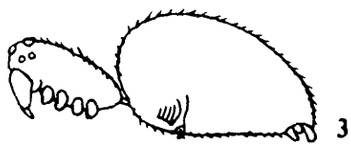
According to the modern classification that is most generally accepted, which excludes various groups of animals of uncertain position, the class Arachnida is divided into nine orders. Two degenerating groups *Tardigrada* and *Pentastomida,* whose claim to be regarded as Arachnida are somewhat slender. The members of the class Arachnida may be grouped into the following orders 1. SCORPIONIDA, 2. PEDIPALPIDA, 3. MICROTHELYPHONIDA, 4. SOLPUGIDA, 5. RICINULEI, 6. OPILIONES, 7. PSEUDOSCORPIONIDA, 8. ACARI, 9. ARANEAE. But with

the exception of the *Microthelyphonida* and *Ricinulei,* all these orders are represented by numerous species and genera in India.

KEY TO THE ORDERS OF THE CLASS ARACHNIDA

1. Abdomen unsegmented.....2
   Abdomen distinctly segmented.....3

2. Abdomen jointed to the cephalothorax by a narrow pedicel (Fig. 3); abdomen provided with spinnerets at the end (Fig. 3); mouth parts not modified to form a sucktorial proboscis.....ARANEAE
   Abdomen fused with the cephalothorax; abdomen without any spinning organs (Fig. 4); mouth parts modified to form a sucktorial probascis (Fig. 4).....ACARI



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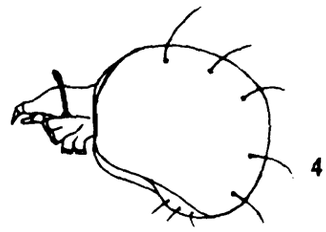

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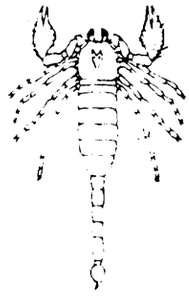
Fig. 3. Lateral view of a spider (Order–Araneae).

Fig. 4. Lateral view of a mite (Order–Acari).

3. Abdomen with a broad tail like prolongation terminating in a poisonous sting (Fig. 5); pectines always present underside at the base of abdomen (Fig. 6); pedipalps stout and chelate (Fig. 5).....SCORPIONIDA
   Abdomen may have a whiplike narrow prolongation but never provided with sting; pectines absent; pedipalps may or may not be stout and chelate.....4

4. Two or three posterior segments of carapace free.....5
   All segments of carapace fused together.....7



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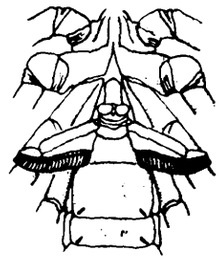

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Fig. 5. Dorsal view of a scorpion (Order–Scorpionida).

Fig. 6. Ventral view of a scorpion shows pectines.

5. Chelicerae enormous in comparison to body size (Fig. 7); racquet organs present underside the last pair of legs (Fig. 8); pedipalps leg like without claws.....SOLPUGIDA
   Chelicerae small and not enormous in size; racquet organs not present on the last pair of legs; pedipalps not leg like.....6

6. Large or medium in body size; caudal appendage may be long or short or absent; first pair of legs long and modified to feelers and each provided with a rounded tip instead of claws (Fig. 9).....PEDIPALPIDA
   Minute in body size; caudal appendage long and many segmented (Fig. 10); first pair of legs long but not modified to feelers and each bearing claws at the tip (Fig. 10).....*MICRO-THELYPHONIDA

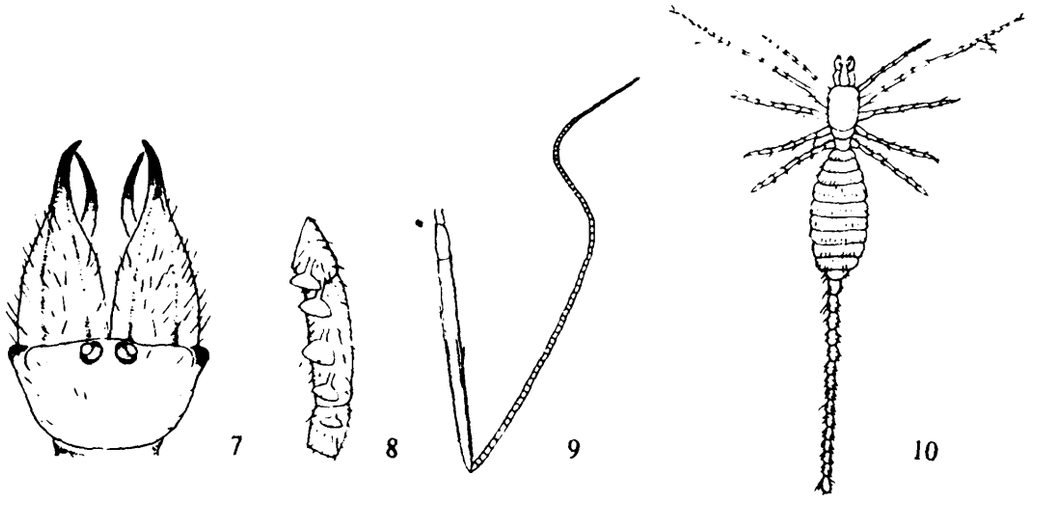


Fig. 7. Dorsal view of carapace of a *Galeodes* sp. (Order-Solpugida).

Fig. 8. Racquet organs on the 4th leg of *Galeodes* sp.

Fig. 9. Feeler like first leg of a member of the order-Pedipalpida.

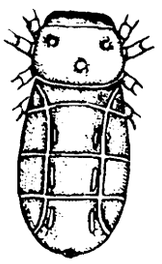
Fig. 10. Dorsal view of a member of the order-Microthelyphonida.

7. Cephalothorax provided with a movable hood (cucullus) in front; eyes absent (Fig. 11); third pair of legs in males modified to copulatory organs (Fig. 12).....*RICINULEI
   Cephalothorax not provided with cucullus in

*The orders Microthelyphonida and Ricinulei are not dealt with in this book as they are not recorded so far from India.

front; eyes present; third pair of legs in males not modified to copulatory organs.....8

8. One or two pairs of lateral eyes present on cephalothorax; chelicerae bearing the spinnerets (Fig. 13); pedipalps larger and chelate (Fig. 14); body scorpion like without tail.....PSEUDOSCORPIONIDA
One pair of median eyes on prominent tubercle present on cephalothorax (Fig. 15); chelicerae not bearing the spinneret; pedipalps small and not chelate; body spider like.....OPILIONES



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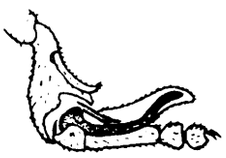

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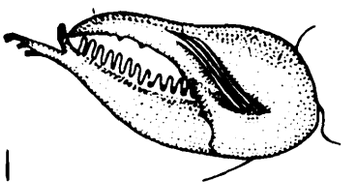

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Fig. 11. Dorsal view of a member of the Order–Riçinulei.

Fig. 12. Third leg of a male ricinulid showing the copulatory organ.

Fig. 13. Chelicera of a pseudoscorpion (Order–Pseudoscorpionida).

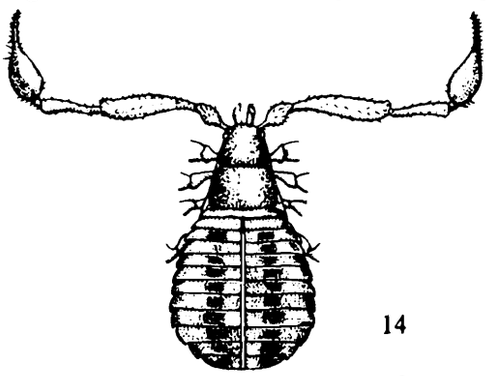

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Fig. 14. Dorsal view of a pseudoscorpion.

Fig. 15. Lateral view of a harvestman (Order–Opiliones).

ORDER ACARI
TICKS AND MITES

The Acari comprising mites and ticks form an important group under the class Arachnida. They are world-wide in distribution and inhabit all possible habitats from the lowest inter-tidal zones to the highest mountains including the deserts, arctic regions and oceans. Some are free living and occur in soil, organic debris, arable land, pastures, salt and fresh water and all types of vegetation while others are either external or internal parasites of invertebrates and vertebrates including man. Mites may be as small as 150μ–200μ

(Fam. Eriophyidae, popularly called gall mites) or may be as big as 13,000μ (some members of *Dinothrombium,* Fam. Trombidiidae, popularly called velvery mite). Size of ticks may vary from 500μ–20,000μ.

Mites and ticks are of immense economic importance. A large number of mites are phytophagous and damage plants by desapping which may result in loss of vigour and in reduction of growth and yield. Some are vectors of plant viral diseases, while others cause malformations and deformations of plants. A good number of mites infest stored food grains in granaries. The parasitic mites and ticks attack domestic animals, poultry birds and human beings inflicting either direct injuries or they act as vectors of viral, bacterial, rickettsial and protozoan diseases causing heavy mortality of cattles.

Acari like other arachnids have four pairs of legs, a pair of chelicerae and a pair of pedipalpi, but can easily be distinguished by the lack of or inconspicuous somatic segmentation (Fig. 16). The Araneae too share this character but the Acari are differentiated from Araneae with the help of the following key (after Krantz, 1970).

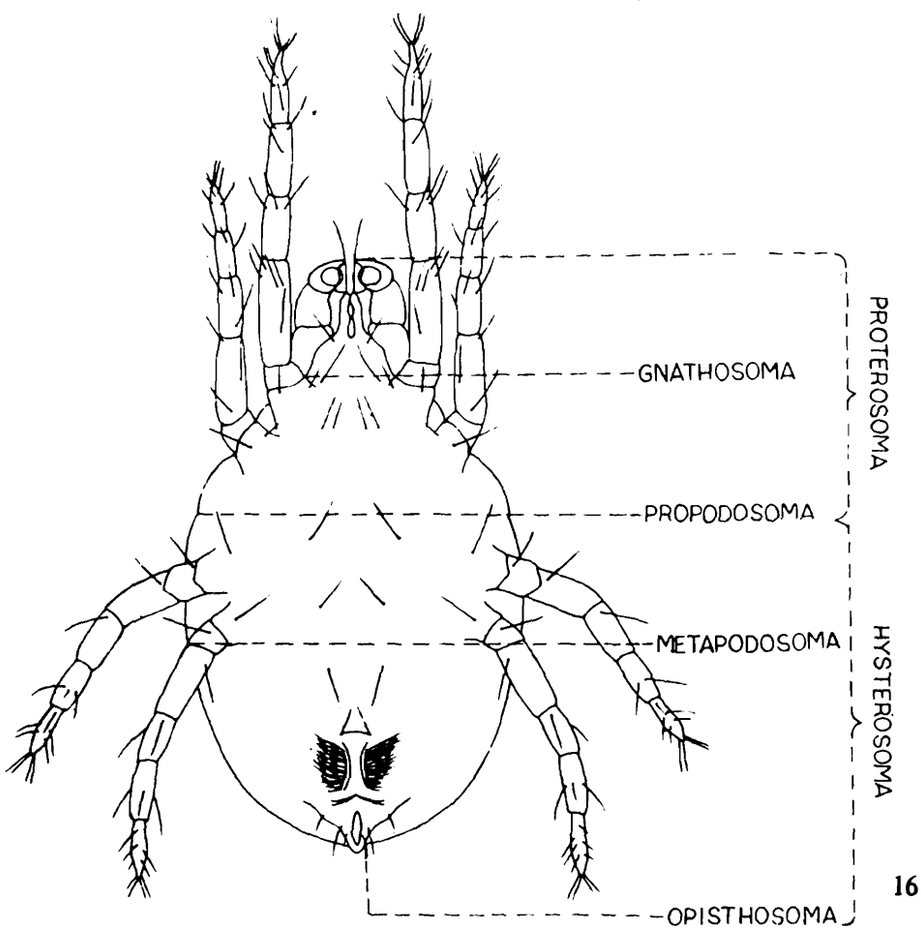

Fig. 16. Ventral surface of Acari showing arbitrary divisions of the body.

1. Mouth parts inserted anteriorly on the cephalothorax, which comprises fused head and thoracic segments; legs also borne on cephalothorax, which is connected to the abdominal portion by a narrow pedicel..... ARANEAE

Mouthparts contained in a discrete anterior gnathosomal portion of the body in which the legs are inserted (Propodosoma), broadly joined to the portion of the body behind the legs (Opisthosoma) to form the idiosoma..... ACARI

The Acari are all dioecious and the sexes can normally be easily separated. They are mostly oviparous but a few may be also ovoviviparous. Facultative parthenogenesis, both arrhenotoky (producing only males) and thelytoky (producing only females), are also not uncommon in Acari. The developmental stages of Acari include one or more active larvae between egg and adult. The larva is hexapod, while all subsequent stages and adults normally have 4 pairs of legs. Sometimes the two larval stages are replaced by resting stages, the nymphochrysalis and the imagochrysalis. Free living Mesostigmata normally have 4 active stages, *viz.*, larva, protonymph, deutonymph and adult. The cryptostigmatid mites pass through 5 active stages as larva, protonymph, deutonymph, tritonymph and adult. In Prostigmata, the life cycle is rather complicated as the larva may moult directly into adult or it may pass through only deutonymphal stage or through three nymphal stages, i.e., the protonymph, deutonymph and tritonymph stages. In some cases the deutonymphal stage may be missed. The characteristic feature of some astigmatid mites is the presence of an optional rion-feeding hypopial stage between proto- and tritonymphs. This is produced to withstand adverse environmental condition.

Collection of Acari is a highly specialised job. The free, soil inhabiting mites are best collected directly by extraction through modified Tullgren funnel based on heat-desiccation method. Besides, flotation method using $MgSo_4$ (Berlese, 1921) or benzol-water method (Salt & Hollick, 1944) can also be used. Among the parasitic forms, the external parasites can be collected by combing and brushing the body of the host after anaesthesising the host. Sometimes caging the host above the Berlese-Tullgren funnel is also advised for collecting parasitic mites. The parasites from living birds are collected by Fair Isle apparatus (Williamson, 1954). Internal

parasites are collected by direct examination of the host. Specialised types of light traps are also used for collecting parasitic trombiculid mites. The attached ticks are collected from the body of their hosts by hand-picking or by brushing. However, the unattached ticks are collected by flag-dragging. Several methods are known for collection of plant associated mites but the most common one is the direct examination of the infested plant parts under stereobinocular microscope and picking the mites with a fine camel-hair brush moistened with alcohol. Besides, flotation method, brushing method, jarring method, etc., are also known. The water mites are either collected by Dipnet or by Birge-net. All the Acari (except Eriophyidae) are preserved in alcohol (70%). A few drops of glycerine are often added to avoid drying of specimens. Prior to mounting in mounting medium, the specimens are treated in Lactic acid to stretch appendages and to make the taxonomic characters visible. The specimens are normally mounted in Hoyer's medium made of the following ingredients when mixed in the order as mentioned Dist. water–50 ml., Chloral hydrate–50 gms., Glycerine–20 ml., Gum arabic–30 gms.

The Acari are characterised as the most heterogeneous group. Some rarely show somatic segmentation and some inconspicuous segmentation. Body is divided into Proterosoma (gnathosoma+ propodosoma), and Hysterosoma (metapodosoma+opisthosoma). Propodosoma, metapodosoma and opisthosoma are together called *idiosoma*. Gnathosoma is composed of pre-cheliceral, cheliceral and pedipalpal segments. It bears a pair of chelicerae and a pair of pedipalpi. Chelicera is 2 to 3 segmented, often chelate and is variously modified to suit the different modes of feeding. Pedipalp is 5 to 7 segmented, sometimes one or more segments may be fused. The pedipalp is basically a sensory organ but may be modified for capturing prey. Idiosoma is composed of propodosoma (region bearing I and II pairs of legs), metapodosoma (region bearing III and IV pairs of legs) and opisthosoma (region posterior to metapodosoma) and may be elongate, oval, sub-circular, circular, convex or dorso-ventrally flattened. The idiosoma is covered with one or more shields bearing variable number of setae arranged in a definite pattern, which is an important character in acarine taxonomy. Ventrally, the idiosoma may be divided by sejugal furrow and may or may not have shields. Anteriorly, a sclerotized sternal region may be found. The anal and genital

orifices are usually set on sclerotized shields. Legs are 2-4 pairs. Legs may be armed with spurs, tactile and sensory setae and tarsus may terminate in claw-like or sucker-like apotele. All these structures represent important taxonomic characters. The position of stigmata is of extreme importance in higher classification of Acari. In the suborder Prostigmata, the stigmata are present at the base of gnathosoma; in Astigmata, they are lacking; in Cryptostigmata, they are hidden; in Metastigmata, they are in the region of coxae IV; in Mesostigmata, they are present in latero-medial region; and in the suborder Notostigmata, they are present on dorsum.

The classification of Acari has a long history. Linnaeus (1758), in his 10th edition of 'Systema Naturae', included about 30 species but all under one genus. Megnin (1876) based his classification on ecological criteria. Kramer (1877) based it essentially on respiratory system and Michael (1884) summarised it into Acarina–tracheata to include Prostigmata, Oribatidae, Gamasidae, Ixodidae, Tarsonemidae and Myobiidae and Acarina-atracheata to include *Glycyphagus, Dermaleichus, Histiostoma, Listrophorus, Myocoptes, Phytoptus, Demodex* and Sarcoptidae. Canestrini (1891) accepted Kramer's system but proposed 4 new ordinal names, *viz.,* Astigmata (to include Atracheata of Kramer), Mesostigmata (to include Gamasidae of Kramer), Metastigmata (to include Ixodidae of Kramer) and Cryptostigmata (to include Oribatidae of Kramer). Berlese (1899) recognised 5 orders, *viz.,* Vermiformia, Mesostigmata, Prostigmata, Heterostigmata and Cryptostigmata. Later (1913), he modified his classification and divided Acari into 6 suborders namely Astigmata, Cryptostigmata, Heterostigmata, Mesostigmata, Notostigmata and Prostigmata. Oudemans (1906) elevated Acari to a class and divided it into 5 subclasses basing on the number of stigmata, *viz.,* Astigmata. Lipostigmata, Zemiostigmata, Octostigmata and Distigmata but later, gave Acari an ordinal status and divided it into 6 suborders, Notostigmata, Holothyroidea, Parasitiformes, Trombidiformes, Sarcoptiformes and Tetrapodili. Reuter (1909) gave new names to all the suborders of Berlese. Vitzthum (1929) followed Reuter's classification. Baker and Wharton (1952) recognised Acari as an order and divided it into 5 suborders, *viz.,* Onychopalpida, Mesostigmata, Ixodides, Trombidiformes, and Sarcoptiformes. Evans *et al.* (1961) treated Acari as subclass and divided it into two superorders I. Acari-Anactinochaeta (including orders Notostigmata, Tertrastigmata, Mesostigmata and Metastigmata) and II. Acari-Actinochaeta

(including orders Cryptostigmata, Prostigmata and Astigmata). Krantz (1970) recognised Acari as a subclass and divided it into Order I. Opilioacariformes (including suborder Notostigmata), Order II Parasitiformes (including suborders Mesostigmata and Metastigmata) and Order III. Acriformes (including suborders Prostigmata, Astigmata and Cryptostigmata).

A key for the separation of orders and suborders and a list of Indian suborders, families and genera are given here for ready reference.

KEY TO THE ORDERS AND SUBORDERS OF ACARI
(after Krantz, 1970)

1. With one to four pairs of stigmata located dorsolaterally or lateroventrally on the hysterosoma; specialized propodosomal sensory organs absent.....ORDERS PARASITIFORMES AND OPILIOACARIFORMES.....2

   Without hysterosomal stigmata; propodosomal sensory organs, when present, often in the form of trichobothria or more specialized structures in distinctive insertions.....ORDER ACARIFORMES.....5

2. With a terminal, subterminal or basal simple or tined apotele on the palpal tersus; hypostome serving only as part of the floor of the gnathosoma; tarsus I only rarely with dorsal sensory pit.....3

   Pedipalpal tarsus without apotele; hypostome modified into a piercing organ with retrorse teeth; dorsum of tarsus I with a distinct sensory pit (Haller's organ); stigmata behind coxae IV or laterad between coxae II-IV, each surrounded by a stigmal plate elongate peritremes absent.....SUBORDER METASTIGMATA

3. With one or two pairs of hysterosomal stigmata, palpal tarsal apotele never terminal; with or without peritremes.....SUBORDER PARASITIFORMES.....4

   Hysterosoma with four pairs of dorsolateral stigmata, tarsus of palp with one or two terminal claws; peritremes absent.....ORDER OPILIOACARIFORMES, SUBORDER NOTOSTIGMATA

3. DERMANYSSIDAE Kolenati
4. LAELAPIDAE Berlese
5. EVIPHIDIDAE Berlese
6. MACROCHELIDAE Vitzthum
7. MACRONYSSIDAE Oudemans
8. PACHYLAELADIDAE Vitzthum
9. PARASITIDAE Oudemans
10. PHYTOSEIIDAE Berlese
11. OTOPHEIDOMENIDAE Treat
12. PODOCINIDAE Berlese
13. RAILLIETIDAE Vitzthum
14. RHODACARIDAE Oudemans
15. SPINTURNICIDAE Oudemans
16. VEIGAIIDAE Oudemans
17. TRACHYTIDAE Tragardh
18. URODINYCHIDAE Berlese
19. UROPODIDAE Berlese
20. DIPLOGYNIIDAE Tragardh
21. SCHIZOGYNIIDAE Tragardh
22. DIGAMASELLIDAE Evans
23. SEJIDAE Berlese
24. EPICROSEJIDAE
25. RHINONYSSIDAE Trouessart

SUBORDER II. PROSTIGMATA

Family

1. PYEMOTIDAE Oudemans
2. SCUTACARIDAE Oudemans
3. TARSONEMIDAE Kramer
4. HARPAGOPALPIDAE Viets
5. HUNGAROHYDRACARIDAE Motas and Tanasachi
6. ATURIDAE Thor
7. AXONOPSIDAE Viets
8. EYLAIDAE Leach
9. LIMNOCHARIDAE Grube
10. PROTZIIDAE Koenike
11. HYDRACNIDAE Leach
12. HYDROVOLZIIDAE Thor
13. HYDRODROMIDAE Viets
14. ANISITSIELLIDAE Koenike
15. HYDRYPHANTIDAE Thor
16. LEBERTIIDAE Thor
17. SPERCHONIDAE Thor
18. THERMACARIDAE Sokolow
19. TORRENTICOLIDAE Piersig
20. THYASIDAE Viets
21. HYGROBATIDAE Koch
22. LIMNESIIDAE Thor
23. PIONIDAE Thor
24. UNIONICOLIDAE Oudemans
25. MIDEOPSIDAE Koenike
26. ERYTHRAEIDAE Oudemans
27. TROMBICULIDAE Ewing
28. TROMBIDIIDAE Leach
29. PTERYGOSOMIDAE Oudemans
30. CHEYLETIDAE Leach
31. DEMODICIDAE Nicolet
32. MYOBIIDAE Megnin
33. SYRINGOPHILIDAE Dubinin
34. STIGMAEIDAE Oudemans
35. TENUIPALPIDAE Berlese
36. SITEROPTIDAE
37. TETRANYCHIDAE Donnadieu
38. TUCKERELLIDAE Baker and Pritchard
39. CUNAXIDAE Thor
40. HALACARIDAE Murray
41. ERYNETIDAE Oudemans
42. TYDEIDAE Kramer
43. EDELLIDAE Duges
44. DOLICHOCYBIDAE
45. LABIDOSTOMIDAE Oudemans
46. MICRODISPIDAE Paoli
47. ERIOPHYIDAE Nalepa
48. RHYNCAPHYTOPTIDAE Keifer
49. PYGMEPHORIDAE

SUBORDER III. ASTIGMATA

Family

1. ACARIDAE Ewing and Nesbitt
2. GLYCYPHAGIDAE Berlese

3. LARDOGLYPHIDAE Oudemans
4. SAPROGLYPHIDAE Oudemans
5. ANOETIDAE Oudemans
6. ANALGIDAE Trouessart
7. DERMOGLYPHIDAE Megnin and Trouessart
8. EPIDERMOPTIDAE Trouessart
9. FALCULIFERIDAE Oudemans
10. PROCTOPHYLLODIDAE Megnin and Trouessart
11. PTEROLICHIDAE Trouessart
12. CYTODITIDAE Oudemans
13. LISTROPHORIDAE Canestrini
14. PSOROPTIDAE Canestrini
15. PYROGLYPHIDAE Cunliffe
16. KNEMIDOCOPTIDAE Furstenburg
17. MYIALGESIDAE Trouessart
18. SARCOPTIDAE Trouessart
19. TEINOCOPTIDAE Fain

SUBORDER IV. CRYPTOSTIGMATA

Family

1. COSMOCHTHONIIDAE Grandjean
2. HYPOCHTHONIIDAE Berlese
3. TRHYPOCHTHONIIDAE Willmann
4. EPILOHMANNIIDAE Oudemans
5. LOHMANIIDAE Berlese
6. EUPHTHIRACARIDAE Jacot
7. DAMAEOLIDAE Grandjean
8. ORIBATELLIDAE Jacot
9. ORIBATULIDAE Thor
10. BASILOBELBIDAE Balogh
11. CHAUNOPROCTIDAE Balogh
12. CEPHEIDAE Berlese
13. NANHERMANNIIDAE Sellnick
14. PELOPIDAE Ewing
15. GALUMNIDAE Jacot
16. HAPLOCHTHONIIDAE Hammen
17. PHTHIRACARIDAE Perty
18. OPPIIDAE Grandjean
19. OTOCEPHEIDAE Balogh
20. TECTOCEPHEIDAE Grandjean
21. HAPLOZETIDAE Grandjean
22. EREMOBELBIDAE Balogh
23. SUCTOBELBIDAE Grandjean
24. SPHAEROCHTHONIIDAE Grandjean
25. MALACONOTHRIDAE Berlese
26. LIODIDAE Grandjean
27. MOCHLOZETIDAE Grandjean
28. PLATEREMAEIDAE Tragardh
29. BELBIDAE Willmann
30. MICROZETIDAE Grandjean
31. LIACARIDAE Sellnick
32. METRIOPPIIDAE Balogh
33. CARABODIDAE Koch
34. EREMELLIDAE Balogh
35. SCUTOVERTICIDAE Grandjean
36. CERATOZETIDAE Jacot
37. MYCOBATIDAE Grandjean
38. MESOPLOPHORIDAE Ewing
39. CYMBAEREMEIDAE Sellnick
40. THYRISOMIDAE Grandjean
41. GUSTAVIIDAE Oudemanns
42. GEHYPOCHTHONIIDAE Skrenzke
43. BRACHYCHTHONIIDAE Balogh
44. BELBODAMAEIDAE Bulanova-Zachvatkina
45. EREMAEIDAE Sellnick
46. EREMULIDAE Grandjean
47. HYDROZETIDAE Grandjean
48. CAMISIIDAE Oudemans
49 NOTHRIDAE Berlese
50. AMERIDAE Grandjean
51. HERMANNIIDAE Sellnick

SUBORDER V. METASTIGMATA

Family
1. IXODIDAE Murray
2. ARGASIDAE Canestrini

ORDER SCORPIONIDA
THE SCORPIONS

The order Scorpionida (Scor-pi-on'i-da) includes only the scorpions (Fig. 17). Scorpions are the most venomous arachnids inflicting very painful bite, though all are not fatal to human beings. The sting of a scorpion rarely, if ever, proves fatal to man, although

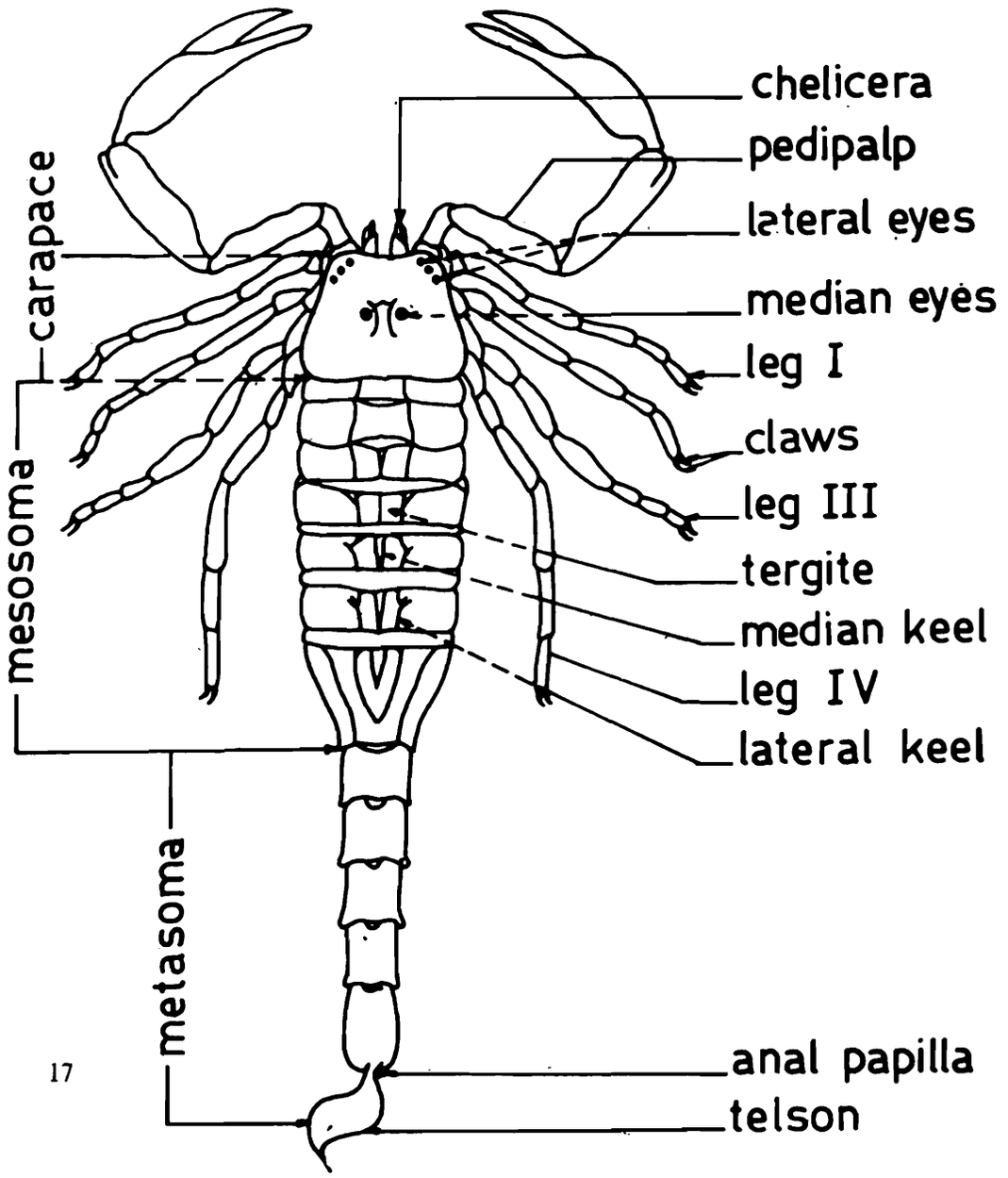

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Fig. 17. Dorsal view of a typical scorpion showing different parts.

the larger species produce serious wounds. The phylogenic origin of scorpion is not exactly known, it is presumed that they have evolved from the extinct Eurypterids or gaint water-scorpions. The Eurypterids were fully aquatic in habits and existed before 400,000,000 years ago, during the Silurian period. In the same period the other parallel and well established aquatic group was Silurian scorpions. Both of these had many common characters such as compound eyes, external book gills and similar chewing structure on the first segments (coxae) of the first pair of appendages.

The most striking features of scorpions are the large size of the pedipalps, which are furnished with very stout chelae, and the division of the abdomen into two portions–a broad pre-abdomen consisting of seven segments, and post-abdomen or slender tail-like division or cauda, consisting of five segments. At the end of the post-abdomen there is a large poison-sting, which appears like a segment (Fig. 17).

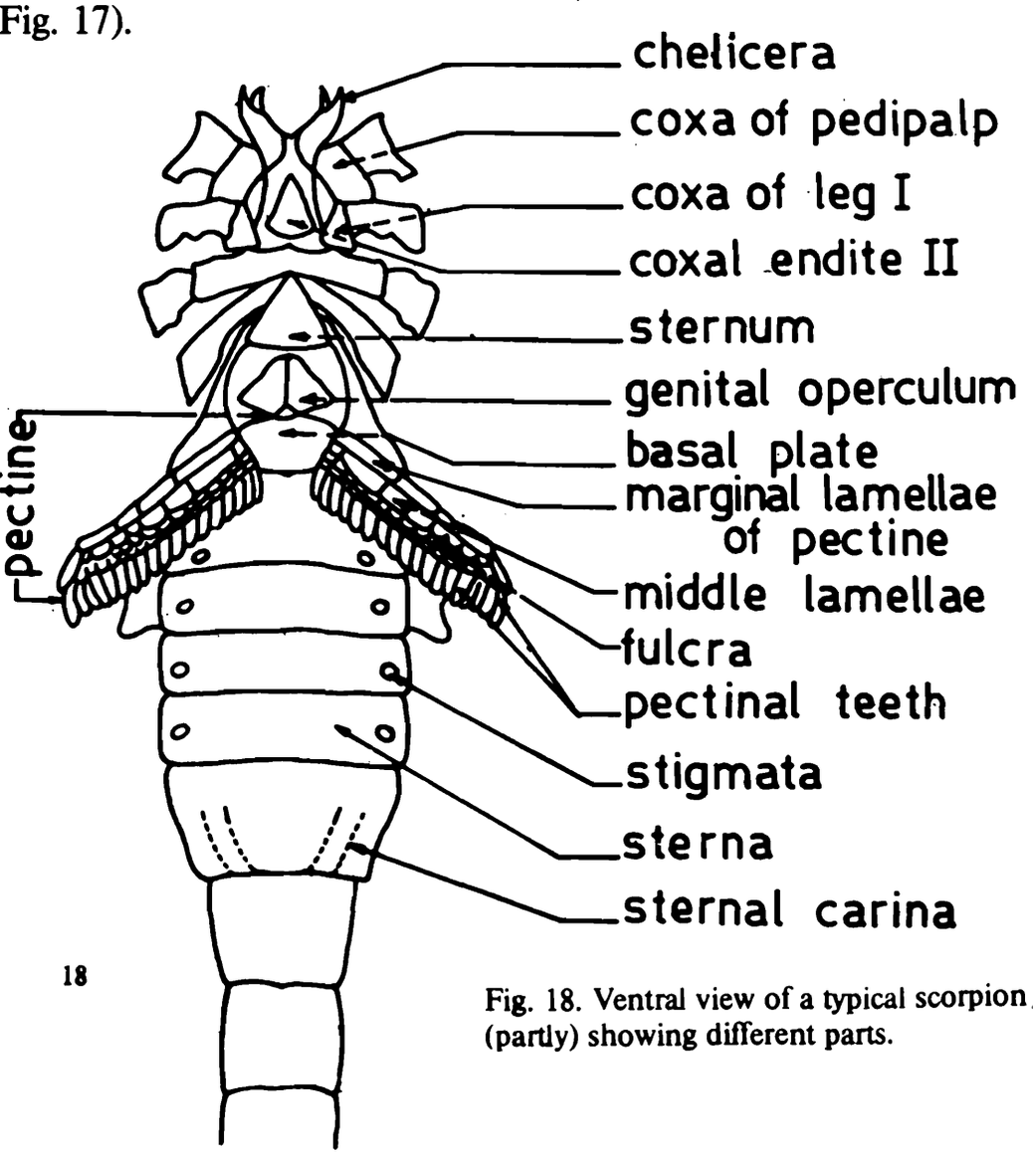

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Fig. 18. Ventral view of a typical scorpion (partly) showing different parts.

The cephalothorax is compact and unsegmented; the abdomen is broadly joined to the thorax; the chelicerae are chelate; the coxae of the pedipalps are fitted for crushing the prey, which is seized by the large chelae (Fig. 20). The remaining four pairs of cephalothoracic appendages are fitted for walking. They are seven jointed, the tarsus consisting of three segments, and the patella being wanting; the legs are not chelate, but are furnished with tarsal claws. The coxae of the first two pairs of ambulatory legs, each bear an endite, which is directed towards the mouth and helps to hold the prey opposite the mouth.

The cephalothorax bears a pair of eyes near the middle line, the median eyes, and on each side near the cephalo-lateral margin, a group of lateral eyes and each such group consists of two to five eyes.

The adult scorpions possess a pair of comb like organs, the pectines (Fig. 18), on the lower side of the second abdominal

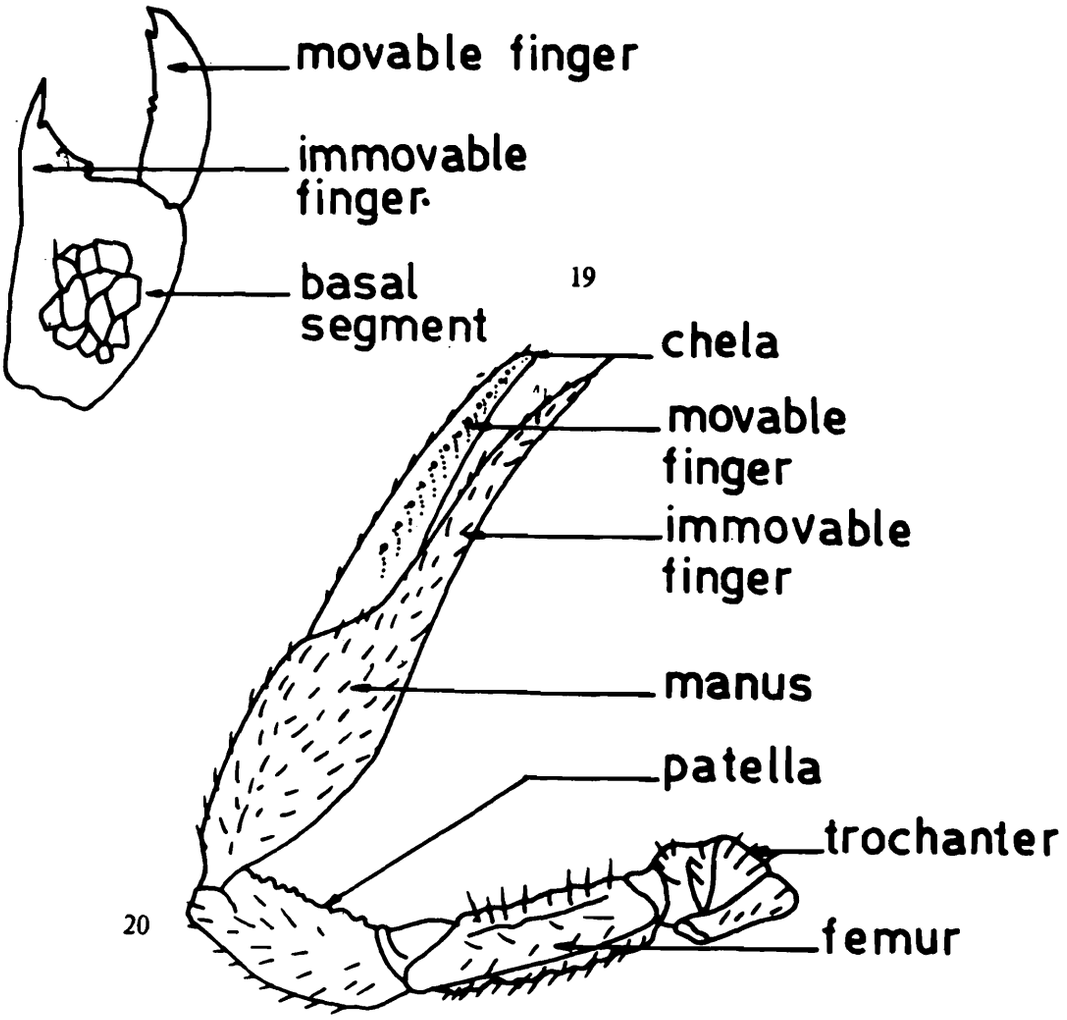

Fig. 19. Dorsal view of a chelicera of scorpion showing different parts.

Fig. 20. Dorsal view of a pedipalp of scorpion showing different parts.

segment. The real function of these organs is not yet known, but it has been suggested that they are tactile. Scorpions breath by means of book-lungs, of which there are four pairs of opening on the lower side of the third to the sixth abdominal segments. The sexes of scorpions differ in that the male has broader pincers and a longer post-abdominal segment. Scorpions do not lay eggs. The young is developed within the mother's abdomen. After birth the young ones remain on mother's back for 10 to 20 days, during which they complete two molts. At birth, the youngs are white but after first molt they start changing their body colour. After second molt, the youngs become very active and aggressive and are ready to lead an independent life. The youngs attain maturity very slowly and according to Fabre (1923), some species of scorpions require about five years to reach their maturity.

All scorpions are strictly nocturnal in habits and very shy animals and hide themselves under stones, barks, and of logs thin crevices. They are equally defensive and sting if molested. Scorpions are found all over the world, except in some very cold northern countries. They are very common and widely distributed in tropical and subtropical areas. They are abundant in arid and semi-arid zones of the world. They are found at very low altitudes at sea-shore and also at very high altitudes on the Himalayas and Alps.

Very little information about Indian species is available regarding their habits and habitats. Considerable effort has been made to study the particular habits, habitats influencing their distribution in some parts of Southern Africa. According to the habitats, the scorpions are divided into three categories as burrowing (pelophilous), rock dwelling (lithophilous) and arboreal. On the basis of available data about species of Indian scorpions, they could possibly be divided into three above-mentioned different categories.

Various genera of Indian Buthidae, such as *Odontobuthus, Androctonus, Orthochirus, Compsobuthus, Mesobuths,* and Chactoids like *Palamnaeus* and Ischrids are true burrowing in habits. Among these burrowing scorpions Buthids and *Palamnaeus* species do not dig deep burrows, they use small pit like burrow for their shelter. The Ischnurids dig very deep (about 25-50 mm deep) burrow at the base of which a flask-shaped house is prominent, where the animal stays during the daytime. The Ischnurids are

generally found in plains and soft grounds of low altitudes. *Palamnaeus* burrows are usually protected by boulders and are not more than 150-225 mm deep. Buthid-burrows are difficult to locate as the burrows are very small in diameter and cannot be easily recognized. Some buthids inhabit in colony and all members of colony live in the same burrow or hole. The Vaejovids are flat scorpions and prefer to live in cracks and crevices. These scorpions are very active and run swiftly, if disturbed.

Vaejovids and Chaerilids are the scorpions of high altitude regions. Very little is known about the habits and habitats of Chaerilids; the data from labels show that they generally hide under stones and logs. They are strictly confined to the Himalayan ranges, while Vaejovids show distribution in the Himalayas as well as at some places of Sahyadri ranges in Deccan. Practically, there is no information about the habits and habitats of Indian species belonging to the genera *Charmus, Sterochirus, Hemibuthus, Lychas* and *Isometrus.*

Most scorpions avoid water, some live amidst plants near the sea-shore, moving about the intertidal zone and able to remain under tidal water for a short time. Some scorpions are cave dwellers and lack of eyes.

The terminology of body parts for systematic studies on scorpion is made upto date by Stahnke (1970). On the dorsal covering of the cephalothorax, there are often more or less distinct keels distinguished as the fore, middle, hind, median and lateral keels respectively. These keels are connected with each other in various ways. That part of the fore median keels which is above a median eyes, is termed the superciliary ridge. The anterior seven abdominal segments are as broad as cephalothorax and together with the lateral, they form the trunk. The remaining five abdominal segments along with the telson, form the tail. The terms, carapace (prosoma) and opisthosoma, are also used for the cephalothorax and the abdomen respectively. The opisthosoma is further divided into mesosoma and metasoma representing the anterior seven abdominal segments and the 'tail' respectively.

The unsegmented sclerotized plate covering the cephalothorax is the carapace. Each of the anterior seven abdominal segments is

dorsally covered by a sclerotized plate called tergite, which has an anterior transversely raised portion, the pretergite. The tergites become progressively longer posteriorly. The seventh tergite is abruptly narrowed posteriorly, so that its posterior width is nearly equal to that of the first caudal segment. The ventral side of the carapace is covered anteriorly by the coxae of the walking legs and maxillary lobes (coxal endites) of the first and second legs and posteriorly by the sternum. The first abdominal segment has two small sclerotized plates, called the genital opercula, which are usually united medially in the female and completely or partially separated in the male. In the female, they cover the genital aperture–the gonotreme and in the male may partially or completely cover the two genital papillae. The second segment has a small sclerotized plate, called the basal piece which serves as a point of attachment and articulation of the pectines. Segments from third to seven are completely covered ventrally by sclerotized plates called sternites, which occasionally have an anterior transversely raised portion, the presternite. Sternites I-IV are each provided with a pair of stigmata for book-lungs. The tergites and sternites are laterally connected by the pleural membrane.

The metasoma (tail) consists of five sclerotized rings, (constantly increasing in length posteriorly) and the telson. Distinct tergites and sternites are not discernible. A dorsal furrow is present along the length of the metasoma, which sometimes shows sexual dimorphism. There are five pairs of carinae; as they are dorsals, dorso-laterals, median laterals, inferior laterals, and inferiors present on the first four caudal segments. In the fifth caudal segment, which is generally the longest of the five, the dorsal carinae are absent. The median laterals are often weakly developed and only one inferior median carina is present. At the posterioventral end of the fifth segment is found the anal rim, which bears anterior and posterior transverse crests.

The appendages of the cephalothorax consist of the chelicerae, pedipalps and walking legs (Fig. 17). Each chelicera consists of a basal segment and a chela. The pedipalps consist of the segments *coxa, trochanter, femur, patella* and *chela*. The last can be subdivided into manus, its finger and tarsus. Tarsus is the movable finger. Various keels (carinae) are present on the surface of femur, patella

and chela, which are of taxonomic importance. Each leg is divided into coxa, trochanter, femur, patella, tibia, tarsus. Tarsus consists of tarsomere I and tarsomere II and a pretarsus, which bears two lateral claws and a ventro-median claw. A minute tibial spur is present in the tibio-tarsal connective tissues in some families of the order Scorpionida, whereas the pedal spurs situated in the connective tissue between tarsomere I and II, are present in all scorpions. These spurs are sometimes forked or have lateral subdivisions.

Pectines are tactile in function. Each of the pectine consists of linearly arranged sclerotized structures from the exterior to the interior margins. These sclerotized structures are marginal lamellae, median lamellae, subtriangular fulcra and pectinal teeth (Fig. 18). Ventro-anterior margin of each tooth is provided with numerous minute stubby bristles called sensillae or sensory setae. Marginal lamellae are three in number. Median lamellae vary in shape and numbers. Fulcra are small subtriangular sclerites situated between the base of the teeth. The teeth vary in shape and numbers. On the basis of numbers of pectinal teeth, the scorpions are divided into two groups as Polydont (Buthoid scorpions) and Oligodont (Chatoid scorpions).

Scorpion taxonomy is based oncharacters, such as, the size and shape of the above body parts, the number, size and shape of the super structures found on these parts as well as on the markings and protruberances, etc.

The structure of carapace is one of the useful characters in taxonomy of scorpions. Its general appearance, the surface features and the size and spatial relationships of the median and lateral eyes are also important for classification. The anterior margin of the carapace, which may be concave, straight or convex, is a distinguishing character. Different types of measurement for the carapace are recommended by Stahnke (1970) which are not subject to allometric developments. These are length (longitudinal distance between the anterior and posterior margins if either margin is lobed), anterior width (the distance between the exterior margins of the first pair of lateral eyes), posterior width (maximum lateral margin to margin distance in posterior portion of carapace), first lateral eyes to median eyes (distance between adjacent margins

of these eyes), median eyes to anterior margin (distance from anterior margin of carapace to anterior margin of median eyes), width of median ocular tubercle (distance between the exterior margins of the median eyes). Other features of carapace useful in taxonomy are the size and density of the tubercles and the nature of furrows and carinae. The denticles on the superior and inferior margins of chelicerae are also of some taxonomic value.

In the pedipalps, the manus of the chela has a system of ridges (keels, carinae), which can be used as distinguishing characters of higher taxa. The patella and femur of the pedipalps are also provided with carinae, which are of taxonomic importance. The various measurements of pedipalp structures are total length i.e., the sum total of the respective lengths of the femur, patella and tibia (coxal and trochanter lengths to be omitted because of their irregular form which may lead to an error); tibia length (shortest distance from proximal margin at point of biopatellae articulation, approximately through trichobothria to distal tip of finger); manus length (from proximal margin at the point of articulation to digital commisure), manus width (maximum interior to exterior marginal width); manus thickness (maximum distant between inferior and superior surfaces); tarsus length (the shortest distance from the most superior point of the tarsotibial articulation to the most distal point of the tarsus); patella length (the length of the non-telescoping portion along with the dorsal surface); patella width (maximum basic width at midway between distal and proximal margins); femur length (the length of the non-telescoping portion along with dorsal surface); femur width (maximum width at distal one-third).

The length of mesosoma can be best obtained by taking the sum of the individual tergal lengths, measured along with median-line and including only the sclerotized area; this will include the pretergite. The nature of granulation and carinae on each tergite is also of great taxonomic value. The granulation and nature of carinae on last sternite can also be considered as important character in many of the species. The size and shape of book lungs are important. The number and size of pectinal teeth and the sensillae on the pectinal teeth are also of taxonomic importance. The number of pectinal teeth and the sensillae are seen to vary with sex. The surface features, carinae and three dimensional variation in size of the tail, i.e., metasoma are also of great taxonomic importance. Taxonomic

variations in the telson are in the three dimensions of the vesicle, the surface features and the length, taper and curvature of the aculeus, and the absence or presence of a subaculear tooth, spine or tubercle.

The accurate length of the tail (metasoma) is the sum total of the non-telescopic portion of each segment plus the length of telson. The length of telson is the shortest distance between the heel of the vesicle and the tip of the aculeus. Height and width measurements of each segment, are taken separately. The measurements should not extend to the extremities of any large abrupt, protruberances but only near their base.

The only movable projections of taxonomic value are the trichobothria found on the femur, patella and tibia (chela i.e., manus and immovable finger) of the pedipalps. Their number and the distance between each other are very important as specific characters. The different families have different types of trichobothrial patterns.

The scorpion fauna of India was explored in for the first time by Pocock (1900). Later many scorpiologists like Birula (1913-1928), Hirst (1915), Handerson (1913) and Mani (1959), have added some new species and sub-species from India. Very recently Tikader and Bastawde (1976, 1981) made a comprehensive studies on Indian scorpions.

KEY TO THE FAMILIES OF INDIAN SCORPIONS

1. Legs furnished with two pedal spurs; trichobothrial pattern on pedipalp of A, B or C type.....2
   Legs furnished with single pedal spur; trichobothrial pattern on pedipalp always of C type (but number of trichobothria on patella varies).....4

2. Dorsal arm of movable finger of chelicerae furnished with four minute teeth on inner margin; sternum generally triangular and narrowed in front; III and IV pairs of legs generally provided with a tibial spur; trichobothrial pattern of A type (Fig. 21).....BUTHIDAE

   Dorsal arm of movable finger of chelicera furnished with two or three minute teeth on

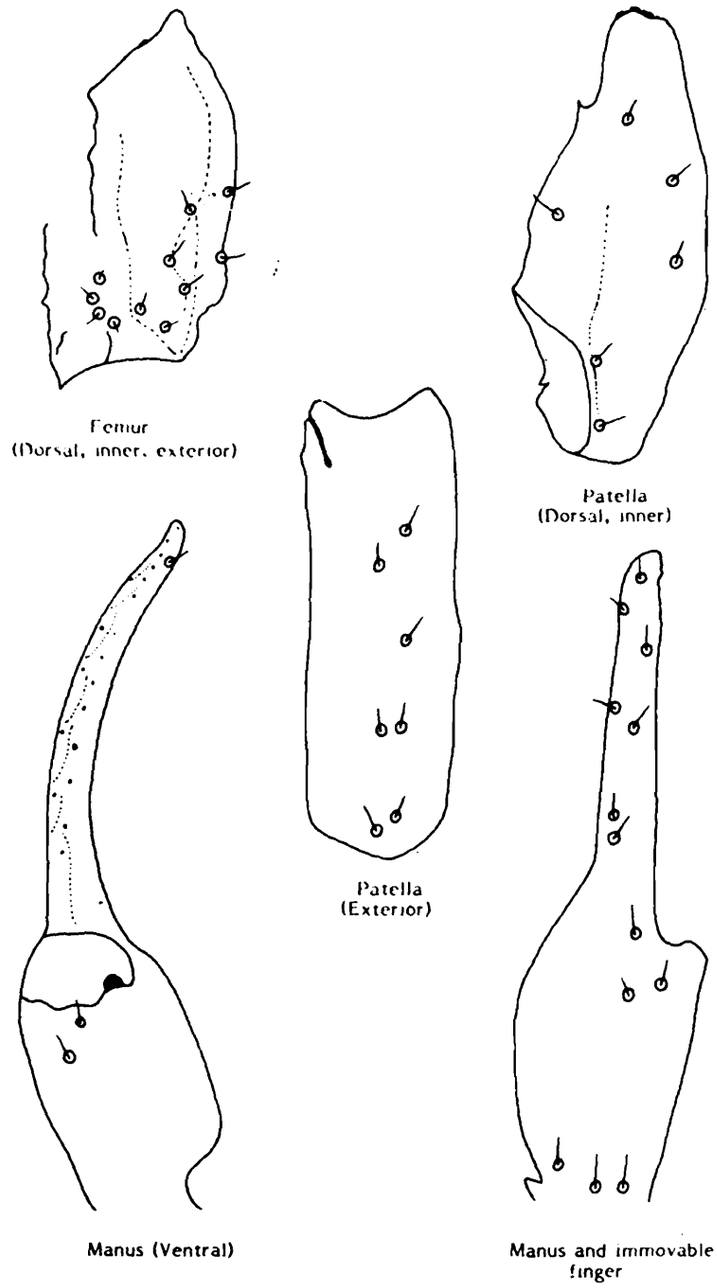

Fig. 21. *A*–type trichobothrial pattern on Pedipalp of a scorpion.

inner margin; sternum broad and pentagonal, III and IV pairs of legs without tibial spur; trichobothrial pattern of B or C type (Figs. 22 & 23).....3

3. Anterior margin of carapace straight, two pairs of lateral eyes furnished with an amber coloured spot below; anterior border of the coxa of 1st pair of legs expanded anteriorly and truncated; stigmata of book-lungs circular; trichobothrial pattern of B type (Fig. 22).....CHAERILIDAE

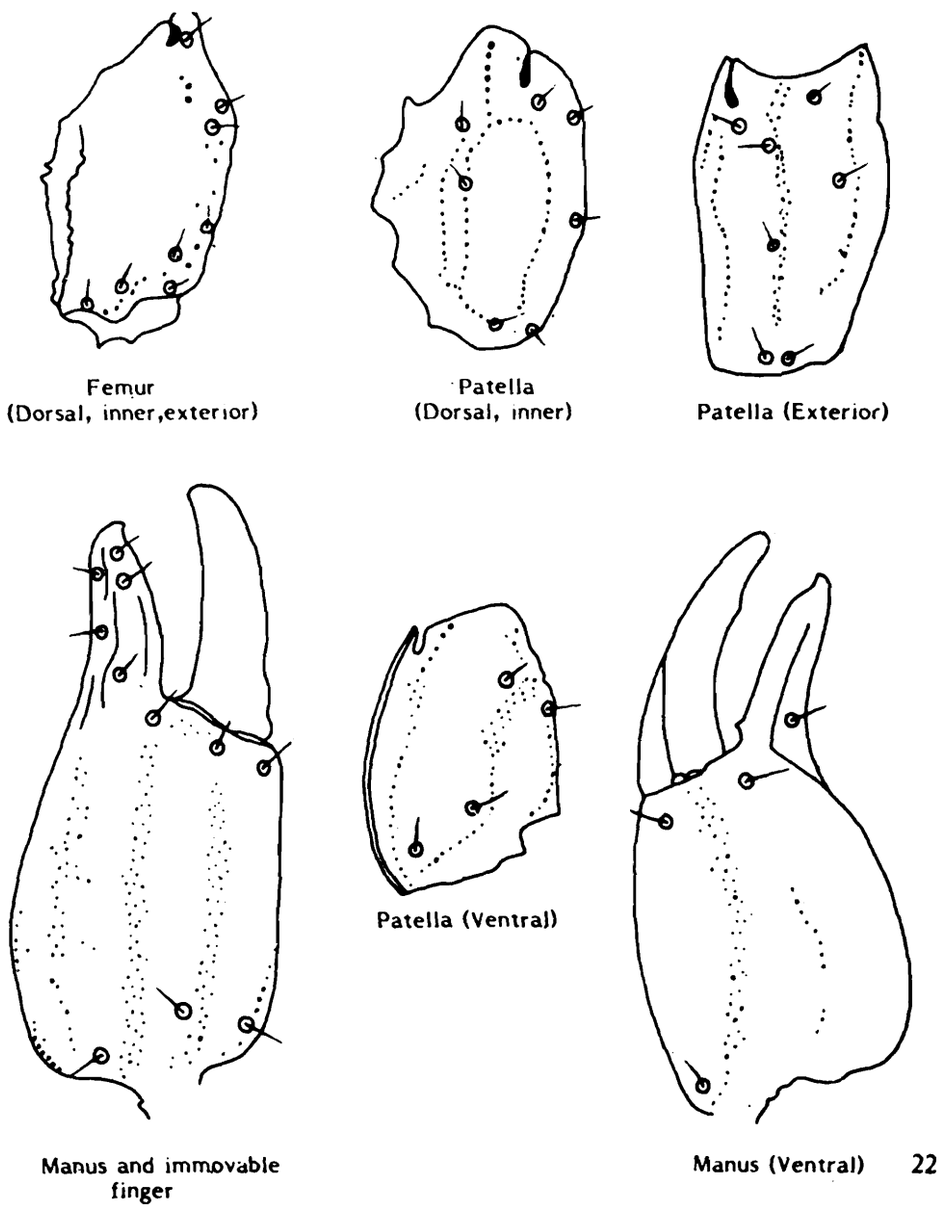

Fig. 22. *B*–type trichobothrial pattern on Pedipalp of a scorpion.

Anterior margin of carapace deeply notched at the centre; three or four pairs of lateral eyes without an amber coloûred spot below; anterior border of the coxa of 1st pair of legs narrow in front; stigmata of book-lungs elongated and slit-like; trichobothrial pattern of C type (Fig. 23).....VAEJOVIDAE

4. The manus of pedipalp flat; tail weak and compressed; distal lateral edge of tarsi of the legs not produced into any lobe and not over-

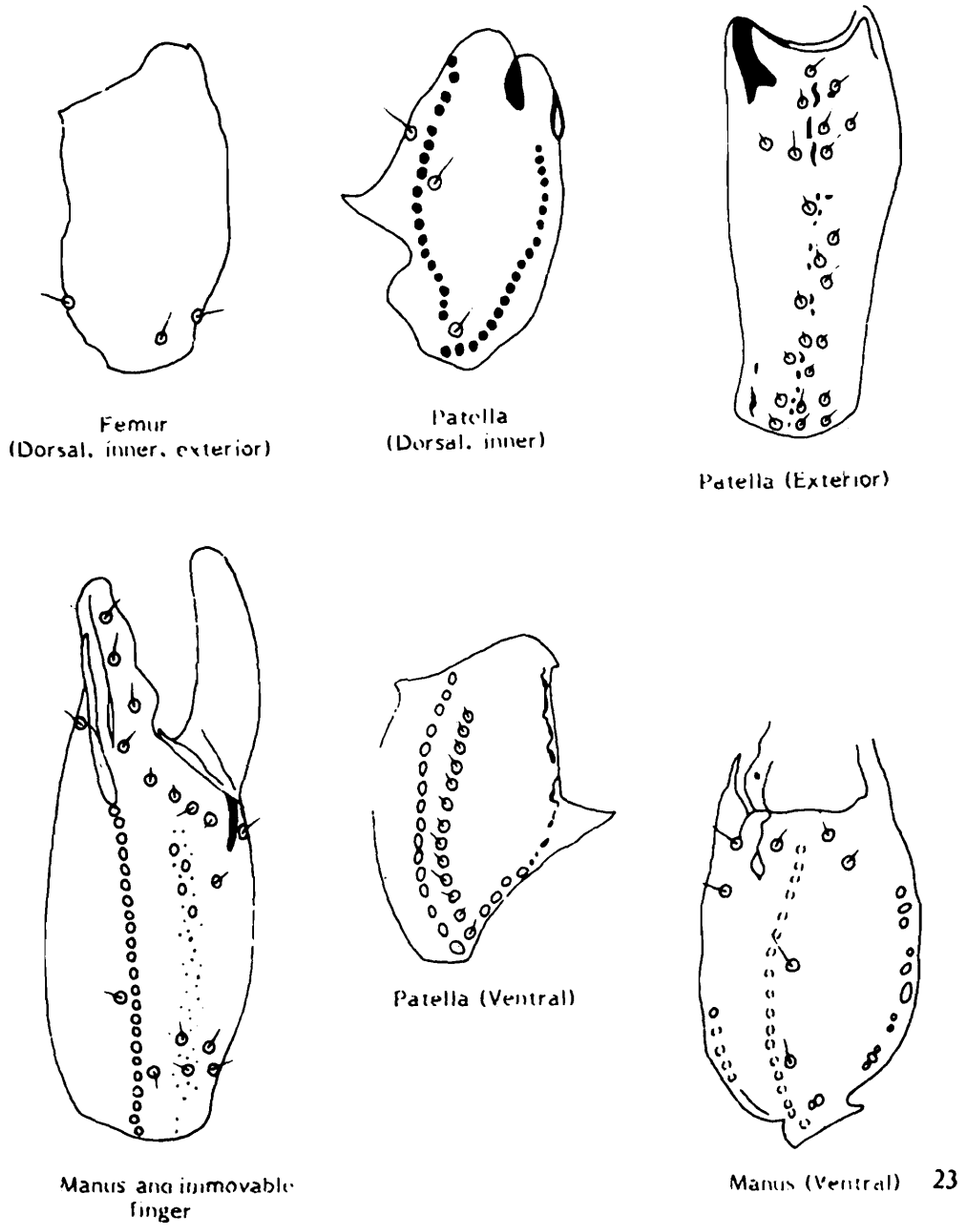

Fig. 23. *C*-type trichobothrial pattern on Pedipalp of a scorpion.

lapping the base of the claw but straight and forming a right angle with the claw-lobe.....ISCHNURIDAE

The manus of pedipalp not flat; tail strong and not compressed; distal lateral edge of the tarsi of legs produced into a rounded lobe and overlapping the base of the claw and forming an acute angle with the base of the claw-lobe.....SCORPIONIDAE

Family BUTHIDAE (Bu'thi-dae)

The members of this family are most common and easily recognised by the triangular sternum. All legs are furnished with a pair of pedal spurs, which sometimes have small lateral spurs. In many genera,the tibial spur is present on III and IV legs. There are three to five pairs of lateral eyes, often provided with ocular tubercles. Pectines generally long and provided with numerous teeth, polydont.

This is a large family, containing more than 50 known species, representing 2 subfamilies, 12 genera from India. Nearly half the species of scorpions occurring in our fauna belong to this family (Fig. 24).

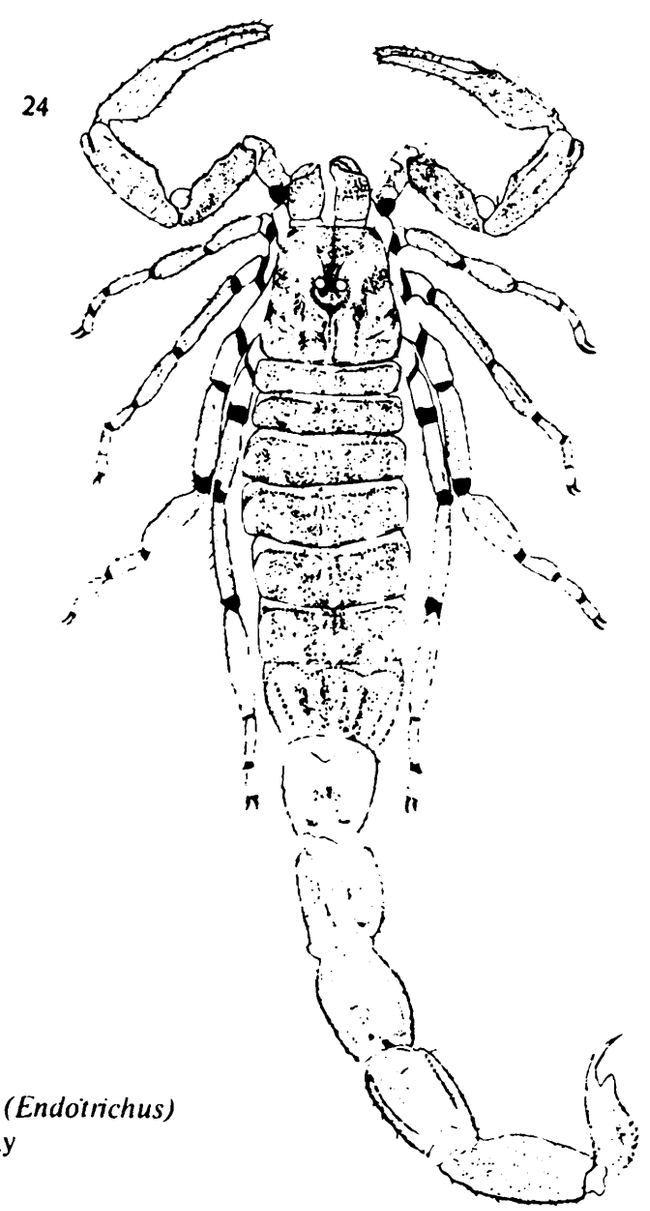

Fig. 24. Dorsal view of *Lychas (Endotrichus) laevifrons* Pocock of the family -BUTHIDAE.

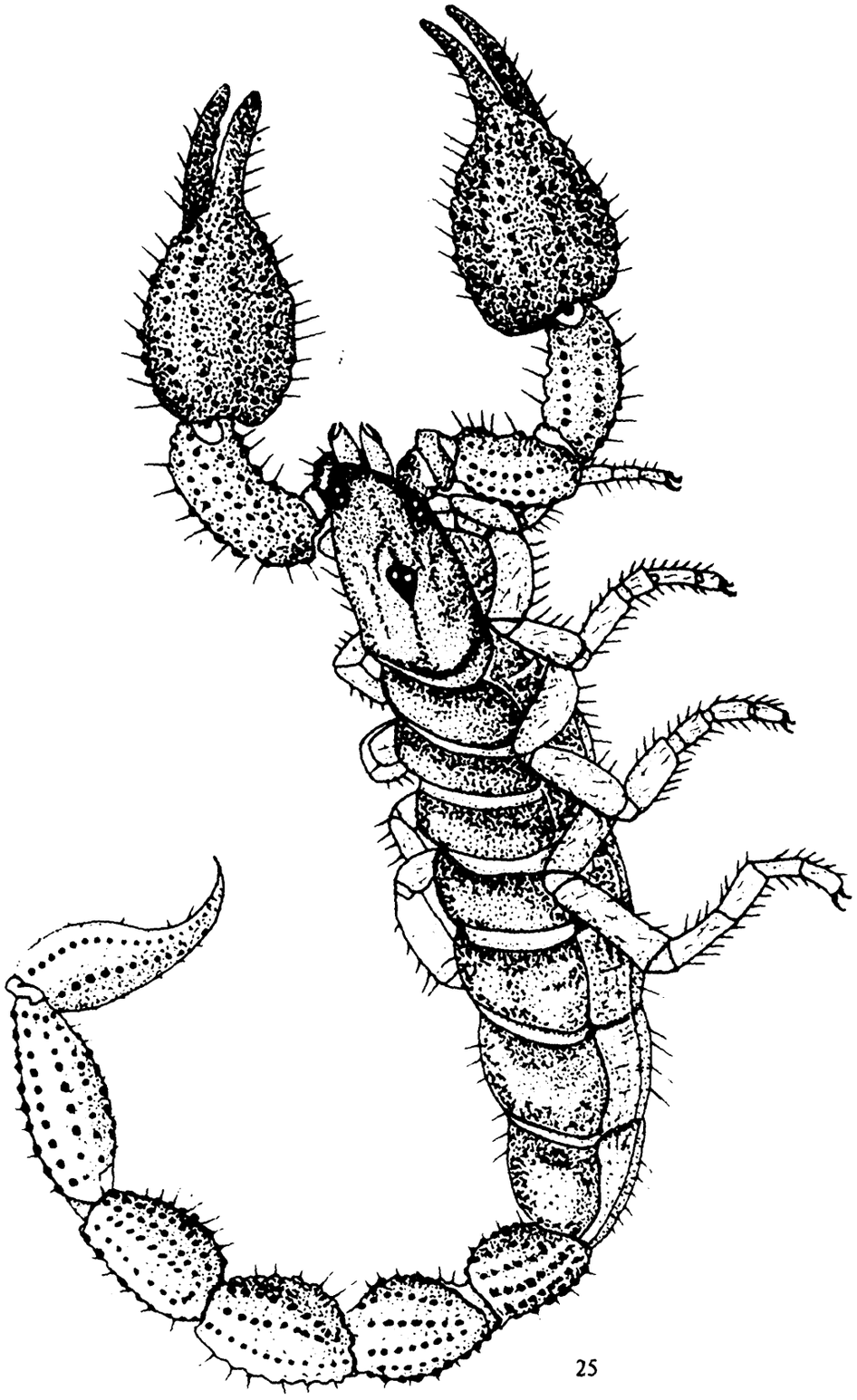

Fig. 25. Dorso-lateral view of *Chaerilus tricostatus* Pocock of the family–CHAERILIDAE.

Family CHAERILIDAE (Chae'rili-dae)

The members of this family are not common and recognised by the form of the sternum, which is pentagonal with posterior median

pit. (Anterior margin of coxa of 1st pair of legs expanded anteriorly and truncated). Legs provided with a pair of pedal spurs but anterior spur never double. Tarsomere II provided with two rows of stout bristles on the ventral side and provided with a median series of very fine spicules. Pectines short, weekly developed with few teeth. The stigmata of book-lungs circular. This is a small family, containing only nine species, representing with a single genus from India (Fig. 25).

Family VAEJOVIDAE (Vae-jov'i-dae)

There is one spur on each side at the base of the last tarsal segment of the last pair of legs. There are three lateral eyes on each side. Anterior margin of coxa of first pair of legs narrowed in front. The sternum is usually broader than long, with a deep median furrow and with the sides nearly parallel. There is no spine under the sting. There is a single genus with 3 sub-genera and 15 species in this family in India (Fig. 26).

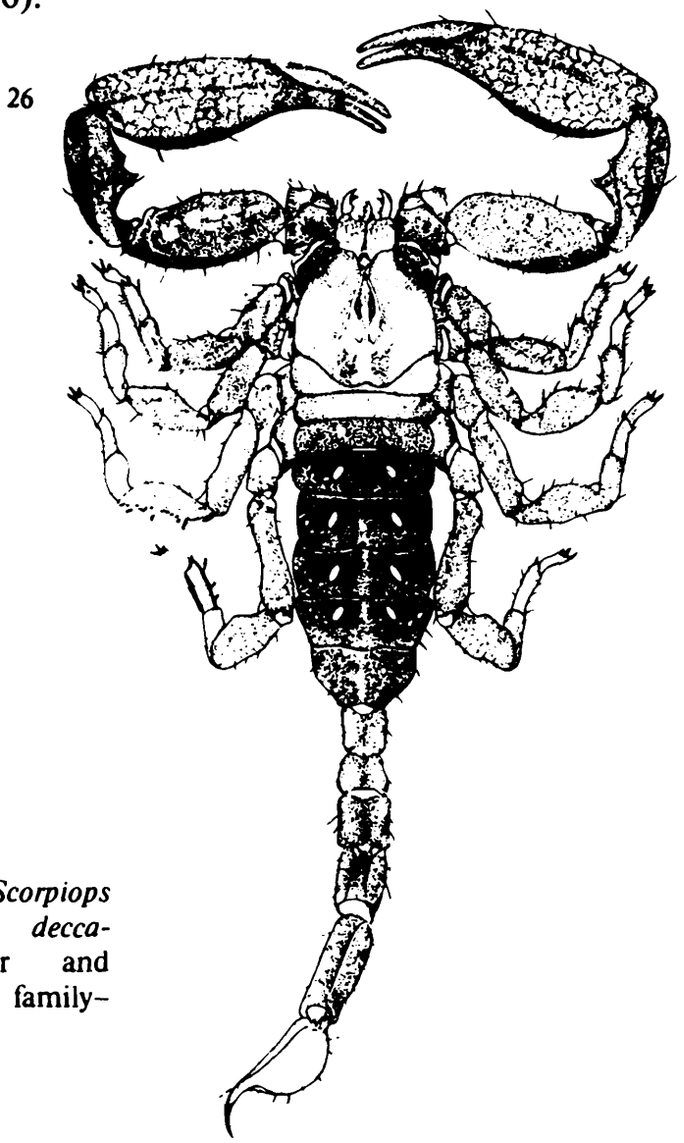

Fig. 26. Dorsal view of *Scorpiops (Neoscorpiops) deccanensis* Tikader and Bastawde of the family–VAEJOVIDAE

Family ISCHNURIDAE (Isch'nuri-dae)

The scorpions of this family have furnished legs with a single pedal spur. Anterior margin of coxa of 1st pair of legs narrowed in front. Sternum broad and pentagonal. Genital operculum divided in male but undivided in female. Both movable and immovable fingers of mandible without tooth along the lower edge. There is no spine beneath the aculeaus on caudal vesicle. Extremity of tarsi squarely truncated, forming almost a right angle with the base of the claw lobe, and not produced into a rounded lobe overlapping the claws at the side. Carapace, abdomen and chelae flat and depressed; hand with strong and complete finger-keel; edges of finger of chela granularly dentate, not produced into sharp triangular teeth. Tail thin and strongly compressed. There are 3 genera and 7 species represented this family in India (Fig. 27).

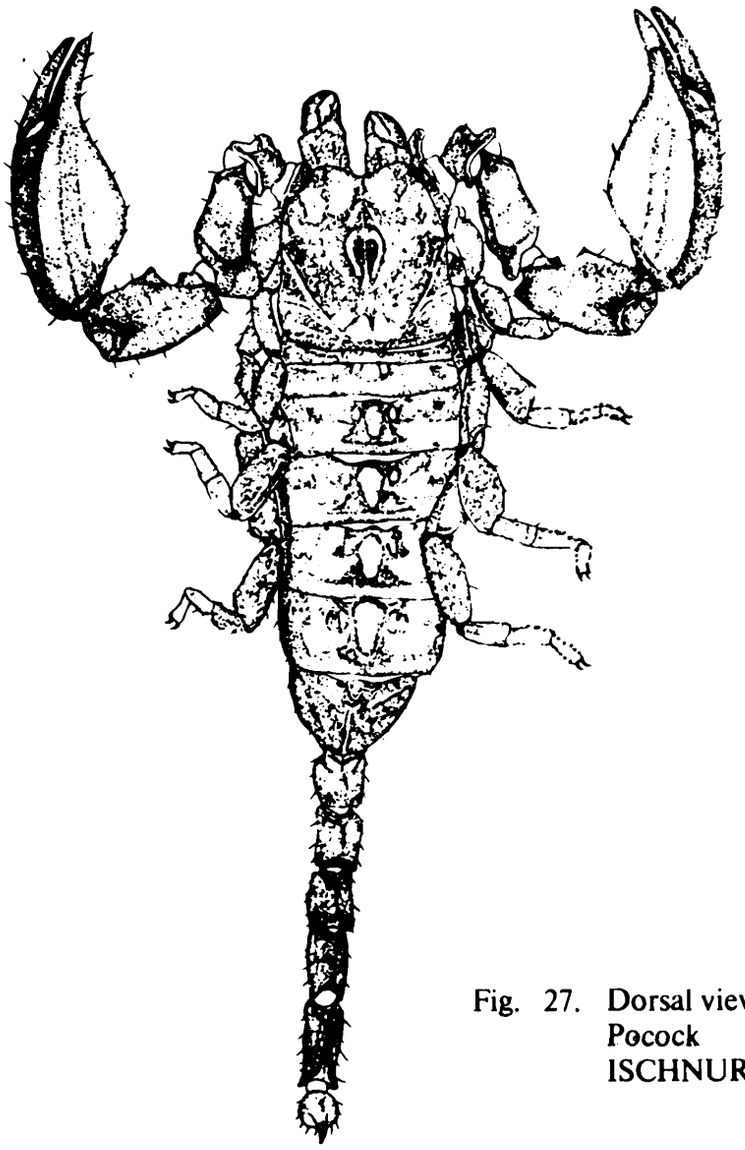

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Fig. 27. Dorsal view of *Hormurus higripes* Pocock of the family-ISCHNURIDAE

Family SCORPIONIDAE (Scor-pi-on'i-dae)

The scorpions of this family are wide spread throughout the tropics of the world. The family contains the largest members of the order. They come close in most respects with the family Buthidae. Body and chelae are not flat and depressed; hand usually convex above, the finger-keel absent, or not so strong and complete as in the

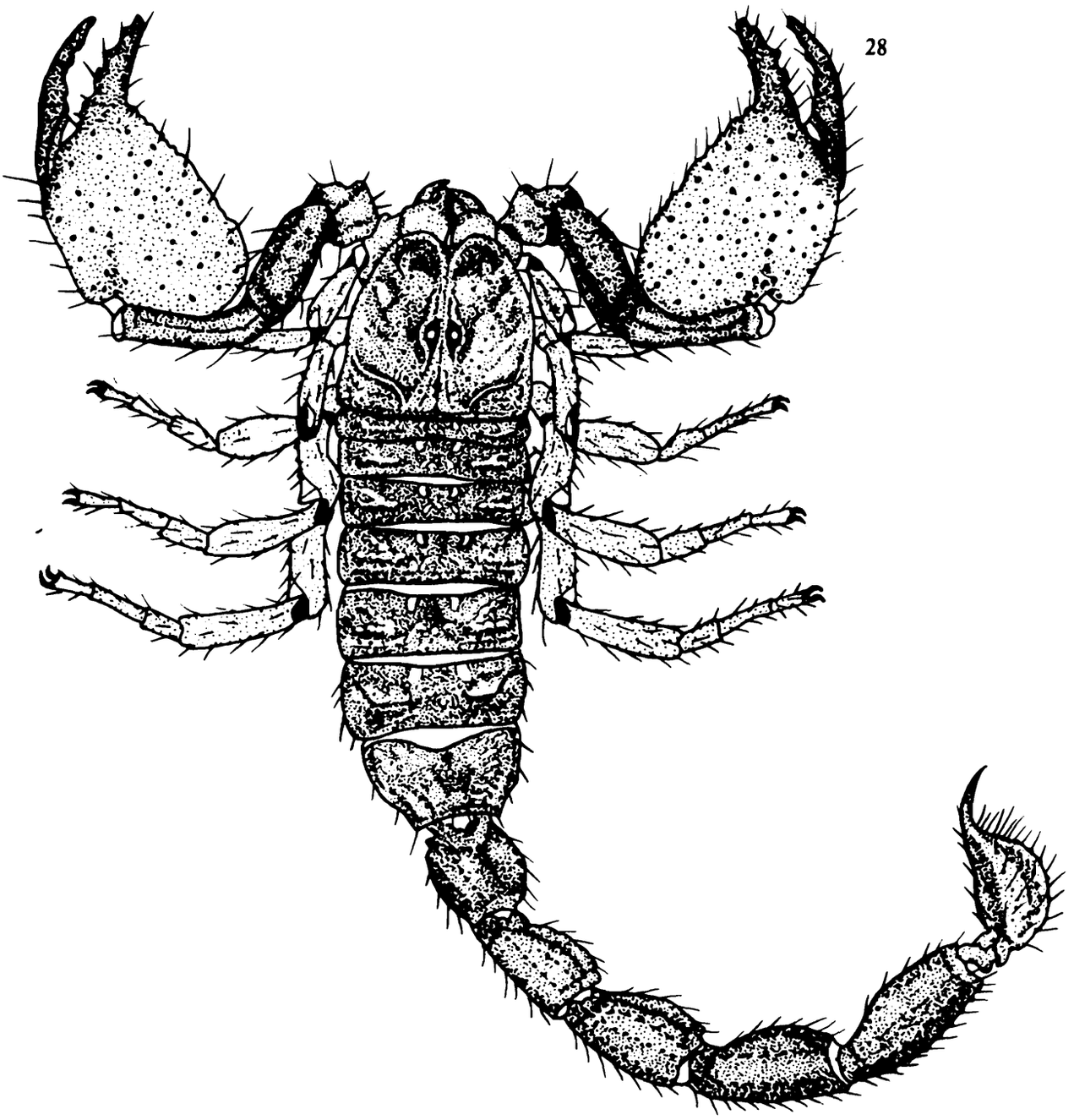

Fig. 28. Dorsal view of *Heterometrus (Gigantometrus) flavimanus* (Pocock) of the family–SCORPIONIDAE.

Ischnuridae; fingers armed with strong triangularly pointed teeth. Anterior margin of coxa of first pair of legs narrowed in front. Tail powerful, not compressed. The scorpions of this family are large in size. The species *Palamnaeus swammerdami* Simon is the largest scorpion of India and measures 140 mm (6 inches). Its near ally the West African species *Pandinus imperator,* is the largest scorpion in the world which sometimes reaching a length of 180 mm (7 inches). Only a single genus and 4 sub-species with 23 species occur in our fauna (Fig. 28).

The Indian scorpion fauna, recorded so far, representing the following families, subfamilies, genera and subgenera.

ORDER SCORPIONIDA

Family I. BUTHIDAE Simon
- Subfamily 1. BUTHINAE Pocock
  - Genus 1. **Lychas** Koch
    - Sub-genus 1. **Distotrichus** Tikader & Bastawde
    - Sub-genus 2. **Alterotrichus** Tikader & Bastawde
    - Sub-genus 3. **Endotrichus** Tikader & Bastawde
  - Genus 2. **Hemibuthus** Pocock
  - Genus 3. **Orthochirus** Karsch
  - Genus 4. **Charmus** Karsch
  - Genus 5. **Stenochirus** Karsch
  - Genus 6. **Buthotus** Vachon
  - Genus 7. **Compsobuthus** Vachon
  - Genus 8. **Vachonus** Tikader & Bastawde
  - Genus 9. **Mesobuthus** Vachon
  - Genus 10. **Androctonus** Hempr. & Ehrenb
  - Genus 11. **Odontobuthus** Vachon
- Subfamily 2. CENTRURINAE Kraepelin
  - Genus 12. **Isometrus** Hempr. & Ehrenb
    - Sub-genus 4. **Raddyanus** Vachon
    - Sub-genus 5. **Closotrichus** Tikader & Bastawde

Family II. CHAERILIDAE Pocock

Genus 13. **Chaerilus** Simon

Family III. VAEJOVIDAE Thorell
Subfamily 3. SCORPIOPSINAE Kraepelin
Genus 14. **Scorpiops** Peters
Sub-genus 6. **Neoscorpiops** Vachon
Sub-genus 7. **Scorpiops** Vachon
Sub-genus 8. **Euscorpiops** Vachon

Family IV. ISCHNURIDAE Pocock

Genus 15. **Chiromachetes** Pocock
Genus 16. **Hormurus** Thorell
Genus 17. **Iomachus** Pocock

Family V. SCORPIONIDAE Pocock

Genus 18. **Palamnaeus** Thorell

ORDER SOLPUGIDA OR SOLIFUGAE

The Arachnids of the order Solpugida or Solifugae sometimes known as false-spiders or wind-scorpions, are among the most formidable of the terrestrial invertebrates. The solpugida include a moderately large group of curious arachnids which are primitive. They are not considered as rare within the region they inhabit. They are commonly nocturnal and hide away during the daytime. The body of solifuge is hairy and divided into two parts, a prosoma or cephalothorax and an opisthosoma or abdomen which are ten segmented and united to one another with a narrow pedicle as in spiders. The chelicerae are extremely well developed forming two powerful pincers with which they prey is killed (Fig. 29). Sometimes these chelicerae are very long as the entire prosoma and they have possibly the most formidable jaws in the animal world.

The legs of the solifugae are quite characteristic. The first pair of legs is long and rather feeble and is not used for walking but is carried stretched out in front and used as additional tactile organs. The remaining legs are true ambulatory limbs, the fourth pair are the

strongest of all and bear ventrally five funnel-shaped sensory organs called *malleoli* or *racquet organs.* Among these five organs two on the coxa, two on the trochanter, and one on the trochantella. Each organ consists of a slender basal piece or *stalk,* and an expended distal piece–the *blade.*

Solpugids are nocturnal, exclusively predatory and carnivorous, having and extraordinary voracity. Though they principally are desert forms but they live in forests in India. Some of the species dig holes in the ground, and females at the breeding season live in burrows for the protection of themselves and their youngs. The common food of Solifugae are insects, including hard beetles, they also kill and eat large spiders, scorpions and small lizards. Very little is known about the enemies of Solpugida, but probably they are eaten by insectivorous birds, small mammals and reptiles.

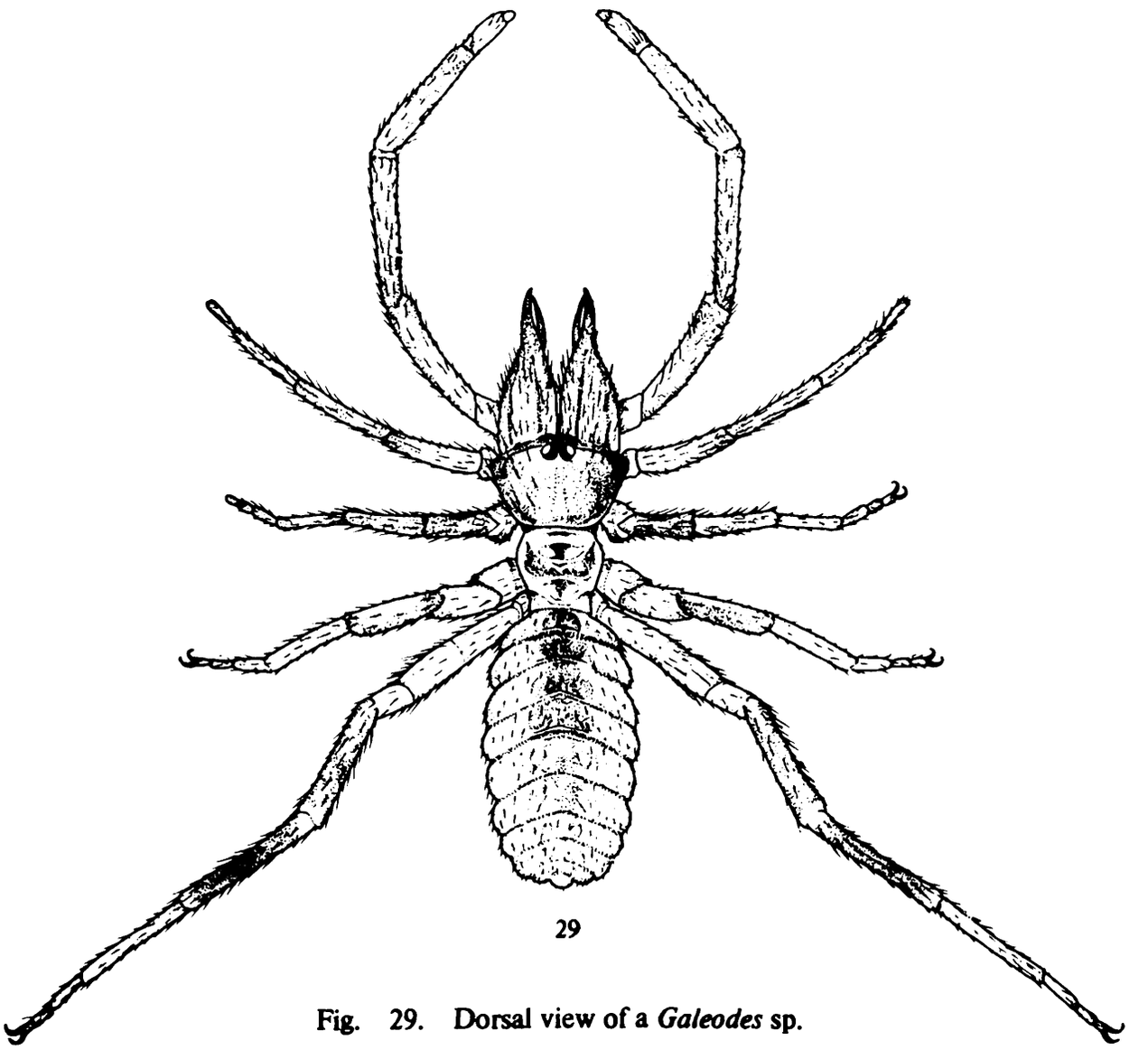

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Fig. 29. Dorsal view of a *Galeodes* sp.

This group of Arachnida is somehow moderately represented from our country. About a century ago, Pocock (1900) dealt with Solifugae in his Fauna of British India (Arachnida) and attempted to workout the Indian forms of this group including only 15 species distributed in 2 families and under 3 genera. After Pocock till today, unfortunately there is no attempt to explore this group of animal in our country.

ORDER PEDIPALPIDA

THE WHIP-SCORPIONS

These strange animals are found in the Oriental Region from India and Sri Lanka to the Fiji Islands and New Herbrides, and extend northwards into China and Southern Japan; Neotropical Region from Brazil northwards into the Southern States of North America. They are absent from Africa, Madagascar, Australia and New Zealand. In their general forms, they bear some resemblances to scorpions; but they can be easily distinguished from scorpions by the form of the pedipalps, of the first pair of legs and of post abdomen.

These arachnids are of moderate or large size, none of them are minute like Microthelyphonida. Cephalothorax is longer than wide, the carapace sometimes segmented posteriorly; the ventral surface narrow and furnished with two or three sternal plates. The first pair of legs are elongated, slender and antenniform (Figs. 30 & 31), and are modified into feelers. Each first leg consists of six segments *coxa, trochanter, femur, patella, tibia* and *tarsus;* the tarsus is divided into many segments, the last of which has a rounded tip instead of claws. The rest of legs ambulatory in function, and consists of 7 segments named as above with the addition of a *protarsus* which precedes the three-jointed tarsus; the tarsus bearing three claws; coxae of second and third legs not widely separated in the middle line of sternal area. The abdomen is segmented and consists of 12 somites, represented by tergal and sternal plates. The respiratory organs are two pairs of book-lungs; they open on the posterior edge of the second and third abdominal segments.

The whip-scorpions are of both tailed and tailless forms. In tailed whip-scorpions, the last three abdominal somites are annuliform or

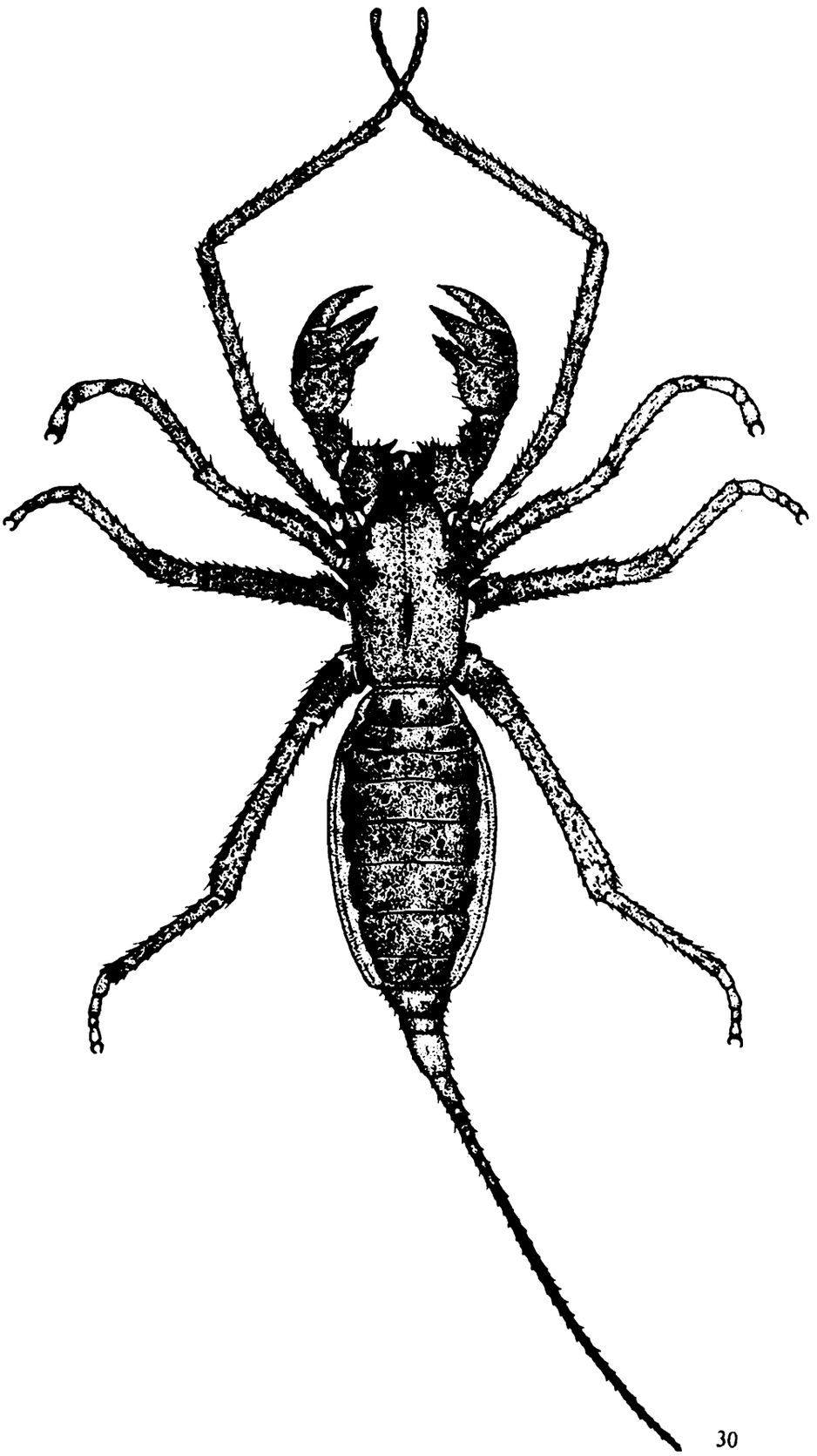

Fig. 30. Dorsal view of a tailed form of whip-scorpion, *Thelyphonus indicus* Stoliczka.

cylindrical, forming a movable stalk for the postanal skeletal piece, which consists of a single segment of many jointed caudal flagellum or filament (Fig. 31). In the family Schizomidae, this caudal appendage is short, consists of 1-3 segments. The tailless whip-scorpions do not possess any caudal appendage (Fig. 31).

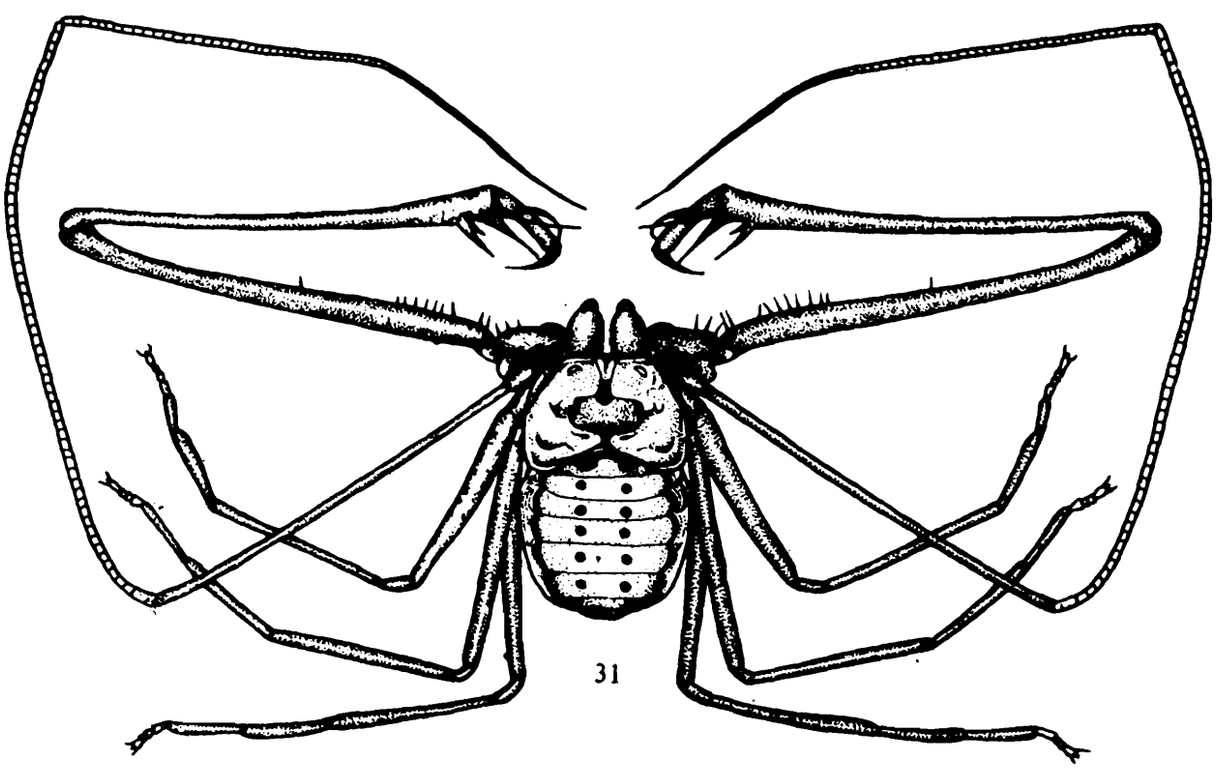

Fig. 31. Dorsal view of a tailless form of whip-scorpion, *Phrynichus phipsoni* Pocock.

This order is divided into three families separated as follows (after Warner 1935).

1. Cephalothorax longer than broad, with nearly parallel sides; caudal appendage present.....2

   Cephalothorax broader than long, with the sides strongly arched; caudal appendage absent.....TARANTULIDAE

2. Carapace with transverse segmentation posteriorly; caudal appendage short, 1-3 segments.....THELYPHONIDAE

   Carapace without transverse segmentation; caudal appendage long, many segmented.....SCHIZOMIDAE

Pocock (1900) revised this group of arachnids in his Fauna of British India (Arachnida), where it was divided into two separate orders–Uropygi and Amblypygi. Indian forms of Uropygi represented by 6 genera and 19 species out of 2 families, where Amblypygi contains 4 genera and 6 species in 2 families. But in this book, these two orders are represented as a single order–Pedipalpida and classified likewise (after Werner 1935). It is felt that there are lot of confusions regarding the taxonomy of Indian forms of whip-scorpions, so a wide revisionary work is needed.

The tailless whip-scorpions are in many ways intermediate between the whip-scorpions and the true spiders. They resemble the former in habits, being found under stones, fallen tree-trunks or in crevices of rocks and termite mounds; and differ in lacking of caudal appendages, abdomen jointed with the carapace by a slender pedicel, these are present in spiders. According to Gravely (1915) the Indian forms of tailless whip-scorpions appear to breed at about the same time of year. The eggs, number of which varies from 15-60 or more, are carried under the abdomen of female. The newly hatched youngs are white, like young scorpions they climb up on the dorsal surface of the abdomen of the mother till their first moult.

ORDER
PSEUDOSCORPIONIDA OR CHELONETHI
THE PSEUDOSCORPIONS

The Order–Pseudoscorpionida (or Chelonethi) are small, dorso-ventrally flattened arachnida commonly called Pseudoscorpions or false-scorpions, which resemble scorpions in the general form of their pedipalps and body, except that the hind part of the abdomen is not narrow as in the post-abdomen or metasoma of scorpions (Fig. 32). They have no caudal sting. The body of pseudoscorpion is flattened, which enables these small creatures to live in narrow spaces, as beneath the bark of tree, between the leaves of a book and crevies in buildings. They are generally seclusive in habits, occurring mostly in dark, damp places, beneath the bark, in soil cover, rotten logs of wood, under stones and in poultry houses. A good number of them seem also to prefer to live in the nests of birds. Because of their natural habitat in dark places and their small size these animals escape the notice of the naturalists. The pseudoscorpions have great

diversity of form and occur in a variety of habitats. They have not, however, attracted much attention of the Zoologists in our country so the number of known species is negligibly small, though they are very common and abundant. Recently, Murthy and Ananthakrishnan (1977), and Sivaraman (1980) have dealt with pseudoscorpions. They have attempted at a comprehensive compilation of the Indian fauna of this group including about more than 100 species distributed under 47 genera and 13 families. The pseudoscorpions fauna is one of the major orders of the Arachnida and in number of species, they take the second place. Among Arachnida (mites not included), at present about 2,300 species, belonging to 410 genera under 19 families of pseudoscorpions, are known from the world.

The pseudoscorpions are small shy creatures. The dorsal surface of the prosoma or cephalothorax is formed of a large sclerite bearing the eyes and six pairs of appendages the chelicerae, pedipalps and four pairs of legs. The chelicerae are complexly developed structures which serve as grasping, spinning, cleansing and sensory organs, and are pre-oral in position. Each chelicera is composed of two segments. Their fingers bear a series of complicated structures known as the serrulae and laminae. The serrula exterior is keel-like and set with fine teeth and attached for varying degrees of its length to the movable finger while the serrula interior, attached to the base of the fixed finger, is even more variable in form. A flagellum, formed of setae whose number and shape are valuable taxonomic characters, is also attached to the fixed finger.

The mouth is situated between the basal segments of the six-segmented pedipalps. The pedipalps are enormously developed and resemble the claws of scorpions (Fig. 32). They serve as prehensile organs to capture and kill the prey and bear sensory hairs or setae. The immovable finger of the chela has a row of cutting teeth along its inner edge, the last of which is considerably enlarged. Through this passes the duct of the elongated poison gland, which itself is embedded in the finger. In certain families both fingers are equipped with poison glands.

The four pairs of walking legs differ from those of other arachnids, in fact the tibia is unsegmented so that there is no patella. At the same time in many species, the femur is divided into two distinct segments. The number of tarsal joints is of great systematic value

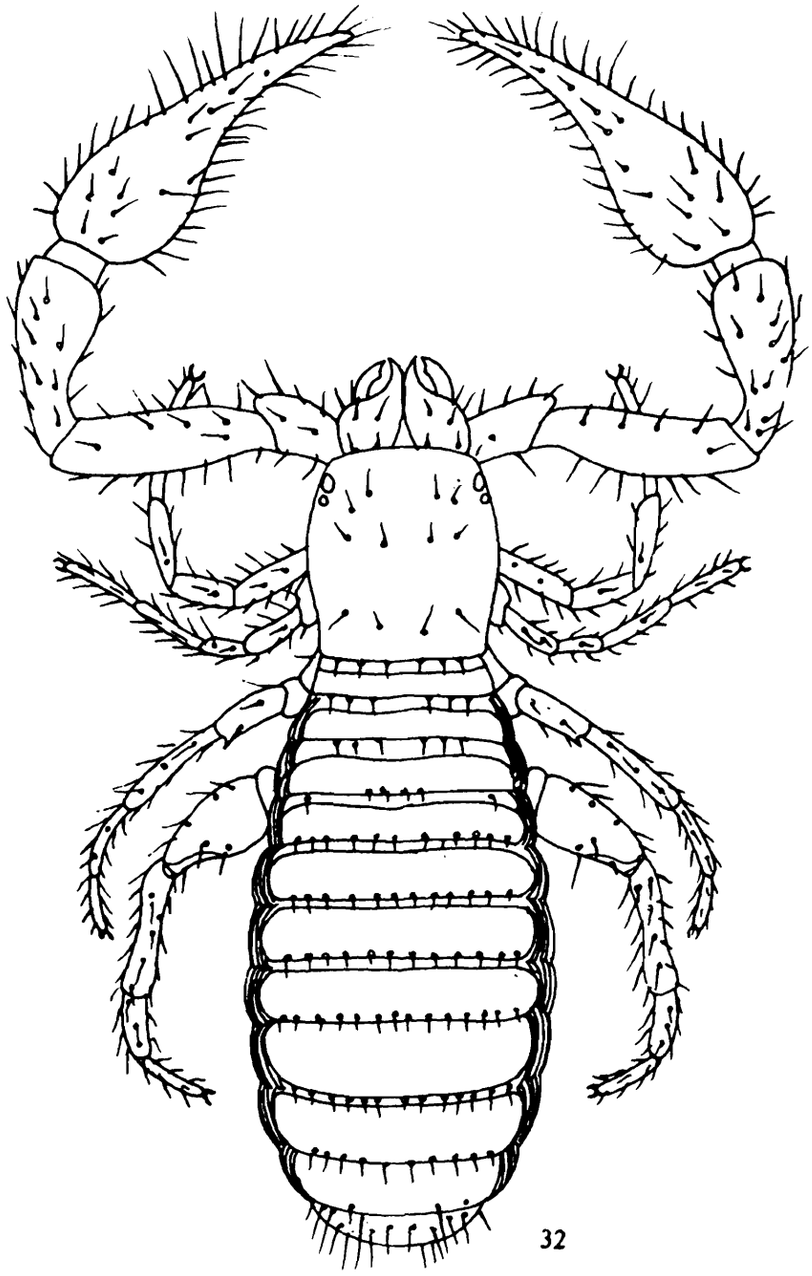

Fig. 32. Dorsal view of a pseudoscorpion.

and is the chief character upon which the three suborders of the pseudoscorpions are differentiated. According to the basis of the segments on the legs, the order Pseudoscorpionida is divided into three suborders. In the suborder Monosphyronida, each leg has six segments *coxa, trochanter, basifemur, telofemur, tibia* and *tarsus.* In the Diplosphyronida, the tarsus of each leg consists of the proximal metatarsus and the distal telotarsus so that the leg appears

to be made up of seven segments. The Heterosphyronida have in the first two legs a single tarsal segment each, whereas each of the third and fourth legs has two tarsal segments. Pseudoscorpions are exclusively carnivorous and feed on living or recently killed prey such as collembols, psocids, thysanura and other small insects. They are not usually cannibalistic but cannibalism has been observed in some Indian species like *Euryolpium indicum* Murthy and Ananthakrishnan, *Calocheiridius beieri* (Murthy) and *Oratemnus indicus* (With). The poison glands seem to serve a definite purpose by secreting a toxic substance by which the prey is usually paralysed. Pseudoscorpions are having with poison glands in both the fingers, kill their prey very quickly. The phenomenon is observed in which the chelicerae are cleaned by the chelae. Incidentally one false-scorpion has been observed by Vachon (1949) to rob another of its food after a short struggle.

Large bodied pseudoscorpions belonging to the suborders Monosphyronida and Diplosphyronida, are collected by hand picking from underneath the bark of trees and logs, underneath stone and rotten wood and leaves. Medium sized specimens are collected by lifting litter and debris on a piece of white cloth. Bulk collection of the pseudoscorpions in these ways is laborious and time consuming because of their small size. The most efficient method of collecting Pseudoscorpions is the use of Berlese funnels.

An excellent scientific account of the pseudoscorpions with morphological descriptions of the species occurring in France, was published by Simon (1874-1937) and later Balzan (1891) proposed an excellent classification. The most important pioneer work on the American pseudoscorpions is that of Bank (1895) who gave a synopsis of the species known at that time and described many species from America. After Bank, and more recently there was a monographic revisionary work of the order Chelonethi by Chamberlin (1931) who based his system on an intensive analytical study of the morphology and ecology of these creatures, and introduced the classification which was now generally accepted by Chelonethologists. Although the systematic portion of this monographical work deals with the higher categories and deals with only upto the generic level, students will find it indispensable to any serious study of the pseudoscorpions. Most of the American species are listed by Beier (1932) in his comprehensive treatment of the

world fauna. The order is a difficult one for the beginner,because of the requirements in preparation and technique which must be satisfied before any critical study can be attempted.

Chamberlin has divided the order into three suborders, all of which are found in India. They are based on the segmentation of the legs and may be separated as follows.

KEY TO THE SUBORDERS OF THE ORDER PSEUDOSCORPIONIDA

1. First and second legs with a single tarsal segment, third and fourth legs with two tarsal segments.....HETEROSPHYRONIDA (CHTHONIINEA)

   Tarsi of all legs with an equal number of segments.....2

2. All legs with two tarsal segments, so that the legs have six segments exclusive of the coxae; primitively four-eyed, sometimes secondarily two eyes or blind.....DIPLOSPHYRONIDA (NEOBISIINEA)

   All legs with single tarsal segment; always two-eyed or blind.....MONOSPHYRONIDA (CHELIFERINEA)

The Indian pseudoscorpions are represented so far by the following suborders, families and genera.

I. Suborder : HETEROSPHYRONIDA
FAMILY I. TRIDENCHTHONIIDAE
Genus 1. **Compsaditha** Chamberlin

FAMILY II. CHTHONIIDAE
Genus 2. **Paraliochthonius** Beier
Genus 3. **Tyrannochthonius** Chamberlin
Genus 4. **Lagynochthonius** Beier
Genus 5. **Lechytia** Balzan

II. Suborder : DIPLOSPHYRONIDA
FAMILY III. NEOBISIIDAE
Genus 6. **Microcreagris** Balzan

FAMILY IV. HYIDAE
Genus 7. **Hya** Chamberlin
Genus 8. **Indohya** Beier

FAMILY V. IDEORONCIDAE
Genus 9. **Dhanus** Chamberlin

FAMILY VI. OLPIIDAE
Genus 10. **Calocheiridius** Beier & Turk
Genus 11. **Olpium** Koch
Genus 12. **Indolpium** Hoff
Genus 13. **Parolpium** Beier
Genus 14. **Euryolpium** Redikorzev
Genus 15. **Amblyolpium** Simon
Genus 16. **Indogarypinus** Murthy & Ananthakrishnan
Genus 17. **Heterolpium** Sivaraman

FAMILY VII. GARYPIDAE
Genus 18. **Garypus** Koch
Genus 19. **Geogarypus** Chamberlin

FAMILY VIII. FEALLIDAE
Genus 20. **Fealla** Ellingsen

III. Suborder MONOSPHYRONIDA
FAMILY IX. CHEIRIDIIDAE
Genus 21. **Pseudocheiridium** Chamberlin
Genus 22. **Apocheiridium** Chamberlin

FAMILY X. STERNOPHORIDAE
Genus 23. **Sternophorus** Chamberlin
Genus 24. **Indogaryops** Sivaraman

FAMILY XI. ATEMNIDAE
Genus 25. **Paratemnus** Beier
Genus 26. **Oratemnus** Beier
Genus 27. **Atemnus** Canestrini
Genus 28. **Anatemnus** Beier
Genus 29. **Micratemnus** Beier

Genus 30. **Catatemnus** Beier
Genus 31. **Stenatemnus** Beier
Genus 32. **Tullgrenius** Chamberlin
Genus 33. **Diplotemnus** Chamberlin

FAMILY XII. CHERNETIDAE
Genus 34. **Lamprochernes** Tomosvary
Genus 35. **Indochernes** Murthy & Ananthakrishnan
Genus 36. **Parachernes** Chamberlin
Genus 37. **Pselaphochernes** Chamberlin
Genus 38. **Ochrochernes** Beier
Genus 39. **Orochernes** Beier

FAMILY XIII. CHELIFERIDAE
Genus 40. **Withius** Kew
Genus 41. **Metawithius** Chamberlin
Genus 42. **Hygrochelifer** Murthy & Ananthakrishnan
Genus 43. **Ellingsenius** Chamberlin
Genus 44. **Microchelifer** Beier
Genus 45. **Nannocheliferoides** Beier
Genus 46. **Lophochernes** Chamberlin
Genus 47. **Lophochelifer** Beier

ORDER OPILIONES OR PHALANGIDA
THE HARVESTMEN

The members of the order Opiliones or Phalangida are the harvestmen, the majority of which can be recognised by their long and slender legs and segmented abdomen which is jointed to the cephalothorax across the whole breadth and not by a narrow pedicel like spiders (Fig. 33). The cephalothorax is composed of six segments and is separated from the abdomen by a fairly deep groove. The carapace is generally smooth and, in most species, bears two eyes, which may rarely absent. The eyes are always situated on a prominent ocular tubercle near the middle of the cephalothorax. The body of harvestmen is usually covered with spines, pointed tubercles and bristles. On the underside of the body, the coxae of the legs almost meet in the middle, so that there is no sternum as in spiders.

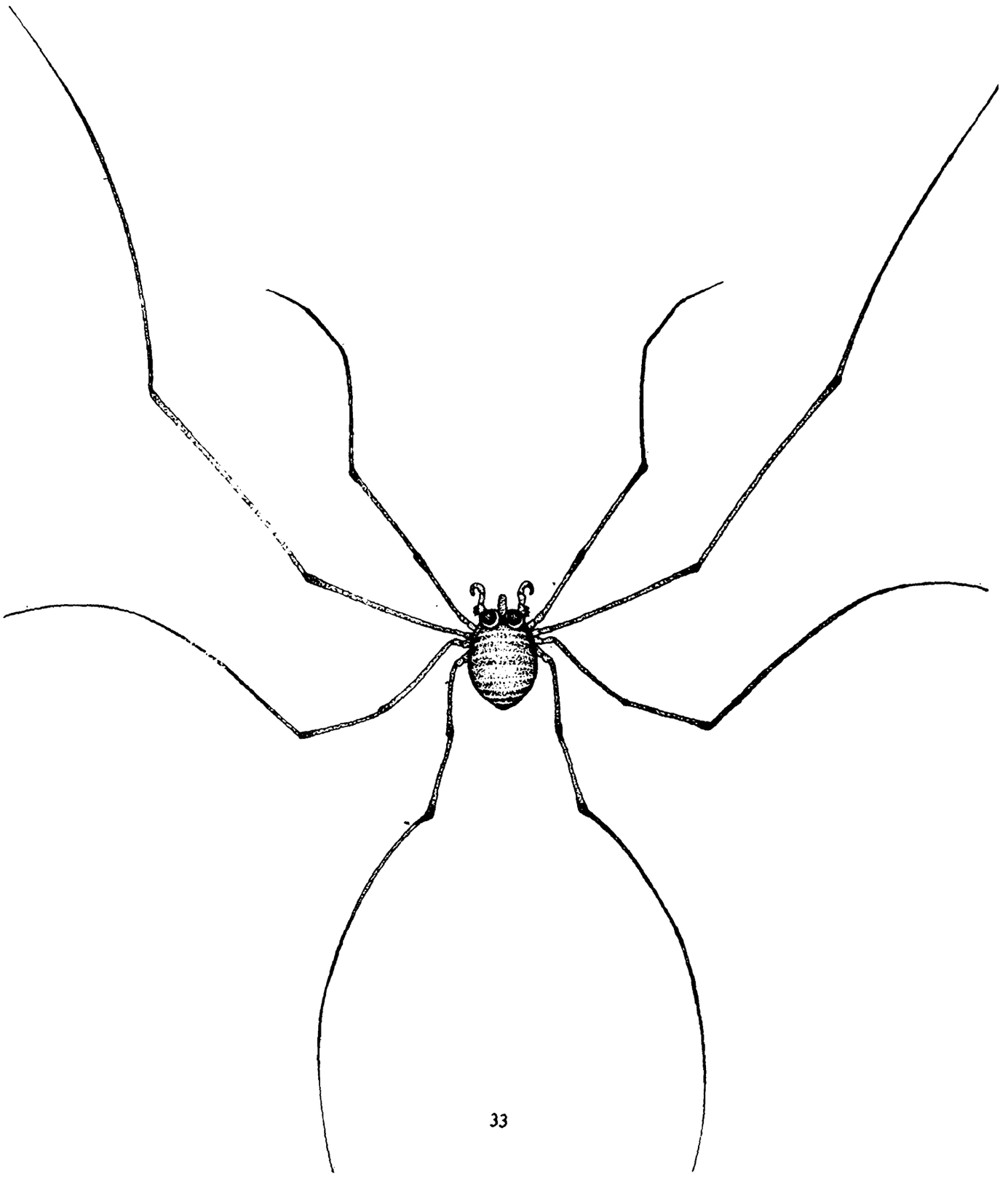

Fig. 33. Dorsal view of a harvestman (Order–Opiliones).

The abdomen is composed of ten segments, but these can be distinguished only in the most primitive suborder Cyphophthalmi, in others not more than nine tergites are present. The Opiliones are divided into three suborders of which the Cyphophthalmi is the most primitive and other two suborders are Mecostethi and Plagiostethi.

The adults ordinarily hide during day, but at twilight they wander out in search of food. Some species are often found in the fields, where they are congregate in large numbers (Fig. 34).Sometimes, they congregate in a similar manner on the tree trunk. The name harvestmen for these creatures was probably suggested by the fact that they are most often seen on the field during harvest time. The Harvestmen are primarily carnivorous and usually feed on fresh or recently dead animal tissues, but they also eat various organic matter such as bread, fat, the gills of fungi, etc.

The Opiliones (harvestmen) are among the most ubiquitous arachnids that are too conspicuous to escape notice, and the Indian subcontinent has a large diversity of harvestmen fauna, rich in variety as well as abundance. But unfortunately in our country practically not much has been done on this group. Only Roewer (1929) made some attempts to work out the Indian harvestmen and described 167 species distributed under 40 genera of the subfamily Gagrellinae of the family Phalangodidae. There are excellent works on these animals in the European countries and America. Roewer's monumental work on these group "Die Weberknechte der Erde" appeared in 1923 and adopted the Simon's classification and included all harvestmen under three suborders. (1) Mecostethi (2) Plagiostethi (3) Cyphophthalmi, with description of about 1,600 species in 12 families.

3. THE CHARACTERS OF THE ARACHNIDA

At a glance, the Arachnids can be distinguished from other air-breathing arthropods by the absence of antennae–the feeler like appendages projecting forward from the head. The Arachnida may be characterised as follows with the exception of some Ticks and

Note : *The order–Araneae has been dealt in details in the chapter IV in this book.*

Mites. The arthropodeous animals in which the body in the adult is never composed of more than 18 somites (segments) and is divisible into two main regions a prosoma or cephalothorax and an opithosoma or abdomen. In the scorpions and in some other forms, the abdomen is again divided into two portions the broad preabdomen and a slender tail-like postabdomen.

Cephalothorax consists of six somites, each of which is provided with a pair of appendages. The somites are fused together and covered by a dorsal hard chitinous shield–the *carapace.* The ventral surface of the cephalothorax is also typically supplied with one or more median plates–the *sterna,* sometimes the sterna are partially or wholelly absent by the ingrowth of the basal segments of the appendages which may meet in the mid-ventral line. Often the sternal plates are united and form a single ventral plate to the cephalothorax.

The *eyes* are simple and eight in number, and vary greatly in their position. In some forms the eyes are borne on an ocular tubercle at the middle of the cephalic part. The eight eyes in which two or four, are situated close together in the middle line–the *median eyes* and rest three or two on each side–the *lateral eyes,* set in cluster or separated from each other.

Another striking characteristic feature of Arachnida is the absence of true jaws, so in the Arachnida the prey is crushed by cephalothoracic appendages. The arachnids suck the blood of their victims by means of a sucking stomach. They crush their prey but do not masticate it. The *mouth* is a minute aperture placed near the lower part of the anterior extremity of the cephalothorax. It is bordered above by a membranous or horny upper lip–*labrum* and usually below the lower lip–*labium* or anterior sternal plate which acts as lower lip.

Six pairs of appendages are borne by the cephalothorax, in the most arachnids, the first two pairs are used for seizing and crushing prey and the last four pairs are legs. The first pair of appendages are termed the *chelicerae* which are placed close together beneath the front edge of the carapace above the mouth. Each chelicera is chelate and consists of two, rarely of three segments. The terminal segment

of the chelicera is the *movable finger* closing aginst a prolongation of the basal segment known as *immovable finger*. The second pair of appendages are the *pedipalp,* are very variable in function and form, being sometimes prehensile and pincer-like termed *chelae,* sometimes tactile and leg-like termed *palpi.* In male spiders, the pedipalps are highly modified and specialised as copulatory organs termed *palpal organ.* Each pedipalp is typically six segmented–*coxa, trochanter, femur, patella, tibia, tarsus,* but when the basal segment–coxa acts as a masticator of food termed the *maxilla.* The tip of the tarsus is typically affixed a *claw,* which may be freely movable or fused to the segment. The remaining four pairs of appendages are collectively called as the *legs.* The first of these four pairs often acts as tactile organ in some groups and is not used for progression. Typically each of these limbs consists of seven segments–*coxa, trocher, femur, patella, tibia, metatarsus* and *tarsus.* The tarsus is armed with two or three claws and sometimes this terminal segment may be secondarily subdivided into two or more segments.

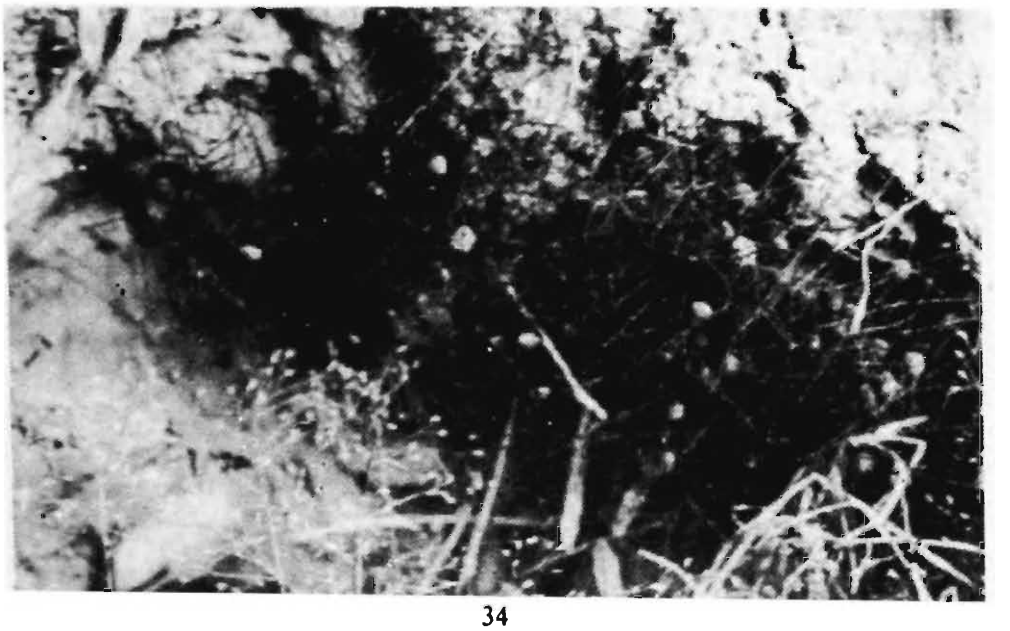

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Fig. 34. Congregation of a number of harvestmen in the paddy-field.

The *abdomen* may be united to the cephalothorax by a narrow *pedicel*–the seventh somite, and is usually without appendages. If abdominal appendages are present, they are small in size and are used for the purposes of silk-spinning and reproduction, not for locomotion. The abdomen may be segmented being furnished with dorsal plates–*tergites* or ventral plates–*sternites* or no such plates are developed, and the external signs of segmentation are either abolished or obscure. The abdomen is pitted dorsally and ventrally by a few pairs of scars called *sigilla,* which mark the point of attachment of a series of internal dorso-ventral muscles.

Among *internal organs,* the *generative organs* open upon the ventral side of the first or second abdominal somite beneath the *genital operculum.* The respiratory organs are either *book-lungs* or *tracheae* or both, open upon the ventral side of the abdomen through paired apertures–the *stigmata.*

In arachnids, the sexes are seperate and in some the sexual dimorphism is very much remarkable. They are either viviparous or oviparous. The youngs are born or hatched from the egg, in a form substantially resembling their parents without any metamorphosis, but undergo a series of successive moults. The individuals are generally terrestrial, carnivorous, either diurnal or nocturnal.

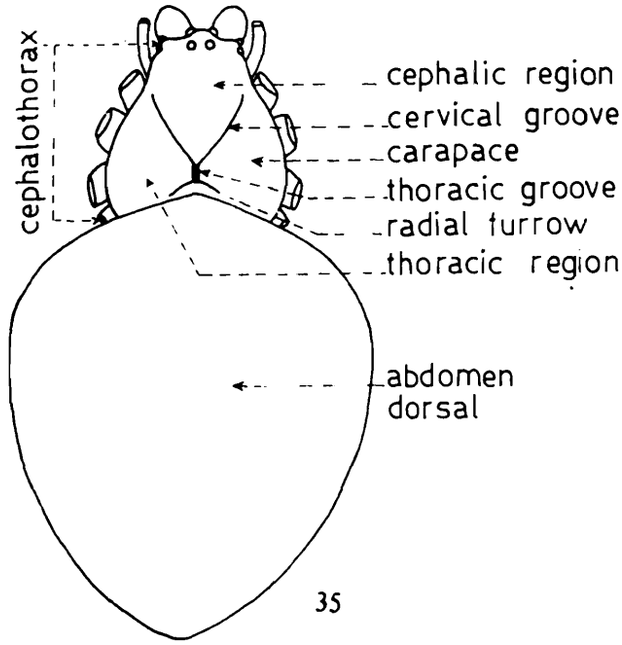
CHAPTER II ANATOMY OF SPIDER

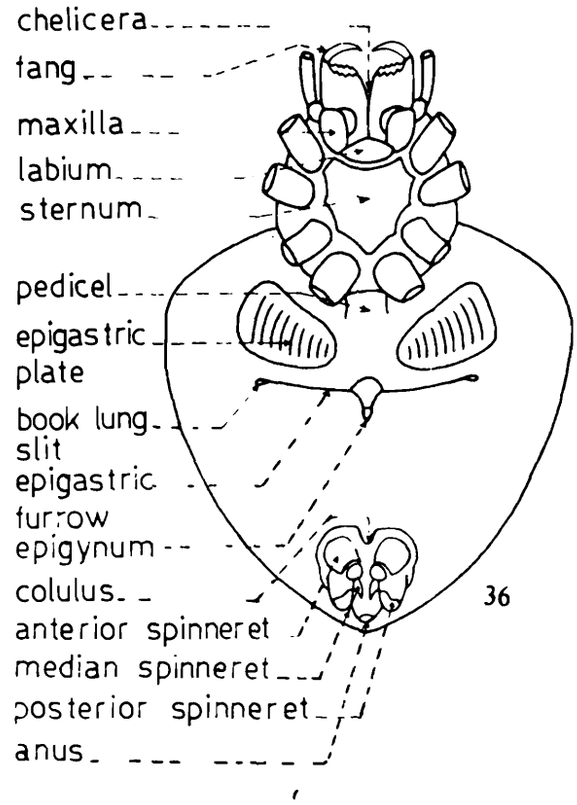
1. EXTERNAL ANATOMY

The body of a spider is divisible into two distinctive *cephalothorax* and *abdomen,* connected by a narrow *pedicel.* The cephalothorax is covered dorsally by a hard sclerotic, the *carapace,* and ventrally by the *sternum* as in text figs. 35 and 36. The anterior margin of sternum articulates movably with the *labium.* With a few exceptions, there is a deep transverse groove forming a kind of hinge between the sternum and the iabium. The legs are articulated in the pleural membrane between the lateral edges of the carapace and sternum.

On the cephalic region, six to eight simple eyes are present. The eyes are generally of two kinds, black or *diurnal* and white or *nocturnal* eyes. When only one type is present, the condition is described as *homogeneous* in contrast to the *heterogeneous* where both the types are present. The eyes are usually arranged in a double row. The *anterior row* and the *posterior row.* Each row usually contains four eyes. The rows of eyes are frequently curved. If the curvature is such that the lateral eyes are further forward than the median eyes, the row is called *procurved,* and if the lateral eyes are further backward than the median eyes, the row is called *recurved* as in text fig. 42. According to their position, the eyes are described as the *anterior medians,* the *posterior medians,* the *anterior laterals* and the *posterior laterals.* The cephalic area, occupied by the eyes, is known as *ocular area.* The area margined by the four median eyes, is termed as *ocular quad.* The area between the anterior row of eyes and the anterior margin of carapace is *clypeus.* There is often a depression in the middle of the thoracic region called *thoracic groove* as in text fig. 35.

There are six pairs of appendages on the cephalothorax. The first pair of appendages are the *chelicerae.* Each chelicera bears a curved *fang* at its apex. The inner surface of chelicera may be finely denticulate and may also have a groove, into which the fang can be closed when not in use. This groove may also be armed with teeth on each side; the outer margin of this groove is described as *promargin* and the inner margin as *retromargin.* There are sometimes long stout hairs on the promargin to constitute the so called *fang-scopulae* as in text fig. 39. The pedipalps are the second pair of appendages, each





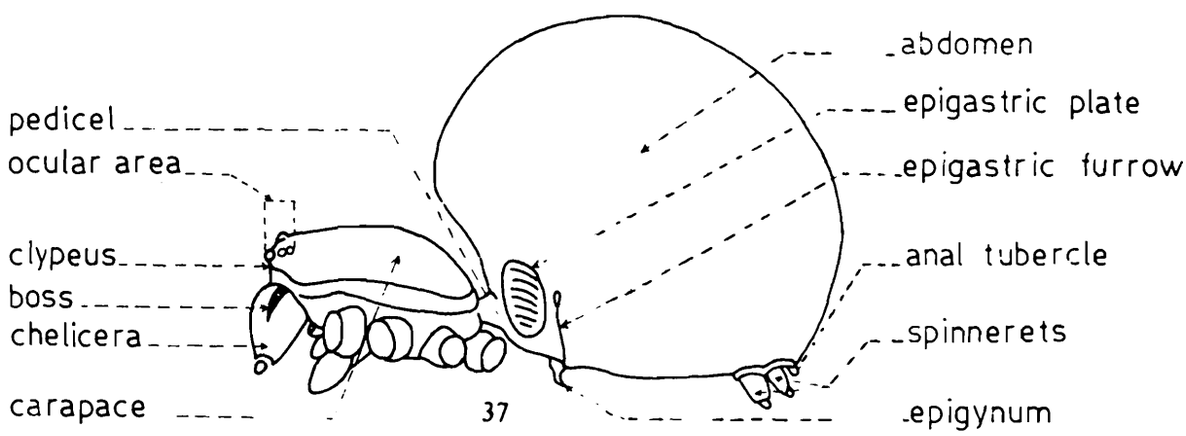


Fig. 35. Dorsal view of a typical spider, legs omitted.

Fig. 36. Ventral view of typical spider, legs omitted.

Fig. 37. Lateral view of a typical spider, legs omitted.

one is composed of six segments, *viz., coxa, trochanter, femur, patella, tibia* and *tarsus* as in text fig. 38. In females the tarsus is simple and may or may not be with a single claw. The basal segment the coxa of pedipalp expands into a single plate like structure called *maxilla,* each side of which is generally provided with thick tuft of hairs called *scopulae* as in text fig. 38. In mature males, the tarsus of

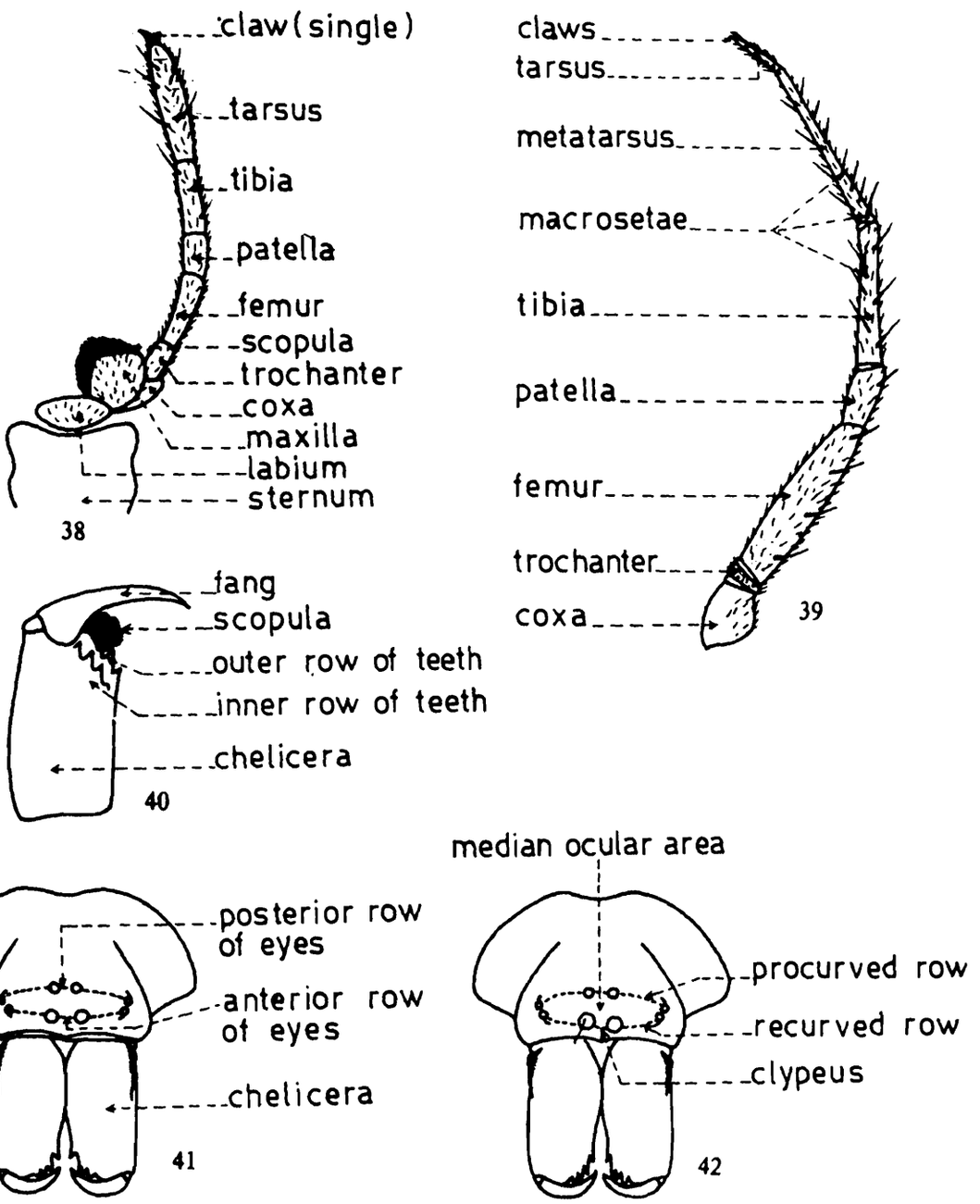


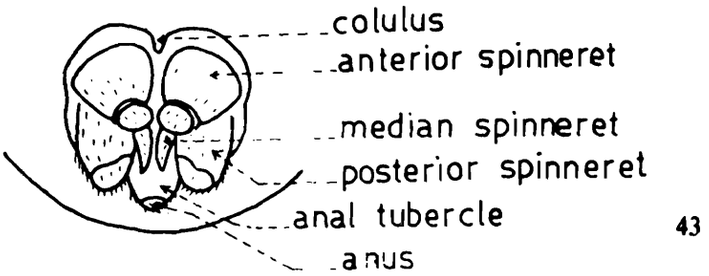
Fig. 38. Labium, maxilla and pedipalp of a female spider.

Fig. 39. Inner view of chelicera.

Fig. 40. Lateral view of a leg.

Fig. 41. Face, front view of a typical spider.

Fig. 42. Face, front view of a typical spider showing arrangement of eyes.



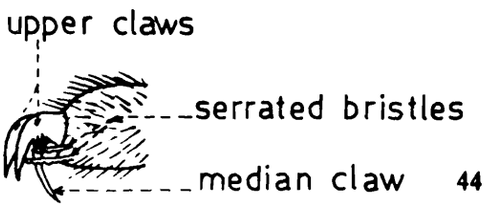


Fig. 43. Ventral view of spinnerets.

Fig. 44. Distal end of tarsus showing claws of a typical araneid spider.

palp is modified to carry a complicated copulatory organ called palpal organ. Detail of this organ of male spider has been discussed in the reproductive system. There are four pairs of legs designated as I, II, III and IV respectively. Each leg is composed of seven segments, *viz., coxa, trochanter, femur, patella, tibia, metatarsus* and *tarsus* as in text fig. 40. The legs are variously clothed with spines, spicules, bristles and hairs of different types. The distal ends of tarsi are provided with two or three claws. A characteristic tuft of hairs called *claw-tuft* is sometimes found just above the claw. Spines on the dorsal surface of the legs are distinguished as *dorsal spines* and those on the ventral side as *ventral spines,* as in text fig. 40. The paired claws of tarsus may be armed with a few teeth.

At the posterior end of the abdomen the alimentary canal opens from a more or less distinct *anal tubercle.* Below the anal tubercle, there are most striking features of a spider-the *Spinnerets,* by means of which a spider weaves its snare or thread. The spinnerets are finger like in form and usually six in number, but may be two pairs or even can be reduced to a single pair. The first or *anterior pair,* the second or *median pair* and the third or *posterior pair* of spinnerets as in text fig. 43. The anterior spinnerets consist almost always of two segments each, the median spinnerets are not segmented and the posterior spinnerets usually consist of each of two segments, but

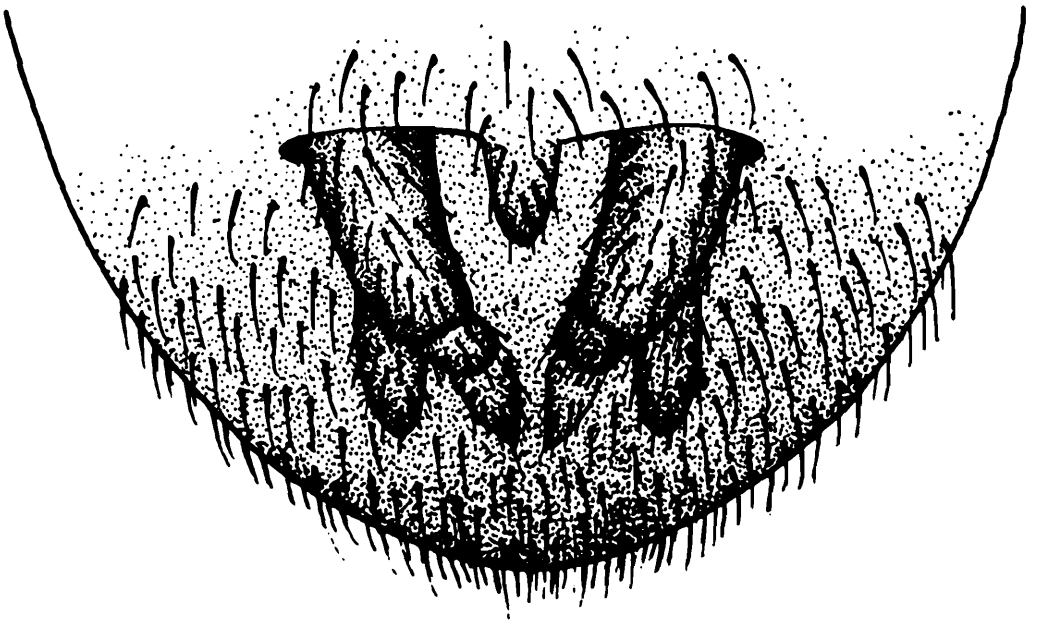


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Fig. 45. Ventral view of cribellum of a typical cribellate spider.

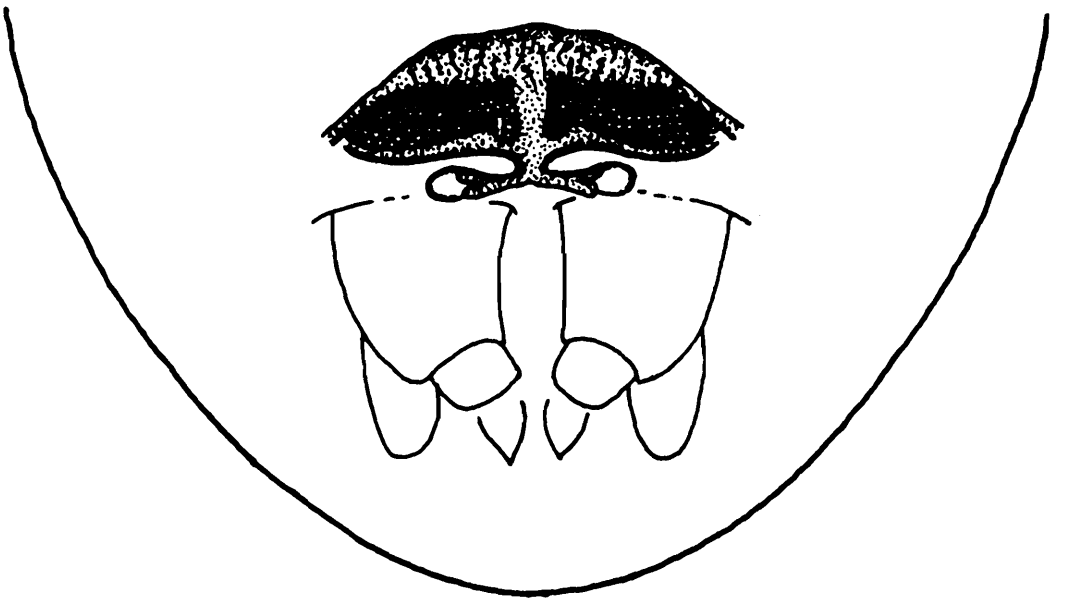

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Fig. 46. Ventral view of an abdomen showing colulus.

sometimes of three or even four segments. The spinnerets are provided with many minute tube like structures–the *spigots* from which a number of different kinds of silk is produced, which depending upon the type of gland associated with the spigots. No existing spiders are known in which the eight spinnerets are fully developed as functional organ but in *Liphistius,* which is known as segmented spider of the family–Liphistiidae, however, full eight spinnerets are present but only four external ones possess functional spinning glands. In some families (cribellate spiders) there is a plate possessing a sieve like surface immediately in front of the spinnerets. This sieve like plate is called *cribellum* as in text fig. 46, from which a special kind of silk is combed by a series of curved bristles comprising the *calamistrum,* borne on the metatarsus IV. A small apparently functionless appendage is found between the bases of anterior spinnerets, which is termed the *colulus* as in text fig. 45. The colulus is normally slender and pointed but in a number of spiders it may be somewhat flattened in appearance.

The ventral surface of abdomen is provided with one or two pairs of *book-lungs,* followed by one or two pairs of *spiracles.* The female genital organ is the *epigynum* which is placed just anterior to a transverse fold, know as the *epigastric furrow* as in text fig. 36. The female genital organ or epigynum has been discussed in details in the reproductive system. The pedicel is covered by a sclerotized plate or a series of plates called the *lorum.* The shape of these plates is of use in distinguishing certain lycosid and pisaurid spiders.

2. INTERNAL ANATOMY

The Body-wall

Three layers of body wall of a spider can be recognized, the outer protecting layer–the *cuticula,* an intermediate cellular layer–the *hypodermis* and an inner delicate membranous layer–the *basement membrane* as in text fig. 48. The cuticula layer is composed of two layers–the outer pigmented layer called the *primary cuticula* and the inner thick non-pigmented layer called the *secondary cuticula.* The hardness of certain parts in the cuticula, is due to the presence of *chitin.* A portion of the body wall may be sharply distinguished from the surrounding part by being chitinized is called a *sclerite* and a narrow line between the two sclerites is termed as *suture.*

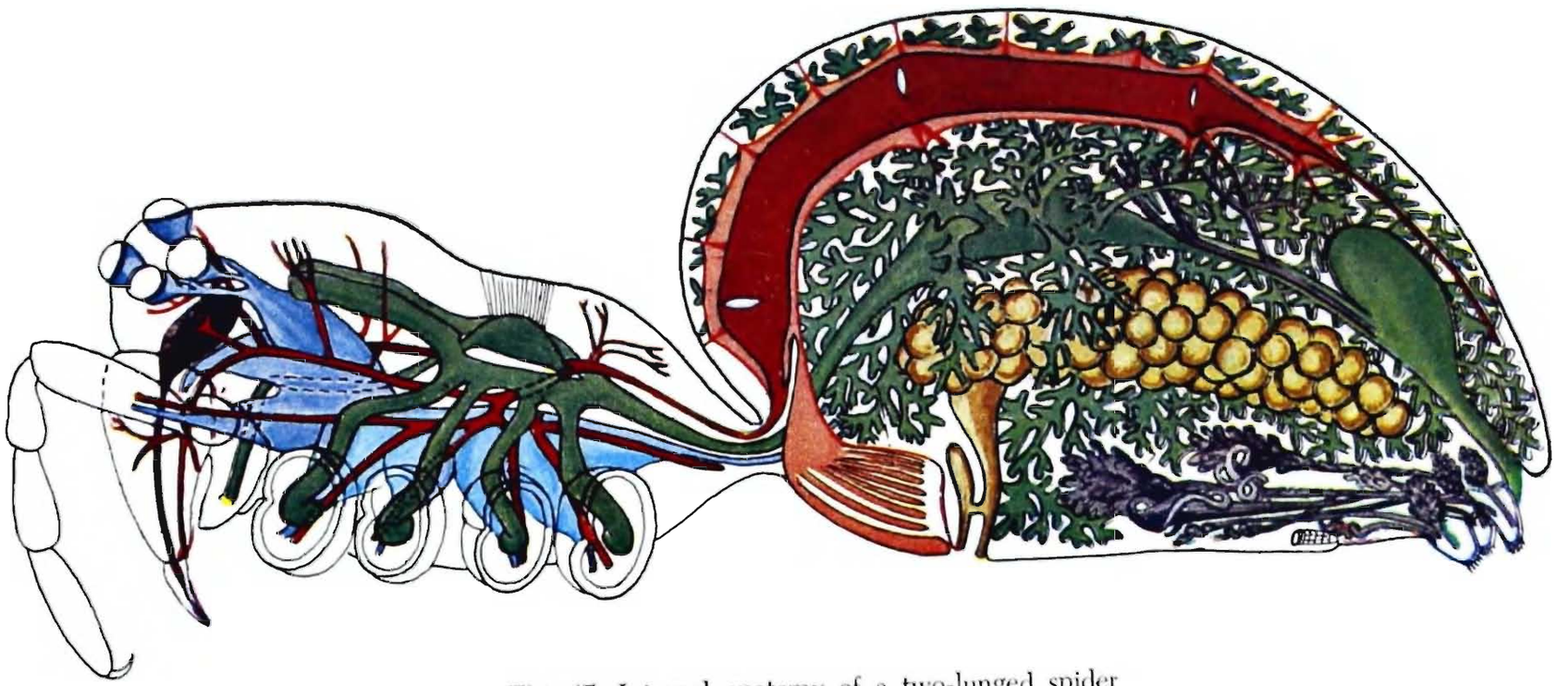
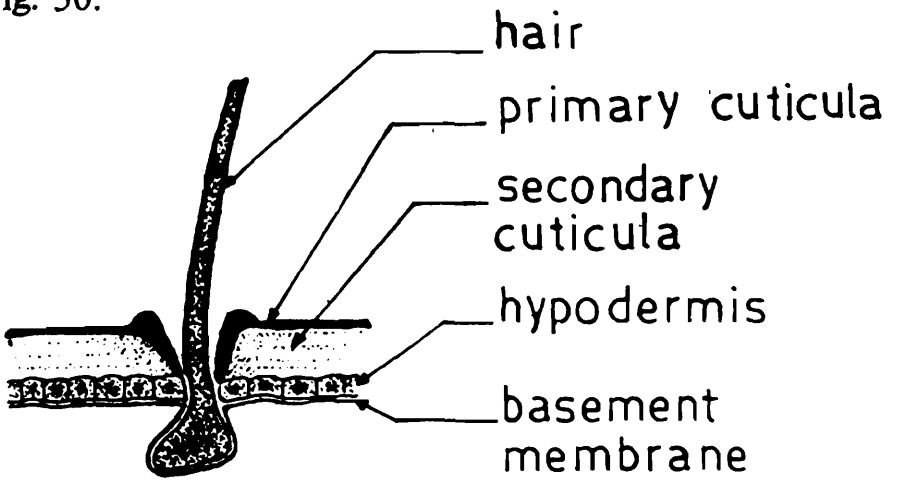


Fig. 47. Internal anatomy of a two-lunged spider

The cuticle may be provided with different appendages like *hairs* or *setae* and *movable spines*. The hairs or setae are more or less same thing, with no distinction except the degree of stiffness. So hairs are extremely slender and very flexible types where as setae are rather stiff. Each hair of a spider arises from a more or less cup-like cavity in the cuticula, which may be made more pronounced by a ring-like elevation of the surrounding part as in text fig. 48. In addition to the firm outer layer of the body wall there are found, within the body cavity, certain hard parts which serve for the attachment of muscles–these are endoskeletons. In the cephalothorax of spiders, there is a horizontal plate above the ventral ganglion and below the alimentary canal, to which many muscles are attached–this hard plate is known as *endosternite* of cephalothorax as in text fig. 49. In the abdomen, there are vestiges of an endoskeleton. These vestiges are three centres of attachment of muscles and may be designated as the *first, second* and *third abdominal endosternites* as in text fig. 50.



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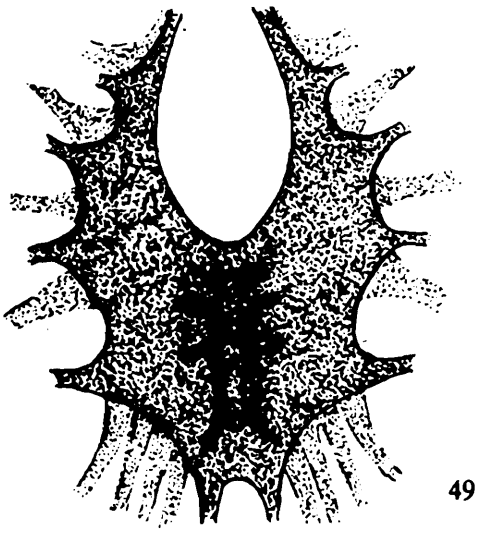

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Fig. 48. Sector of the body wall of a spider.

Fig. 49. Endosternite of the cephalothorax of a spider.

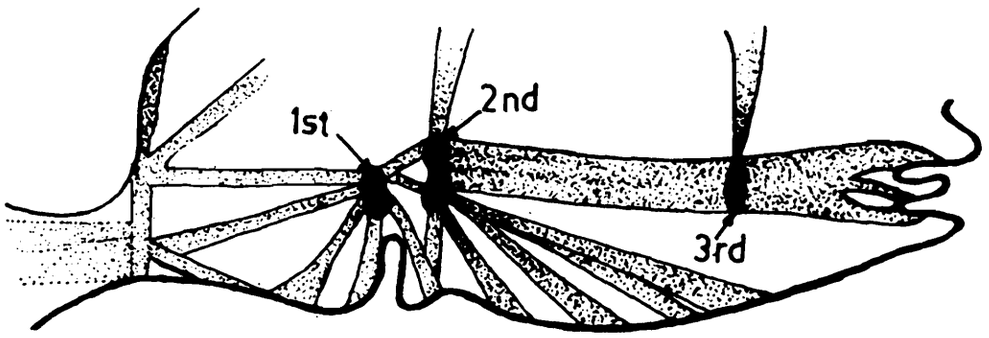

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Fig. 50. Three abdominal endosternites with principal muscles attached to them.

The Muscular System

The muscles of spider are either colourless and transparent, or yellowish-white and are of almost gelatinous consistence. The chief muscles are attached to the inner surface of the body wall or to the endosternites. Prominent muscles are attached to the sucking stomach of spider. The muscles of cephalothorax are extremely well developed where as those of abdomen are greatly reduced.

The muscles of body wall are greatly reduced in case of spider. This might be due to the fact that the segments of the cephalothorax are fused and the abdomen is practically unsegmented. There are vestiges of both circular and longitudinal "skin–muscles." The muscles of the cephalothorax, in a large proportion, serve to move the appendages. Of these muscles, some have their origin on the inner surface of the body wall and the others on the endosternite. In each case, they extend to the basal segment of the appendages. The muscles within the appendage also produce the movement of different segments of the appendage. Dorsally as well as ventrally, the sucking stomach is covered with strong muscles to enlarge the cavity of the organ. Other than these dorsal and ventral muscles, the stomach is also supplied with sphincter muscles as in text fig. 51.

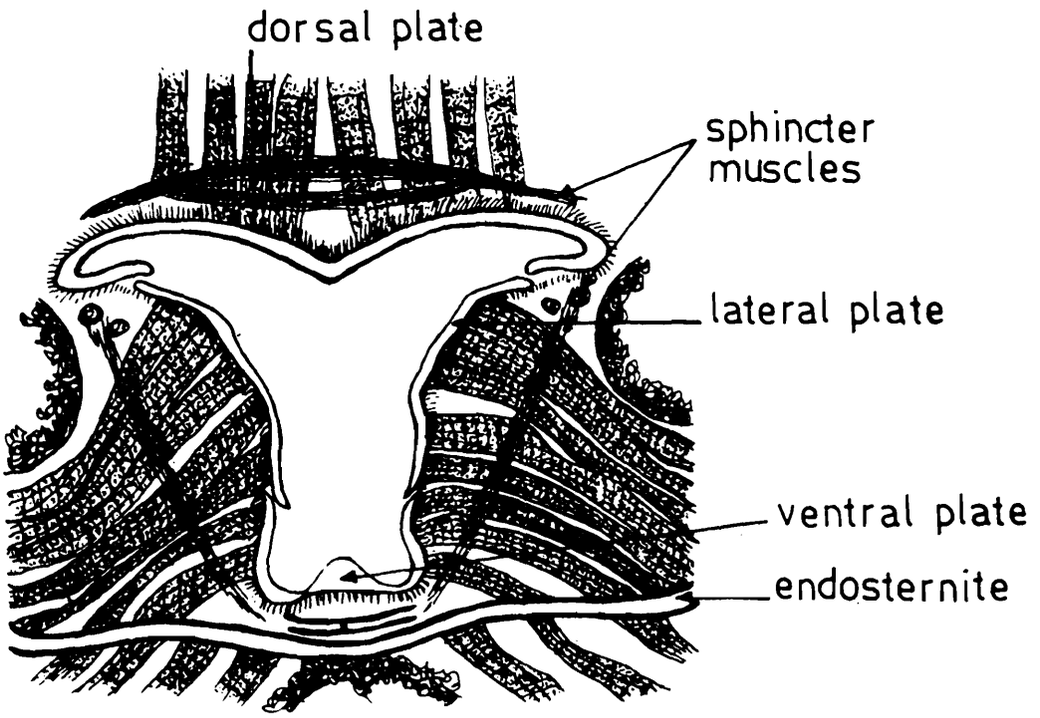

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Fig. 51. Cross section of the sucking stomach and adjacent parts.

The muscles of abdomen are very difficult to trace out as they are much reduced and other viscera are so greatly developed. Among the prominent muscles of the abdomen, there is a series extending from the pedicel to three endosternites of the abdomen, and from the third endosternite to the spinnerets. These have been named as the longitudinal ventral muscles. The muscles extending backwards from the third abdominal endosternite are those that for the movement of spinnerets.

The Respiratory System

In general, spiders are provided with two kinds of respiratory organs, the *book-lungs* and *tubular trachae.* But some spiders possess only one of these two but the greater number of spiders possess, both.

The book-lungs are the respiratory sacs filled with air, each of which opens by a slit-like spiracle on the ventral side of the abdomen near its base. Generally, the first pair of book-lungs open, one on each side, in the epigastric furrow, when the second pair open a little behind the first pair. In side each book-lung, there project a series of

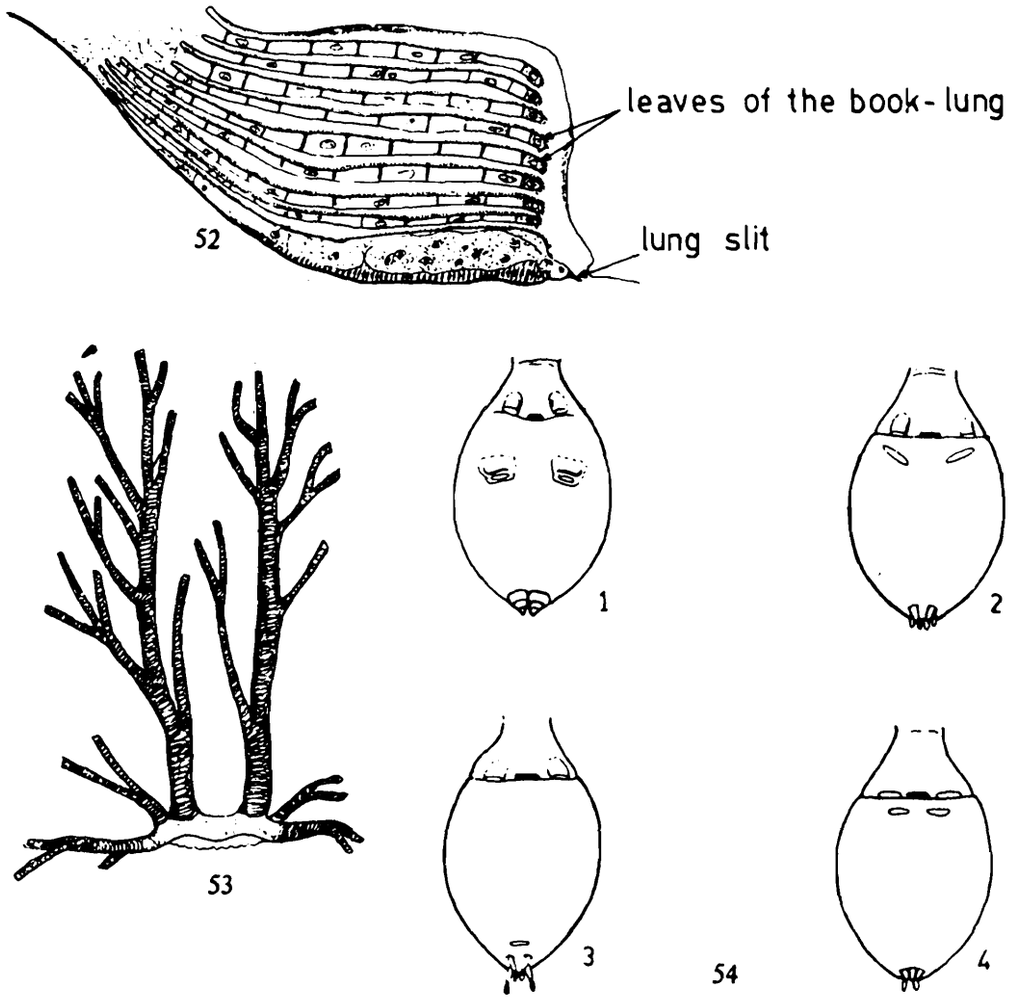


Fig. 52. A book-lung of a spider.

Fig. 53. Tubular tracheae of a spider.

Fig. 54. Illustrations showing the distribution of book-lungs and tracheal spiracles.

horizontal leaf-like folds from the anterior wall, thus the structure looks like a book as in text fig. 52. Each leaf of the book-lung consists of a flattened sac-like fold of the body wall and hence of two lamellae. These lamellae are connected at frequent intervals by vertical supports; and the leaves are kept apart as the air can circulate between them. The blood passes from the body-cavity into the lumen of each leaf, and thus the respiratory process takes place through the walls of the leaves.

The tubular tracheae in spiders generally open by a single spiracle, placed on the middle of the ventral side of the abdomen; often it is near the middle length of the abdomen but usually it is only a short distance in front of the spinnerets. In a few spiders this spiracle

is situated just behind the lung-slits. The tracheae are paired organs even when they open by a single spiracle as in the text fig. 53.

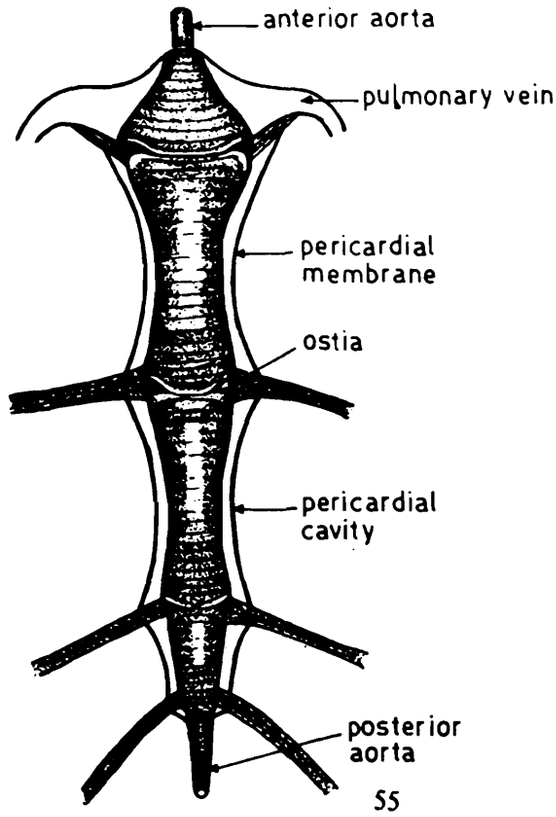
Distribution of book-lungs and tracheal spiracles is as in text fig. 54.

1. With two pairs of book-lungs as in tarantulas and the Hypochilidae.
2. With one pair of book-lungs and one pair of tracheal spiracles as in Filistatidae, Oonopidae, Dysderidae, etc.
3. With one pair of book-lungs and a single tracheal spiracle as in all true spiders.
4. With two pairs of tracheal spiracles as in Caponiidae.

The Circulatory System

The circulatory system of spider is incomplete, during the part of its course, the haemolymph enters the body cavity. It consists of a single tubular *heart* and a number of smaller ramifying blood vessels which are reduced in extent with the increase of the tracheal system.

The heart is placed near the anterior surface of the abdomen along with mid-dorsal line as in text fig. 47, and is often visible through the integument of living spider. The heart is a simple tube, without valves, surrounded by a pericardial membrane and suspended by pericardial ligaments as in text fig. 55. The wall of the heart is pierced by paired openings–the *ostia,* through which the blood is received into the heart. In the most primitive of spiders (Liphistiidae) five pairs of ostia are present. In the four-lunged spiders, there are four pairs of ostia, but in the Araneomorph spiders only three or two pairs of ostia remain. The anterior portion of the heart is continued as the *anterior aorta* into the cephalothorax where it branches and ramifies to supply the blood to the organs of the cephalothorax and the appendages. A valve is present in the dorsal aorta which prevents back flow of blood. The abdomen is supplied with the blood from the posterior end of the heart which continues as the posterior aorta and also from a series of paired lateral arteries which rise from the heart near each pair of ostia. After leaving the arteries the blood passes into the spaces of the body cavity and is accumulated in two longitudinal sinuses, one dorsal and one ventral, which lead to the base of the abdomen. The blood is here oxygenated through the book-lungs and then passes into two large vessels–the *pulmonary veins,* which convey the blood to the pericardial cavity from where it enters the heart through the ostia.



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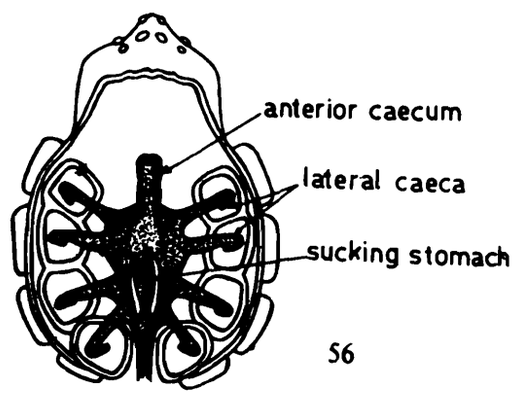

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Fig. 55. Dorsal view of heart of a spider.

Fig. 56. Dorsal view of the cephalothoracic part of the alimentary canal.

The Digestive System

The alimentary canal consists of three regions which are of different in origin. The fore-gut is derived from the *stomodaeum,* the hind-gut is derived from the *proctodaeum* and the mid-gut is originated from *endoderm.* Both fore-gut and hind-gut are lined with a chitinous layer continuous with the cuticle while the mid-gut is lined with a layer of cells which forms the digestive epithelium.

The mouth is formed by the meeting of an anterior plate–the *rostrum* and a ventral plate attached to the sternum–the *labium,* also *maxillae* which are rising from the coxae of the pedipalps. These are fringed with hairs which help the passing of food into the buccal cavity. The fore-gut consists of a *pharynx* which leads up more or less vertically from the mouth into the *oesophagus* which passes back horizontally between the dorsal and ventral nerve masses to the *sucking stomach.* This sucking stomach of a spider is an enlarged portion of the fore-gut, whose function is indicated by its name. It is situated just behind the point where the fore-gut emerges from the nervous collar and rests upon the endosternite as in text fig. 51. The chitinous *intima* of the fore-gut is greatly thickened in this region affording a firm support for powerful muscles. The cross-section of sucking stomach shows the thickened intima consisting of four longitudinal plates–a dorsal, a ventral and one on each side as in text fig. 51. From the dorsal plate very strong muscles extend to the entail surface of the median furrow of the cephalothorax, and from the ventral and lateral plates the muscles extend to the endosternite. Dilator muscles are attached to the pharynx and the sucking stomach.

The mid-gut follows directly from the sucking stomach and is divided into two portions–the *thoracenteron* in the cephalothorax and the *chylenteron* in the abdomen which are joined by a narrow tube–the *connecting mid-gut* that passes through the pedicle. The thoracenteron is composed of a number of caeca–the single *median anterior caecum* and four pairs of *lateral caeca* as in text fig. 56, these are variable from simple lobes to most complex ramifications. The chylenteron fills the space defined by the heart dorsally and the silk glands and reproductive organs ventrally. It consists of lobed diverticula which produce digestive enzymes and also store food.

The hind-gut is enlarged dorsally to form a large diverticulum–the *stercoral chamber* in which the faeces are stored before being excreted. The *Malpighian tubes* are paired tubes which open into the alimentary canal near the union of mid-gut and hind-gut. Each of these tubes is branched and the branches ramify among the alimentary tubules. They are supposed to correspond to the kidneys in function.

The Reproductive System

The two sexes are distinct in all Arachnids; and in each sex the reproductive organs lie in the abdomen, and open near its base.

1. *Male Reproductive Organs*

With the exception of the male palpal organ, the reproductive system of spiders is very simple. The paired *testis* are situated in the anterior part of the abdomen between the ventral body wall and the longitudinal ventral muscles, and the *vasa deferentia* are two long tubes continued in front as two long and often much coiled sperm ducts from the testis. Both the vasa deferentia open into a common pouch, the *seminal vesicle* as in text fig. 57, which in turn opens through a single opening on the middle line of the body in the epigastric furrow. There is no copulatory organ directly connected with the outlet of the reproductive glands, but the seminal fluid is transferred to the female at the time of mating by means of a highly specialised appendages–the *palpal organ* of male. Here the palpal organ of a male *Araneus* sp. is described in details for example.

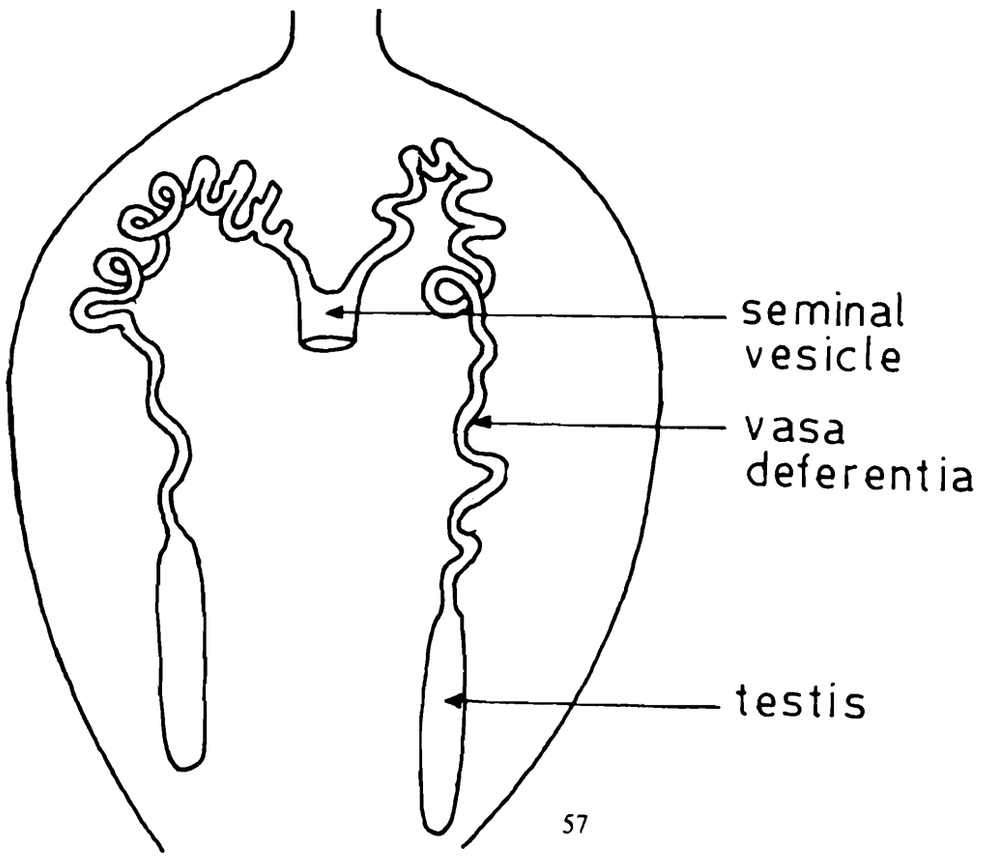

Fig. 57. Internal reproductive organs of a male spider.

The palpal patella of a male bears two prominent spines at its apex, sometimes it may be a single one. The most striking feature of the tibia is its shortness. The tarsus consists of two parts–the *cymbium* and *paracymbium*. The paracymbium is only a prominent hook like apophysis arising from the base of the cymbium which is a bowl shaped structure holding the whole genital bulb. The cavity of the cymbium at the base, is known as *alveolus* which is much more extended nearly the whole length of the cymbium. The cymbium contains a coiled tube called *receptaculum seminis,* the proximal portion of this tube is slightly enlarged and ends blindly, whereas the distal end is slender and extends like a coil and terminal portion of the receptaculum seminis is the *embolus*. The embolus is often termed the *style*. The whole coiled structure is bulb–like in appearance and attached to the alveolus of the cymbium, is known as the *genital bulb*. In the unexpanded bulb of *Araneus* sp. as in text fig. 58, the *subtegulum, tegulum* and *terminal lobe* of bulb bearing a long and slender terminal apophysis, are visible. The structure inside the genital bulb, is a complicated one and consists of many accessories for reproductive purposes. When such a palpus is boiled in a solution of 10% Caustic Potash, the bulb becomes expanded and the different structures can be seen.

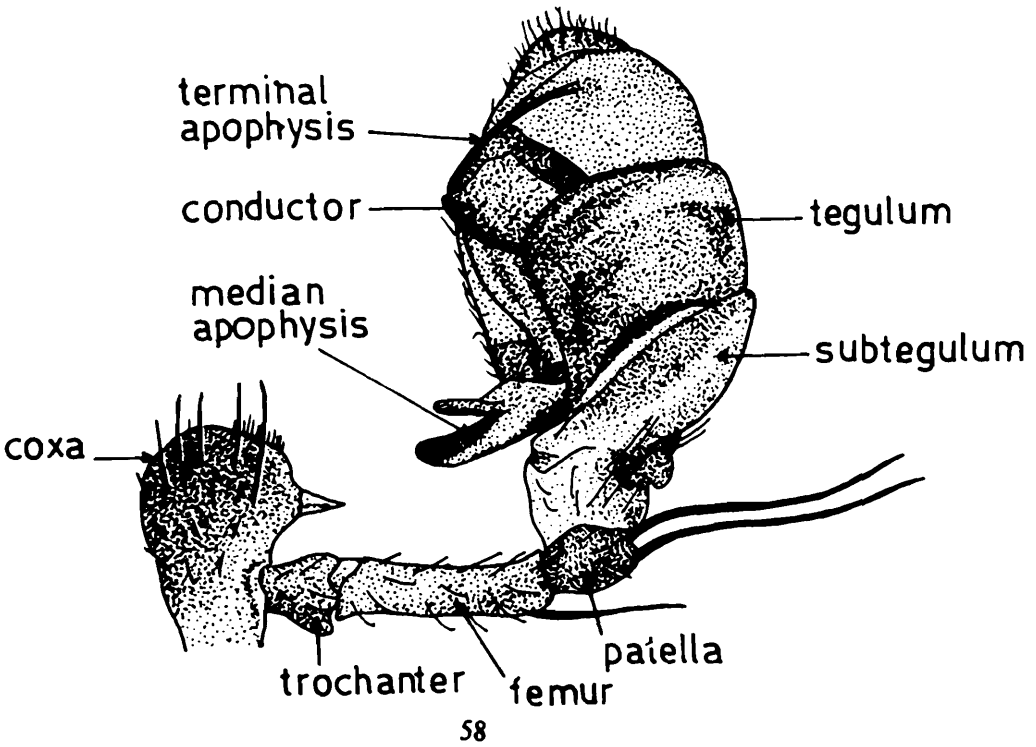

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Fig. 58. Dorso-lateral view of an unexpanded palpal organ of a male *Araneus* sp.

The expanded bulb of male *Araneus* sp. is being explained here as it is seen in the lateral view, text fig. 59.

The basal haematodocha–it is a sac-like structure by means of which the genital bulb is attached to the cymbium within the alveolus. This sac like haematodocha is ordinarily completely concealed by other parts of the bulb and is visible only in expanded palpal organ. The wall of haematodocha consists of elastic connective tissue, at the time of pairing it is distended with blood.

The *subtegulum* is a ring-like sclerite which has both narrow and wide ends, only the wider part of this structure is observed. The *tegulum* is also a ring like sclerite which is seen broad from lateral view and narrow on the mesal aspect. In the more expanded bulb there is seen a large haematodocha between the subtegulum and tegulum which is known as *middle haematodocha.* The *median apophysis* is a conspicuous spur like appendage which projects from the ventral side of the bulb. Shape and position of the median apophysis vary from species to species.

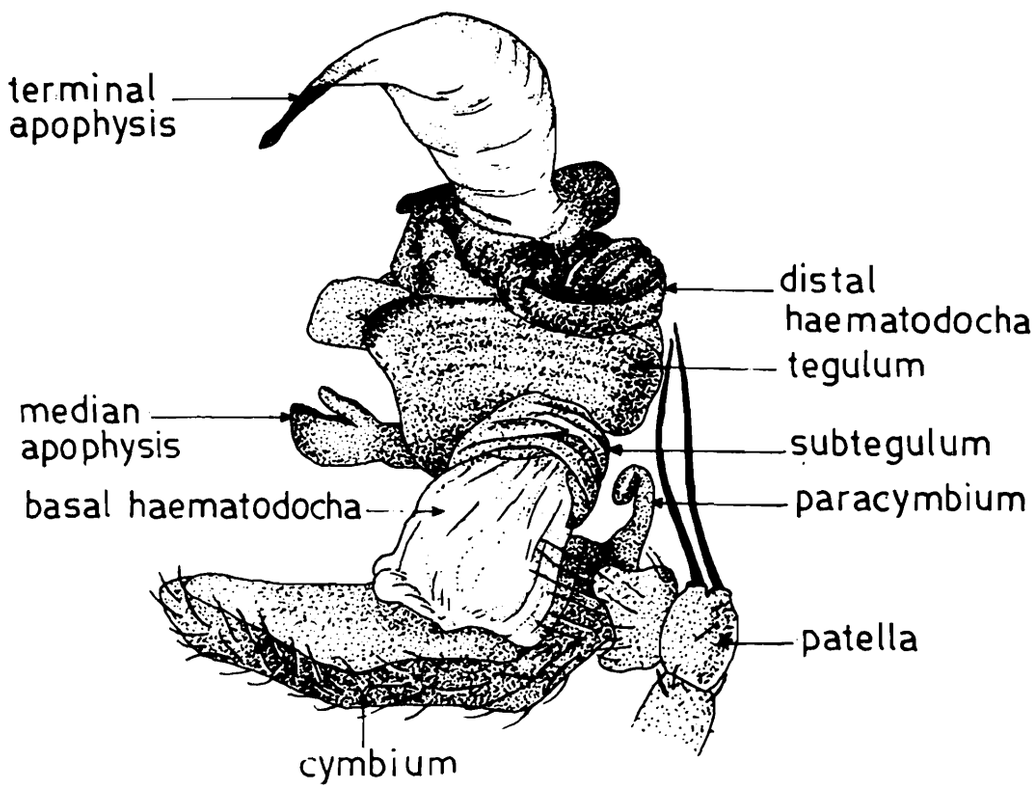

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Fig. 59. Ventro-lateral view of an expanded palpal organ of a male *Araneus* sp.

The *conductor* is a sclerotic structure which gives support to the *ejaculatory duct* of embolus. The conductor arises at the base of the apical division of bulb and closely connected with the tegulum. The *radix* and *stipes* are two segments of embolic subdivision, which connect the middle and apical divisions of the bulb. The *embolus* is the organ through which the ejaculatory duct opens. It projects ventrally between the distal end of the stipes and the conductor.

The *distal haematodocha*–it is a large haematodocha which is present in the apical part of the bulb and overshadows the major portion of the bulb. The *terminal* and *sub-terminal apophysis* are two remarkable spear like or lobe like chitinized appendages. The embolic subdivision of the bulb ends in this spear shaped terminal apophysis.

2. *Female Reproductive Organs*

Internal reproductive organs of a female spider consist of *ovaries, oviducts, uterus, vagina* and *spermathecae* as in text fig. 60.

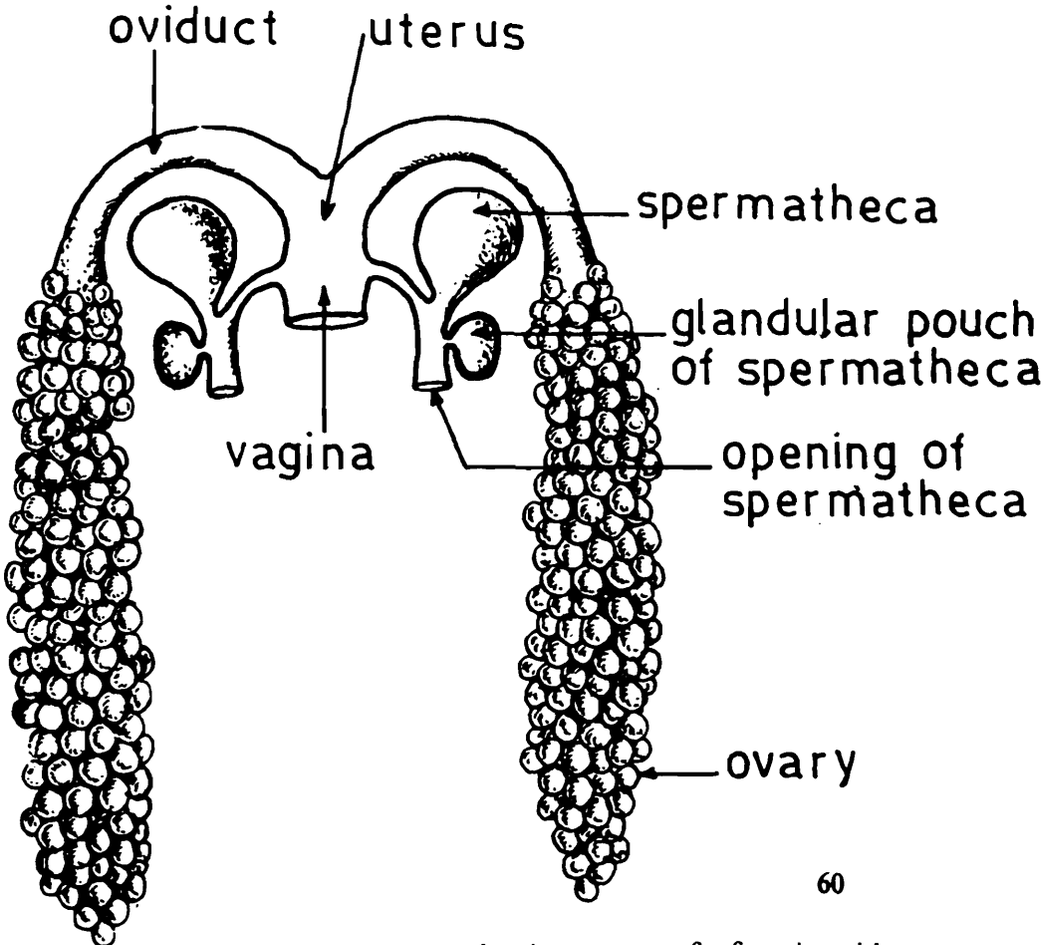
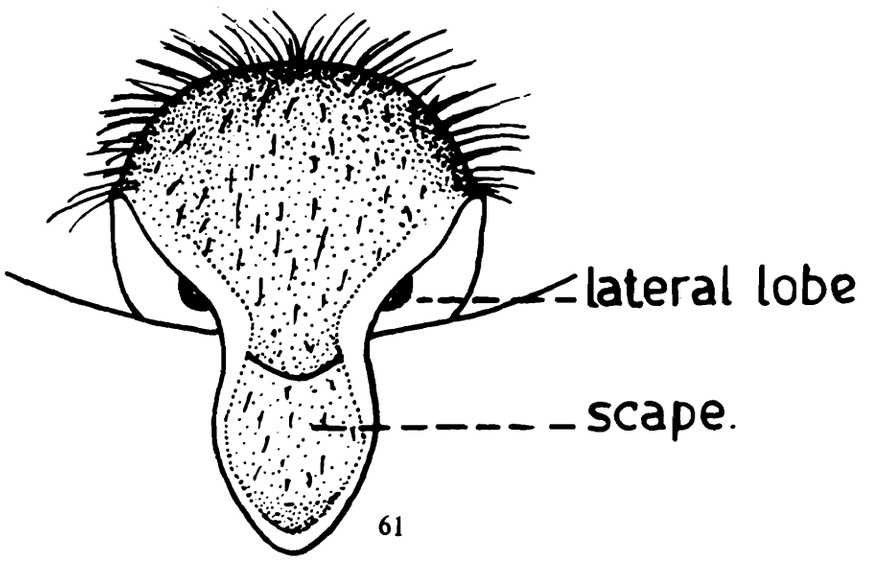


Fig. 60. Internal reproductive organs of a female spider.

The *ovaries* are placed in the abdomen below the intestine. The structures are of two broad tubes bearing numerous ovarian follicles which appear like a cluster of grapes. The size of the ovaries varies greatly, depending on the state of the development of the eggs. Before the egg laying period they become greatly distended and occupy a considerable part of the abdomen. Each ovary opens through a short *oviduct* and these in turn open into a common pouch –the *uterus* which leads to the *vagina* and this vagina opens externally on the middle of the body in the epigastric furrow.



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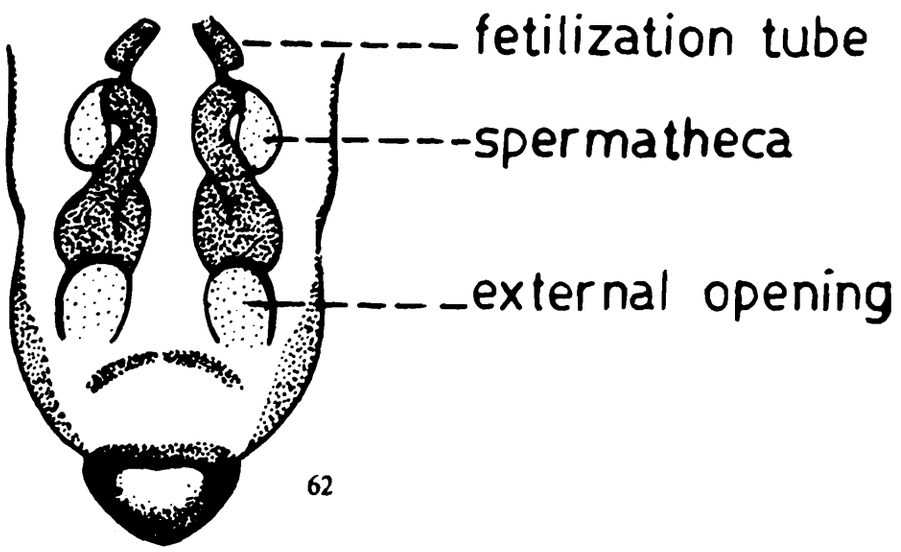

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Fig. 61. Ventral view of epigynum of a female *Neoscona* sp.

Fig. 62. Posterior view of epigynum of a female *Neoscona* sp.

The *spermathecae* are special pouches or diverticula of the vagina, for the reception of the seminal fluid at the time of mating. The vagina and spermathecae are invaginations of the body wall and are lined with a chitinous intima. In some spiders like Atypidae, Tetragnathidae, etc. the spermathecae are the diverticula of the vagina, so there is only a single external opening of the reproductive organs. But in most spiders, the spermathecae are more or less detached and have separate external openings. There are three external openings of the system–the opening of the vagina which sometimes opens on the epigastric furrow and a pair of openings of the afferent ducts leads to the spermathecae. In this type a duct connects the spermathecae of each side with the vagina as in text fig. 60. The duct leading from the external opening of a spermatheca to the large reservoir of the organ, sometime bears a prominent pouch like enlargement which has thick chitinized walls. This organ is of glandular in nature since it has an epithelium of gland cells. So it is often called the gland of spermatheca. In the external genitalia or epigynum the outer openings of the affarent ducts of spermathecae, are seen as in text fig. 62.

The external genitalia or *epigynum* is a chitinous structure situated mid-ventrally just above the epigastric furrow as in text fig. 61. The epigynum may be either bulb like or plate like. A pair of external openings are there for receiving the palps of male during mating. Sometimes a chitinous structure called *scape* is present at the middle which facilitates to guide the male palps into the orifices at the time of mating. Often the scape is accompanied with paired *lateral lobes* as in text fig. 61.

The Nervous System and Other Sense Organs

The Nervous System of spider may be divided into two, *viz.,* the *central nervous system* and the *visceral nervous system* like other arthropods, as seen in the text fig. 64.

1. *The central nervous system*

It is entirely concentrated into the cephalothorax in an adult true spider. In the early developmental stages, there is a pair of ganglia in each segment of the body; but in the course of embryonic development the ganglia consolidated into a single mass in the cephalic part surrounding the oesophagus as in text fig. 47. This

mass includes the brain and sub-oesophageal ganglion,but they are not distinct as they are found in insects.

The Brain–This portion of the central nervous system lies above the oesophagus. The optic nerve and the branches to the chelicerae arise from the brain, text fig. 47.

The sub-oesophageal ganglion–This part of the central nervous system lies below the oesophagus. This ganglion gives rise the nerves extending to the pedipalps and those extending to the legs; and from the posterior end two large abdominal nerves are extended as in text fig. 64.

2. *The Visceral nervous system :*

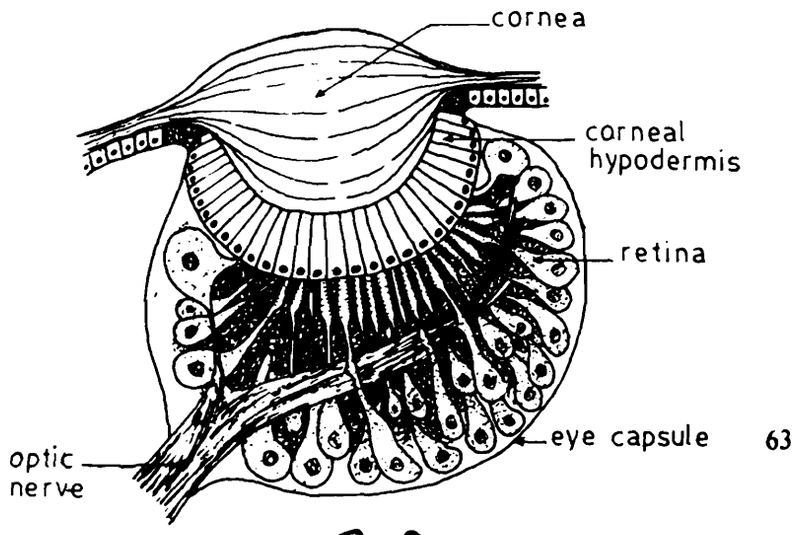
A visceral nervous system is present in spiders like other Arachnids. It consists of an unpaired nerve connected with the brain by paired nerves and running along the oesophagus and stomach.

Sense organs of spiders are composed of eyes, Lyriform organs or slit organs, organs of touch and tarsal organs. These organs are described below in details.

Eyes–The eyes are always simple as in text fig. 63. The *cornea* or *lens* is a modified and unpigmented part of the body wall and is continuous with it. The cornea is renewed at each moult in the same way as the rest of the cuticle. Immediately below the cornea there is the *corneal hypodermis* which is continuous with the hypodermis of the body wall with a bit modified. After corneal hypodermis the *retina* lies and is composed of a layer of *visual cells*. Each cell consists of several parts. There can be distinguished a cell body with a nucleus; the cell body is connected with the central nervous system by means of a nerve fibre and a hard structure known as *optic rod* or *bacilli*. Two types of eyes are found which are distinguished by the position of the nuclei of the retina with reference to the position of the layer of the optic rods. In one type the nuclei are in front of the optic rods–this type of eyes are termed *prebacillar eyes*. In other type the nuclei lie behind the optic rods–such eyes are termed *postbacillar eyes*. The anterior median eyes are postbacillar while other eyes are prebacillar. The prebacillar eyes generally have a *tapetum* which is a layer of cells behind the retina containing small crystals which reflect back the light, and for this reason these eyes

may appear light in colour, while the anterior median eyes lack of tapetum and thus appear dark.

The eye capsule is a sheath enclosing the eye. It appears to be continuous with the sheath of the optic nerve. Each anterior median eye is provided with a muscle extending from the eye capsule to the body wall and these are the only eyes in which the retina can be moved. In most spiders the eyes probably serve only the perception of light and shadow, but in hunting spiders like Lycosidae and Salticidae, the shape of the objects may be perceived. Thus, the elaborate courtship behaviour is found in these families.



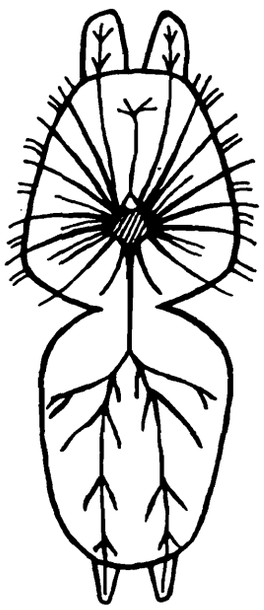


Fig. 63. Cross-section of an eye of a spider.
Fig. 64. Nervous system of a spider.

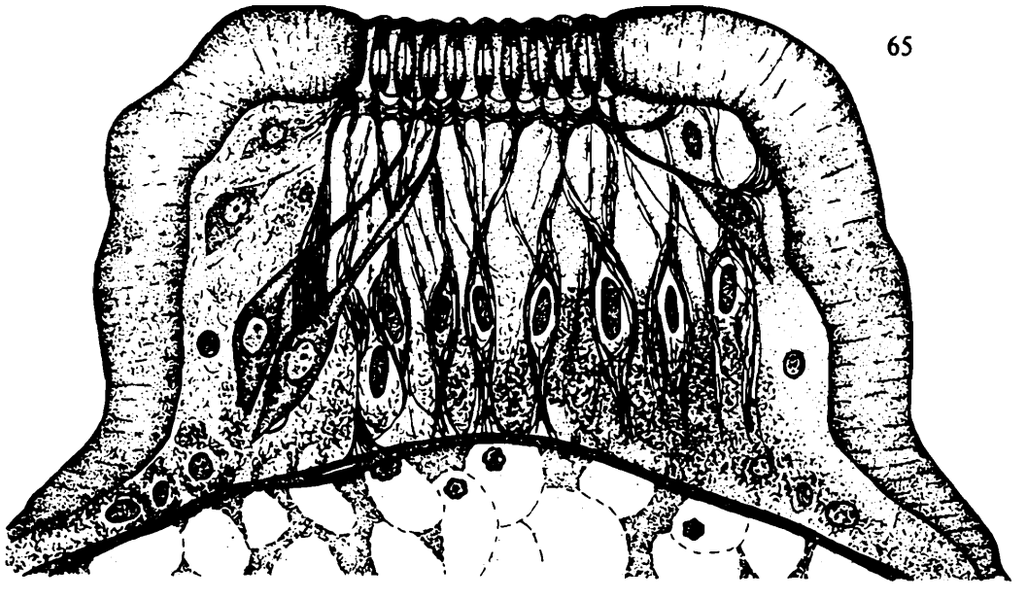


Fig. 65. Cross-section through a Lyriform organ of a spider.

Lyriform organs or Slit organs–The Lyriform or Slit organs consist of minute slits ranging from 10μ to 100μ in length and from 2μ to 3μ in width. On the floor of these slits there is a very thin cuticule below which there is a sensory *neurone* as in text fig. 65. These slits occur in the sternum and in the cuticle of most of the segments of legs except the tarsi, and of the mouth-parts. In the sternum the slits may occur singly or in groups. But the more characteristic form of these organs, is found on the appendages where they usually occur near the distal end of a segment as in text fig. 66. In this type there are several slits grouped side by side and the cuticula surrounding the group of slits and that of the spaces between them is greatly thickened. The space between the slits suggested the cords, and the outer rim of the organ like the frame of a Lyre, hence the name Lyriform. Internal structure of the Lyriform organs shows a nerve-end cell beneath each slit. This cell is elongated in structure with a nucleus at its proximal end near its connection with a nerve, and the distal end is long and slender extending to the thin layer of cuticula limiting the slit within. McIndoo's experiments (1911) indicate that the Lyriform organs are olfactory in function.

The organs of touch–These are distributed generally over the surface of the body, structually they are hollow *hairs* or *setae,* each provided with a nerve connection. *Trichobothria* on the tarsi of some spiders are sensory in function as in text fig. 67 & 68.

Tarsal organs–A single tarsal organ each is found on the dorsal surface of the tarsi of the palp and legs of many spiders. This is usually a dome shaped cup like elevation which opens at the top and at the base provided with one or more small extensions of neurones as in text fig. 69. Some authors consider that this organ is olfactory in function but it is also found that it plays some role in the location of drinking water.

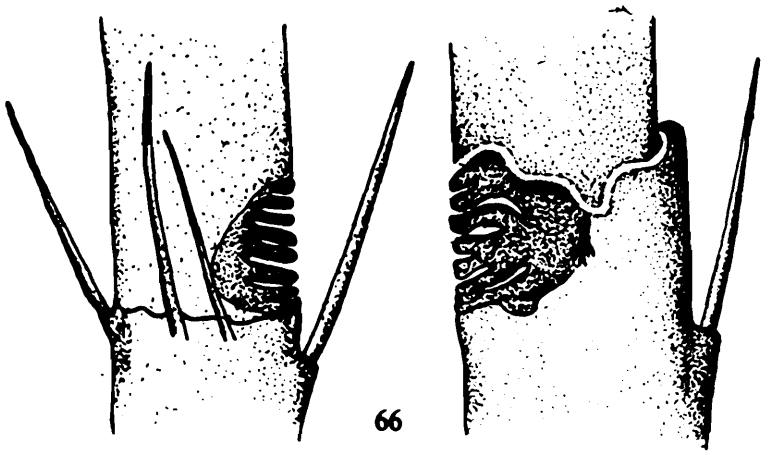


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Fig. 66. Lyriform organs on the legs of a spider.

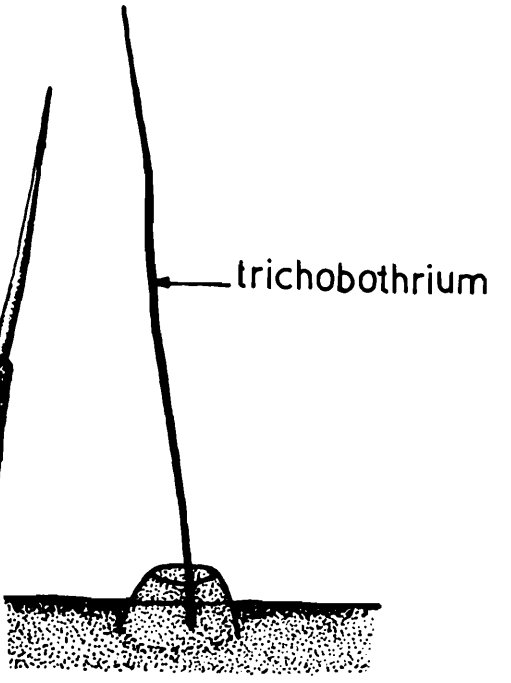

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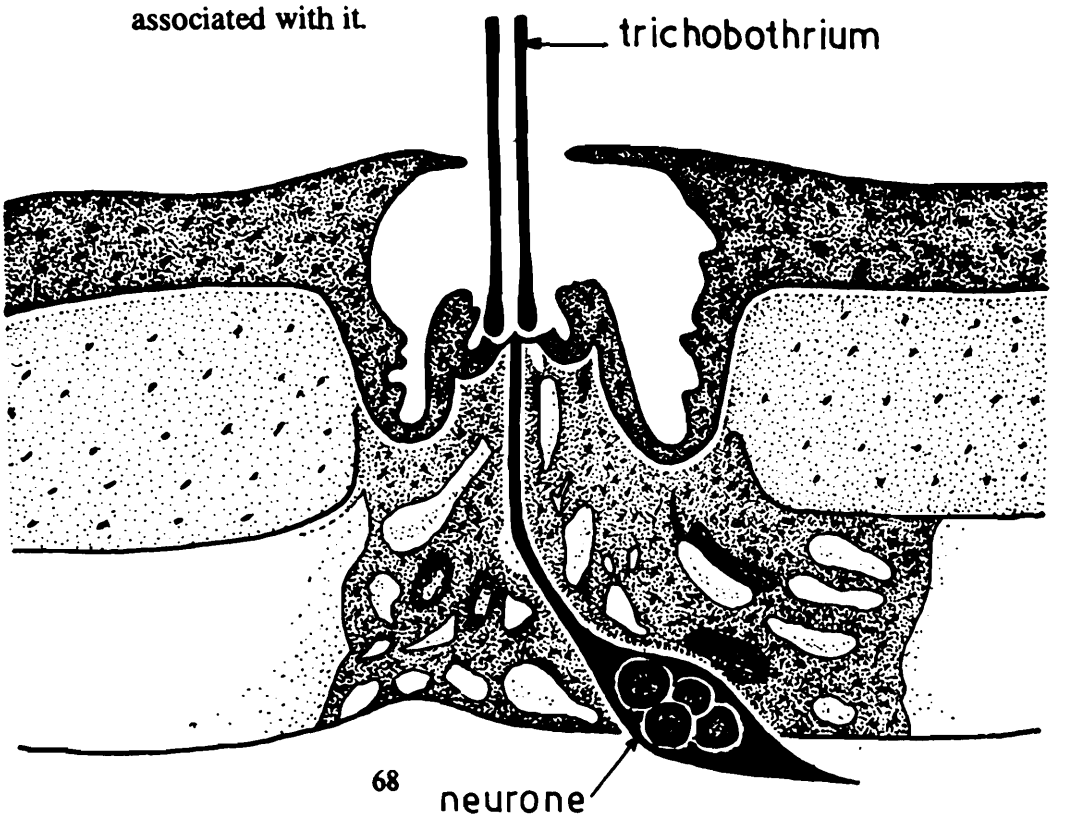
Fig. 67. A single trichobothrium on the leg surface of a spider.

Fig. 68. Cross-section showing the trichobothrium with a multinucleate neurone associated with it.



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The Excretory System

The principal excretory organ of a spider is *Coxal gland* whereas *Malpighian tubules* also serve some accessory excretory function which are discussed in the digestive system. The coxal glands are situated within the cephalothorax as in text fig. 70.

There are four main types of coxal glands in the spiders as in text fig. 71, which show progressive simplification. In the Mygalmorphae the most complicated type of coxal gland is seen, where the excretory *saccules* lie to the outside of the endosternite near the 1st and 3rd legs as in text fig. A-71. These large saccules are lined with cells which have the ability to excrete waste materials. This waste product passes through a convoluted labyrinth into a straight tube from which the exit tubes pass the contents to the surface of the spider. In Mygalomorph spiders there are two saccules and two exit tubes. The exit tubes are present just behind the 1st and 3rd coxae of the legs. In true spiders the exit tube behind the 3rd coxa is not present and the posterior saccules is lacking and

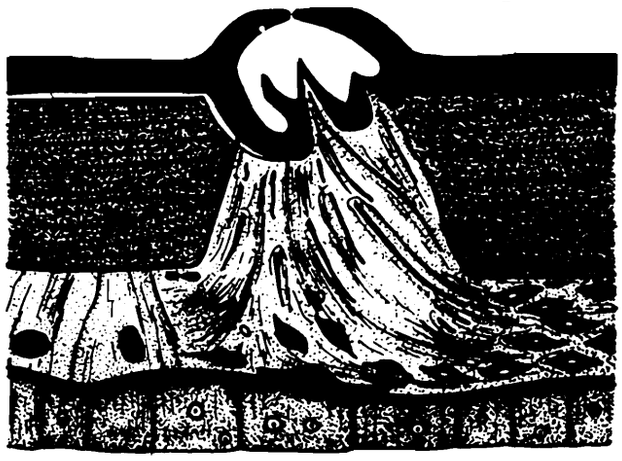

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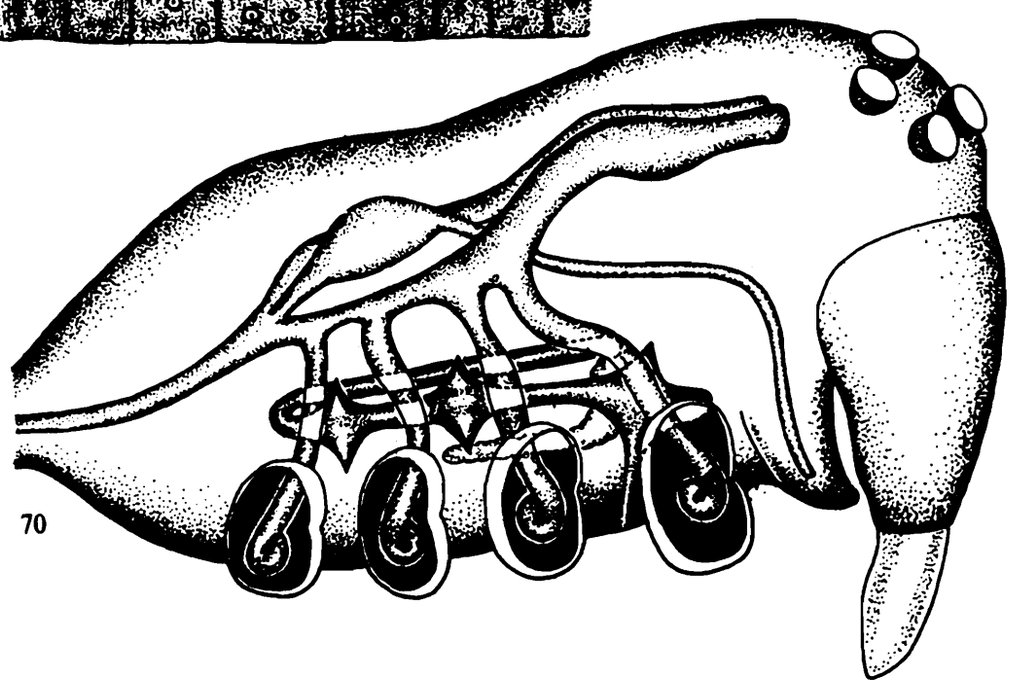
Fig. 69. Cross-section through a tarsal organ of a spider.

Fig. 70. Diagram showing the position of coxal glands in the cephalothorax of a spider.



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labyrinth, if present, not convoluted. The Lycosidae, Thomisidae, Salticidae, Gnaphosidae, Ctenidae, etc., possess the system as in the text fig. B-71, whereas Dysderidae, Scytodidae, etc., possess the same as in text fig. C-71. This system is simple in more advanced group of spiders; the web spinners such as Araneidae, Theridiidae, Pholcidae, etc., where the labyrinth is absent and the saccule directly opens to the surface from behind the 1st coxa as shown in text fig. D-71

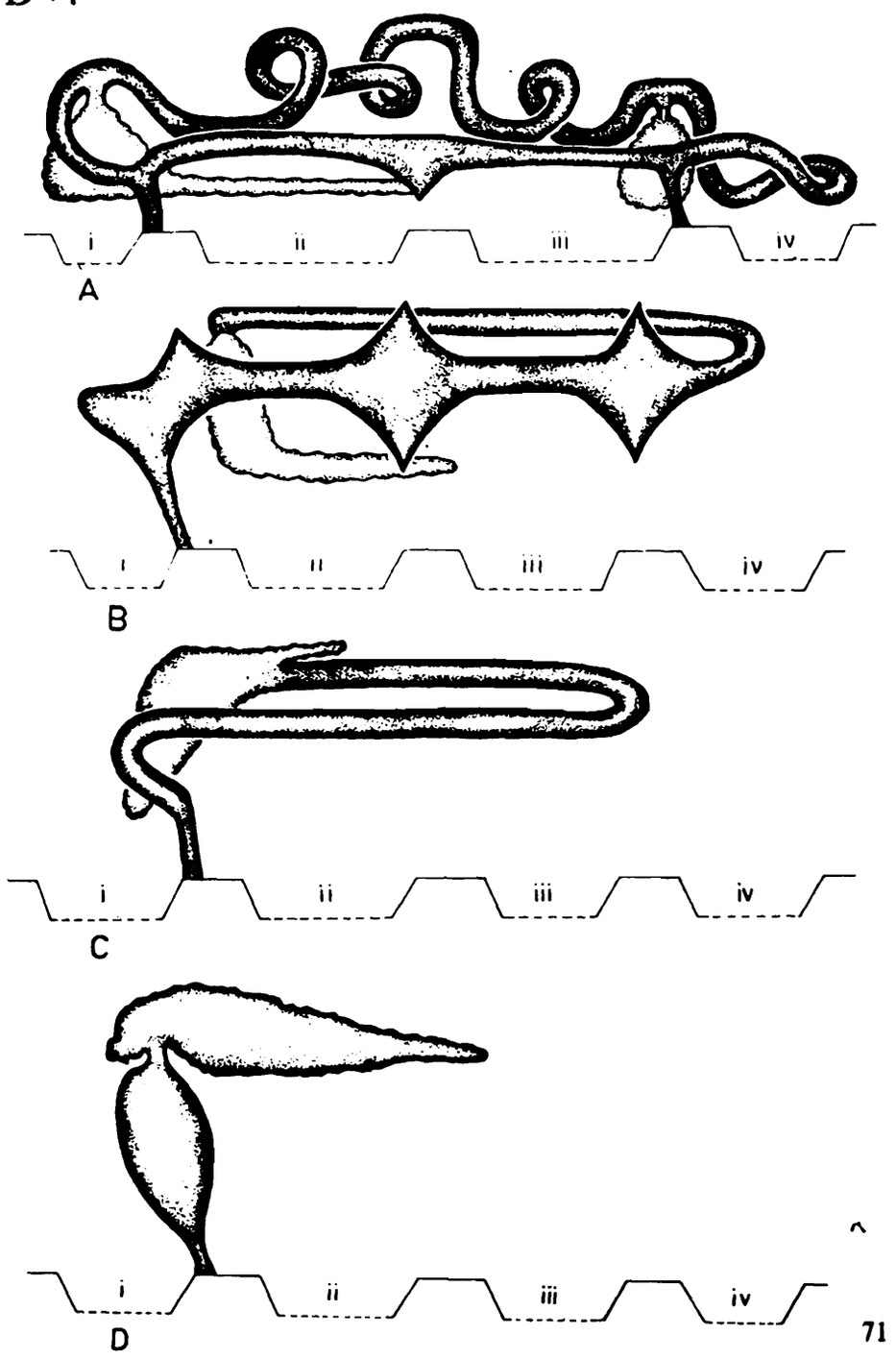


Fig. 71. Different types of coxal glands in spiders.

CHAPTER III : LIFE OF SPIDERS

Spiders are among the most ubiquitous arthropods that are too conspicuous to escape notice. The Indian sub-continent has a large diversity of spider fauna, rich in variety as well as abundance. The careful observer of spiders soon learns that the members of the different families differ greatly in their modes of life; even within the limits of a single family striking variations can exist. In fact, each and every species has great diversity of behaviour, while agreeing with closely allied forms in the more general features of their life history, they exhibit specific peculiarities.

1. DEVELOPMENT OF SPIDERS

The mature female spider lays eggs in a mass. The eggs are usually protected to some extent by a covering of silk, the *egg-sac* or *cocoon;* but sometimes they are merely agglutinated and are without a silken covering. This is the case in some members of the Pholcidae and Scytodidae, both of which are house spiders. The eggs of running spiders are laid upon a sheet of silk, which is then wrapped around the egg mass, or another sheet is made over the eggs. Some spiders enclose a padding of silk before closing up the egg-sac. In some species the outer covering is thin and meshy, where as in others it may be either quite tough or papery in texture. It may be fastened to the surface of bark, on a twig, under a leaf or stone; or it may be suspended in the web or retreat, either with a stalk or without; or it may be carried around by the mother attached to her spinnerets, held by her chelicerae or legs or held under her sternum. The shape may be spherical, plano-convex or biconvex or less commonly pear-shaped.

Many species desert their egg-sacs after oviposition and never see their offspring. On the other hand among the thomisids, salticids, many clubionids and gnaphosids,the mother usually mounts guard over the sac until the young spiderlings emerge. The lycosid female carries her young on her body and the pisaurid constructs a nursery web and mounts guard outside, a little below the nursery, until sometime after the spiderlings have emerged.

Sometimes the egg-sac being merely a loose web of threads and so being flimsy, does not conceal the eggs and can be seen from outside. In other cases it is very elaborate in structure. Several types of egg sacs are described later in the discussion of the motherhood of spiders.

As a rule, the eggs hatch in a comparatively short time after they are laid. The egg-shell is broken, in the case of certain spiders at least, by a tooth on the base of the pedipalps. Although the eggs hatch soon after they are laid, the spiderlings continue to remain within the egg-sac for some considerable time. Some species of spiders living in the cold places, pass the long winter as spiderlings within the egg-sac. In these species, the eggs are laid in autumn, the spiderlings soon hatch, but remain in the egg-sac till the following spring. It may thus happen that a spider like *Nephila* sp., whose entire life is about one year in duration, spends nearly one half of this period within the egg-sac. On the other hand, the young of other species leave the egg-sac soon after hatching.

The number of eggs in a sac varies from only one or two up to 25 or 30 often from 100 to 300. In one instance 2000 were counted in a sac of the orb weaver, *Araneus* sp. Some spiders make more than one sac (upto 20 or more) and occasionally three or four may be seen in a web at the same time.

The number of times a spiderling moults before maturity varies with the species. In general, the smaller species moult fewer times than the larger species.

Like many other arthropods, spiders are able to withstand loss of one or more appendages without being greatly inconvenienced. If for example a spider is grasped by a leg, the appendage may be *autotomized* but the spider escapes. Provided another moult is not too near, the missing appendage regenerates, though it may be somewhat smaller than the normal.

2. THE FOOD OF SPIDERS

All spiders are carnivorous. Their prey consists chiefly of insects; but they also feed on other spiders, if the situation permits and even on weaker members of their own species. This cannibalism is not

confined to the young spiders, but is also true of adults. Because of this tendency to cannibalism a social or communal life is hardly to be expected.

Some of the spiders are true orb-web weavers, others make irregular webs, in a few cases they make the umbrella-shaped inverted complicated webs and still others make the sheet webs spread on the ground with a funnel retreat. Some spiders restrict themselves to very damp situations and others live successfully in dry habitats. According to their web building ability, generally the spiders are considered as weavers or non-weavers. The weavers make the snares to trap insects as their food,while the non-weavers hunt the prey by chasing or by stalking. When an insect prey is caught in the web, the spider quickly rushes in and injects the poison through its cheliceral fangs into the prey to kill it, often biting it repeatedly, and ultimately sucks the body fluid of the prey. The orb-webs of the spiders of the genera *Araneus, Argiope, Leucauge* and *Gasteracantha* are made within the branches of low bushes or on small trees and in between the rocks. Generally, they spin their new webs every night or repair damaged webs. They not only catch flying insects in their webs, but also entangle the jumping insects. The spiders of the family Uloboridae also prepare webs similar to those of Araneidae. The members of the family Pholcidae prepare irregular snares on the inside corners of walls as well as on the inner side of roofs in houses. The pholcid spiders hang upside down from their snares. Insects such as houseflies and mosquitoes caught in these webs are sucked by the pholcids. Thus they not only contribute in reducing the number of these insects in houses, but also help in the biological control of insects. The family Eresidae prepares compact nests with many holes of entrance and exit on the leaves and branches of the bushes and trees. Some part of the nest is expanded like a broad sheet. These nests are commonly seen in our country on *Acacia* trees and other shrubs. The flying and jumping insects caught in the sticky sheet, are killed on the sheet and dragged inside the nest by the spiders. Their social behaviour is seen by a number of individuals taking part in one hunt or sucking the same prey. Insects belonging to the orders Orthoptera, Lepidoptera, Coleoptera, Hemiptera, Diptera and Hymenoptera are the usual prey of these spiders. The body remains of the dead prey are not thrown out of the nest.

The spiders of the family Lycosidae (wolf-spiders) are unique in having both weavers as well as hunters. Only the spiders of the genus *Hippasa* prepare expanded sheet-like webs on the ground with funnel retreats wherein they hide. The spider waits inside for the prey to fall on the expanded sheet and as soon as some prey is caught on the webs, the spider comes out of the funnel retreat to bite, kill and suck the prey.

Other spiders that prepare no such webs or snares to catch their insects prey for food, are commonly called hunting or running spiders. The spiders of the families like Lycosidae, Gnaphosidae, Clubionidae, Heteropodidae, Salticidae, Oxyopidae and Thomisidae belong to this group. They either chase their prey and catch them by running them down as in Lycosidae (wolf-spiders), or wait and stalk their prey as in Salticidae (jumping-spiders) or Thomisidae (crab-spiders) or Heteropodidae (Giant crab-spiders). Insects belonging to the orders of Diptera, Hemiptera, Collembola, Dermaptera, small Coleoptera, small butterflies and moths are used as food by the lycosid spiders.

The mouth of a spider is fitted only for the taking of liquid food. The body fluid is sucked from its victims with the help of its chelicerae and the endites of pedipalps. Observations on spiders in confinement show that some of them at least require water frequently. It is, however, evident that most others obtain their moisture from only the liquid of their victim.

Although spiders are extremely voracious, they are capable of enduring long spells of starvation. It was experimented that a female *Theridion* spider was known to exist for eighteen months without any food in a closed vial.

3. SPIDERS AND THEIR PREY

Many devices are resorted to by spiders in hunting the prey. Some like the wandering spiders, stalk their prey; others lie in ambush for it; many trap it by means of snares; and a few live as commensals.

The wandering spiders Among the more familiar examples of wandering spiders are the wolf-spiders (Lycosidae), the jumping

spiders (Salticidae), and some of the crab-spiders (Thomisidae). These run about in search of their prey and pounce upon it when an opportunity occurs.

The ambushing spiders : Some of the crab-spiders, like *Misumena* and *Thomisus,* hide in flowers and capture insects that visit them. Many of the burrowing spiders lie in ambush at the entrance of their burrows, and spring forth to seize insects that come near.

The web-building spiders : The great majority of sedentary spiders do not wander in search of prey, but they spin webs or snares for the trapping of insects, and wait either in or near the webs where they can easily rush upon the entangled insects.

The commensal spiders : The members of the family Eresidae prepare compact nests with many entrance and exit-holes on the leaves and branches of bushes and trees. Some part of the nest is expanded like a broad sheet. These nests are commonly seen in our country on *Acacia* trees and other shrubs. The flying and jumping insects caught in the sticky sheet are killed on the snares and dragged inside the nest by the spiders. Their social behaviour is evident from the number of individuals taking part in one hunt or in sucking a single prey. This social phenomenon is shown by the members of the family Eresidae and they are represented in our country by a single genus *Stegodyphus.* There are more examples of feeding at the same table with other species, or commensalism as it is termed, which is exhibited by species of the genus *Argyrodes* of the family Theridiidae. These small spiders live in the snares of larger web-building species and feed upon the smaller entrapped insects that are neglected by the owner of the web.

Means of killing the prey : Spiders kill their prey by means of venom secreted by a pair of glands in the cephalothorax; the ducts from these glands open, one on each side through a minute pore near the tip of the fang of the chelicera.

Most of the web-building species swathe their victims in a sheet of silk. The act of swathing can be easily observed by throwing a large insect on to the web of a *Araneus* or *Neoscona.* The spider first rushes at the insect and pierces it with the fangs of its chelicerae, and then

darts back into a position of safety, this may be repeated several times, or if the spider is not afraid of its victim, the repeated biting may not be needed. Then the spider approaches the insect and pulling out a sheet of silk from its spinnerets with one hind leg and thrusts the sheet against the insect. In doing this, the spider uses first one hind leg and then the other. In the case of a large *Argiope* this sheet of silk is sometimes an inch in length, the body of the spider being held that far from the insect, and under this conditions the sheet can be seen to be composed of a very large number of parallel threads. As soon as the sheet is fastened to the insect, the spider rolls the insect over and over and thus manages to wrap it completely in its shroud. After the prey is sucked only a small mass of undigestible material, such as the chitinous elements, remain to be discarded.

4. SILK OF SPIDERS

The term silk is generally used to designate the thread spun by the silkworm, the caterpiller of the silk moth–*Bombyx mori,* from which nearly all of silken fabrics are made; but the term is also applied to other similar products. In this sense, silk is produced by various animals and is used by them for many different purposes.

The silk organs of spiders are the most complicated silk glands placed inside the abdomen. This condition might be expected from the fact that a single species of spider spins several distinct kinds of silk; for example, an orb-weaving spider spins five different kinds of silk. Since spiders spin several kinds of silk it is obvious that there are several kinds of silk glands which are functionally different. Seven different kinds of silk glands have been recognized. These differ in form, in number in colour, in the structure of their ducts, and in the nature of their products. No single spider has been found to possess all of the seven kinds of silk glands; but three of the kinds have been found common in all species of spiders and a fourth kind is wanting in only two families. The three other kinds are each characteristic of a particular group of spiders, and no two of them are found together. Each of the three groups of spiders that possesses a characteristic kind also have been provided with the first four kinds. Hence the presence of five kinds in a single spider is common. The comb-footed spiders of the family Theridiidae possess all six of the

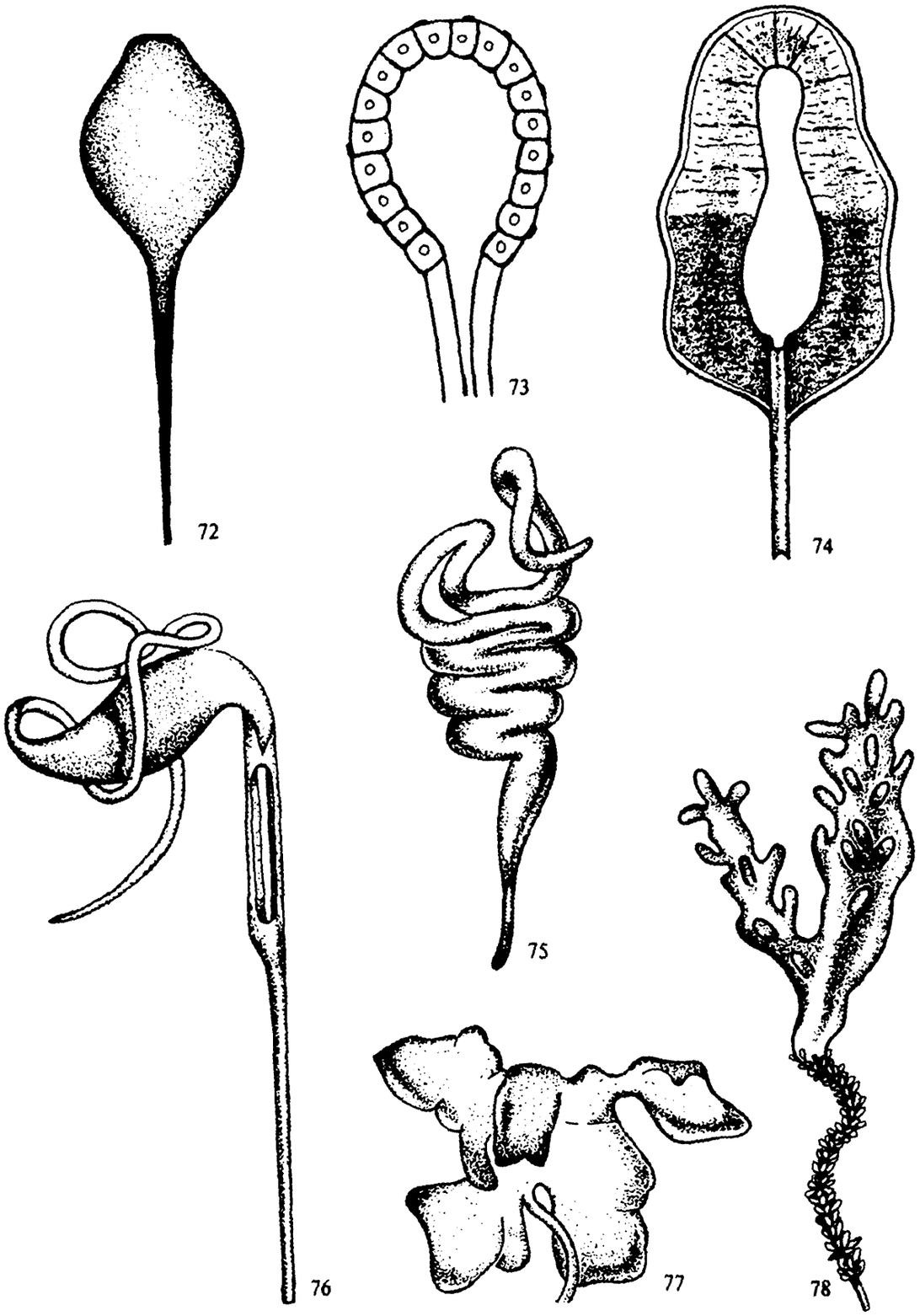
remaining types of glands, and are the only ones having lobed glands, which secrete the material of the swathing film. These spiders thus are provided with one more set of glands than their close relatives, the sedentary orb weavers and the linyphiid spiders.

The silk glands of spiders are secreting organs located within the abdomen. There are different kinds of silk glands found in the spiders. Even the oversimplified classifications demonstrate conclusively that the spinning organs and glands of spiders are the most complicated structures known for the production and utilisation of silk. The several types of glands and uses of their silk products are described below.

1. The *Aciniform,* or *berry-shaped glands* (Figs. 72 & 73) These glands are found in all spiders and are characterised by their nearly spherical shape and resemblance to various berry fruits, such as, a raspberry. There are four clusters, each containing from a few to as many as hundred glands, produce the silk through each of the posterior and median spinnerets. The swathing band is a product of these glands. According to some authors, they also produce the ground lines for the viscid drops.

2. The *Pyriform,* or *pear-shaped glands* (Fig. 74) These glands are also found in all spiders and occur in two clusters of a few to one hundred or more, and communicate with the front spinnerets. Spiders make the attachment discs with the help of their silk but they sometimes contribute wild threads to the thicker draglines.

3. The *Ampullate,* or *bellied glands* (Fig. 75) These glands are found in all spiders, and usually are present as four large, long, cylindrical glands, but frequently there are six, eight or even twelve in number. They open through spigots which are located on the inner side of each of the anterior and middle spinnerets. Most of the dry silk of spiders, the dragline being the chief agent, is produced in the ampullate glands. Comstock suggested that the ground line of elastic silk in the orb-web weavers, is produced by these glands, two of which have been modified for the production of these important elements. The fact that the yellow silk of *Nephila* is spun from the anterior spinnerets partially confirms this opinion.



Figs. 72-78. Silk glands of Spiders. Fig. 72. Aciniform or berry-shaped glands. Fig. 73. Section of Aciniform gland. Fig. 74. Section of Pyriform or pear-shaped gland. Fig. 75. Ampullate or bellied gland. Fig. 76. Cylindrical gland. Fig. 77. Aggregate or tree-form gland. Fig. 78. Lobed gland.

4. The *Cylindrical glands* (Fig. 76) These longs, and cylinder shaped glands are open, wanting in males, and are lacking in the spiders of the families Dysderidae and the Salticidae. There are six or more glands and each gland opens on the inside of posterior spinnerets through a spigot. They produce the silk for the egg-sac.

5. The *Aggregate,* or *tree-form glands* (Fig. 77) There are six of these irregularly branched compound glands, opening on the inner surface of each posterior spinnerets through spigots. These glands are found only in the spiders of the families Araneidae, Linyphidae, and Theridiidae, and produce the viscid drops for the viscid threads of the web.

6. The *Lobed glands* (Fig. 78) These glands found only in the spiders of the family Theridiidae, These are irregular and lobed in shape, opening on the posterior spinnerets through spigots. The swathing film of the theridiid spiders is produced by these glands, which are developed largely at the expense of the aciniform glands.

7. The *Cribellum glands :* There are numerous, spherical glands opening on the cribellum through many tiny pores. They occur only in the cribellate spiders, and secrete the woof of the hackled band threads.

The silk of spiders is a fibroprotein which is produced as a liquid in varied and voluminous abdominal glands. When drawn out of the spinnerets, the liquid ordinarily hardens to form the familiar silken threads. It is believed that the mechanical stretching of the silk during the drawing of the lines is responsible for the hardening, rather than exposure to air or any chemical process. Viscid silk is produced in some of the glands and remains sticky for long periods. An analysis of the silk has shown that it is a complex albuminoid protein quite similar to that produced by the silk-worm, although this similarity is denied by some investigators. The silk of the silkworm comes out from modified salivary glands located in the head, whereas that of the spider is derived from transformed coxal glands in the abdomen.

The several types of spinning glands are described but now it is most essential to consider the nature and uses of the different kinds of silk.

The dragline–Most of the spiders as they move from place to place, spin a thread which marks their course; this thread has been termed the *dragline.* Draglines are the most commonly observed threads of spiders, due to this thread the spiders drop from an elevated position to a lower place. The dragline is a constant companion of spiders of all ages and all kinds, excepting a small group of primitive spiders of the family Liphistiidae. On draglines, the spider balloons for long distances for their dispersal. The dragline is the lifeline of the spider. It is an aid in preventing falls from precipitous surfaces, and may also serve as a means of escaping enemies. Web making spiders often drop from their webs on these lines and hide in the vegetation. Even they can drop down and hang suspended in the mid-air until the danger is over, whereupon they climb up to their original position. The hunting spiders jump headlong over cliffs or leap from the sides of buildings to escape capture, and float down gently on their silken ropes. The irregular webs and the foundation of an orb-webs are made of draglines. Sometime the dragline may be made of four strands, or even of a great many threads drawn from several spinnerets.

The attachment disks–The spiders are running along some object and spinning a dragline and this line frequently fasten with some intervals to the object on which they are running. The method of making an attachment disk can be easily observed by enclosing a living spider in a bottle, and watching it with a hand lens as it fastens its dragline to the sides of the bottle. An examination of the disk with a microscope shows that it is composed of a large number of fine threads.

The swathing band–The band of silk with which the orb-weaving spiders envelop their prey may be termed the swathing band. Each band is composed of multiple threads which fascilitates to bind the prey.

The swathing film–Spiders of the family Theridiidae use in swathing their prey a film of silk which differs from the swathing band of the orb-weavers. This silk is emitted from 2-4 spigots. These spigots are the outlets of the Lobed glands; which have been found only in the spiders of the family Theridiidae.

The viscid thread–In the webs of orb-weaving spiders there occurs a peculiar viscid threads, which produce the spiral line forming the large part of the orb. This is the trapping portion of the web; the viscid nature of the silk causes it to adhere to an insect touching it, and the elasticity of the thread prevents the insect from breaking it at once and allows the insect to become entangled in other turns of the spiral. In this way the prevention of the escape of the insect is assured, if the victim is not too powerful. When highly magnified this viscid and elastic line is seen to be composed of two elements, first the axis of the thread consisting of two strands and second a series of globular drops borne upon this axis. The axis is the elastic element of the thread and the drops are the viscid portion. In the webs of some of our larger spiders, the viscid drops on the spiral line can be seen with naked eyes. The silk of the viscid drops is believed to be secreted by the aggregate or treeform glands which open through spigots on the posterior spinnerets.

The hackled band threads–By the term hackled bands may be designated the special threads spun by spiders having a cribellum and a calamistrum. These threads are flat and more or less ribbon-like structures. The structure of the hackled bands differs in different families, and sometimes, in different genera of the same family. These threads are woven by the calamistrum borne on the metatarsi IV of the criballate spiders.

The silk of the egg-sacs–The silk of the egg-sac of many spiders presents an appreciably different appearance than does other silk spun by the same spiders. According to some researchers, this silk is produced by the cylindrical glands of the female spiders.

5. TYPE OF WEBS OF SPIDERS

The spiders create special attention to the naturalists because of their unique weaving capability to construct their webs with geometrical precision and beauty. The snares or webs of different spiders differ greatly in structure.

The single-line snare The stick spiders of the genus *Miagrammopes* of the family Uloboridae are creatures of the tropics and oriental region. The snare of *Miagrammopes* is a single horizontal

line, attached at both ends to branches, that stretches about four feet across open spaces in the forest. They have developed marvelous trapping device for catching prey with the help of a single line orb-web.

The triangle web : The web of *Hyptiotes* (Family Uloboridae) spiders looks like a triangle; at first sight it appears like a fragment of an orb-web; but a little study will show that it is a complete web. It consists of four plain lines corresponding to the radiating lines of an orb-web, and supported by these a variable number of threads which appear like sections of the spiral line of an orb-web. From the point where the radiating lines meet a strong line extends to one of the supporting twigs.

Orb-webs : The two-dimensional snare known as the orb-web is a crowning achievement of the aerial spiders. To the layman the web is an engineering triumph, a fixed geometrical object that symbolizes *spider* and partially allays unreasoning distrust of the creature. The characteristic feature of an orb-web is that the central portion, the part lying within the supporting framework, consists of a series of radiating lines of dry and inelastic silk. According to the families and genera of the spiders, the different webs of this type vary greatly in structure, shape and size.

In the more symmetrical of the orb-webs, the viscid line extends throughout the major part of its length as a spiral line. The web of *Araneus* is an excellent illustration of this kind of a web. Such webs are termed *complete orbs.* Details of orb-weaving mechanism have been enumerated in the next part of this chapter.

Irregular webs or nets : The irregular webs, where threads are extending in all directions, are built by the domestic spiders like *Theridion* and *Pholcus.* Most members of the families Theridiidae and Pholcidae and a few other spiders spin irregular webs.

Sheet-webs : The most familiar example of a sheet-web is that of *Linyphia.* Here the principal part of the web consists of a more or less closely woven sheet extended in a single plane and consisting of threads extending in all directions in that plane with no apparent regularity of arrangement.

Funnel-webs : The principal part of a funnel-web is sheet-like in structure; but webs of this type differ from the true sheet-webs in having a tube extending from one edge; this tube leads to the retreat of the spider or serves as a retreat. The web of the common grass-spider of the genera *Agelena* (Family Agelenidae) and *Hippasa* (Family Lycosidae) are good examples of this type of funnel-web.

6. ORB-WEAVING MECHANISM OF INDIAN ARANEID SPIDERS

Among spiders the members of the family Araneidae are unique for their orb-webs of geometrical precision. Their finished product is a masterpiece of craftmanship. The webs mainly serve as traps to capture the prey, but often also camouflage the spiders from their prey and predators. The threads of webs are nothing but the solidified secretion of silk glands, situated inside the abdomen. The silk secretion is a kind of protein and solidifies as soon as it comes into contact with the air. The secretion of silk gland is extruded from the minute microscopic spigots on the mound of spinnerets.

The orb-weaving spiders are of various kinds, and the modes of web-building are also different to some extent. Primarily two types of operations are seen. One, the bridge line along with the outer frameworks are constructed first. The orb-webs are either vertical or horizontal in position with the adjacent supporting objects. The other type, where after formation of bridge line, V-shaped two radii are formed from a second thread just below the upper bridge line, and the other radii along with outer frames are constructed. But in both the types the operations are somewhat variable according to the availability of adjacent support. After the formation of all radii, the spider constructs the non-viscid spiral thread from the centre to the periphery which is later replaced by viscid spiral thread from periphery to centre.

Here the two types of web-building operations are discussed.

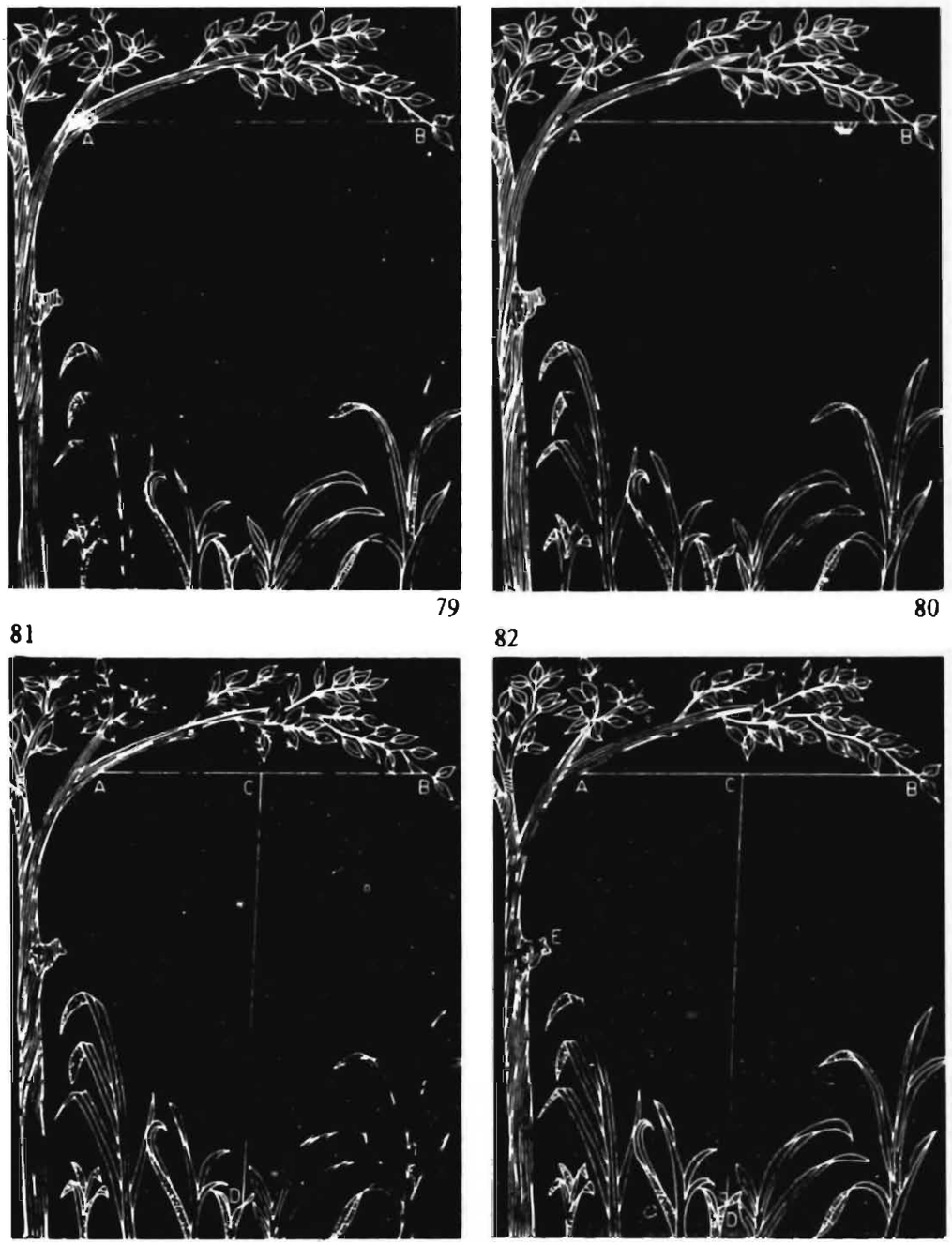
In the first instance the spider *Gasteracantha mammosa* C. L. Koch (= *G. brevispina*) lays out silk from its spinnerets to the wind from at a point *A* until the free end of the thread gets entangled to an

end *B* on the shrub (Fig. 79). From *A* the spider goes over to the point *B* and sticks the end firmly there. The spider then walks back and forth along the line to strengthen it by laying more silk on to it. Thus the *bridge line A—B* is established (Fig. 80). From *A* the spider proceeds unto the middle of the bridge line i.e. *C*, from where it drops down a thread over a weed below and fixes the thread at *D* on the weed (Fig. 81). From this point the spider continues the thread and carrying it loose by one of its hind legs so as not to entangle on the supporting weeds on which it walks, and goes over the weeds upto a stump *E* of the shrub where it entangles the line. Now, it climbs up along the branch from *E* by trailing the thread and attaches it to the point *A* (Figs. 82, 83). Thus *D—E* and *E—A* outer frameworks have been formed.

Then the spider crosses the bridge without any trailing thread upto *B* and from there it drops down on the weed below by a *dragline* thread and fixes it at the point *F* on the weed, thus *B—F* is formed (Fig. 84). From the point *F* the spider crawls down along the weed with a thread to form *F—D* (Fig. 85). In this way a pentagonal framework is built with the bridge line *A—B* and outer four *boundary lines B—F, F—D, D—E* and *E—A*. The line *C—D*, which passes from the middle of the bridge line *C* as a diameter through the centre of the entire space upto the middle of the opposite boundaries of the future web.

After this, the spider starts to construct the *radial threads* through a point on the already formed diameter *C—D*, which will be the centre or *hub* of the future web. In anticipation to this operation, it crawls upto a point *G* on *D—C*. At *G* the spider attaches a thread and trailing it loose behind proceeds upto *C* and from there it goes a little distance towards *B* and at point *H* entangles the line tight and makes the radius *GH* (Fig. 86). From *H* point the spider moves a few centimetres further towards *B* and at the point *I* fixes a fresh thread and trailing it loose comes back to *G* along with the radius *HG* and by pulling tight the thread at *G* the spider makes *IG* radius. (Fig. 87).

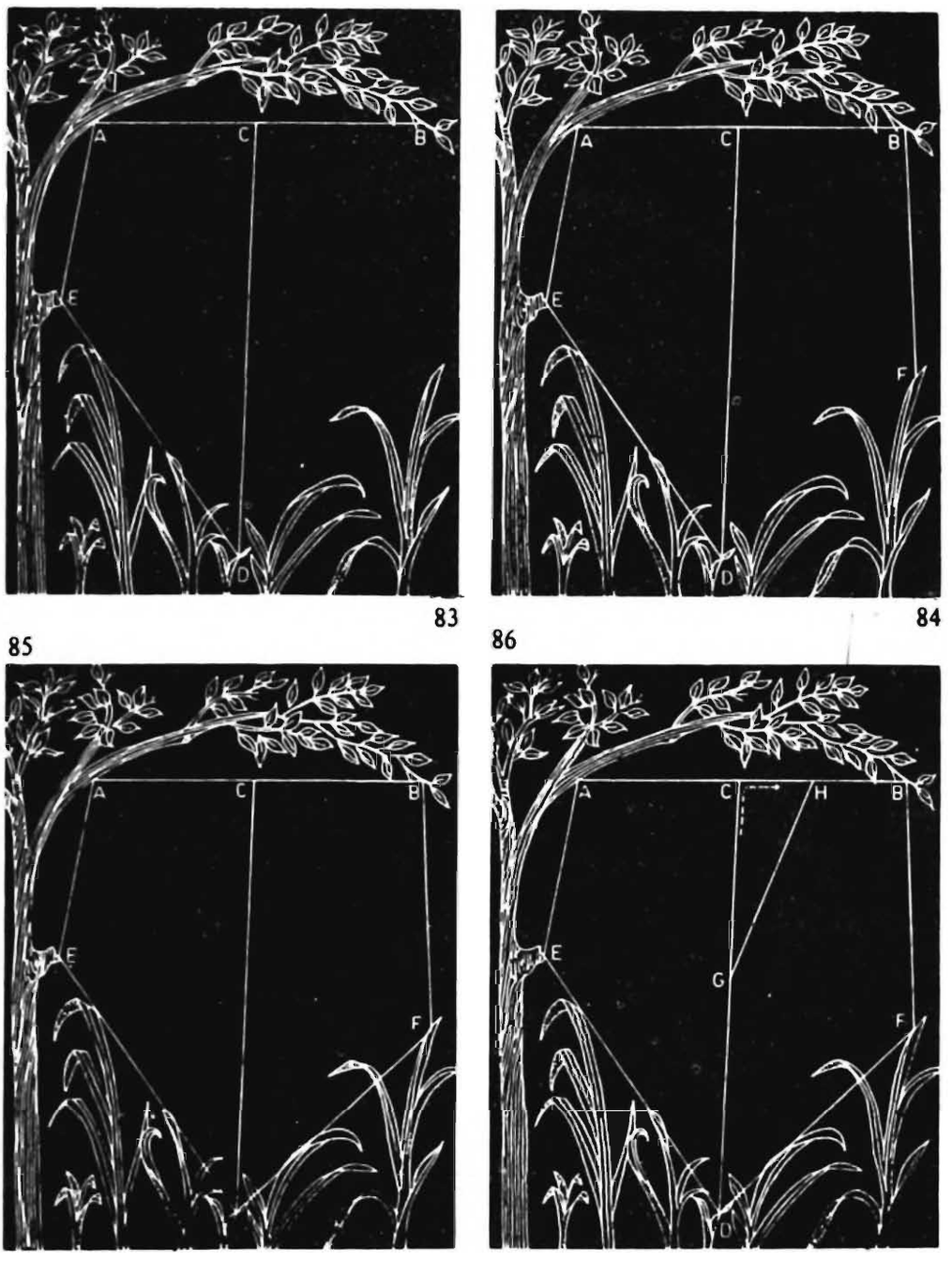
Next, the spider spins a new thread from *G* and trailing the line loose descends to *D* and turns towards *E*, at *J* it fixes the thread tight and thus the radial thread *GJ* is formed (Fig. 88). From *J*, the spider moves a little away towards *E* upto the point *K*, where it fixes a new



Figs. 79-82. Orb-weaving mechanism of *Gasteracantha mammosa* C. L. Koch.

thread and carrying the thread upto *G* via *JG* and attaches it to *G*. In this way another radial thread *KG* is formed. The spider repeats the operation to construct the radial threads in pairs. Such pairs are laid alternately on the right and left until the required radii sufficient to hold the future web, have been formed (Fig. 89).

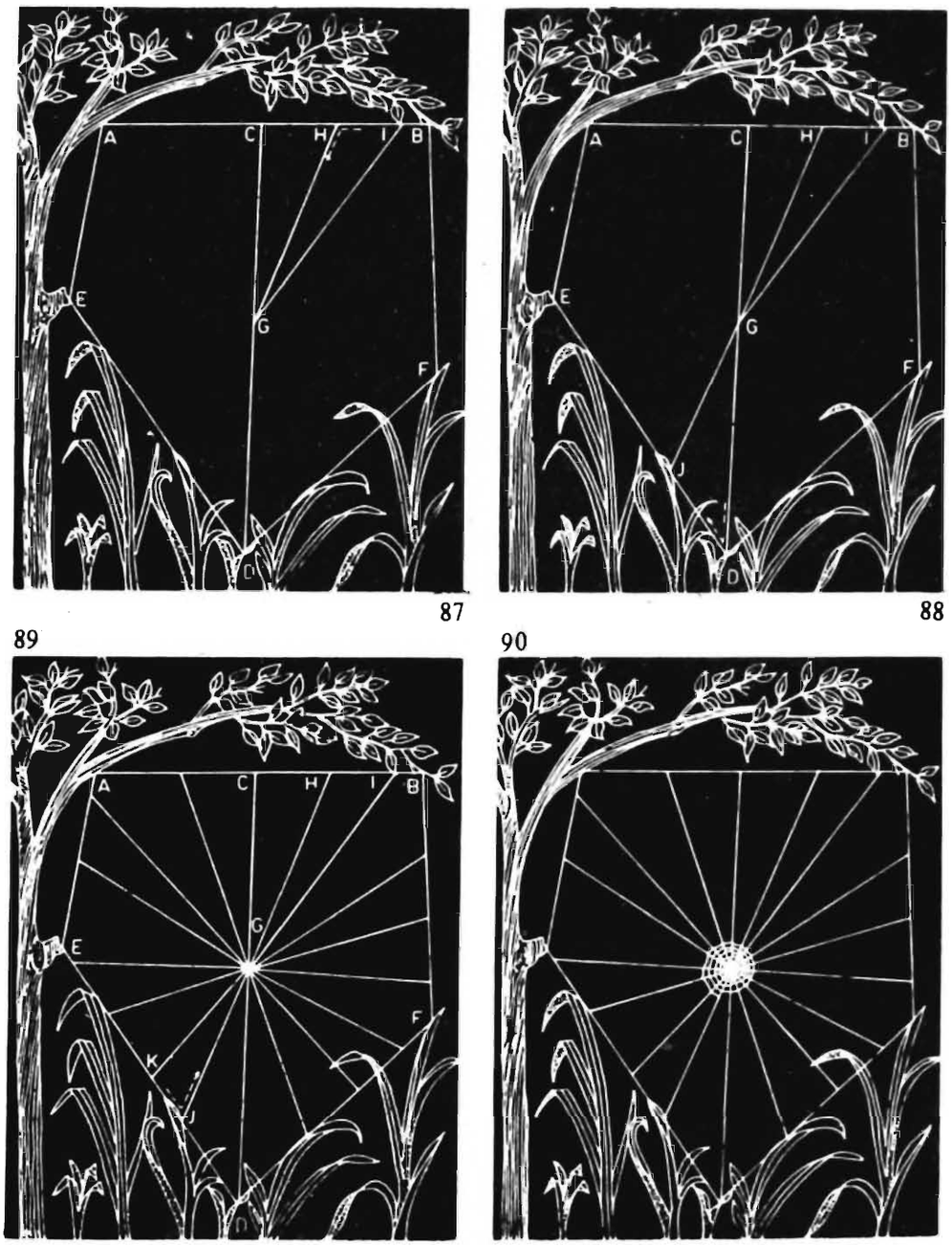
After completion of all radii, the spider moves to the centre of the web and evidently to give sufficient support to the radial threads, it



Figs. 83-86. Orb-weaving mechanism of *Gasteracantha mammosa* C. L. Koch.

spins a few turns of spiral threads immediately outside the hub. This small spiral around the hub is called the *attachment zone* (Fig. 90), and it is, of course, completed before the spider starts a temporary non-viscid spiral. Because of this attachment zone, the radial threads are getting the uniform tension.

Once the hub and the attachment zone are completed, the spider starts to weave a spiral from the end of the attachment zone and



Figs. 87-90. Orb-weaving mechanism of *Gasteracantha mammosa* C. L. Koch.

continuing to the periphery in an anticlockwise direction (Fig. 91), with turns as far as the spider can stretch. The thread of this *temporary spiral* is coarse and non-viscid and its function is to hold the radial threads for subsequent operations.

When the temporary spiral is completed, the spider reverses its direction, rolls up the old thread and puts down the new, finer and

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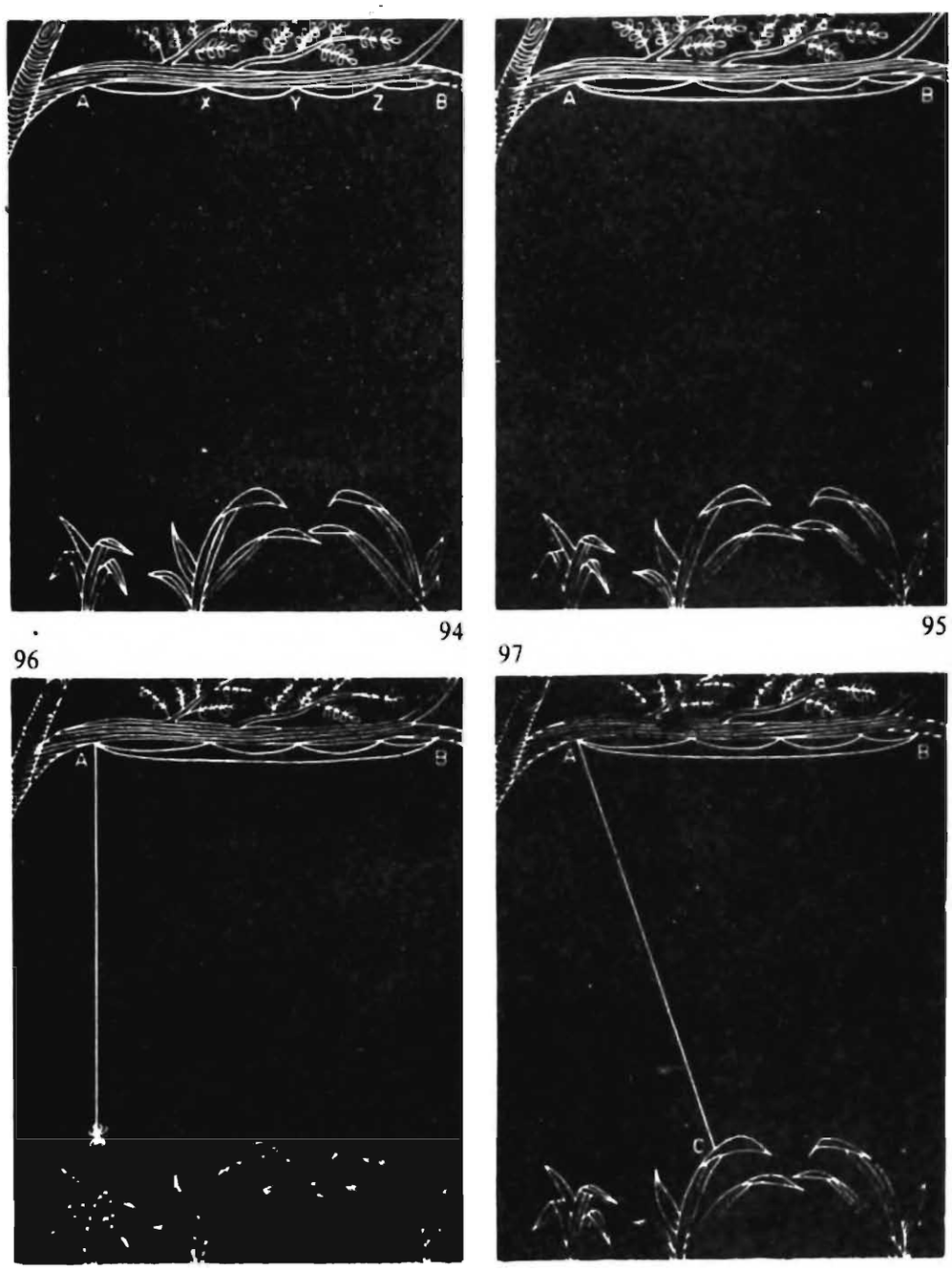
Figs. 91-93. Orb-weaving mechanism of *Gasteracantha mammosa* C. L. Koch.

more closely interspaced viscid silk, which is elastic too (Fig. 92). This *viscid spiral* is woven in a clockwise direction with measured action and uniform speed. In spinning the viscid thread the spider fastens it to a radius and then moves on pulling out the thread from the spinnerets, but before the thread is fastened to another radius the spider takes hold of it with the claws of one hind leg, and straigh-



Figs. 94-97. Orb-weaving mechanism of a young *Araneus* spider.

tening this leg pulls out from the spinnerets; the spinnerets are then applied to the next radius and the thread fastened in place. After this the spider takes away its hind leg and the thread contracts to the length of the space between the two subsequent radii.

The viscid spiral does not cover entirely unto the hub but leaves a space called *free zone* (Fig. 93) between the viscid spiral and the

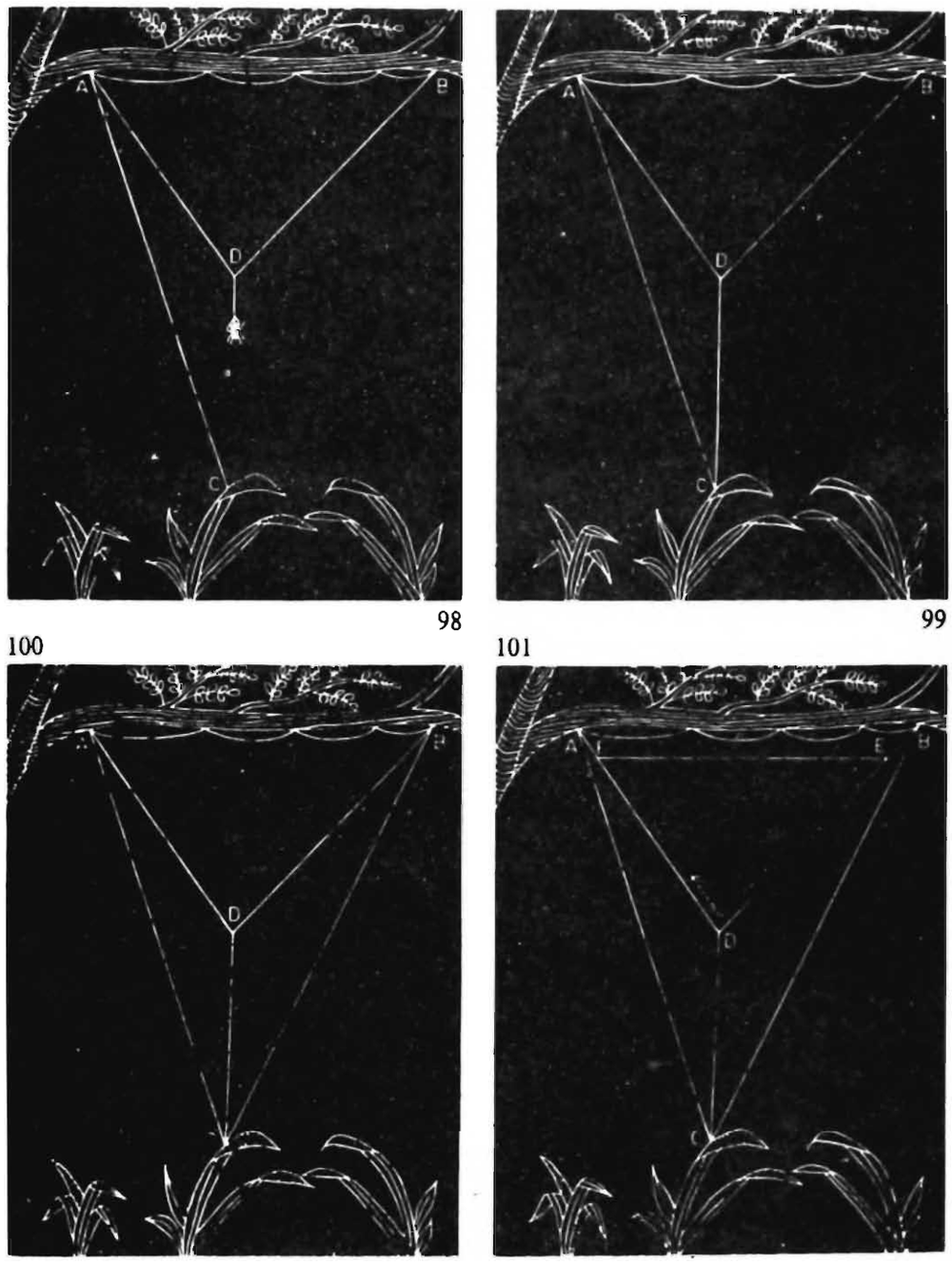
attachment zone. By following the above mentioned modes of operation to construct the web, the final product gets a "geometrical precision" which reveals the highest achievement of the craftmanship of orb-weaving spiders (Fig. 93).

In the second instance the young *Araneus* spider starts to weave its web at the beginning of dusk. At point *A* on a tree branch it fixes a thread and then crawls along the branch in an inverted position by trailing behind the thread carefully and attaches at points *X, Y, Z* and finally at *B* (Fig. 94). From *B* the spider returns to *A* carrying behind a loose thread which it fixes to *A*. Thus an upper bridge line *A*—*B* is established (Fig. 95).

Soon after this the spider drops down by a thread upto a level of a small plant below (Fig. 96). To reach to the plant the spider dangles to and fro, and as soon as it gets the plant, fixes the thread on any of the branches firmly. Through this oscillation and also with the help of wind it reaches to the plant (Fig. 97). Thus *A*—*C* is formed, and along this *A*—*C* the spider climbs back to *A* and then towards *B* upto *D*, the mid-point of *A*—*B*. At the point *D* the spider cuts the thread and attaches the spinnerets to the cut end, and makes the thread *A*—*B* longer by rotating itself. Thus a *V*—shaped structure of thread is formed (Fig. 98). From the bent point of *V* the spider drops down by a thread forming a *Y* and attaches the end of the thread at *C* (Fig. 99).

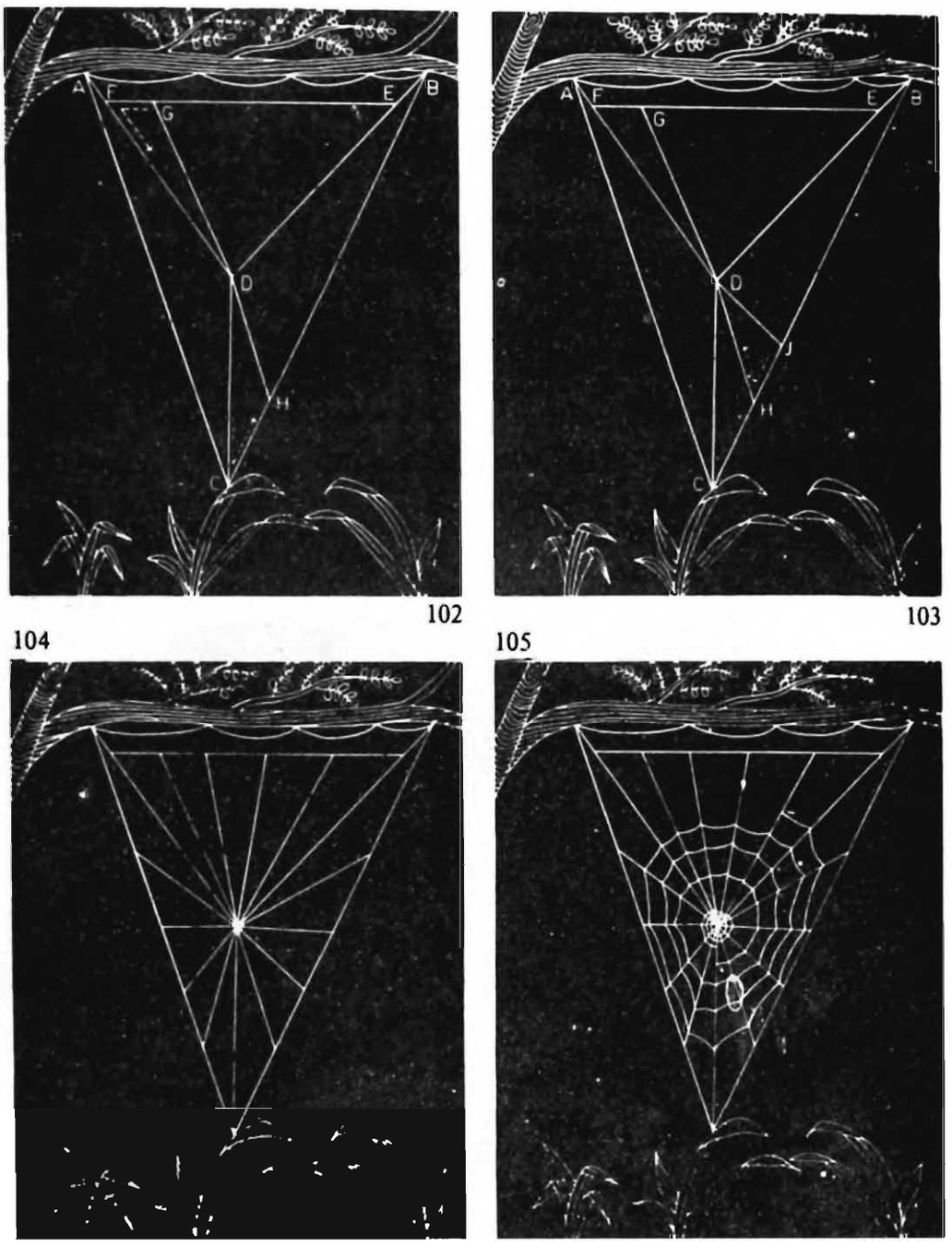
The spider then fixes a thread at *C* and trailing it behind and climbs upto *B* following the way *C*—*D*—*B*. At *B* the thread is hauled tight and fixed (Fig. 100). Thus a boundary line of the framework of the future orb-web *C*—*B* is formed. From *B* the spider moves down a little distance towards *D* and fixes a thread there at *E*. The spider then trails loose a thread and goes upto *F* via *D*, a little below of *A*, where the thread is pulled tight and fixed. Thus the upper boundary line *E*—*F* is formed after removing the original bridge line *A*—*B* (Fig. 101).

From *F* the spider moves a short distance towards *E* and at *G* fixes a thread, and by holding it carefully not to be entangled to any pre-existing thread, the spider moves upto *D* via *F*. At *D* the thread fixes tight. Thus the radial thread *GD* is formed. Then from *D* the spider



Figs. 98-101. Orb-weaving mechanism of a young *Araneus* spider.

trails a thread upto *H* via *C*, where the thread is pulled and fixed tightly at *H*. In this way another spoke *DH* is formed (Fig. 102). The spider then moves to the point *J* and attaches a thread there and returns to *D* via *H* to fix a thread to form the spoke *JD* (Fig. 103). By following the same procedure all other spokes or radial threads of the future orb-web are formed, one or two to the right alternating with one or two to the left (Fig. 104).



Figs. 102-105. Orb-weaving mechanism of a young *Araneus* spider.

Next the spider starts the subsequent phases to complete the orb-web, so the attachment zone and non-viscid spirals are formed after leaving the free zone as stated in the first case (Fig. 105). Then the non-viscid spiral is removed by closer meshed viscid spiral, weaving clockwise from periphery to the centre. (Fig. 106). In this way the orb-web in vertical plane is constructed by *Araneus* spiders. Different features of a typical orb-web are shown in the text-fig. 107.

Net element *"Thread"* Generally large orb-weavers produce thicker threads. In the same species of spider, the diameter of the thread changes with age. The thread thickness of an adult large orb-weaver is 0.010 mm—0.012 mm. per individual thread. The thread produced by *Nephila* is the strongest among spider's thread. The strong webs of *Nephila,* matted and twisted, are used by South Sea Islanders for various kinds of bags and fish nets (Kullmann, 1975).

As a spider walks around, it usually emits a double or even quadruple thread which is called *"dragline"* This dragline serves as a safety line so that in the face of danger the spider can let itself fall without losing contact with the last attachment disk to which it can return by climbing up the thread.

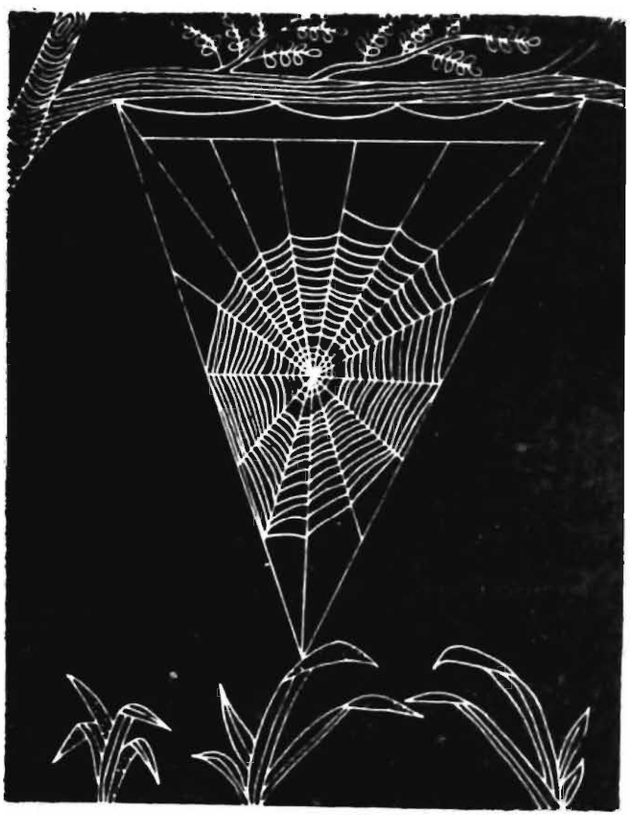


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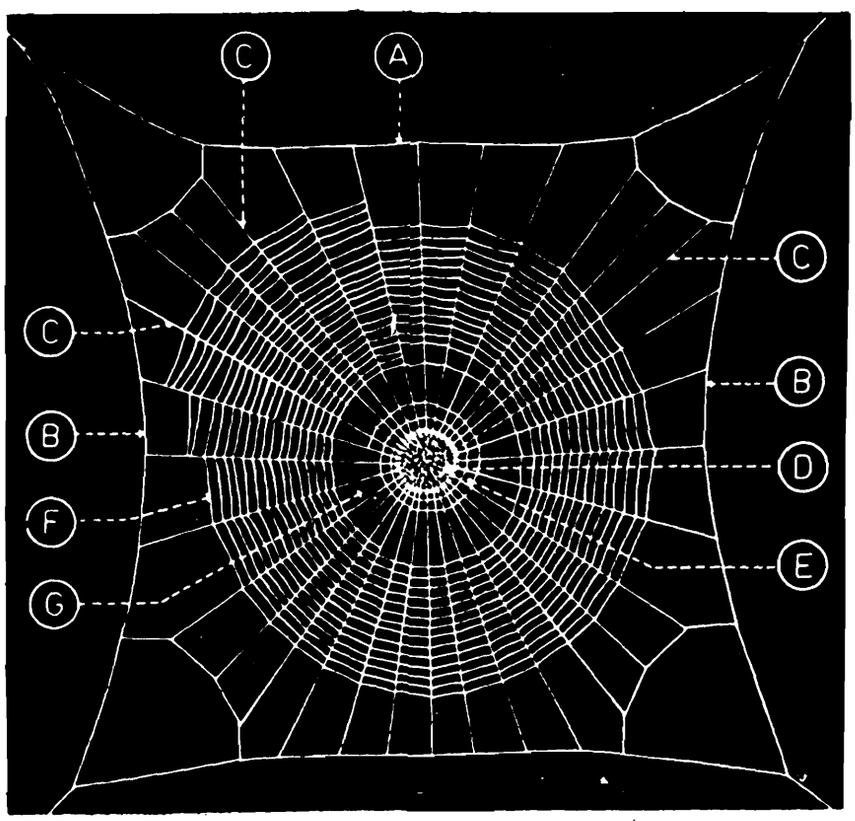
Fig. 106. Orb-weaving mechanism of a young *Araneus* spider.

The mesh of the orb-webs The mesh is the geometrical elements of the web. It is formed by the joining together of the threads and knots of the close lines. They are of four kinds found in orb-webs. The *trapezoid mesh* (Fig. 108) is found in general orb-webs. The *square mesh* (Fig. 109) is constructed in the sheet of the orb-web made by *Cyrtophora*. The *rectangular mesh* (Fig. 110) is constructed by *Nephila*, and the fourth is *irregular mesh* (Fig. 111) which is found in the hub of the orb-web of some araneids.

Net-support Orb-webs are suspended by one or more pairs of threads or thread bundles from the objects close to it, such as grass, plant leaves and branches, ropes, stones, and spanned between them. On one hand it consists of objects found ready such as grass, leaves, branches, fence-wire, stones, walls, etc. and on the other



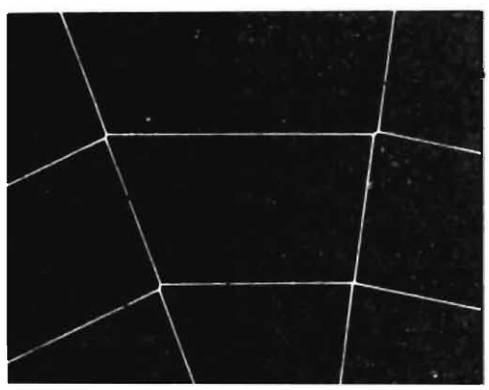
107

Fig. 107. Different parts of a typical orb-web.

A–Bridge line (upper foundation line). B–Outer foundation line. C–Radial thread. D–Hub. E–Attachment Zone. F–Viscid spiral thread. G–free zone.

hand, at adjusting elements such as foundation lines and anchoring threads (Figs. 112, 113). They transmit the forces to the net supports such as branches (Fig. 114). External net supports such as blades of grass (Fig. 115) or wall or building corners (Fig. 116) are known. However, internal net supports, particularly blades of grass, may also be observed (Fig. 117). If the net supports are very elastic, as in case of very long suspension threads or very flexible grass (Fig. 118), their elastic-constructive behaviour is an essential help for trapping the prey.

Special features in orb-webs The spiders of the genus *Gasteracantha* weave some small fussy silk balls along the viscid spiral, which are afterwards entangled with debris to form a rounded mass of waste products of their body size. So it is very difficult to locate the spider in the web (Fig. 119). This is also a kind of protective device. The young *Gasteracantha* may make a stabilimentum where as adults do not (Levi, 1978).



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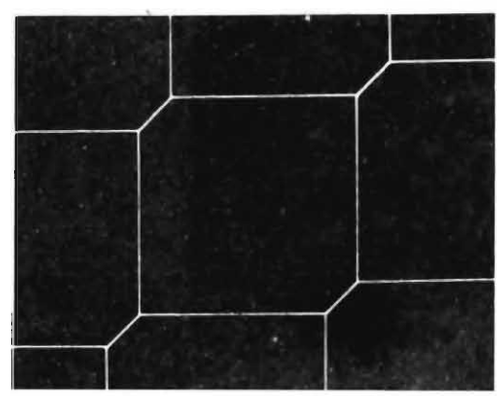

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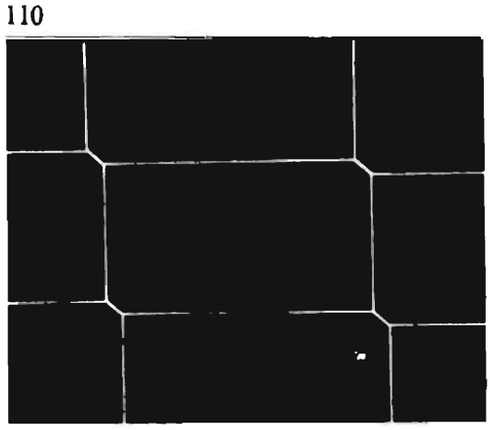

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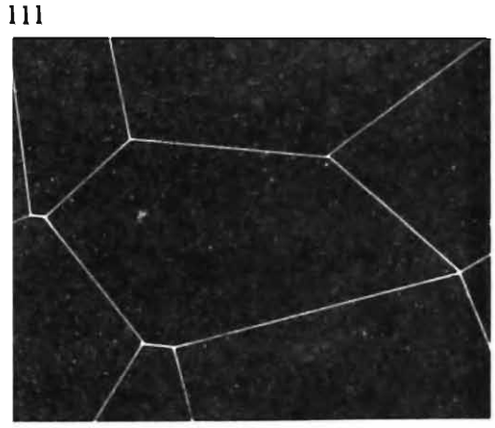
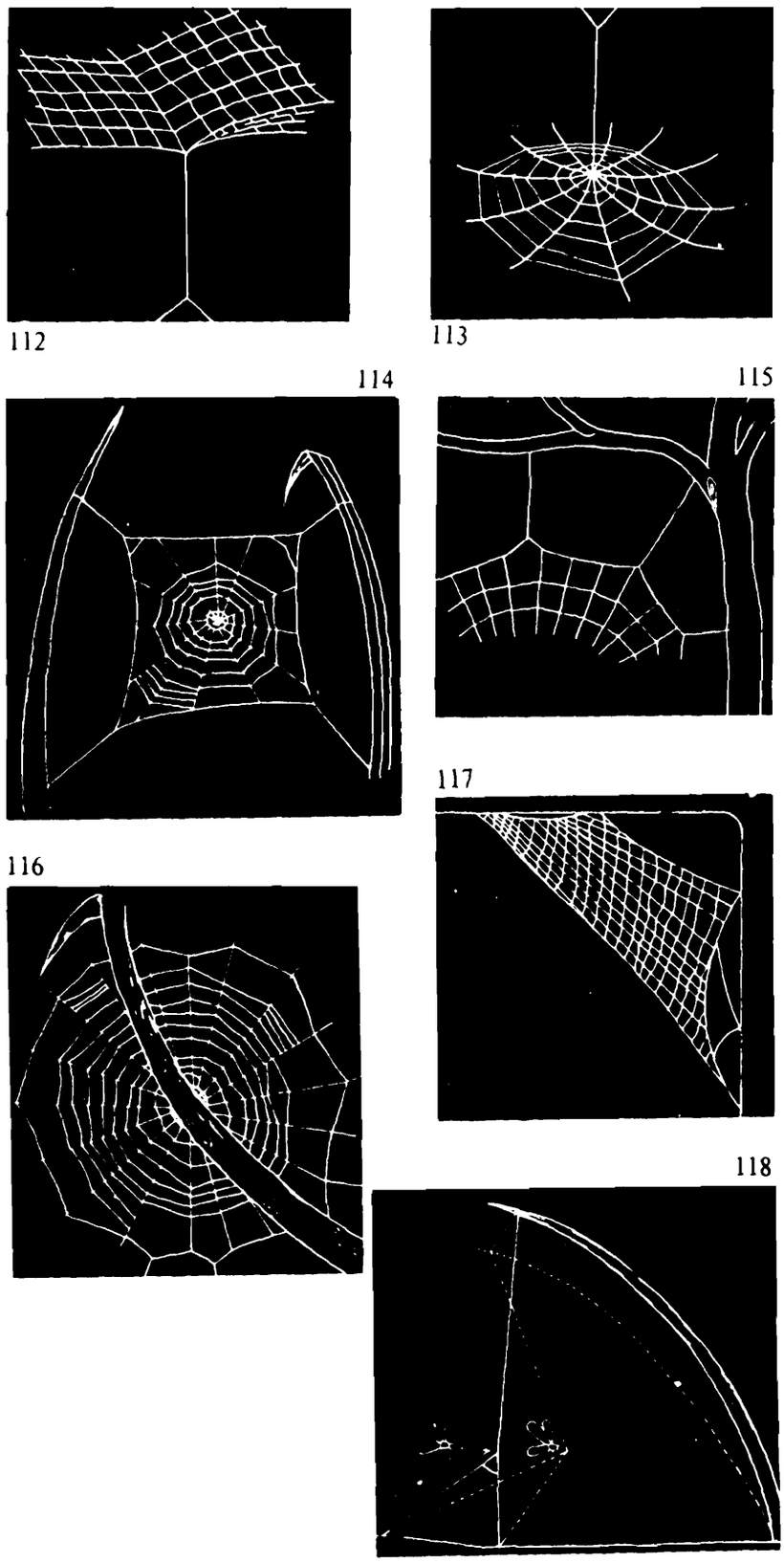


Figs. 108-111. The mesh of orb-webs. Fig. 108. Trapezoid mesh. Fig. 109. Square mesh. Fig. 110. Rectangular mesh. Fig. 111. Irregular mesh.



Figs. 112-118. Net-support of orb-webs. Fig. 112. Anchoring threads. Fig. 113. Anchoring threads. Fig. 114. Tree branches. Fig. 115. Blades of grass. Fig. 116. Building corners. Fig. 117. Blade of grass as an internal net-support. Fig. 118. Very flexible grass.

In the genera *Argiope* and *Cyclosa,* the orb-webs are commonly provided with *stabilimentum.* It is a zigzag ribbon like structure across the hub. It consists of a large number of minute threads resembling a swathing band and spun from the small spigots of the aciniform glands. In the webs of *Argiope,* the stabilimentum is X-marked across the hub (Fig. 120). It is always more elaborate in the young than in adults. Despite its name the ribbon like white bands do not function in support of the web, so it is seen that the webs of largest females often lack stabilimentum. The stabilimentum may obscure the outline of the spider, which does not have a retreat but hangs from the centre of the web (Levi, 1968). It is not periodically replaced as is the viscid silk. Since the decorative stabilimentum is found in diverse groups, sometimes only in the webs of immature, it may have different functions in different webs (Levi, 1978).

In the orb-webs of *Cyclosa,* the stabilimentum is generally small, placed just above and below the hub. *Cyclosa insulana* does not spin stabilimentum but the female spider fastens her egg-sacs in a series across the web from the hub to the upper margin. This looks like a dead twig or debris in a row in the web. The spider hangs in the web in a small gap at the centre between the upper half and the lower half of the structure (Fig. 121). This band of egg-sacs and the spider are of

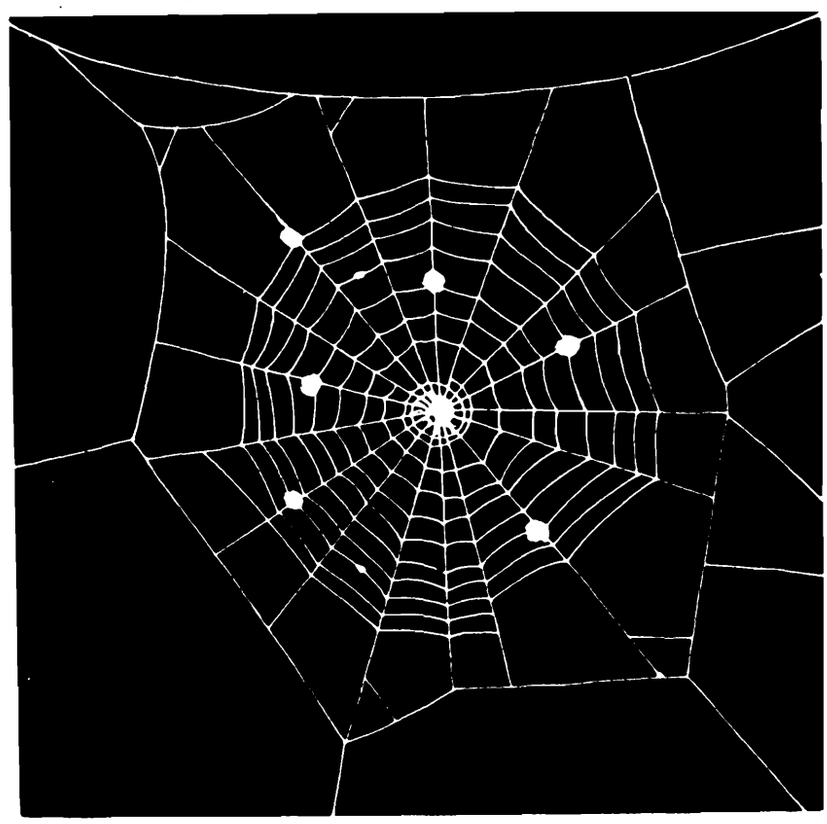


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Fig. 119. Orb-web of *Gasteracantha* with fussy silk balls.

the same grey colour, so it is very difficult to spot the spider in the web. *C. mulmeinensis* constructs horizontal web without any stabilimentum. The spider waits in the hub for the prey and the female fastens its egg-sacs in the webs at a side.

Some orb-weavers wait away from the web in a special *retreat* which is directly connected with the hub by thread called *trap-line*. This retreat is made up of leaves fastened together with silk, a little away above or on side of the web (Fig. 122). When any insect gets trapped in the web, the disturbance caused on the web is communicated to the spider waiting in the retreat, and the spider rushes to get the prey. These retreats or nests are commonly found in *Araneus mitifica, Neoscona rumpfi, N. mukerjei, Parawixia dehaanii, Zygeilla* sp. etc.

Zygeilla builds an orb-web, in which characteristically one sector remains free of viscid spiral threads (Fig. 123). There is one radius

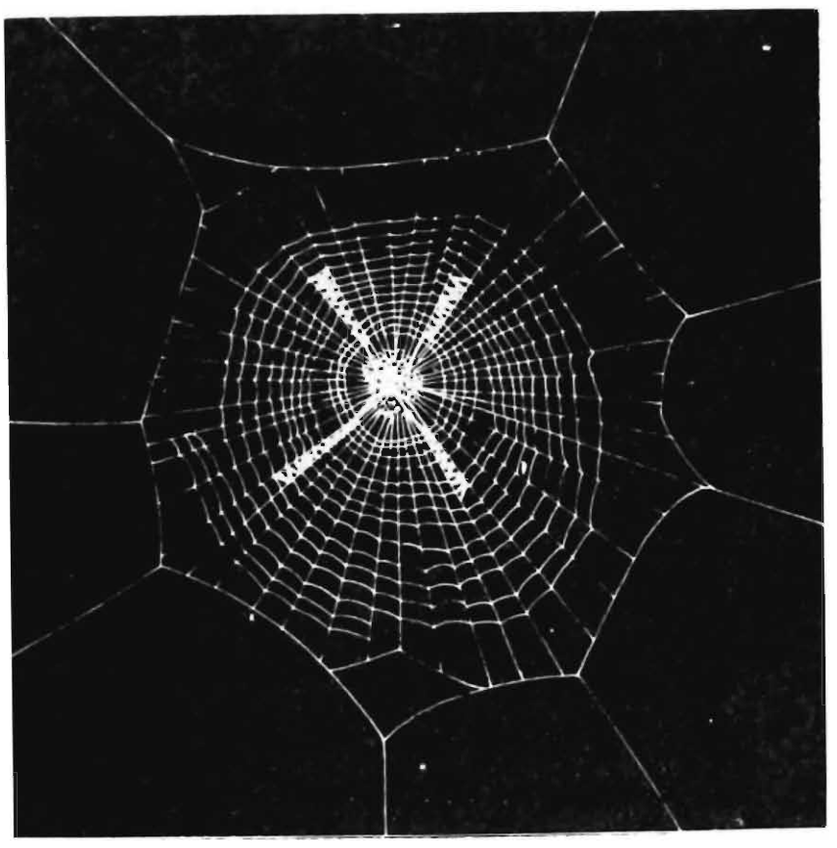

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Fig. 120. Orb-web of *Argiope*, provided with X-shaped stabilimentum.

leading through this open sector to the retreat of the spider as a *trap-line*. The webs are renewed almost everyday.

In case of *Gea*, the orb-web has occasionally a sector missing from the lower half, in contrast to the web of *Zygeilla* where the sector is missing from the upper half. *Gea* constructs the web close to the ground in low vegetation and does not provide any stabilimentum.

In some genera, as in *Meta, Leucauge, Gasteracantha,* the *hub* is open. This open hub fascilitates the spider to move from one face to the other. The hub of *Neoscona* is not fully open but crossed by only one or two threads (Fig. 124), unlike the webs of *Araneus* where the hub is meshed (Fig. 125). *Neoscona* sits in the hub with the tip of the abdomen pushed through the open space of the hub.

Leucauge builds the web in a horizontal plane in low bushes during the day time. Very quickly they construct their webs, which are devoid of retreats. The spider hangs upside down at the centre. Almost everyday they build new nets after removing the old one.

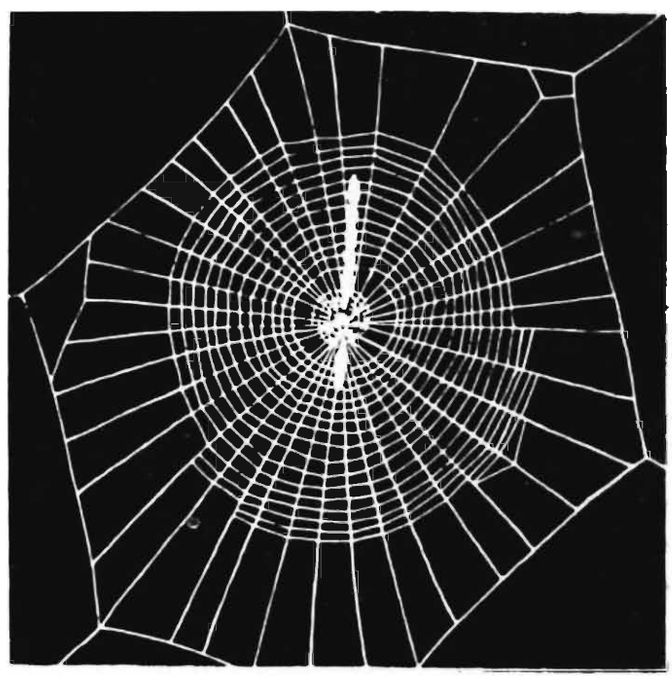

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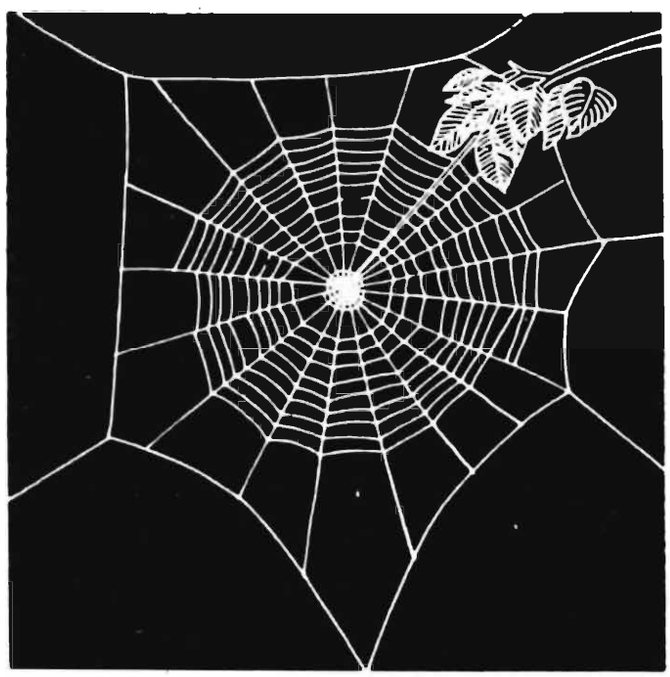
Fig. 121. Orb-web of *Cyclosa insulana* (Costa).

Nephila makes a huge web, nearly one metre or more in diameter in shaded woods. The webs are different in number of respects from those of the others in the family. The radii are pulled out at their direct course to give a notched appearance (Fig. 126), and the viscid spiral is yellowish rather than white.in colour. The silk of *Nephila* is the strongest natural fibre known (Levi, 1968). The strong webs of *Nephila,* matted and twisted, are used by South Sea Islanders for various kinds of bags and fish nets. Unlike other orb-weavers, the *Nephila* makes use of the same web for a long period replacing only the viscid lines. The webs of young *Nephila* are complete orbs but the adults construct incomplete webs in the upper side. *N. maculata* is having an orb-web with a barrier web in the lower side.

Larinia makes the orb-web in low bushes without any retreat. It does not rest in the centre of the web but on the vegetation at the side during the day time. At night it sits in the hub only.



122

Fig. 122. Orb-web of an araneid spider with retreat.

The members of the genus *Cyrtophora* produce the most unusual webs, perhaps the most specialised ones. They make horizontal dome-shaped webs with a barrier-web above and below (Fig. 127). The webs are devoid of viscid silk which is a specialised character since sticky threads are found in almost all araneids. The mesh of the web, which takes several nights to build, is so extra-ordinarily small that it can be said that it is a derived character. The webs of *Cyrtophora* are the best example of highest achievement of technical masterpiece among the spiders. *C. cicatrosa* and *C. citricola* live in large colonies that span huge areas with contiguous barrier webs. These spiders make very few catches but since new webs are not constructed frequently, little energy is spent. The moths or other insects fly against the barrier-web, tumble down to the domes of the horizontal orb-web, and are pulled through by the spider from below the web. The threads of the orb are not viscid and thus the rain water does not affect them, so no need to replace them frequently. It is observed that *Cyrtophora* takes 4-5 nights to complete its web (Kullmann, 1975).

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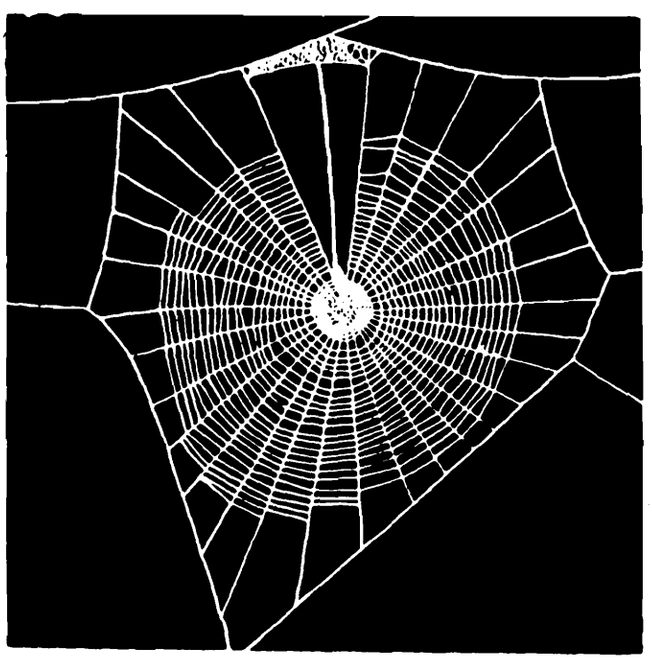


Fig. 123. Orb-web of *Zygeilla*.

7. METHODS OF STUDY

The best place to study the life of spiders is the field where they live in nature, but a few species live in our dwellings, and some others can be kept in confinement for study, but the great majority of them can be best observed in the open air. These creatures are so abundant in the nature that one never feels the lack of material for study. Except in the winter for orb-weavers, all other groups are available for study throughout the year.

Spiders are a primitive group of animals. They occur almost everywhere, on or near water, inside or on the ground, from the seashore to the tops of the high mountains and in various climates from deserts to snowlands. They are distributed extensively in the fields, thick forest floors as well as in the human habitations and deserted buildings, under stones and logs and on tree trunks, flowering shoots, etc. Therefore, the students should pursue their studies in as great a variety of situations as possible.

8. COLLECTION AND PRESERVATION

The collection of spiders is very easy as they are available in a variety of habitats. One of the oldest methods for getting spiders in large numbers is by using a sweep net through tall grass and weeds and picking out the spiders from among the insects and by dropping the debris gathered with them. An effective method is to hold an inverted umbrella underneath the flowering shoots or bushes and to shake thoroughly the plants, then spiders along with a variety of insects, mites, etc., fall in the inverted umbrella. After removing the leaves etc., from the umbrella, the spiders can be transferred into collecting tubes containing rectified spirit or 70% alcohol with the help of a fine brush. It is found that rectified spirit is the best preservative. It is very essential to see that only a small number of specimens of spiders are kept in a single tube, otherwise spider specimens may be deformed or damaged due to the pressure of too many specimens.

For purpose of scientific studies, the collected specimens are to be transferred to a petri dish filled with alcohol and covered with another petri dish, after the specimens are brought to the laboratory. In this condition the specimens are kept for two to three hours for

relaxation of body muscles. Then the body parts, *viz.*, legs, pedipalps, etc., of the specimen are to be adjusted as in the living form with the help of brush, forceps, needles, etc. The specimens should be kept in this condition in the closed pair of petri dishes for overnight before transferring them to tubes for permanent preservation.

If specimens are to be preserved permanently, the bottles should be provided with rubber stoppers as to prevent the evaporation of alcohol which is the preservative used for. In some of the larger collections, the specimens are put in small corked tubes and these are stored in larger bottles filled with alcohol and tightly closed.

The large bodied theraphosid spiders generally live in burrows and are best collected by keeping an empty tube against the burrow and allowing the spider to crawl into the tube. The spider is then put in a cyanide bottle for killing. Later it is transferred to a tube containing 75% alcohol or Rectified Spirit.

The smaller spiders, especially those belonging to the families Oonopidae, Tetrablemmidae and Oecobiidae, which live under bark of trees, corner of wall and debris, need careful search to locate them. A brush dipped in alcohol should be used to transfer the small spiders from under the bark to the tubes containing alcohol. In all cases,too many specimens should not be put in one tube and as far as possible the specimens should be arranged in their normal body form before preservation. Whenever there are more than one specimens, the tubes should be filled with alcohol upto three-forths height and they should be very lightly shaken horizontally to allow the specimens to spread out. Then the tube should be kept in horizontal position overnight so as to allow the specimens to spread out and get fixed in that position. Later on, the tube can be kept in normal position for permanent preservation.

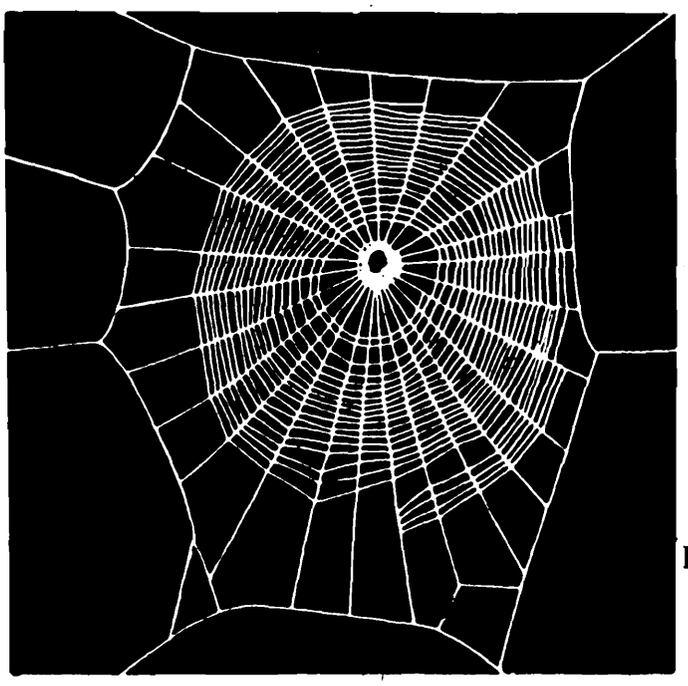
Spiders can be arranged in a petri dish or cavity block filled in alcohol for studies under the binocular microscope. The female epigynum and male padipalps are very important organs for systematic studies. The internal genitalia of female are very important characters and for the study of internal genitalia, it is required to dissect under binocular microscope with the help of very sharp scalpels or pointed tipped razor blade. After dissection of the epigynum it should be cleared and studied in clove oil. After the

studies are over, the dissected epigynum should be kept permanently in micro-vial corked with tissue paper along with the same example in a larger tube preserved with the Rectified Spirit or 75% alcohol. The male padipalp is also to be kept in the same way along with male specimen. Each such tube of spider examples must be properly labelled with collection data. After the specimens are identified the members of each species are transferred to a smaller vial with a label bearing name and sex.

9. DISPERSAL DEVICE OF SPIDER

Spiders have aerial dispersal by means of ballooning, though they possess legs as their locomotory organs. This aerial navigation of spider is more close to that by which many seeds are carried long distances; and the object is the same–the distribution of species. Regarding spiders it is not the seeds or eggs that are distributed but the spiders themselves and the object is consisting of bundle of silk threads by which they are buoyed up when carried by the wind.

Generally the very young spiders exhibit the ballooning or aeronautic habit. The young spiders climb up high on blades of grass, on fence post, the top of twigs, the upper part of some herb or merely the summit of a clod of earth, and the spider tilts the abdomen upwards. From the spinnerets threads are emitted which are paid out as the air currents pull, until the buoyancy of the parachute is enough to support the spider, it then lets go its hold with its feet and is carried off by the wind. These ballooning spiders are carried long distances in this way and they have been met by ships at sea hundreds of miles away from the land.



124

Fig. 124. Orb-web of *Neoscona*.

10. NESTS OF SPIDERS

The nest-building habit is seen in both web making and non-web making spiders, and different types of nests are constructed by these spiders.

Ground dwelling spiders make their nests in the earth. In this type we see the most common nests are the tunnels of the wolf spiders of the family Lycosidae. Some lycosid digs a burrow six or eight inches deep and sometimes build a turret around its entrance (Fig. 128). More remarkable than this above mentioned nest is of the trap-door spider's nest of the family Ctenizidae. These spiders have the habit of digging the tubular burrows in the ground, the walls of this tunnel are lined with silk and the entrance is closed by a single-pieced lid (Fig. 129), hinged with silk at one side. The lid is made to fit so precisely and is often camouflaged with bits of vegetation from the surrounding area, therefore it is difficult to locate the nest. Some ctenizid species build tunnels with a branch, so the entire structure is "Y" shaped (Fig. 130).

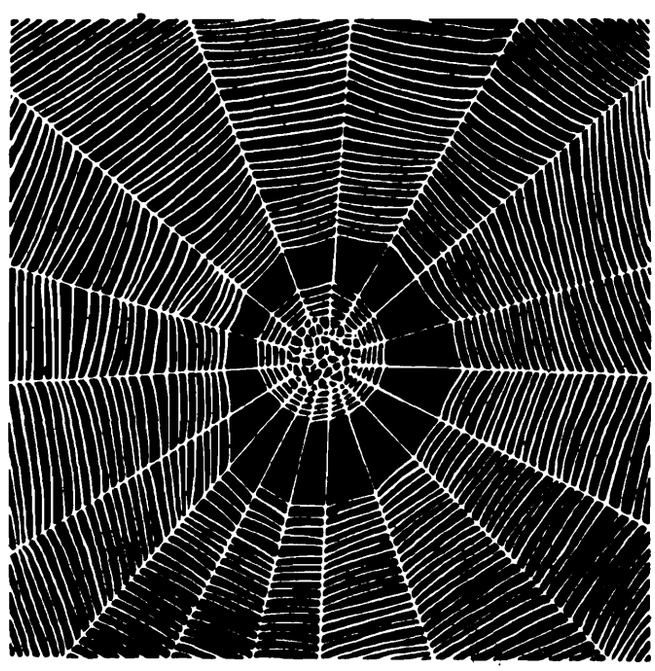


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Fig. 125. Orb-web of *Araneus*.

Many spiders of different families, make nests by folding or rolling leaves and lining the enclosed space with silk. This type of nest is found among clubionids, thomisids, theridiids and many others.

Some orb-weavers live upon their webs and have no nest or retreat but many of them build nests near the web, from where they watch for their prey and retreat when frightened. Many of the orb-weaving spiders roll or fold a leaf or tie several leaves together and line the space with silk. The nest of this type is usually built above the web or at one side and there is a trapline leading from it to the centre or hub of the orb-web, by which any disturbance of the web is communicated to the spider waiting in its nest. *Araneus mitifica* (Thorell) constructs this type of nest aside of the orb-web (Fig. 122).

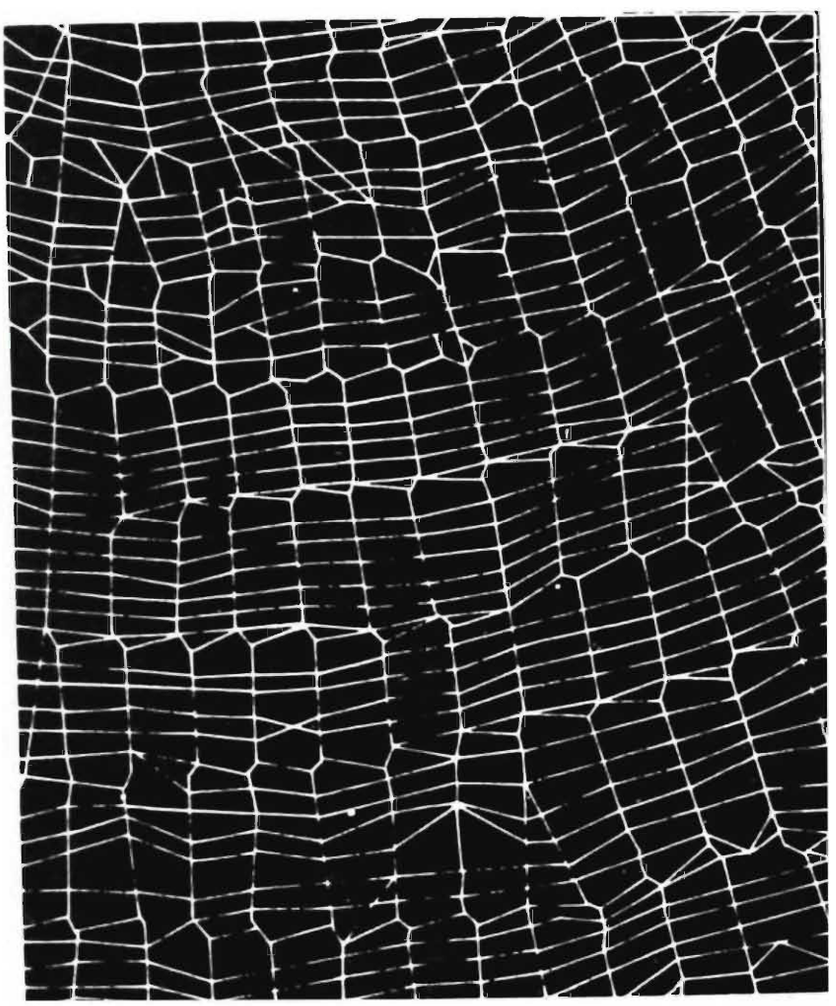

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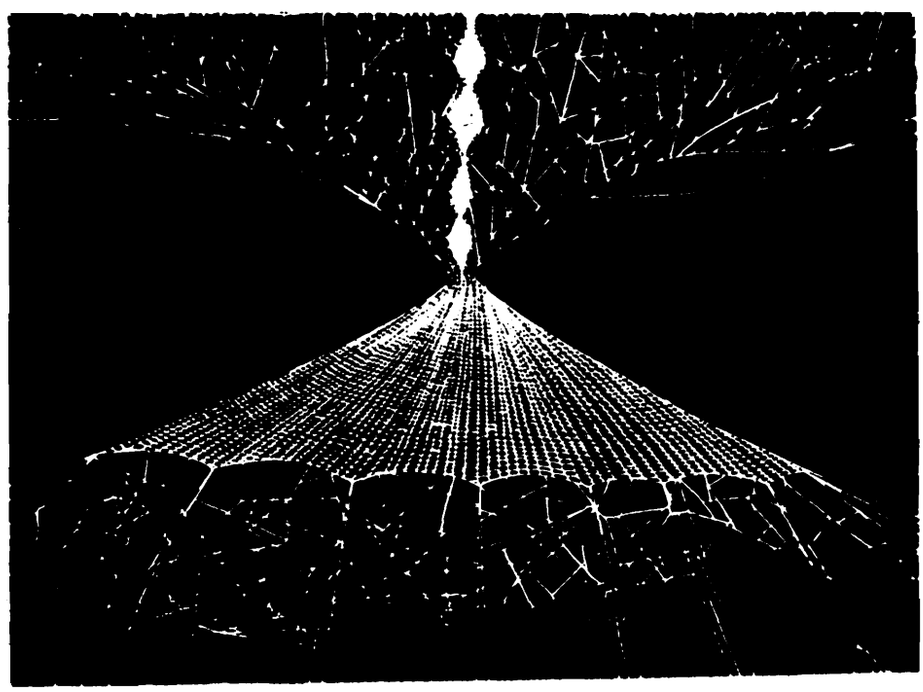
Fig. 126. Part of the orb-web of *Nephila*.

11. SOCIAL SPIDERS

Various degrees of sociality are exhibited by the members of the families Eresidae, Amaurobidae, Uloboridae, Dictynidae, Theridiidae and also a few members of Araneidae. This social behaviour is unique among spiders which are mainly cannibals. The peaceful co-existence of the groups of spiders shows the mutual sharing of their food, defence, predation and repairing of nests, etc. A social status is found in these groups of spiders. Among these, *Stegodyphus sarasinorum* Karsch (Fam. Eresidae) is well studied among the Indian forms. This spider lives in bushes and spins large saccular nest in which many individuals live together. Their nest is very sticky due to presence of cribeller silk. The members of this species exhibit nocturnal activity regarding feeding, web building, disposal and reproductive behaviour. These are found in abundance during the months of October to March. The web building, feeding and repairing of the nest are carried out in groups and the number of spiders present in each nest varies depending upon the size of the nest.

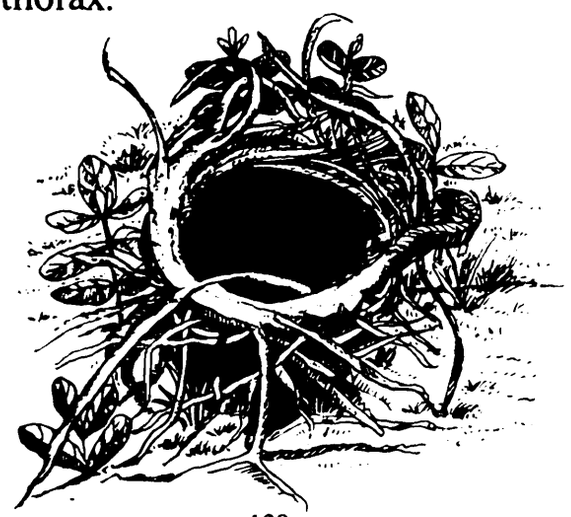


127

Fig. 127. Horizontal dome shaped web of *Cyrtophora citricola* (Forskal) with a barrier web above and below.

12. PAIRING OF SPIDERS

There are many interesting facts regarding the pairing of spiders, but here only brief references are given. Sexual dimorphism is very prominent among spiders. Generally the males are much smaller in size than females with a pair of complicated copulatory organ–the specialised pedipalps known as palpal organ form the cephalothorax.



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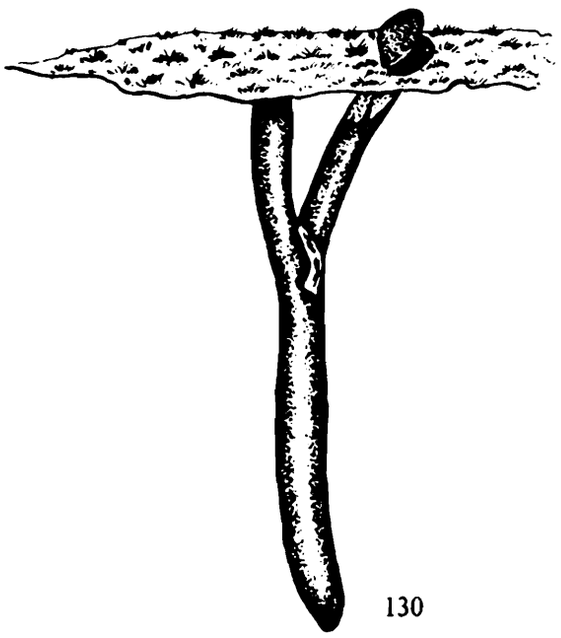

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Figs. 128-130. Nests of spiders. Fig. 128. Turret of the nest of a lycosid spider. Fig. 129. Entrance to tunnel of trap-door spider with a single-pieced lid. Fig. 130. Y-shaped tunnel of trap-door spider.

When the male matures considerable effort is put forth in locating the mature female; it means the web-making species now becomes a wanderer like the hunting spiders. After meeting each other they are found in or near the webs of the females. The approach of the male to the female is made with great care; if the female is not ready to receive his advances, she is apt to pounce upon him and destroy him. The courtship manouvers are usually started by the male and continued by him, though in some cases the female may also take part after she has reached a certain pitch of excitement. In araneid spiders, the male signals by tweaking the threads of the female's web. In addition there may be movements of palpi and abdomen, a sort of dance which varies in different species.

In the jumping spiders (Family Salticidae), the courting habits are very remarkable. The males of some species dance before the females, wave their palpi, or legs, or both and display their bright colours. It is assumed that all of this serves to gain recognition by the females and to stimulate her.

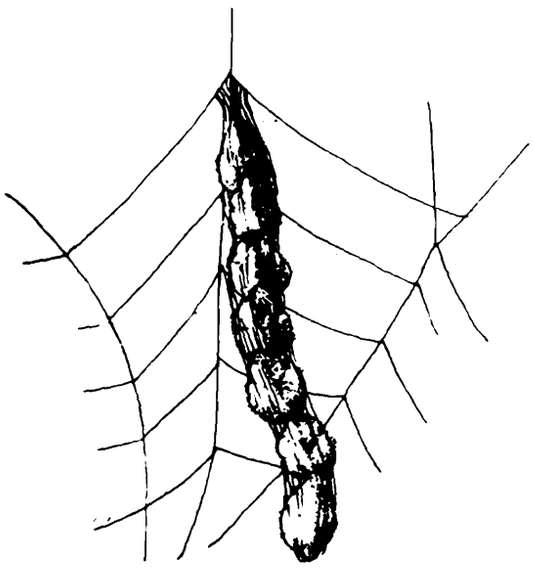
It is a known misconception that the male is always killed by the female after the mating act is over. Actually in some species this can be considered as the general rule. For the great majority the sexes separate peacefully and the male may even mate again later with the same or other females. It is to be expected that the male dies sooner than the female. Though the female of some species can live for 2-3 years or even more, many die shortly after laying their eggs and do not survive the following winter.

13. MOTHERHOOD OF SPIDERS

The motherhood is the most interesting event among spiders. In many groups the uniformity in the mode of motherhood is marked although each species has its own way of carrying out this plan. The first thing is the care of eggs. The eggs are never laid singly but are invariably laid in one or more masses, and each mass is protected by a covering of silk–the *egg-sac* or *cocoon.*

In most species the female deposits her eggs at one laying and enclose them in a single egg-sac, but in certain species the egg laying is extended for a considerable period of time and thus a series of egg-

sacs is formed (Fig. 131) as it is seen in *Cyclosa, Cyrtophora,* etc. The egg-sac is not simply a covering made in a haphazard way but a specialised structure, made in a definite manner; to some extent it is a characteristic of the species. The simplest kind of egg-sac is seen in *Pholcus* where it is a mesh of threads holding the mass of eggs together (Fig. 132), the egg mass can be seen through it. In *Araneus* the eggs are enclosed in a fluffy mass of silk without any outline. Many egg-sacs are nearly spherical in shape, some are of pear shaped or cup shaped with a flat top. Generally the outer covering of most egg-sacs is opaque but in some it is translucent. The grass-spider, *Agelena,* makes its egg-sac beneath the loose bark of dead tree and cover them with bits of rubbish. The eggs of wandering spiders are



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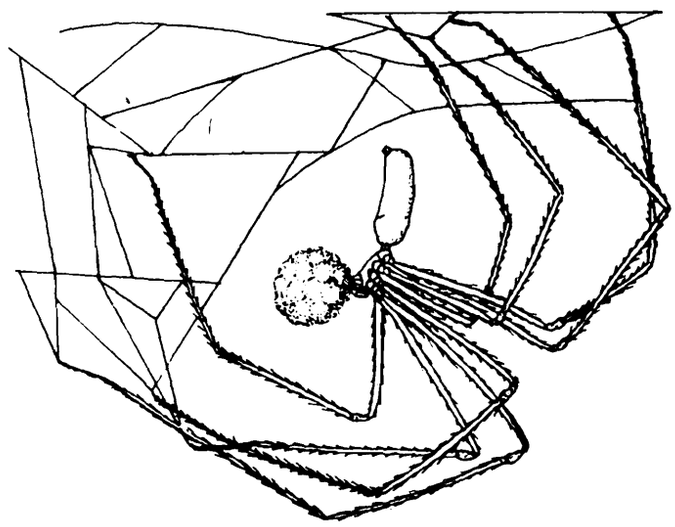

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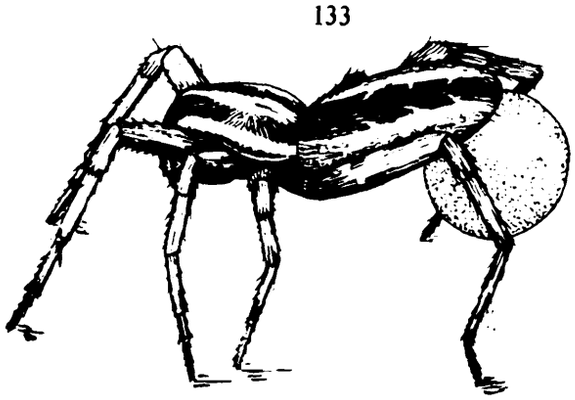

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Figs. 131-134. Motherhood of spiders. Fig. 131. A series of egg-sacs of *Cyclosa,* attached to the net. Fig. 132. *Pholcus phalangioides* female in the web, holding her ball of eggs. Fig. 133. Egg-sac attached to the spinnerets of female *Lycosa.* Fig. 134. Mother of *Pisaurina,* holding egg-sac under her cephalothorax.

laid upon a sheet of silk which is then wrapped around the egg mass, or another sheet is made over the egg mass. Some spiders enclose a padding of silk before closing up the egg-sac.

Most spiders fasten their egg-sac in some secure position. It may be attached to the surface of bark, on a twig, under a leaf or stone or any building corner or it may be suspended in the web or retreat either with a stalk or without; or it may be carried around by the mother adhered to her spinnerets, *viz., Lycosa* (Fig. 133) or held by her chelicerae, *viz., Pholcus* (Fig. 132) or held under sternum as found in *Pisaurina* (Fig. 134).

Many species leave their egg-sacs after egg-laying, but in some, as in *Dictyna,* the female makes her egg-sac within the web; the young soon hatch, then mother and young live together for a considerable period of time in the same web. Thus young are protected from any attack by the presence of the mother, as well as they are saved from making webs to catch their prey. Most remarkable mother care is seen in *Pisaurina* where the female does not make any web to catch prey. She carries her egg-sac under sternum and goes anywhere. When the spiderlings are about to hatch out from the egg-sac, the mother takes it to the top of some herb and fastens it in the centre of a nursery made by spinning a web over the leaves and she guards her young from outside the *nursery web.*

14. VENOM OF SPIDER

So far it is known most spiders have a pair of poison glands in the cephalothorax. Each of these glands has a duct which opens by a pore near the tip of each cheliceral fang. The poison gland is a more or less cylindrical structure which is covered by a layer of spirally arranged muscles which contract to expel the venom (Fig. 135). In most spiders the glands are relatively large in size and extend back beyond the middle of the cephalothorax, but in some the glands are small and placed at the base of the chelicerae.

The venom is apparently used by spiders to kill their prey, but only a few species like certain tarantulas, black widow spiders and some others produce a venom virulent enough to be harmful to man. Most spiders are so timid that they do not bite men even when

handled roughly, but there are some spiders that have been troublesome to man and produce symptoms called arachnidism in the medical literature.

All spiders of the genus *Latrodectus* (Family Theridiidae) are more venomous than other spiders and cause illness to man. The venom is neurotoxic. The victim usually suffers from severe abdominal pain, tightness of the chest due to contraction of intercostal muscles, and contraction of leg muscles. Blood pressure and body temperature may rise with profuse perspiration, nausea etc., sometimes death may result within 14 to 32 hours after biting. Treatment of black widow spider bite is the application of any antibiotic to the biting wound to prevent infection, and to relieve the muscle pain intra-venous injection of 10% Calcium gluconate may be given. In our country *Latrodectus hasseltii* Thorell and *L. h. indicus* (Simon) are reported from some parts in Gujarat and adjoining regions.

Spiders of another genus with painful bite which may cause death, is *Loxosceles* (Family Loxosclelidae). The only Indian species *Loxosceles indrabeles* Tikader is not so harmful to man. *L. lacta* has the most virulent venom than *reclusa, deserta* or *arizonica.* The effects of *Loxosceles* bite are localised, beginning with a blister at the

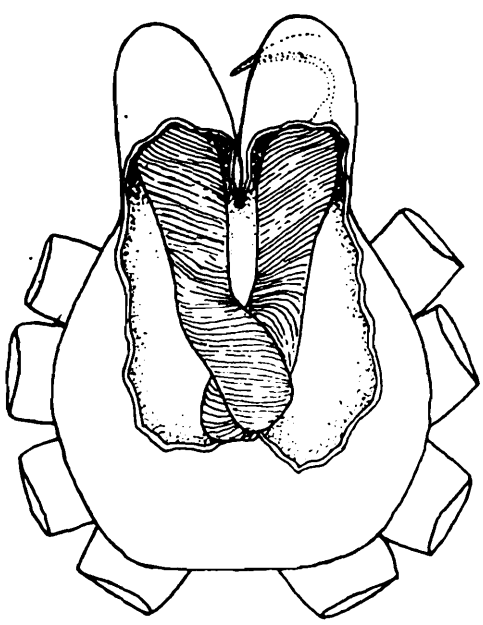

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Fig. 135. Dorsal view of dissected cephalothorax of a spider showing poison glands in position.

site of the wound, the skin turns purple and black over an area of 3-4 square inches, and as it falls away there is left a pit that slowly fills with scar tissue. Sometimes there is liver or kidney damage associated with haemolysis and it is the damage which may result in the death of the victim.

The differences between the two bites can be stated as the *Latrodectus* poisoning is neurotoxic and that of *Loxosceles* is haemolytic. Other less severe symptoms of arachnidism are caused by the bites of members of the spider genera *Chiracanthium* and *Phidippus.*

CHAPTER IV : ORDER–ARANEAE
THE SPIDERS

The order Araneae includes only the spiders. They differ from the other arachnids in having a sac-like unsegmented abdomen, except in *Liphistius;* the abdomen is jointed to the cephalothorax by a slender stalk-like pedicel. The spiders have descended from an ancestral stock in which the abdomen was distinctly segmented. Most of the higher spiders show no definite or superficial evidence of this segmentation, although it is possible to find some traces in very young spiders. In the case of four-lunged spiders external segmentation is retained to a greater or lesser degree. In many of the trap-door spiders and funnel-web spiders, there is a distinct hard plate at the base of the abdomen, which marks the position of the second abdominal somite. This plate is homologous with the first dorsal tergite of *Liphistius.*

The segments of the cephalothorax are very closely united so that none are distinct. Generally the spiders have eight simple eyes which are apparently the primitive character of this order. There are six eyes in some families due to the early loss of the anterior median eyes. In a few species the number is even further reduced to four or to two. An aberrant condition is the total loss of eyes in some cave spiders. This blindness of spider is apparently a recent acquired character as is evidenced by the fact that eight eyed, six eyed, two eyed, and totally blind species often belong to the same genus.

The chelicerae are two segmented and usually hook-like, that is the claw is folded back into a groove in the basal segment, like the blade of a pocket-knife folded into the handle. The chelicerae are the instruments for passage of venom into the body of the prey, and contain the poison ducts or even the glands sometimes.

The pedipalps are more or less leg-like and are furnished in large number of families with more or less distinct endite. In the male spider the terminal portion of the pedipalp is modified into an organ for the transference of the seminal fluid at the time of copulation. The male pedipalpi of the Orthognatha spiders are quite generalized. In the Labidognatha the whole palpus is specialised into a highly complicated primary and accessory copulatory

apparatus. A correlative evolution has occurred in the epigynum of the female.

The four pairs of the legs are all fitted for walking. The tarsi bear two or three claws. The presence of a median, unpaired claw generally indicates that silk is an indispensable material in the life of spiders. This median claw and serrated bristles are for handling the silk thread.

FAMILIES AND HIGHER CATEGORIES OF SPIDERS

Order ARANEAE

Sub-order Orthognatha

Mesothelae (Atypical tarantulas)

Family

1. LIPHISTIIDAE Thorell 1869
2. ANTRODIAETIDAE Gertsch 1940
3. MECICOBOTHRIIDAE Holmberg 1882

*4. ATYPIDAE Thorell 1870

Opisthothelae (Typical tarantulas)

Family

*5. THERAPHOSIDAE Thorell 1870
6. PARATROPIDIDAE Simon 1889
7. PYCNOTHELIDAE Chamberlin 1917

*8. BARYCHELIDAE Simon 1889
9. MIGIDAE Simon 1892

*10. DIPLURIDAE Simon 1889
*11. CTENIZIDAE Thorell 1887
12. ACTINOPODIDAE Simon 1892

Sub-order Labidognatha

Hypochiloidea

Family

13. HYPOCHILIDAE Marx 1888
14. GRADUNGULIDAE Forster 1955

Neocribellatae

Family

*15. FILISTATIDAE Ausserer 1867

*16. OECOBIIDAE Blackwall 1862
*17. ERESIDAE C. L. Koch 1851
*18. DINOPIDAE C. L. KOCH 1851
*19. ULOBORIDAE Thorell 1869
*20. DICTYNIDAE O. P. Cambridge 1871
*21. AMAUROBIIDAE Thorell 1870
*22. PSECHRIDAE Simon 1890
23. TENGELLIDAE Dahl 1908
24. ZOROPSIDAE Bertkau 1882
25. ACANTHOCTENIDAE Simon 1892
26. AMPHINECTIDAE Forster 1973
27. NEOLANIDAE Forster 1973

Ecribellatae
Haplogynae (Primitive hunters and weavers)
Family
28. SICARIIDAE Keyserling 1880
*29. SCYTODIDAE Blackwall 1864
*30. LOXOSCELIDAE Simon 1890
31. DIGUETIDAE Gertsch 1949
32. PLECTREURIDAE Simon 1893
33. CAPONIIDAE Simon 1890
*34. OONOPIDAE Simon 1890
*35. STENOCHILIDAE Thorell 1873
*36. TETRABLEMMIDAE O. P. Cambridge 1873
37. PACULLIDAE Simon 1894
38. OCHYROCERATIDAE Fage 1912
39. LEPTONETIDAE Simon 1890
40. TELEMIDAE Fage 1913
41. TEXTRICELLIDAE Hickman 1945
42. DYSDERIDAE C. L. Koch 1837
43. SEGESTRIIDAE Simon 1893

Entelogynae
Trionycha
Higher web weavers
Family
*44. PHOLCIDAE C. L. Koch 1851
45. SYMPHYTOGNATHIDAE Hickman 1931
*46. THERIDIIDAE Sundevall 1833
47. NICODAMIDAE Simon 1898

48. NESTICIDAE Simon 1894
49. HADROTARSIDAE Thorell 1881
*50. LINYPHIIDAE Blackwall 1859
51. MICRYPHANTIDAE Bertkau 1878
52. THERIDIOSOMATIDAE Simon 1881
*53. ARANEIDAE (=ARGIOPIDAE) Latreille 1806
*54. TETRAGNATHIDAE Menge 1866
*55. AGELENIDAE C. L. Koch 1837
56. ARGYRONETIDAE Thorell 1870
57. DESIDAE Pocock 1895
*58. HAHNIIDAE Bertkau 1878

Three clawed hunters
Family
*59. HERSILIIDAE Thorell 1870
*60. UROCTEIDAE Thorell 1869
61. MIMETIDAE Simon 1881
62. ARCHAEIDAE C. L. Koch 1854
63. MECYSMAUCHENIIDAE Simon 1895
*64. ZODARIIDAE Thorell 1886
*65. PALPIMANIDAE Thorell 1870
*66. PISAURIDAE Simon 1890
*67. LYCOSIDAE Sundevall 1833
*68. OXYOPIDAE Thorell 1870
69. SENOCULIDAE Simon 1890
70. TOXOPIDAE Hickman 1940

Dionycha (Two clawed hunting spiders)
Family
71. AMMOXENIDAE Simon 1893
*72. PLATORIDAE Simon 1890
*73. GNAPHOSIDAE Pocock 1898
*74. PRODIDOMIDAE Simon 1884
*75. HOMALONYCHIDAE Simon 1893
76. CITHAERONIDAE Simon 1893
*77. CLUBIONIDAE Wagner 1887
78. ANYPHAENIDAE Bertkau 1878
79. AMAUROBIOIDIDAE Hickman 1949
80. ZORIDAE F. O. P. Cambridge 1893

*81. CTENIDAE Keyserling 1877
*82. HETEROPODIDAE Thorell 1873
*83. SELENOPIDAE Simon 1897
*84. THOMISIDAE Sundevall 1833
85. PHILODROMIDAE Thorell 1870
86. APHANTOCHILIDAE Thorell 1873
*87. SALTICIDAE Blackwall 1841
*88. LYSSOMANIDAE Peckham & Wheeler 1888

KEY TO THE FAMILIES OF INDIAN SPIDERS

1. Chelicerae paraxial, i.e. projecting horizontally and fang articulated with chelicera in vertical plane and movable in a plane more or less parallel to the median plane of the body; fang closing backward. With two pairs of book-lungs.....Sub-order ORTHOGNATHA–2

   Chelicerae diaxial, i.e., projecting downward and fang articulated with chelicerae in a vertical plane and movable in a more or less transverse plane; fang not closing backward. Commonly with one pair of book-lungs.....Sub-order LABIDOGNATHA-7

2. Abdomen with one to nine sclerotized tergites. Furrow of cheliceral fang indistinct. Anal tubercle not immediately behind the spinnerets, but separated from the spinnerets by considerable distance.....Atypical tarantulas–3

   Abdomen without sclerotized tergites. Furrow of cheliceral fang distinct. Anal tubercle immediately behind the spinnerets.....Typical tarantulas–4

3. Maxillae normal; labium not fused with sternum. Eight spinnerets situated in the lower middle of the abdomen.....Family LIPHISTIIDAE

   Maxillae strongly developed and labium fused with sternum. Six spinnerets, situated in the lower end of the abdomen.....Family ATYPIDAE

4. Tarsi with only two claws and with claw-tufts.....5

   Tarsi with a small median claw and two large lateral claws and without claw-tufts.....6

Note : Asterisk marked families are represented from India.

5. Chelicerae without a rastellum. Apical segment of the posterior spinnerets cylindrical and at least as long as the 2nd segment.....Family THERAPHOSIDAE

   Chelicerae with a rastellum. Apical segment of the posterior spinnerets small and shorter than the segments that predede it.....Family BARYCHELIDAE

6. Chelicerae with a rastellum. Posterior spinnerets short or moderately long, anterior spinnerets close together at base. Head region much higher than the thoracic region.....Family CTENIZIDAE

   Chelicerae without rastellum. Posterior spinnerets very long, anterior spinnerets separated by at least their length. Head region not higher than the thoracic region.....Family DIPLURIDAE

7. With a cribellum in front of spinnerets and a calamistrum on metatarsus IV, varying from just a few bristles to a row along the entire length of the metatarsus.....Section CRIBELLATAE–8

   Without a cribellum and calamistrum.....Section ECRIBELLATAE–16

8. With two pairs of lungs.....Family HYPOCHILIDAE

   With only one pairs of lungs.....9

9. Anal tubercle large and prominent, two segmented with a fringe of long hairs. Posterior median eyes triangular or irregular in shape. Small spiders of 2.00 mm. to 2.50 mm. long with carapace subcircular.....Family OECOBIDAE

   Anal tubercle of usual type, without a conspicuous fringe of hairs. Posterior median eyes circular.....10

10. Head region large, rounded, high, posterior lateral eyes remote from the rest.....Family ERESIDAE

    Head low, narrowed, posterior lateral eyes very rarely remote from the others.....11

11. Tarsi furnished with ungual tufts and inferior claw.....Family PSECHRIDAE

    Tarsi without ungual tufts and inferior claw.....12

12. Chelicerae fused together at the base. Labium fused to the sternum. Tracheal spiracle considerably in advance of the spinnerets. Calamistrum short.....Family FILISTATIDAE

    Chelicerae not fused at the base. Labium free. Tracheal spiracle in the usual position close to the spinnerets. Calamistrum much longer.....13

13. Tarsi with a dorsal row of trichobothria. Eight eyes, all light in colour, homogeneous.....Family AMAUROBIIDAE

    Tarsi without trichobothria. Eight eyes, either all dark or heterogeneous.....14

14. Eyes eight, heterogeneous, the anterior medians alone dark. Metatarsus IV of usual shaped.....Family DICTYNIDAE

    Eyes eight, homogeneous, all dark. Metatarsus IV compressed and concave above.....15

15. Posterior median eyes largest and directed forward.....Family DINOPIDAE

    Posterior median eyes of moderate size and not directed forward but upward.....Family ULOBORIDAE

16. Tibia and metatarsi I and II with a prolateral row of long spines, at the intervals between which there is a row of much shorter spines, curved near their ends and increasing in length distally.....Family MIMETIDAE

    Tibia and metatarsi I and II without prolateral row of spines.....17

17. Sternum much wider than long, the posterior coxae widely separated.....Family PLATORIDAE

    Sternum not wider than long, posterior coxae not widely separated.....18

18. Posterior spinnerets absent or much shorter than the anterior.....19

    Posterior spinnerets present, not shorter than the anterior.....21

19. Tarsi bear three claws. All legs short, nearly equal in length and do not bear scopulae.....Family ZODARIIDAE

Tarsi bear two claws. I and II legs enlarged and bear scopulae.....20

20. Labium completely fused with the sternum. Two large and remnants of posterior four spinnerets present. Both I and II legs enlarged and relative leg segment lengths normal.....Family STENOCHILIDAE

Labium not fused with the sternum. Only two spinnerets present. I leg very much enlarged and modified. Patella greatly elongated (longer than the tibia), metatarsus shorter than the tarsus.....Family PALPIMANIDAE

21. Posterior spinnerets enormously long, usually longer than the abdomen.....Family HERSILIDAE

Posterior spinnerets shorter and thick.....22

22. Anal tubercle very large, fringed with long hairs, ocular group compact.....Family UROCTEIDAE

Anal tubercle small, not fringed, ocular group not compact.....23

23. Tarsi long and flexible, Labium broader than long, legs very long and slender.....Family PHOLCIDAE

Tarsi of the usual type. Labium longer than wide, legs not very long.....24

24. With less than eight eyes.....25

With eight eyes.....28

25. Eyes six in three groups.....26

Eyes two, four or six in one group.....27

26. Carapace round and high behind. Sternum round behind.....Family SCYTODIDAE

Carapace flat and depressed. Sternum pointed behind.....Family LOXOSCELIDAE

27. Eyes six, median eyes larger than the laterals. Labium not joined with sternum. Epigastric furrow at the normal position.....Family OONOPIDAE

Eyes two, four or six, almost equal in size. Labium joined with sternum. Epigastric furrow far behind the normal position.....Family TETRABLEMMIDAE

28. Anterior row with six eyes.....Family SELENOPIDAE

Anterior row with four or two eyes.....29

29. Tarsi with two claws with claw-tufts.....30

Tarsi with three claws without claw-tufts.....40

30. Tarsal claws without teeth.....Family HOMALONYCHIDAE

Tarsal claws with usual teeth.....31

31. Eyes in three or four rows.....32

Eyes in the more common arrangement of two rows.....35

32. Eyes in four rows, the front eyes very large.....Family LYSSOMANIDAE

Eyes in three rows.....33

33. Front row of eyes more or less situated vertically; median eyes enormously large, second row of two eyes usually very small, often minute, third row of two eyes of medium size.....Family SALTICIDAE

Front row of eyes not vertical and eyes of this row smaller than those of the second, eyes of third row as large as second row.....34

34. First row with two eyes, second row with four and third row with two. Anterior laterals much closer to the posterior laterals than to the anterior medians. Retromargin of cheliceral fang furrow with at least three teeth.....Family CTENIDAE

First row with four eyes, second and third row each with two. Anterior laterals much closer to anterior medians than to the posterior laterals. Retromargin of cheliceral fang furrow with two teeth.....Family ZORIDAE

35. Tracheal spiracle in advance of the spinnerets at least one-third of the distance, between the latter and epigastric furrow.....Family ANYPHAENIDAE

Tracheal spiracle in the usual place just in front of spinnerets.....36

36. Legs, at least, I and II laterigrade, crab like.....37

Legs usually prograde type.....38

37. The first and second pairs of legs much longer and stouter than rest of the legs. Apex of metatarsus not provided with any soft trilobate membrane. Lower margin of fang furrow of chelicerae indistinct and smooth. Colulus present.....Family THOMISIDAE

The first and second pairs of legs not much longer and not stouter than rest of the legs. Apex of metatarsus provided with soft trilobate membrane. Lower margin of fang furrow of chelicerae distinct and armed with teeth. Colulus absent.....Family HETEROPODIDAE

38. Anterior spinnerets conical, contiguous. Maxillae without a transverse or oblique depression. Eyes homogeneous or almost so (with a few exceptions).....Family CLUBIONIDAE

Anterior spinnerets cylindrical, and not contiguous. Maxillae with an oblique depression. Eyes distinctly heterogeneous.....39

39. Eyes in two rows, tarsal claws toothed.....Family GNAPHOSIDAE

Eyes in three rows, tarsal claws smoothed.....Family PRODIDOMIDAE

40. The six spinnerets in a more or less transverse row. Tracheal spiracle removed from the spinnerets at least one-third of the distance to epigastric furrow.....Family HAHNIIDAE

The six spinnerets not in a transverse row, but of the usual arrangement. Tracheal spiracle in the usual place in front of spinnerets.....41

41. Eyes group hexagonal, the posterior row procurved, and anterior row recurved, with the clypeus high. Abdomen pointed behind and legs with very conspicuous spines.....Family OXYOPIDAE

Eyes group not forming a hexagon, and clypeus much lower. Abdomen not pointed and legs without conspicuous spines.....42

42. Tarsus IV, usually provided with a ventral row of 6 to 10 serrated bristles, forming a comb, for at least one-sixth its length from the distal end; this may be poorly developed in males.....Family THERIDIIDAE

Tarsus IV not provided with comb of serrated bristles.....43

43. Tarsi with trichobothria.....44

Tarsi without trichobothria.....46

44. Tarsi with single row of trichobothria. Trochanters not notched (most species living in sheet-webs with a funnel, over which they can run rapidly in an upright position).....Family AGELENIDAE

Tarsi with numerous trichobothria, but irregularly distributed. All trochanters with a curved notch.....45

45. Posterior row of eyes so strongly recurved that it may be considered to form two rows. Median claw smooth or with a single tooth. Anterior piece of lorum rounded behind and fitting into a notch of the posterior piece. Egg-sac carried attached to spinnerets and young carried on mother's back.....Family LYCOSIDAE

Posterior row of eyes not forming two distinct rows but only slightly recurved. Median claw with two or three teeth. Anterior piece of lorum with a notch into which the posterior piece fits. Eggsac held under cephalothorax. Young not carried by mother.....Family PISAURIDAE

46. Clypeus, in most, lower than the height of the median ocular area. Eyes homogeneous (most are orb-weavers).....47

Clypeus usually as high as or higher than the height of the median ocular area. Eyes heterogeneous (the majority are not orb-weavers).....48

47. Epigastric furrow between lung slits procurved. No boss on chelicerae. In most cases the cheli-

cerae large and powerful.....Family TETRAGNATHIDAE

Epigastric furrow nearly straight. Boss present on chelicerae though rudimentary in some cases. Chelicerae not very large.....Family ARANEIDAE (= ARGIOPIDAE)

48. Tibia of male palp without apophysis (though the tibia may be dilated distally). Pedipalp of female in most species with a claw at the end of tarsus. Tibia IV in most species with two dorsal spines, or if only one spine is present then there is one short spine on metatarsi I and II.....Family LINYPHIDAE

Tibia of male palp in most species with at least one apophysis. Pedipalp of female without a claw at the end of tarsus. Tibia IV with a single dorsal spine or bristle, and metatarsi spineless....Family MICRYPHANTIDAE

Note : Families Liphistiidae, Hypochilidae, Mimetidae, Zoridae, Anyphaenidae and Micryphantidae are not so far recorded from India. They are included in the key to satisfy the couplet characters.

CHAPTER V
SPIDER FAMILIES REPRESENTED FROM INDIA

In this part of the book the families of spiders so far recorded from India have been dealt. The general ecological habitats, morphological characters of each family and their distribution in the world are given. Moreover, the generic key, where it becomes possible to complete failing which the names of genera only with the represented Indian species have been given in details. This will be a ready reference for future students of spider taxonomy.

The family Liphistiidae is not included in this chapter but it is important to discuss a little bit regarding this family as it includes the most primitive spiders of the world and have been found so far only in Southern Asia, i.e., Burma, the Malay Peninsula to Sumatra and Sri Lanka which are adjoining land masses to India. The genus *Liphistius* is the only known genus of this family containing 8 species which are doubtlessly the most generalised living members of the order–Araneae. They have segmented abdomen and dorsal surface of each one is furnished with distinct *terga* and the ventral surface with two distinct *sterna* in front, spinnerets are 8 in number, of which 4 are external and segmented and 4 are internal and unsegmented. These spiders have burrowing habit in the soil.

FAMILY 1. ATYPIDAE
(Purse-web Spiders)
Fig. 136

The webs of these spiders are silk lined tubes in the ground, and are extended eight to ten inches up the side of a tree trunk, or along the surface of the ground. When the upper portion of tube is disturbed by the insects over it, the spider rushes to the spot and captures it by biting through the web. This is a small family represented by a single genus. Cephalothorax is very broad in front, with median conical ocular tubercle. Coxa of palp is furnished with large maxillary process. Spinnerets are six in number. Mandible is very large, without rastellum. Sternum with anterior sigilla is not forming a groove at the base of the labium. Legs are weakly spined and furnished with three tarsal claws. They are fossorial.

Distribution : Palaearctic Region from Ireland to Japan; Oriental

region from India, Burma to Java and North America.

Only a single species of this family is reported so far from India.

1. *Atypus southerlandi* Gravely

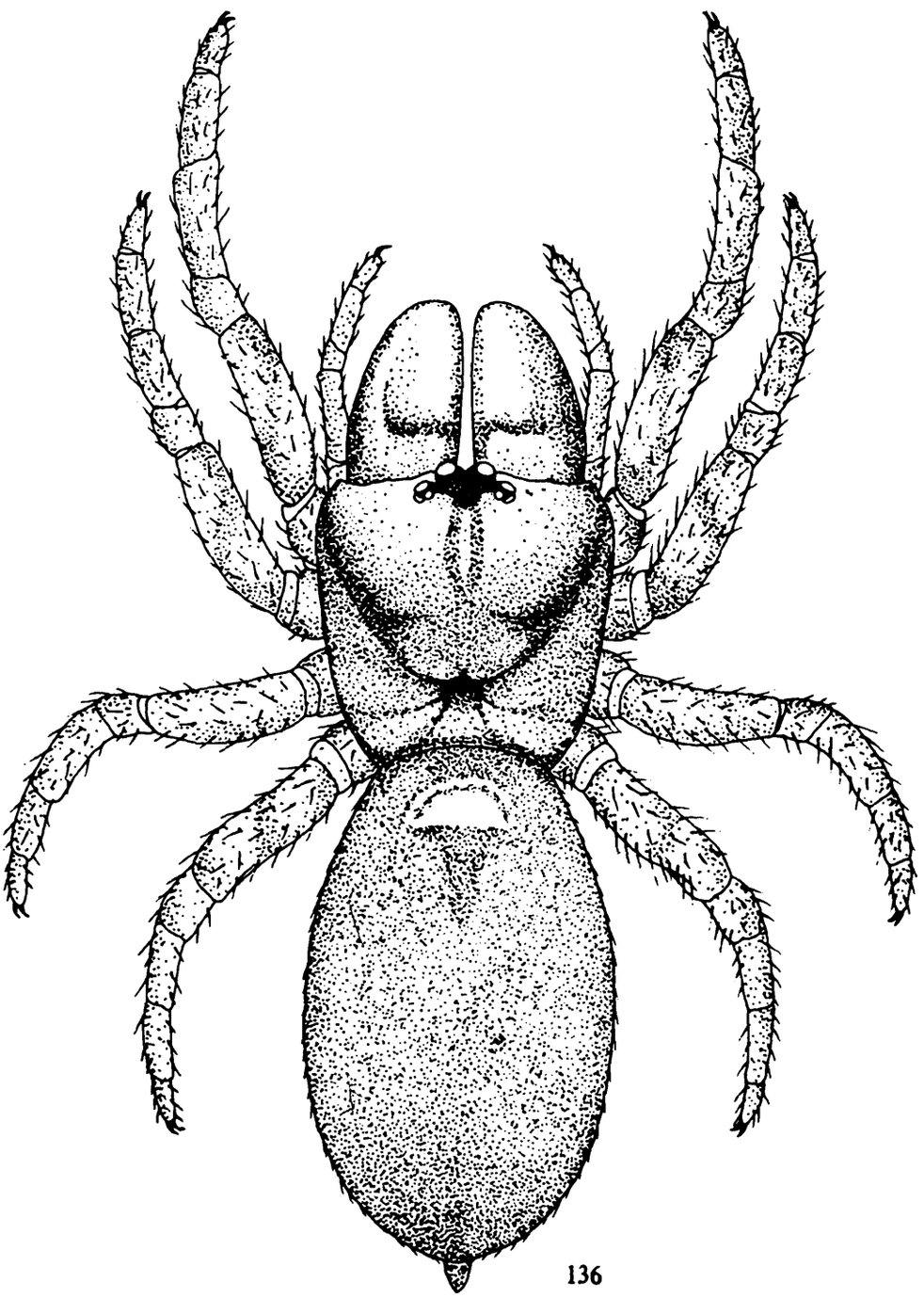

Fig. 136. Dorsal view of female *Atypus southerlandi* Gravely of the family Atypidae.

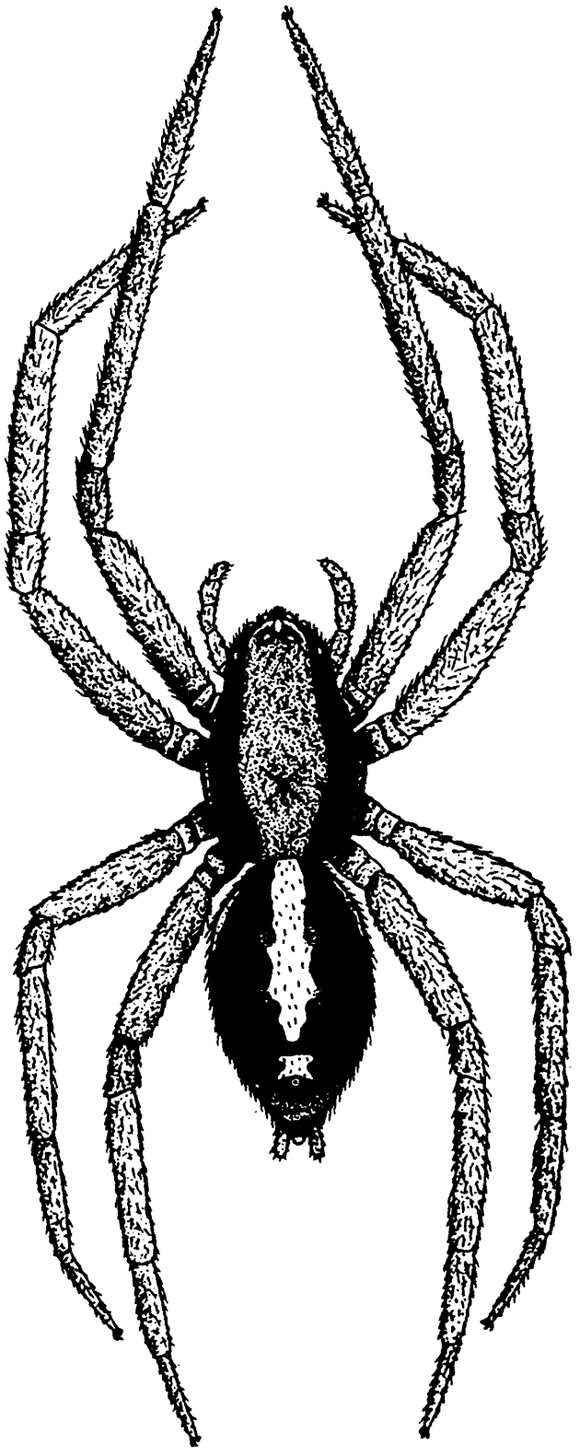

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Fig. 137. Dorsal view of female *Homalonychus joyaus* Tikader of the family Homalonychidae.

FAMILY 2. HOMALONYCHIDAE
Fig. 137

This is a small family of spiders with smooth, tarsal claws and completely lacking denticles. The tarsi are provided with a brush of terminal tenent hairs (claw tufts) and a pair of spurious claws. The chelicerae lack teeth on the margins. Eyes are eight in number and are placed in two rows, of which posterior row is strongly recurved. Previously, the genus *Homalonychus* was included in the family-Zodariidae but recently it is placed in a family of its own.

Distribution : North America (Arizona to California), British Guiana, India.

In India only a single species of this family is reported so far.

2. *Homalonychus joyaus* Tikader

FAMILY 3. THERAPHOSIDAE
(Tarantulas)
Fig. 138

These are our largest spiders, and because of their big sizes and their hairiness, they often attract attention and frighten us. Most of the species are fossorial, but they never close the aperture of the burrow with a movable lid. Other species live under stones, in hollow trees, or take shelter in any natural crevice. The spiders are nocturnal, hiding during the day inside natural cavities in the ground, in abandoned rodent tunnels or similar places, the upper portions of which is lined with silk. Theraphosidae differs from the Barychelidae in having the apical segment of the posterior spinnerets cylindrical and at least as long as the 2nd segment, and in the absence of the rastellum. Eyes are always aggregated on a distinct tubercle.

Distribution : Temperate and tropical countries of the world, but apparently absent from New Zealand.

The Indian genera of this family are referable to the following four sub-families, according to the key.

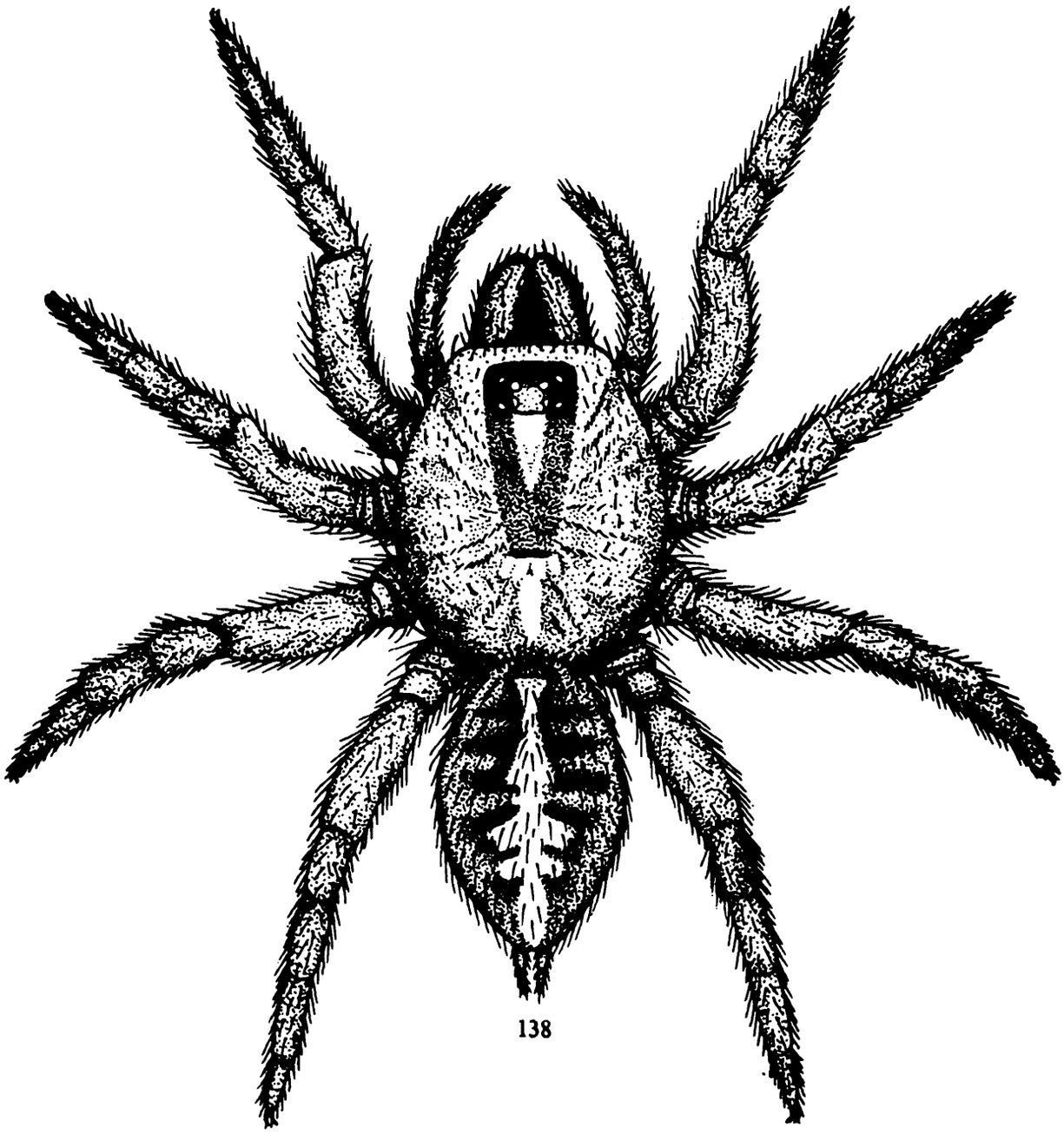

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Fig. 138. Dorsal view of female *Ornithoctonus gadgili* Tikader of the family Theraphosidae.

1. No stridulating organ between the outer surface of the mandible and the inner surface of the coxa of the palp.....THERAPHOSINAE

   A stridulating organ between the mandible and coxa of palp.....2

2. Outer surface of mandible covered with scopula or a pad of feathery hairs.....ORNITHOCTONINAE

Outer surface of mandible not covered with scopulae or pad of feathery hairs.....3

3. Inner surface of coxa of palp (maxilla) furnished with simple scattered, needle-like bristles.....THRIGMOPOEINAE

Inner surface of maxilla furnished with cluster or series of claviform or bacilliform bristles.....SELENOCOSMIINAE

Sub-family THERAPHOSINAE

These spiders have no stridulating organ between the outer surface of the mandible and the adjacent surface of the coxa of the palp, as these two surfaces are smooth or at most with scanty hairs. There is also no stridulating organ between the basal segments of the palp and 1st leg.

Distribution : Mediterranean area of Palaearctic region; Tropical West Africa; India and Burma; America, from the Southern States of the Union of Patagonia.

Key to the genera of the sub-family Theraphosinae

1. Thoracic fovea straight, transverse, at most slightly procurved.....2

Thoracic fovea with distinct by procurved.....3

2. First pair of legs of male with strong tibial spur.....*Plesiophrictus*

3. *P. millardi* Pocock
4. *P. sericeus* Pocock
5. *P. collinus* Pocock
6. *P. tenuipes* Pocock
7. *P. fabrei* (Simon)
8. *P. bhori* Gravely
9. *P. blatteri* Gravely
10. *P. linteatus* (Simon)
11. *P. madraspatanus* Gravely
12. *P. raja* Gravely
13. *P. sataraensis* Gravely
14. *P. meghalayensis* Tikader
15. *P. mahabaleshwari* Tikader

First pair of legs of male without tibial spur.....*Ischnocolus*

16. *I. decoratus* Tikader
17. *I. khasiensis* Tikader

3. Thoracic fovea shallow, sublinear; posterior sigilla of sternum wide apart and small.....*Heterophrictus*

18. *H. milleti* Pocock

Thoracic fovea very deep and strongly procurved, posterior sigilla of sternum large, submedian.....*Phlogiodes*

19. *P. validus* Pocock 20. *P. robustus* Pocock
21. *P. himalayensis* Tikader

Sub-family ORNITHOCTONINAE

Mandibles of these spiders are furnished externally with dense pad (scopula) which are composed of short, close set plumose hairs. Between the scopula and the oral fringe, there is a naked area, which, however, bears posteriorly a small number (about four) of large, slightly curved, plumose bristles springing from the scopula above. Inner surface of maxillae are sparsely hairy, but furnished both above and below the suture with a small number of black tooth-like tubercles. Posterior sternal sigillae are remote from the margin. Legs are with a few spines at apex of tibiae and tarsi, tarsal scopulae are thick and undivided.

Distribution Burma, Siam and India.

Key to the genera of the sub-family Ornithoctoninae

1. Carapace low, ocular tubercle close to edge of clypeus.....*Cyriopagopus*

22. *C. paganus* Simon

Carapace elevated in the cephalic region; ocular tubercle some distance behind edge of clypeus.....2

2. Legs strong and short, thoracic fovea large and scarcely procurved.....*Ornithoctonus*

23. *O. andersoni* Pocock 24. *O. gadgili* Tikader

Legs slender and long; thoracic fovea small and concentric.....*Melopoeus*

25. *M. minax* Thorell

Sub-family THRIGMOPOEINAE

These spiders have stridulating organ between the mandible and the basal segment of the palp (maxilla). On the mandible some of the hairs which form the posterior portion of the oral fringe are modified to form a small cluster of vibratile bristles and on the adjacent surface of the maxillae there are regularly or irregularly arranged stiff aciculate bristles which scrape against those on the mandible when the maxilla is moved up and down.

Distribution : South India.

Key to the genera of the sub-family Thrigmopoeinae

1. Stridulating bristles on maxilla irregularly scattered.....*Haploclastus*

26. *H. cervinus* Simon
27. *H. nilgirinus* Pocock
28. *H. kayi* Gravely
29. *H. tenebrosus* Gravely

Stridulating bristles on maxilla arranged in a definite curved series.....*Thrigmopaeus*

30. *T. insignis* Pocock
31. *T. truculentus* Pocock

Sub-family SELENOCOSMIINAE

These spiders have stridulating organ between the mandible and maxilla, consisting of a row or cluster of vibratile bacilliform bristles on the maxilla and of spines of spiniform bristles upon the lower portion of the outer surface of the mandible. Legs are without spines or with a few only at the extremity of the tarsi. Tibia of anterior leg in male is not spurred. Posterior sternal sigilla is remote from the margin.

Distribution : Ranging from India and Sri Lanka to Australia.

Kev to the genera of the sub-family Selenocosmiinae

1. Legs of 4th pair much thicker than those of 1st pair with the tarsal scopula entire and extending

to base of segment.....*Lyrognathus*

32. *L. crotalus* Pocock
33. *L. saltator* Pocock
34. *L. pugnax* Pocock

Legs of 4th pair weaker than those of 1st pair, with the tarsal scopula divided and apical.....2

2. Thoracic fovea transversely linear; one or more tubercles intermixed with the bacilliform bristles on maxilla.....*Poecilotheria*

35. *P. rufilata* Pocock
36. *P. metallica* Pocock
37. *P. miranda* Pocock
38. *P. regalis* Pocock
39. *P. striata* Pocock
40. *P. vittata* Pocock
41. *P. fasciata* (Latreille)
42. *P. formosa* Pocock

Thoracic fovea crescentically procurved; no tubercles amongst bacilli on maxilla.....3

3. Stridulating organ consisting of short spines on mandible and a single or double row of bacilli overlapped by a fringe of hairs on maxilla.....*Chilobrachys*

43. *C. fimbriatus* Pocock
44. *C. femoralis* Pocock
45. *C. pocockii* Thorell
46. *C. flavopilosus* (Simon)
47. *C. fumosus* (Pocock)
48. *C. andersonii* Pocock
49. *C. hardwickii* (Pocock)
50. *C. stridulans* (Wood Mason)
51. *C. thorellii* Pocock
52. *C. assamensis* Hirst

FAMILY 4. BARYCHELIDAE
Fig. 139

These spiders are mostly ground living and burrowing in habit, which generally, but not always are close to the burrow with a trap door. Medium sized Mygalomorphae which except in the abberant genus *Sason,* resemble the Ctenizidae by being furnished with a *rastellum,* but differ from them and from the Dipluridae in having distinct ungual tufts and only two untoothed or weakly toothed claws on the tarsi. As in the Dipluridae, the sternal sigillae are small and marginal. The spinnerets resemble those of the typical Ctenizidae in forming a compact cluster, the apical segment of the posterior spinnerets being smaller and shorter than the segments that precede it.

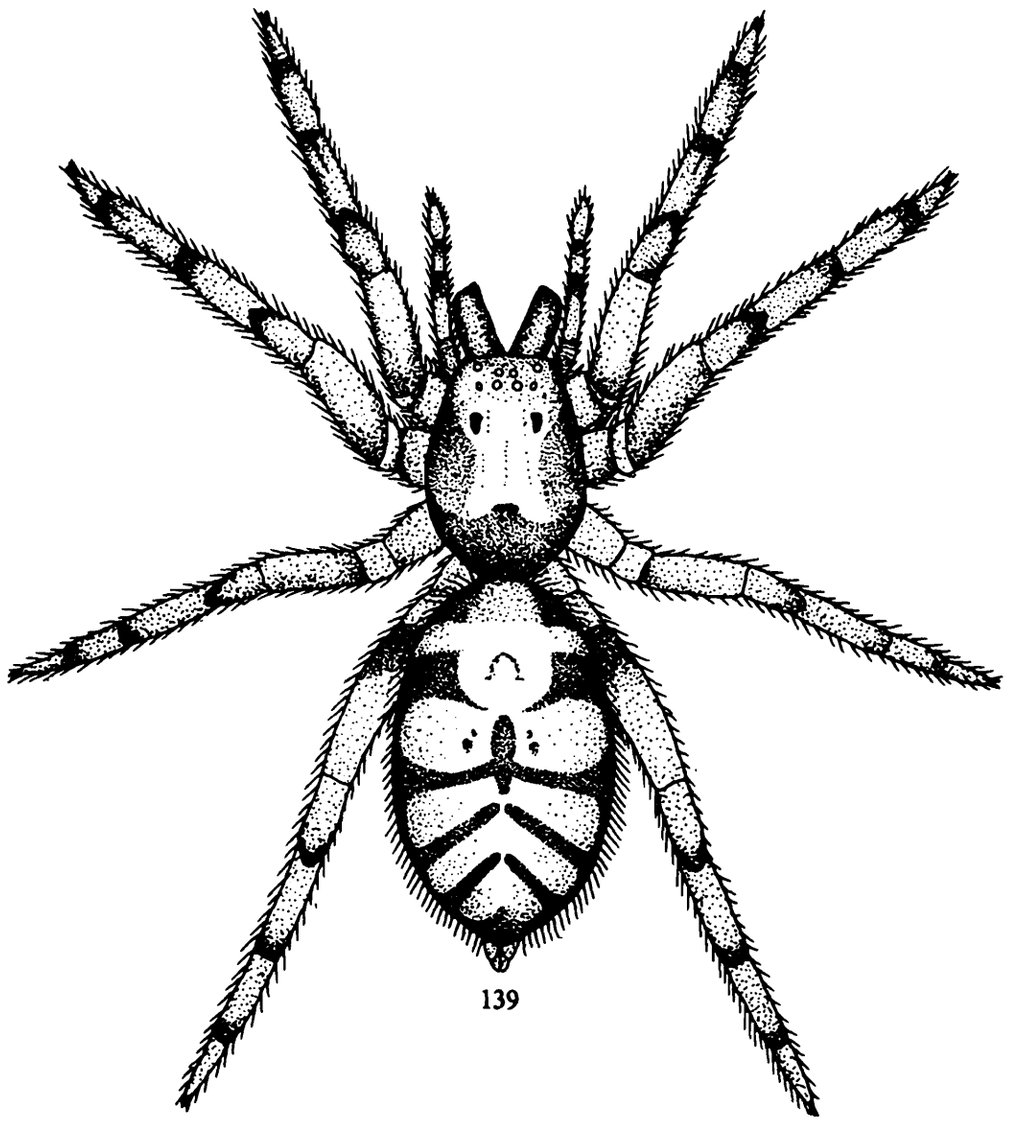

Fig. 139. Dorsal view of female *Sason cinctipes* (Pocock) family Barychelidae.

Distribution : S. Europe; Africa; India and Sri Lanka; Australia and the Fiji Islands; S. America.

Key to the genera of the family Barychelidae

1. Eyes scattered, not aggregated on a tubercle; no rastellum.....*Sason*

53. *S. robustum* (Cambridge)
54. *S. cinctipes* (Pocock)
55. *S. armatoris* Pocock
56. *S. andamanicum* (Simon)

Eyes aggregated on a tubercles; rastellum always present in the female.....2

2. Single pair of spinnerets.....*Diplothele*

57. *D. walshi* Cambridge

Two pairs of spinnerets.....3

3. Thoracic fovea slightly recurved.....*Sasonichus*

58. *S. sullivani* Pocock 59. *S. arthroapophysis* Gravely

Thoracic fovea slightly or strongly procurved.....4

4. Ocular area distinctly wider behind than in front and thoracic fovea strongly procurved.....*Plagiobothrus*

60. *P. semilunaris* Karsch

Ocular area as wide in front as behind and thoracic fovea slightly procurved.....*Sipalolasma*

61. *S. greeni* Pocock 62. *S. ellioti* Simon

FAMILY 5. CTENIZIDAE
(The trap-door spiders)
Fig. 140

The trap door spiders resemble the typical tarantulas of the family Theraphosidae in having the post abdomen situated immediately above the spinnerets. This family includes most of the species that burrow into the soil and cap the opening with a hinged trap door. Mandibles furnished with rastellum, sometimes supported on a strong prominence. Coxa of palp without large maxillary process. Sternum with anterior sigilla large and encircling base of labium; posterior pair large and remote from margin. Tarsi without ungual tufts and provided with three claws. Spinnerets 4 in number, the anterior pair contiguous, posterior pair short or moderate in length.

Distribution : Temperate and tropical parts of the world.

Following species under different genera are represented from India.

Genus *Acanthodon*

63. *A. garoensis* Tikader 64. *A. madrasensis* Tikader

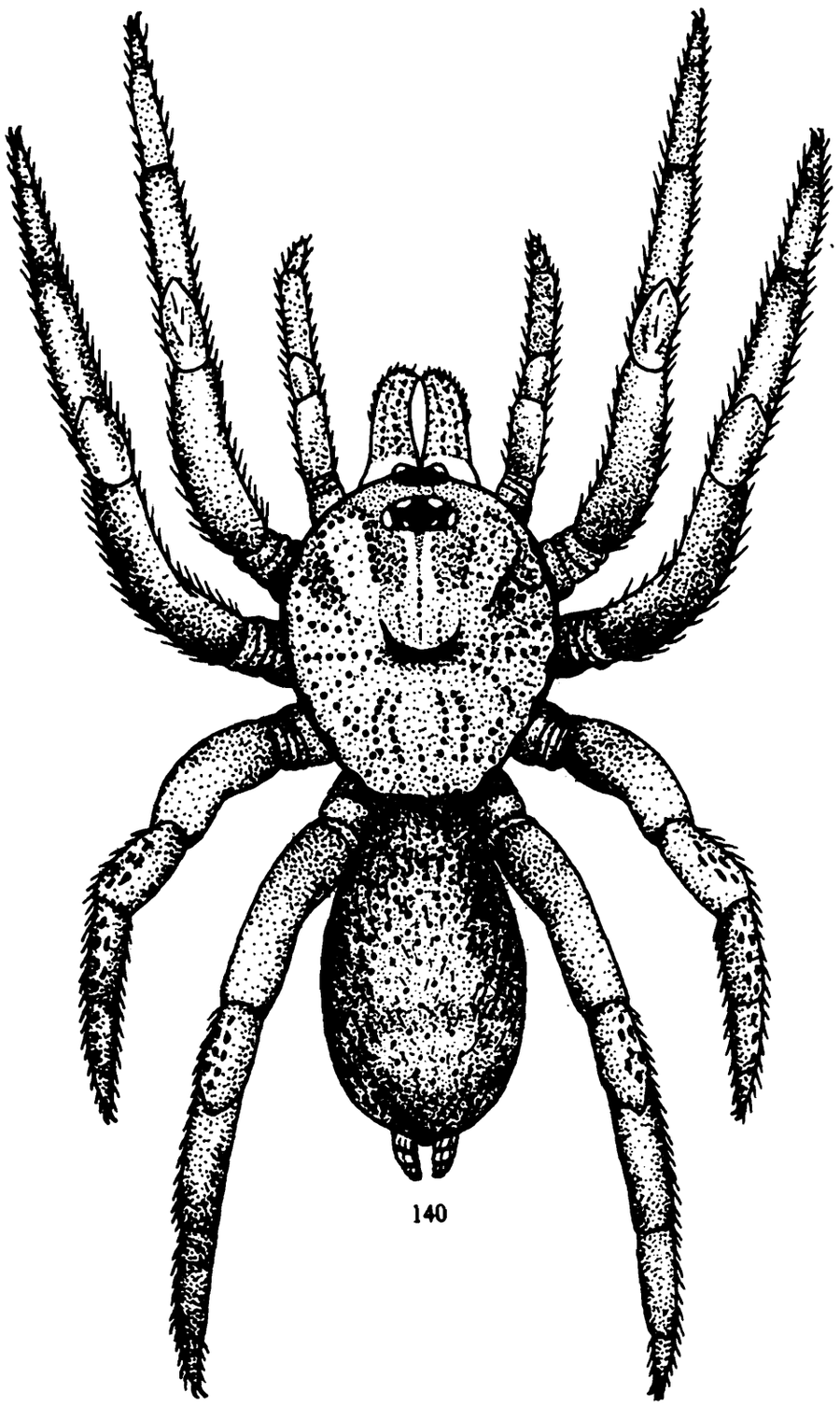

Fig. 140. Dorsal view of female , *Acanthodon garoensis* Tikader, family Ctenizidae.

Genus *Heligmomerus*

65. *H. prostans* Simon

Genus *Nemesiellus*

66. *N. montanus* Pocock

Genus *Idiops*

67. *I. barkudenis* (Gravely)
68. *I. biharicus* Gravely
69. *I. constructor* (Pocock)
70. *I. designatus* Cambridge
71. *I. fortis* (Pocock)
72. *I. fossor* (Pocock)
73. *I. opifex* (Pocock)

Genus *Damarchus*

74. *D. assamensis* Hirst
75. *D. bifidus* Gravely
76. *D. exacavatus* Gravely

FAMILY 6. DIPLURIDAE
(Funnel-web Tarantula spiders)
Fig. 141

These spiders live in tubes lined with silk, which is produced beyond the mouth of the tube in the form of an extended sheet or web constituting a snare. This is a small family. These spiders resemble the family Ctenizidae in having 3 claws, of which the superior claws are strongly toothed and in having no ungual tufts on the tarsi; but distinguished by the absence of the rastellum and the posterior spinnerets are very long and the anterior widely separated, small in size. Sternum provided with marginal sigilla.

Distribution Tropical and Temperate parts of the world.

Key to the genera of the family Dipluridae

1. Terminal segment of posterior spinnerets flexible and as long as preceeding two segments, labium unarmed.....*Ischnothele*

77. *I. dumicola* Pocock
78. *I. indicola* Tikader

Terminal segment of posterior spinnerets not flexible, shorter than preceeding two segments, labium spinulose.....*Macrothele*

79. *M. vidua* Simon

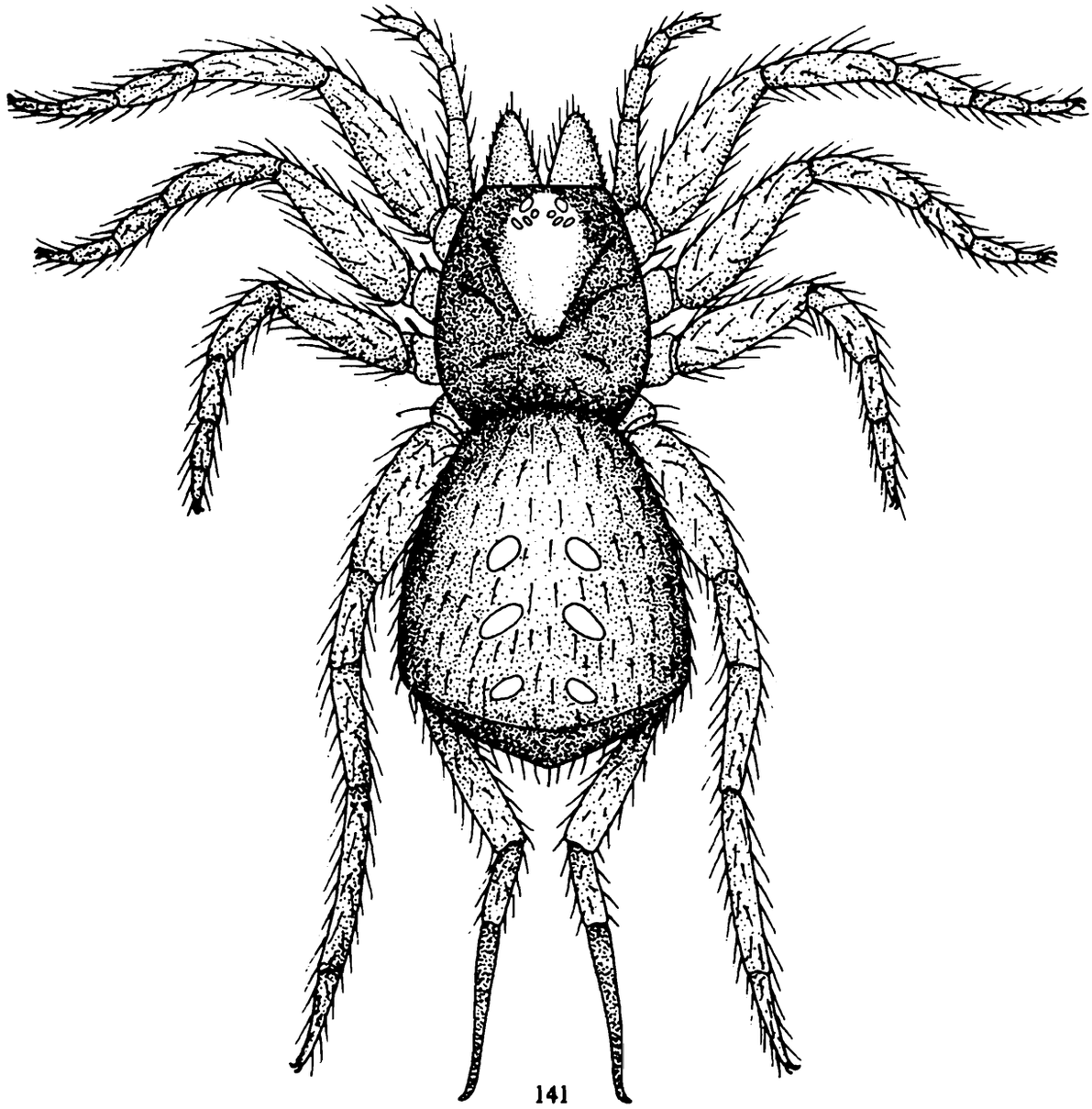

Fig. 141. Dorsal view of female *Ischnothele dumicola* Pocock, family Dipluridae.

FAMILY 7. OECOBIIDAE
Fig. 142

The members of this small family have three tarsal claws, and have both the carapace and sternum wider than long. The spiders live under stones, but are often found in houses, especially in corner angles of walls.

There is a striking similarity between the Oecobiidae and the ecribellate belonging to the family Urocteidae of the old world.

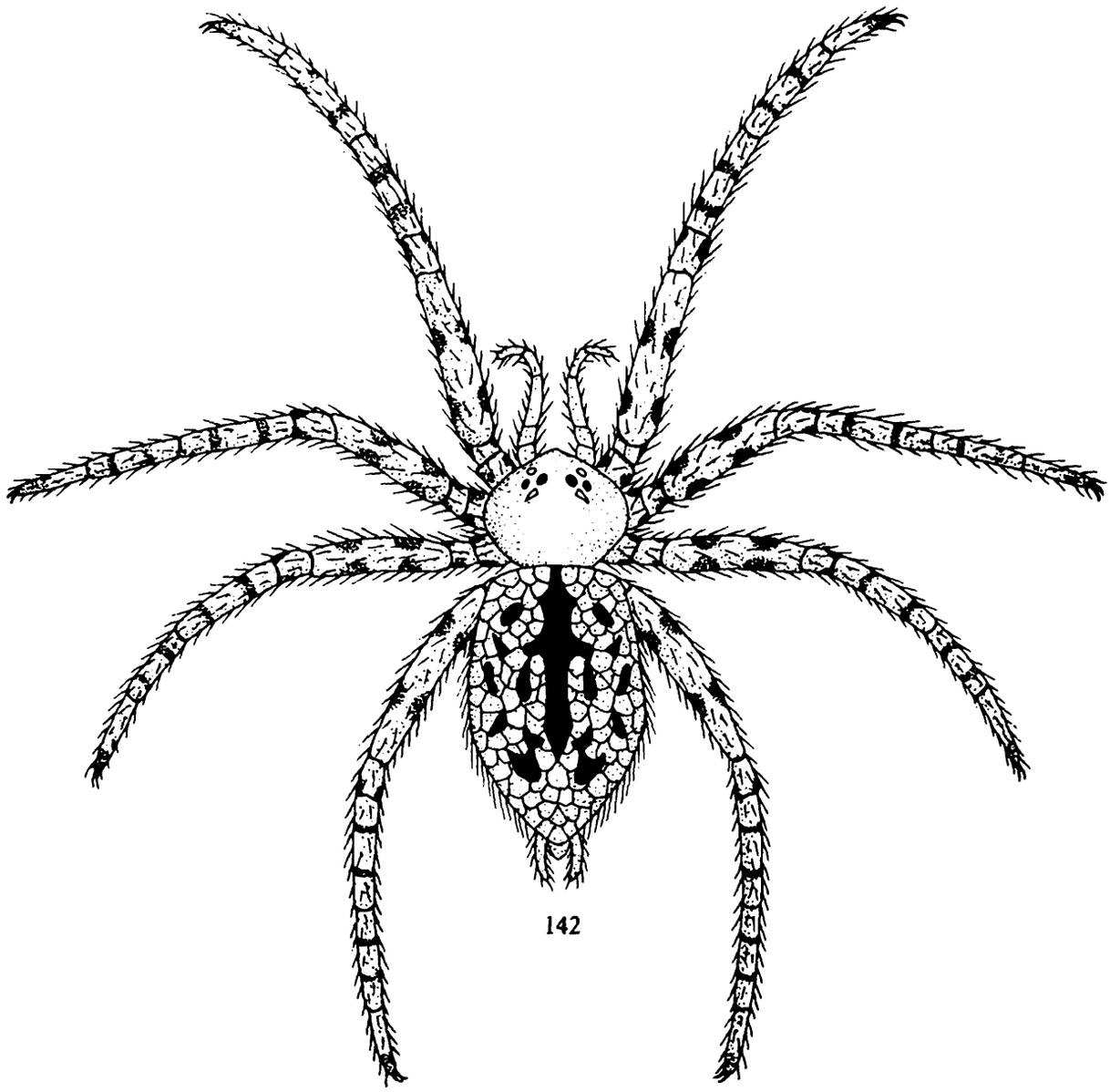

Fig. 142. Dorsal view of female *Oecobius putus* Cambridge of the family Oecobiidae.

Some American workers prefer to consider both as subfamilies within the same family. In this case, the name Oecobiidae, having priority, should be used. Beside the very fundamental difference as evident by the presence or absence of calamistrum and cribellum, only minor external differences can be found.

Distribution Tropical and Temperate parts of the world.

The most common genus is *Oecobius* with two species so far known from India.

FAMILY 8. ERESIDAE
Fig. 143

These are small or medium sized spiders, with the cephalic region of the carapace wide and usually high; the clypeus low, the four median eyes forming a small quadrangle, narrowing in front than behind, the anterior lateral eyes situated on the side of the head, the posterior laterals far removed from the rest of the eyes and situated high up on the posterior portion of the head. The mandibles flat in front, with fang-groove scarcely toothed; maxillae inclined obliquely inwards. Legs strong, weakly spined, with three claws. Abdomen oval and spinnerets with large cribellum. The species of the genus *Stegodyphus* live on bushes where they spin either a large sheet like web accompanied by a tubular retreat or a large saccular nest in which many individuals live together.

Distribution: Central and Southern Europe; Western Asia, China, India, Burma, Sri Lanka; Africa.

The only Indian genus is *Stegodyphus* with five species.

80. *O. putus* Cambridge
81. *O. marathaus* Tikader
82. *S. sarasinorum* Karsch
83. *S. mirandus* Pocock
84. *S. pacificus* Pocock
85. *S. socialis* Pocock
86. *S. tibialis* (Cambridge)

FAMILY 9. PSECHRIDAE
Fig. 144

The medium sized cribellate spiders with long and slender legs, the anterior two pairs being much longer than the posterior two, and all of them furnished with ungual tufts and 3 claws; the superior claws strongly toothed. Head moderately elevated; eyes in two transverse lines; clypeus high. Abdomen oval or cylindrical, with large cribellum. Sedentary spiders, spinning large sheet-like webs.

Distribution: Ranging from India and Sri Lanka to Austro-Malayan area.

Key to the genera of the family Psechridae

1. Cephalothorax narrower, ocular quadrangle longer than wide..... *Psechrus*

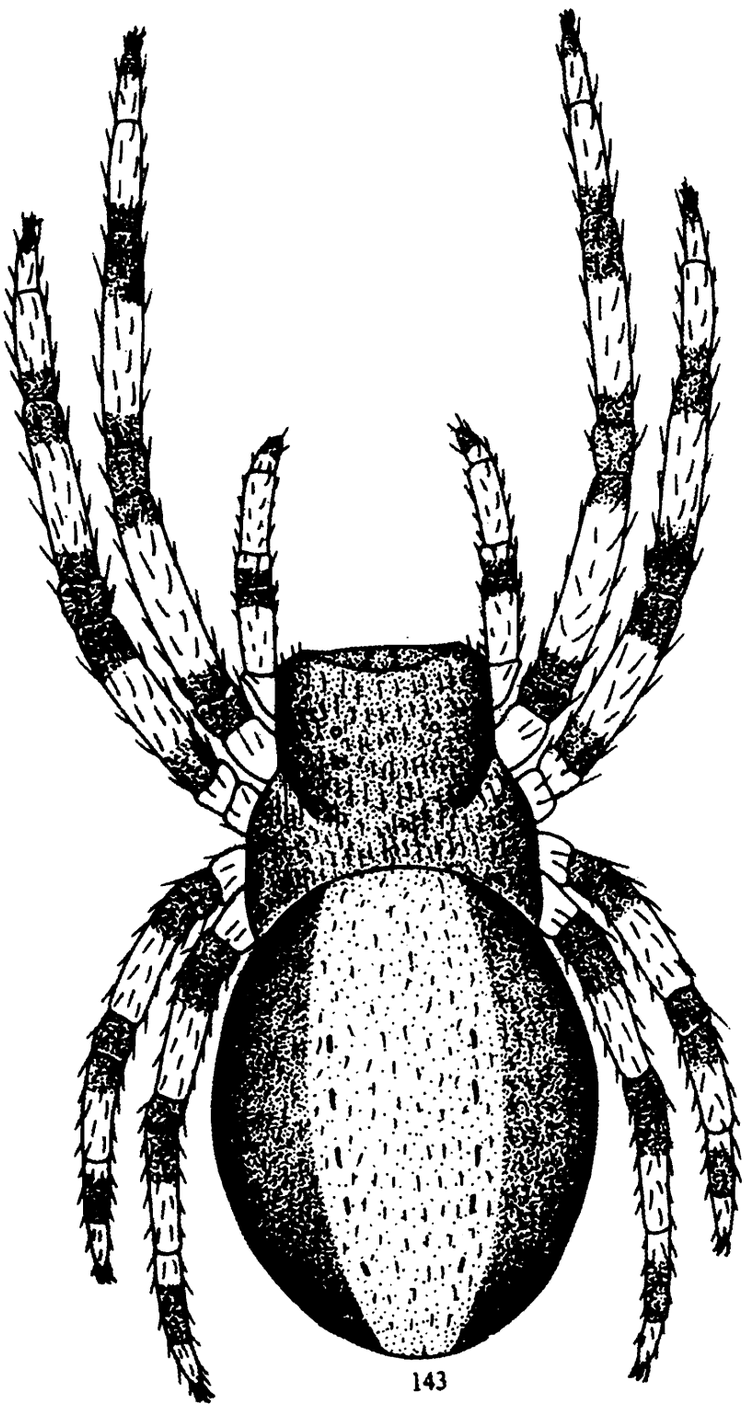

Fig. 143. Dorsal view of female *Stegodyphus pacificus* Pocock, family Eresidae.

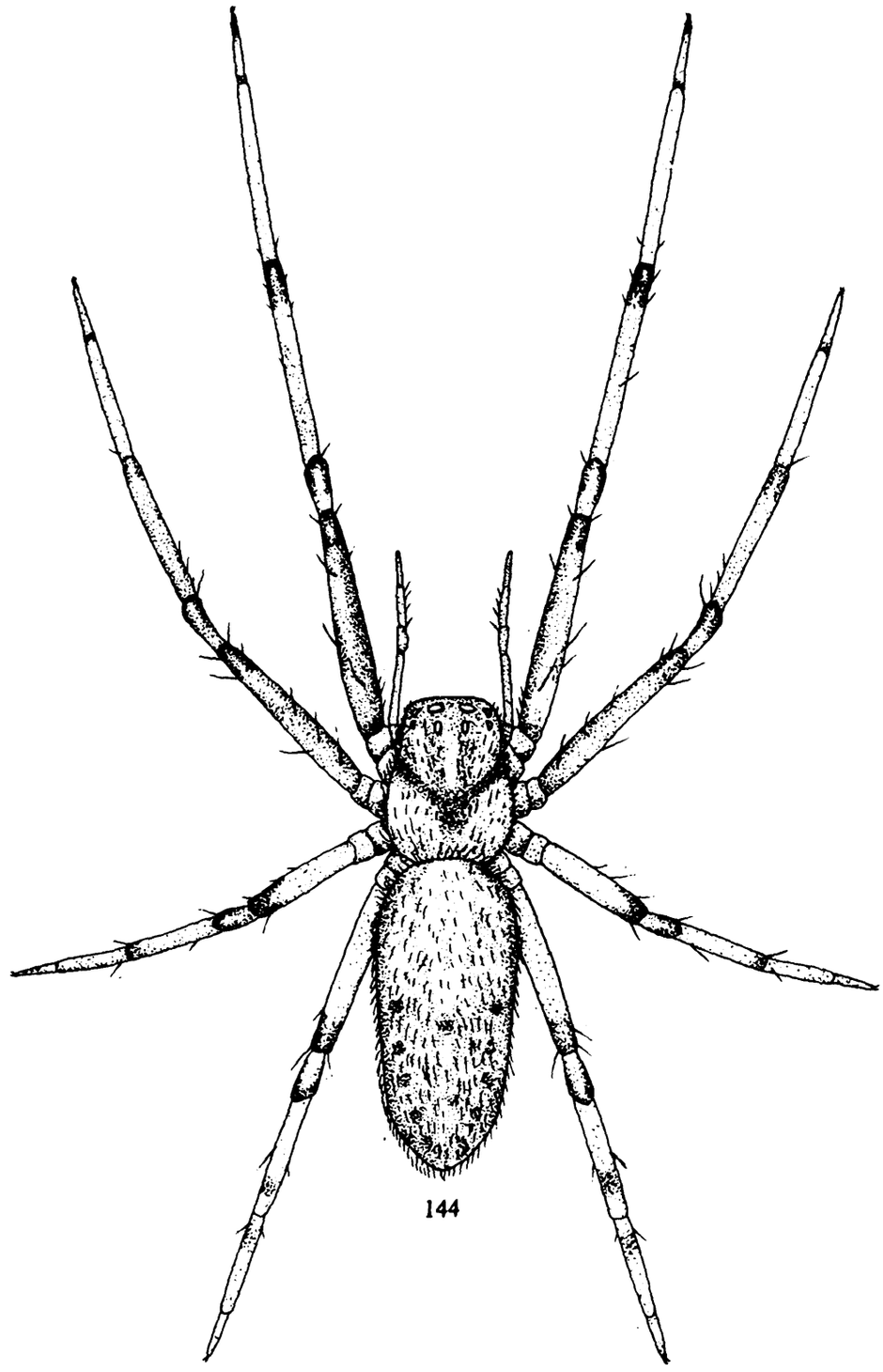

Fig. 144. Dorsal view of female *Psechrus nicobarensis* Tikader of the family Psechridae.

87. *P. himalayanus* Simon
88. *P. torvus* (Cambridge)
89. *P. ghecuanus* Thorell
90. *P. alticeps* Pocock
91. *P. nicobarensis* Tikader

Cephalothorax broader, ocular quadrangle square.....*Fecenia*

92. *F. travancoria* Pocock
93. *F. cylindrata* Thorell
94. *F. maforensis* Simon
95. *F. protensa* Thorell

FAMILY 10. FILISTATIDAE
Fig. 145

The members of this small family build snares under stones, etc., and are often found in or around houses that are not kept up. The threads are quite conspicuous, especially around cracks and crevices. The spider constructs a tubular retreat in which it hides.

The most common and the only genus is *Filistata* with eight species which are all similar in appearance. The eyes are closed together on a raised prominence. The calamistrum present, but very short. The male palp most simple.

Distribution : Cosmopolitan.

Following species are so far recorded from India under the genus *Filistata.*

96. *F. chiardolae* Caporiacco
97. *F. rufa* Caporiacco
98. *F. seclusa* O. P. Cambridge
99. *F. insularis* Thorell
100. *F. nigra* Simon
101. *F. poonaensis* Tikader
102. *F. napadensis* Patel
103. *F. nicobarensis* Tikader

FAMILY 11. AMAUROBIIDAE
Fig. 146

These spiders closely resemble in general appearance with members of the ecribellate family Agelenidae. By some workers they are included in the family Dictynidae, but others, especially the British workers include them in the family Ciniflonidae. The

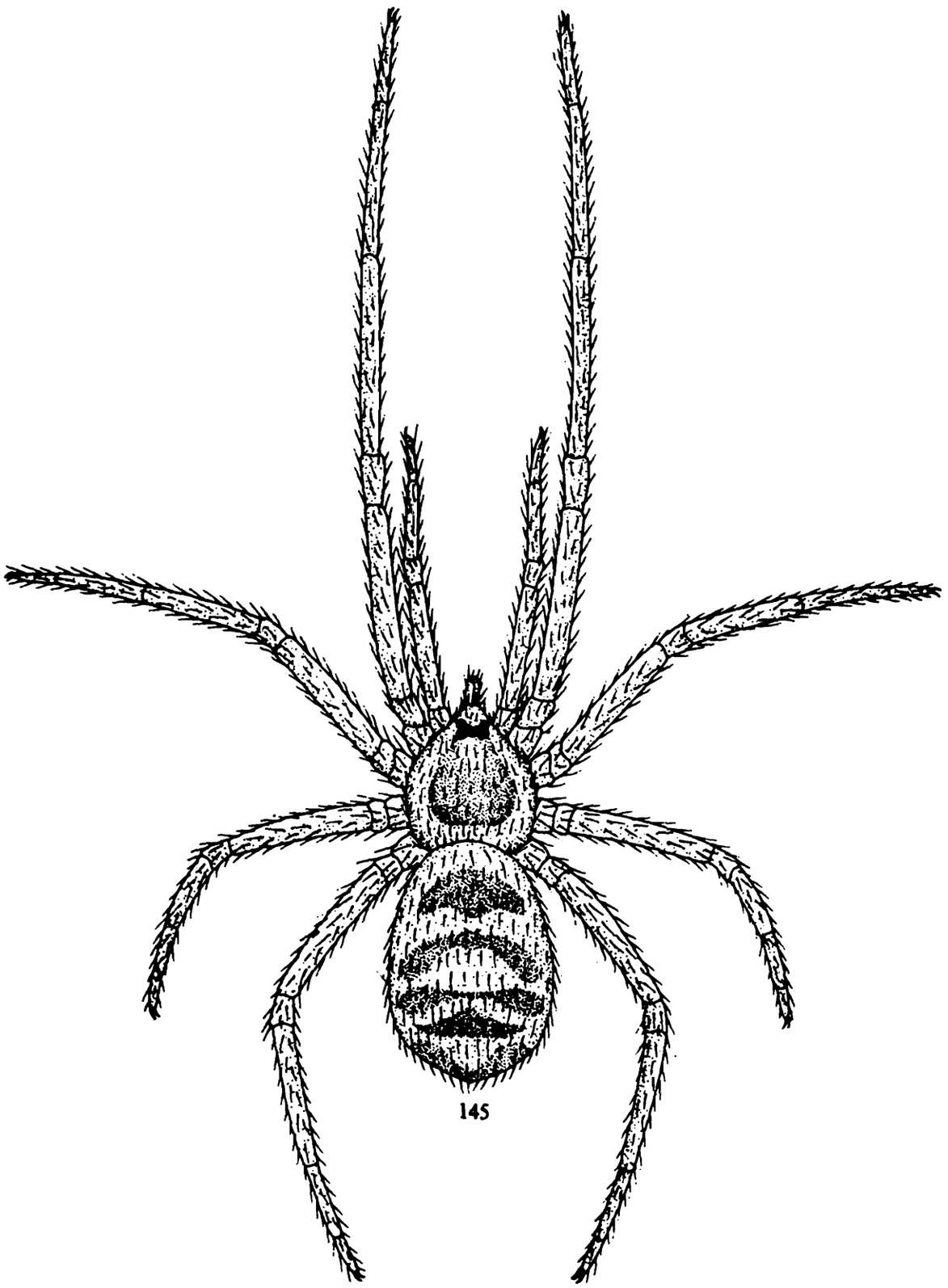

Fig. 145. Dorsal view of female *Filistata poonaensis* Tikader of the family Filistatidae.

sternum is not prolonged between the posterior coxae and the cribellum is divided into two parts.

Distribution Cosmopolitan.

Amaurobius is the only genus so far recorded from India.

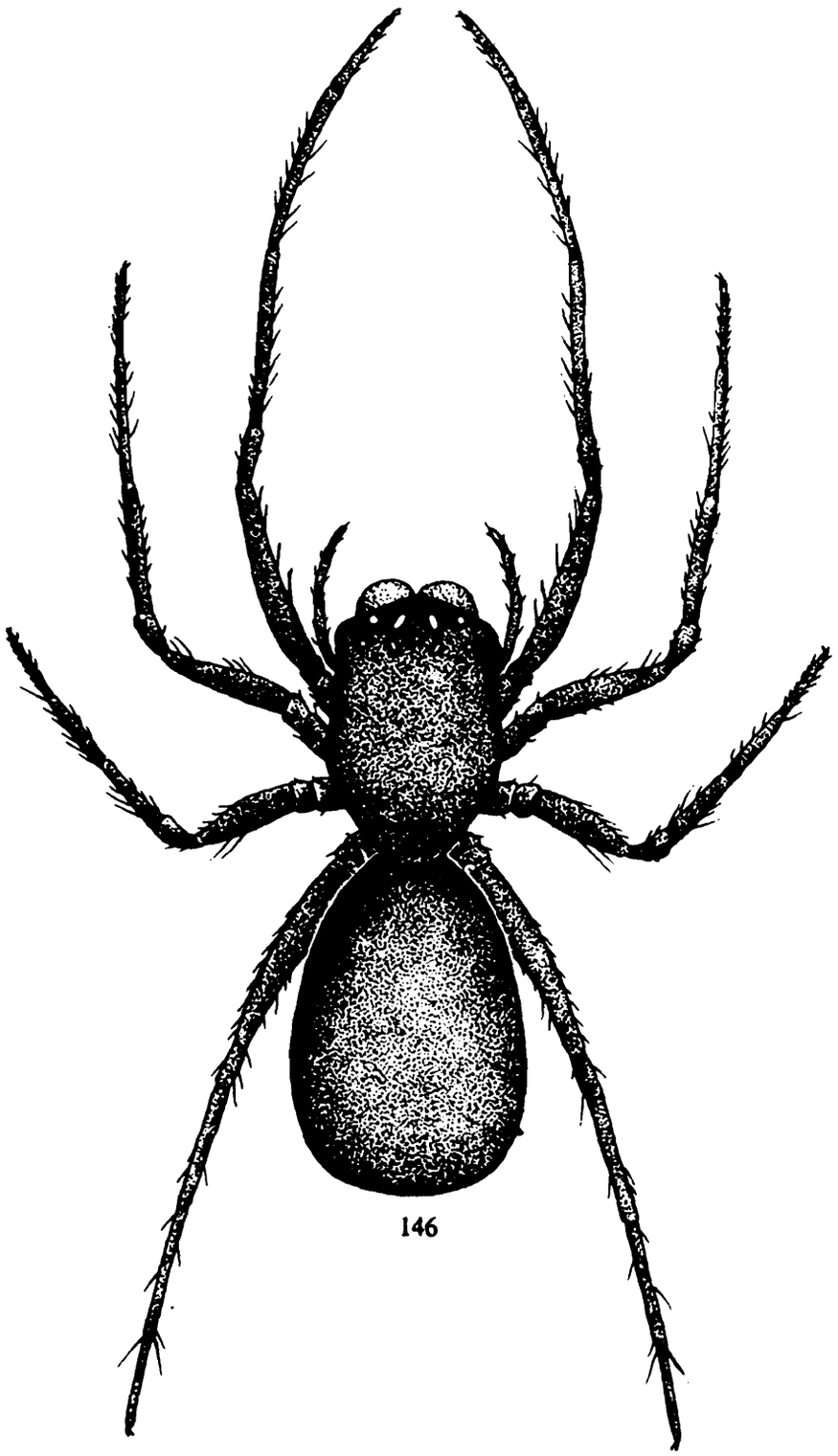

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Fig. 146. Dorsal view of female *Amaurobius andamanensis* Tikader, family Amaurobiidae.

FAMILY 12. DICTYNIDAE
Fig. 147

This is the family of cribellate spiders. Most of the members are small in size, and superficially resemble the members of the family Theridiidae. They build irregular snares in foliage, on the tops of twigs, underneath stones and on upper or lower surface of leaves.

Tarsi without trichobothria, anterior median eyes about as large as others, maxillae long and convergent over labium. The calamistrum occupies the middle half to two-third of the length of metatarsus IV.

Argenna and *Dictyna* are the only two genera represented from India.

Genus *Argenna*

104. *A. nathabhaii* Patel & Patel
105. *A. andamanensis* Tikader
106. *A. patula* (Simon)

Genus *Dictyna*

107. *D. bipunctata* Reimoser
108. *D. grossa* Simon
109. *D. nigricauda* Simon
110. *D. turbida* Simon
111. *D. albida* Cambridge
112. *D. marakata* Sherriffs
113. *D. velifera* Simon
114. *D. rebai* Tikader
115. *D. shiprai* Tikader
116. *D. umai* Tikader
117. *D. bedeshai* Tikader
118. *D. tungabhadrai* Tikader
119. *D. chandrai* Tikader

FAMILY 13. DINOPIDAE
Fig. 148

These spiders are peculiar as their carapace is flattened and abdomen is much elongated. These give them a slender appearance and superficially they look like the spiders of the family Tetragnathidae. But the enormous size of the posterior median eyes gives the face of these spiders a very unusual appearance. Other morphological characters are–the chelicerae are free at the base, cribellum and calamistrum are present, eyes are dark in colour.

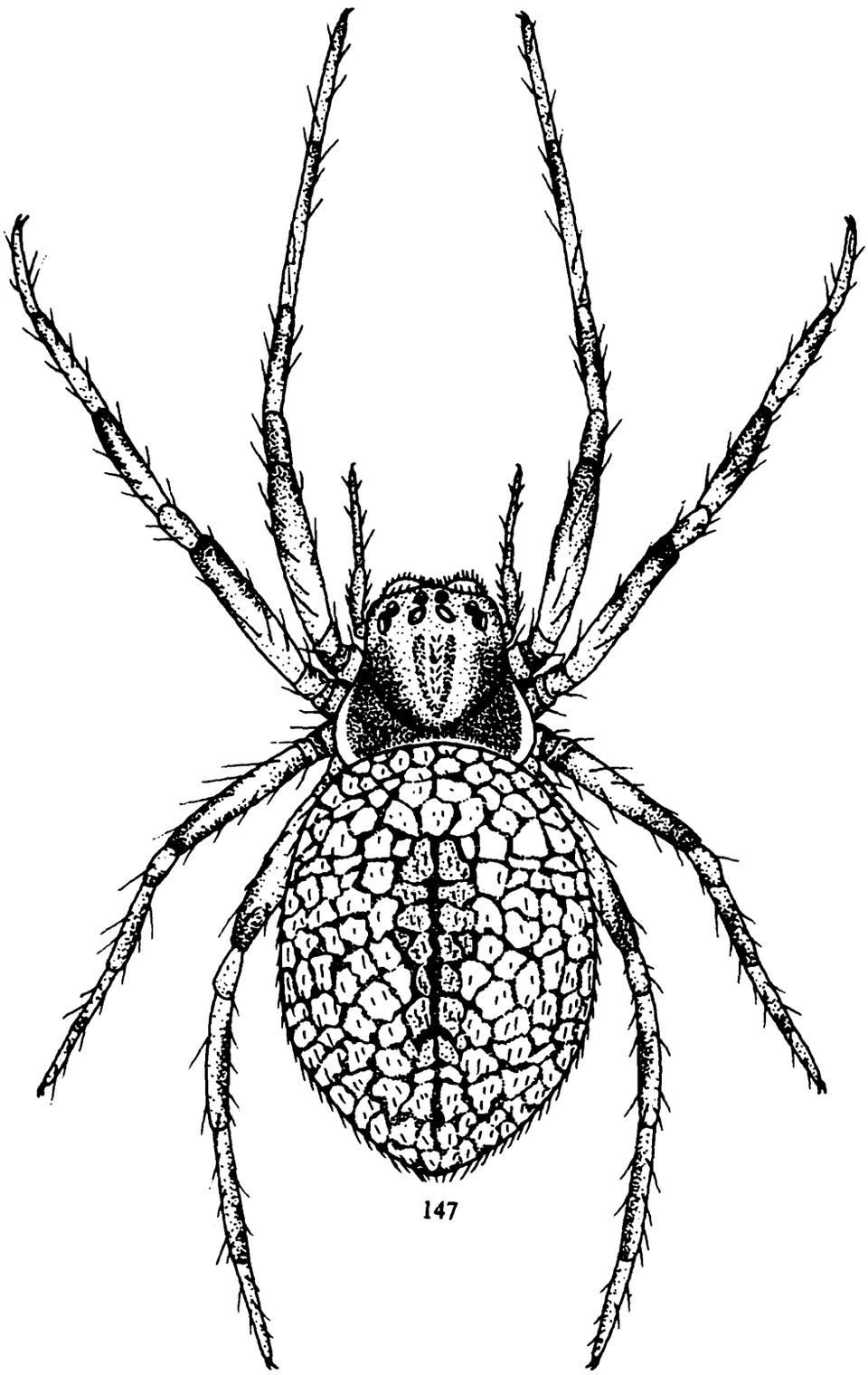

Fig. 147. Dorsal view of female *Dictyna shiprai* Tikader, family Dictynidae.

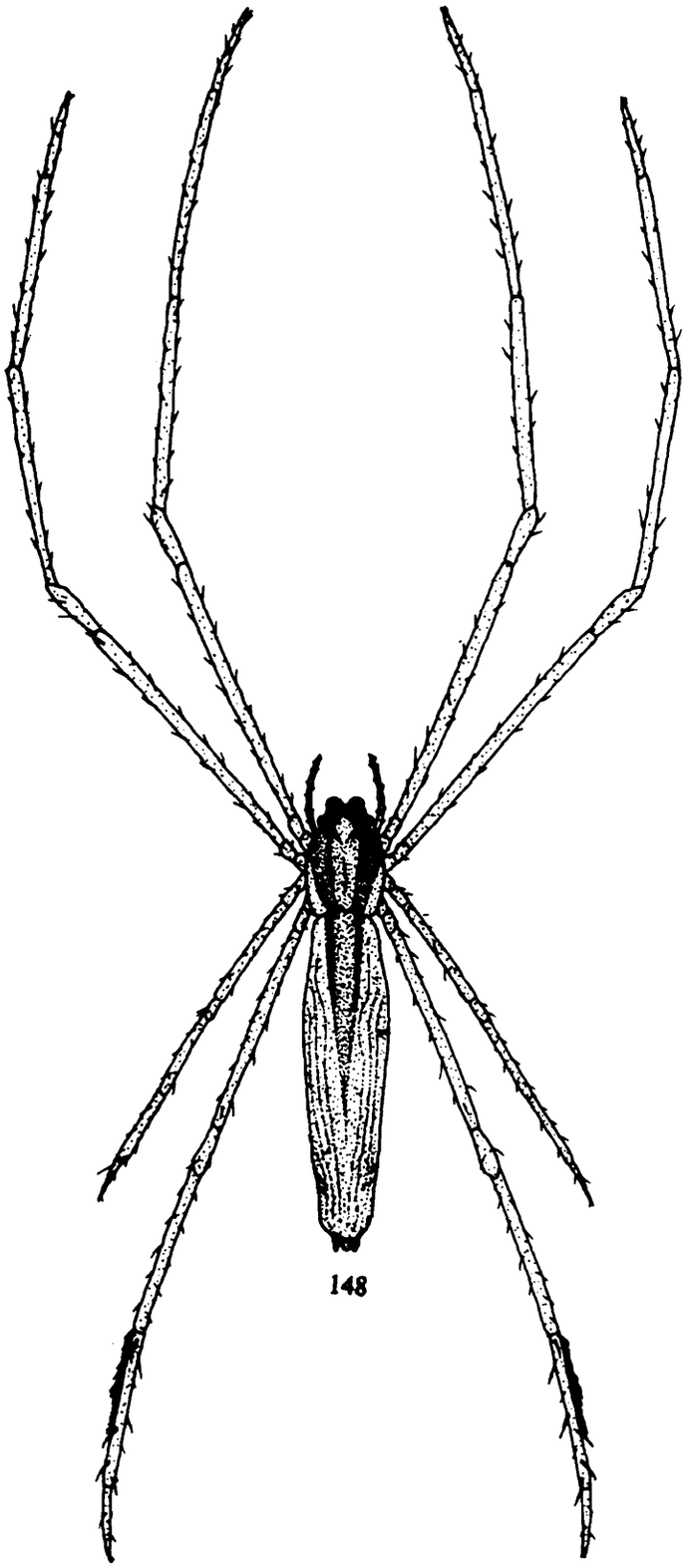

Fig. 148. Dorsal view of female *Dinopis goalparaensis* Tikader & Malhotra, family Dinopidae.

The spiders of this family are very rare and only one genus *Dinopis* is reported so far from India. These spiders are found on the reeds or overhanging trees near the streams and rivers, and rest with anterior legs extended forward and posterior legs backward so they are not easily detected in nature.

Distribution : Africa, Australia, South America, North America and India.

In our country only one species of the genus *Dinopis* is recorded.

120. *D. goalparaensis* Tikader & Malhotra

FAMILY 14. ULOBORIDAE
Fig. 149

These spiders spin geometric orb-webs or sectors of webs, similar to those of the Araneidae and related families. They are unique among spiders in lacking poison glands.

Distribution : Cosmopolitan.

Key to the genera of the family Uloboridae

1. Cephalothorax oval, longer than wide, with two rows of eyes, eyes eight, about the same length and subequal. Tarsus IV more than half as long as metatarsus IV..... *Uloborus*

121. *U. bigibbosus* Simon
122. *U. filifaciens* Hingston
123. *U. forunculus* Simon
124. *U. hilaris* Simon
125. *U. modestus* Thorell
126. *U. khasiensis* Tikader
127. *U. danolius* Tikader
128. *U. krishnae* Tikader

Cephalothorax elongated almost parallel sided. Two rows of eyes of about same length but only four eyes. Tarsus IV not more than half as long as metatarsus IV..... *Miagrammopes*

129. *M. extensus* Simon
130. *M. sexpunctatus* Simon
131. *M. poonaensis* Tikader
132. *M. indica* Tikader
133. *M. sutherlandi* Tikader
134. *M. gravelyi* Tikader
135. *M. kirkeensis* Tikader

Fig. 149. Dorsal view of female *Uloborus krishnae* Tikader, family Uloboridae.

FAMILY 15. PLATORIDAE
Fig. 150

This is a very small family of spiders. A single genus *Plator* is found in our country. Body very flat, legs completely laterigrade; carapace much wider than long; head narrow. Mandibles weakly armed; labium longer than wide; maxillae directed obliquely inwards. Sternum much wider than long, not narrowed behind. Coxae of legs long; 1st leg shorter than the rest, 2nd leg longest, no scopulae or ungual tufts; anterior legs armed with erect spiniform bristles; tarsal claws two and toothed.

Distribution : India, China; S. America.

The only genus *Plator* is represented from India with four species as follows

136. *P. indicus* Simon
137. *P. kashmirensis* Tikader
138. *P. himalayensis* Tikader & Gajbe
139. *P. solanensis* Tikader & Gajbe

FAMILY 16. ZODARIIDAE
Fig. 151

These spiders are found under stones on the ground. The Zodariidae is barely represented in our fauna, only seven genera consisting of a few species have been recorded. The legs are relatively short and stout, and all of them are nearly equal in length. The tarsi are with three claws. The anterior spinnerets are usually considerably longer than the other ones.

Distribution : India, Sri Lanka, Malaya Peninsula, Japan, Burma; Africa, N. America; Australia.

Following species under different genera are recorded from India.

Genus *Lutica*

140. *L. bengalensis* Tikader & Patel
141. *L. deccanensis* Tikader & Malhotra

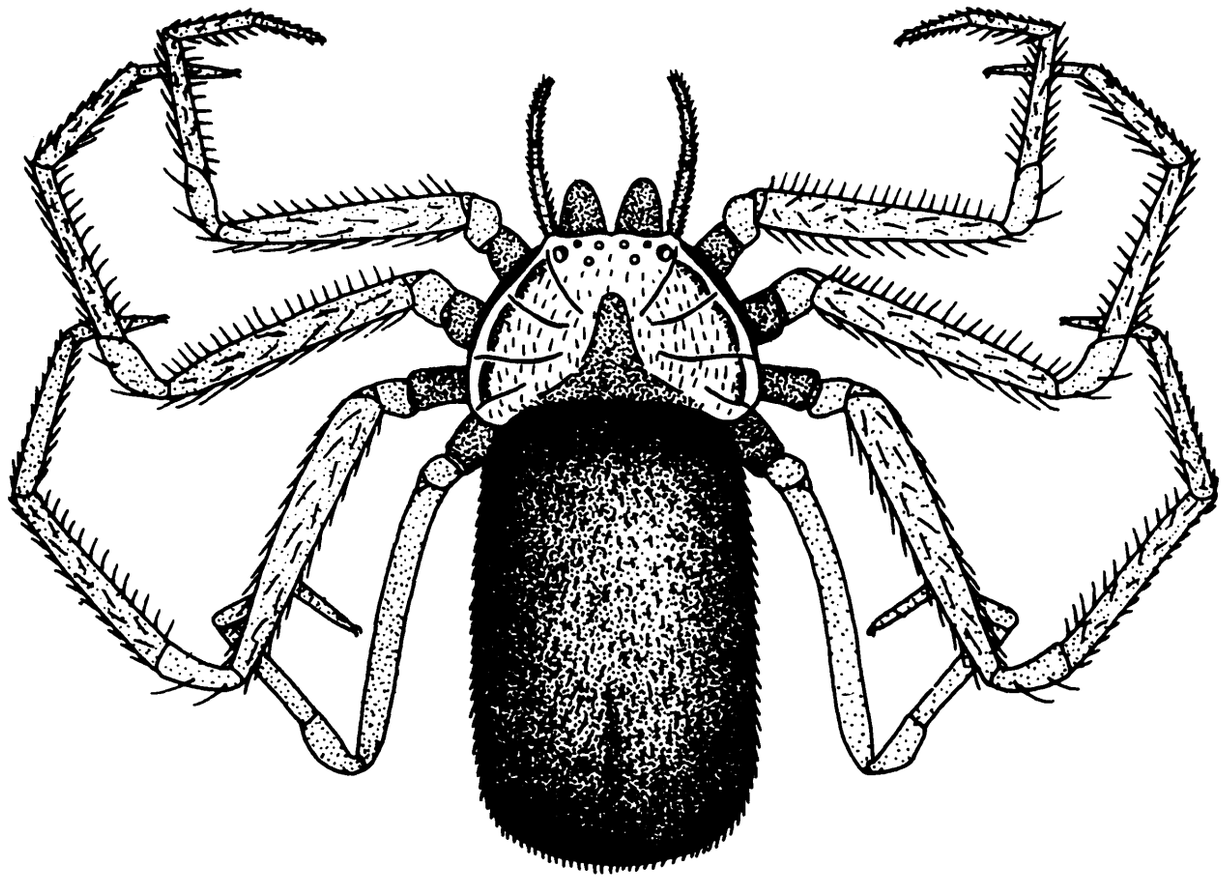

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Fig. 150. Dorsal view of female *Plator indicus* Simon of the family Platoridae.

Genus *Storena*

142. *S. birenifer* Gravely
143. *S. redimita* Simon
144. *S. nilgherina* Simon
145. *S. indica* Tikader & Patel
146. *S. gujaratensis* Tikader & Patel

Genus *Capheris*

147. *C. nitidiceps* Simon
148. *C. stillata* Simon

Genus *Cryptothele*

149. *C. collina* Pocock

Genus *Hermippus*

150. *H. cruciatus* Simon

Genus *Hermippoides*

151. *H. arjunus* Gravely

Genus *Suffucia*

152. *S. cingulata* Simon
153. *S. tigrina* Simon

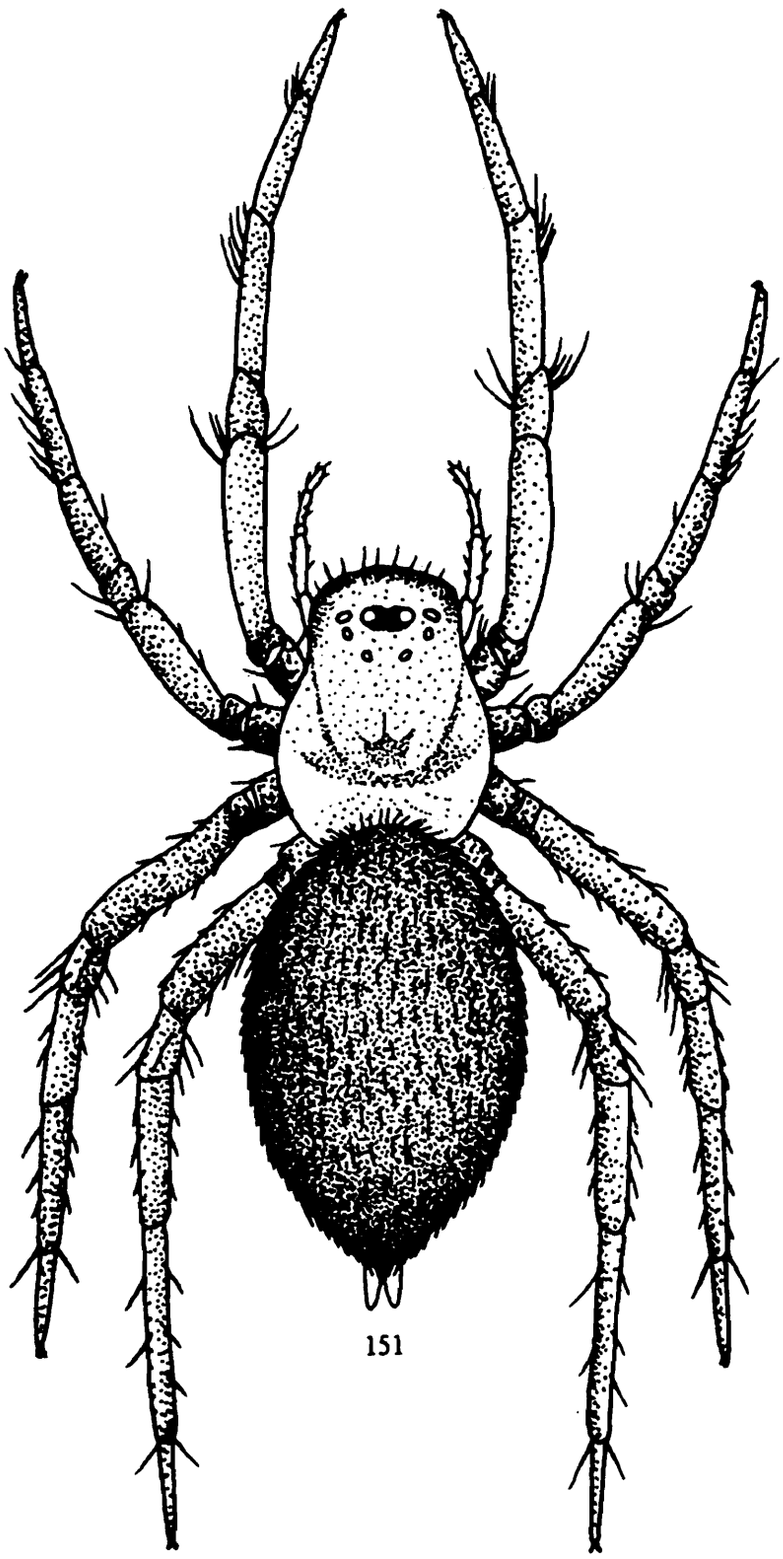

Fig. 151. Dorsal view of female *Lutica bengalensis* Tikader and Patel, family Zodariidae.

FAMILY 17. STENOCHILIDAE
Fig. 152

Stenochilid spiders are instantly recognizable by their peculiar diamond-shaped carapace which may be simple in outline or with numerous undulations; carapace also provided with two thoracic grooves–an anterior groove and a posterior pit; posterior median eyes are unusually long, nearly twice the size of the others; labium completely fused to the sternum. These spiders have both legs I and II enlarged, and bear one pair of large anterior spinnerets with rémnants of the four posterior spinnerets. Female palp without claw.

Stenochilid spiders live in silk tubes about 2 inches long or more beneath large stones on dusty soil or in low prickly bushes.

Distribution : India, Malacca, Philippines and Burma.

154. *Stenochilus hobsoni O. P.* Cambridge

Previously 2 species were recorded from India *viz., Stenochilus hobsoni* O. P. Cambridge 1870 and *Metronax raudus* (Simon) 1884, but after Platnick and Shadab (1974) it is found that *raudus* is synonymised with *hobsoni.* So only one species *Stenochilus hobsoni* O. P. Cambridge is the known example of Stenochilid spiders from India.

FAMILY 18. PALPIMANIDAE
Fig. 153

The spiders of the family–Palpimanidae are characteristic as they posses greatly enlarged first pair of legs, oval outlined carapace; abdomen provided with scutum which is a ring like structure surrounding the entire anterior end and only two spinnerets instead of normal six. Patella I is greatly elongated, longer than the tibia I whereas the metatarsus I is greatly shortened, shorter than the tarsus. The first leg also provided with a single patch prolateral scopulae. The male palpi lack haematodochae. Labium not fused with sternum (cf. Stenochilidae).

Distribution Africa; South America; Asia including India, Japan, Sumatra, Malacca.

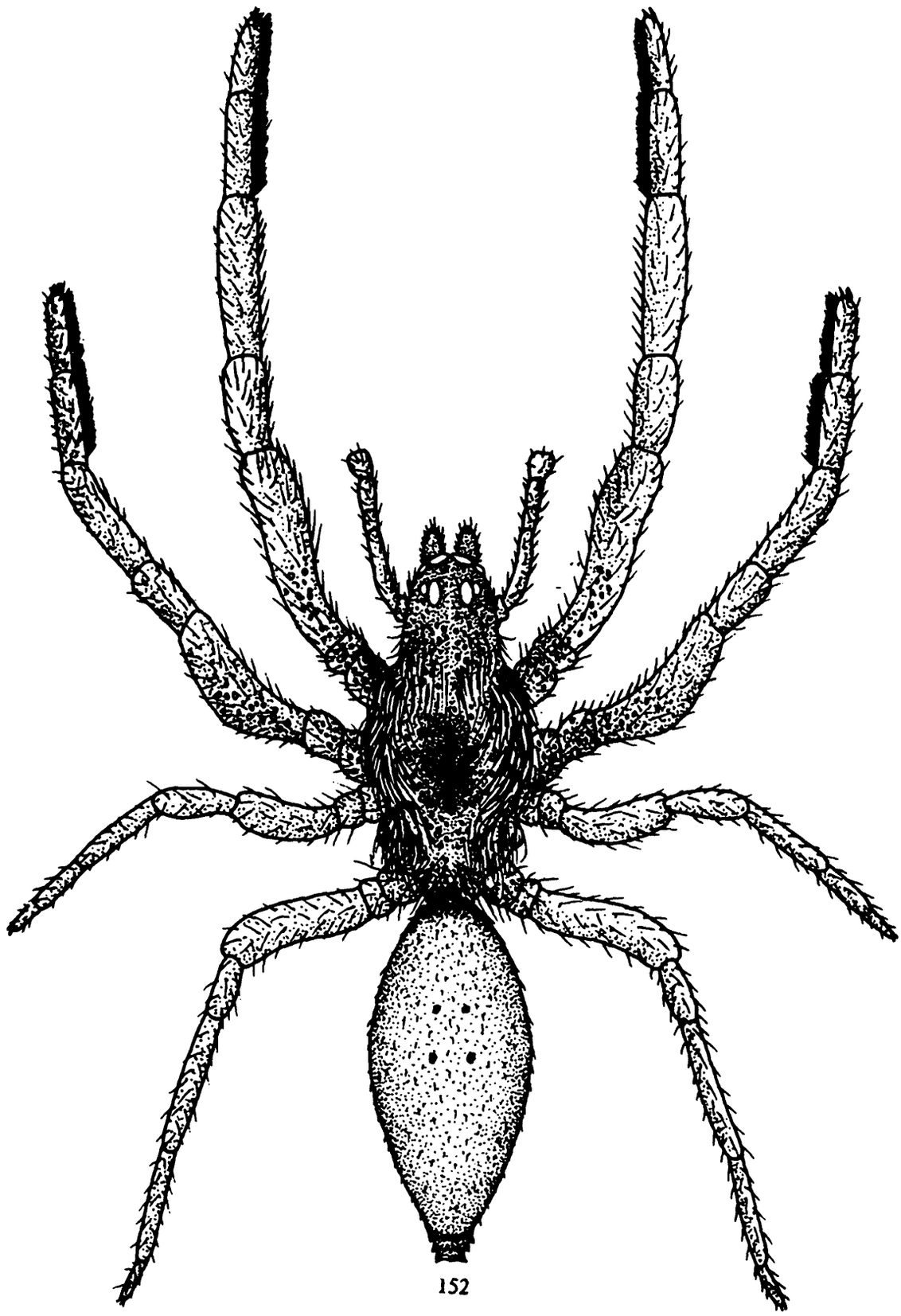

Fig. 152. Dorsal view of female *Stenochilus hobsoni* O. P. Cambridge, family Stenochilidae.

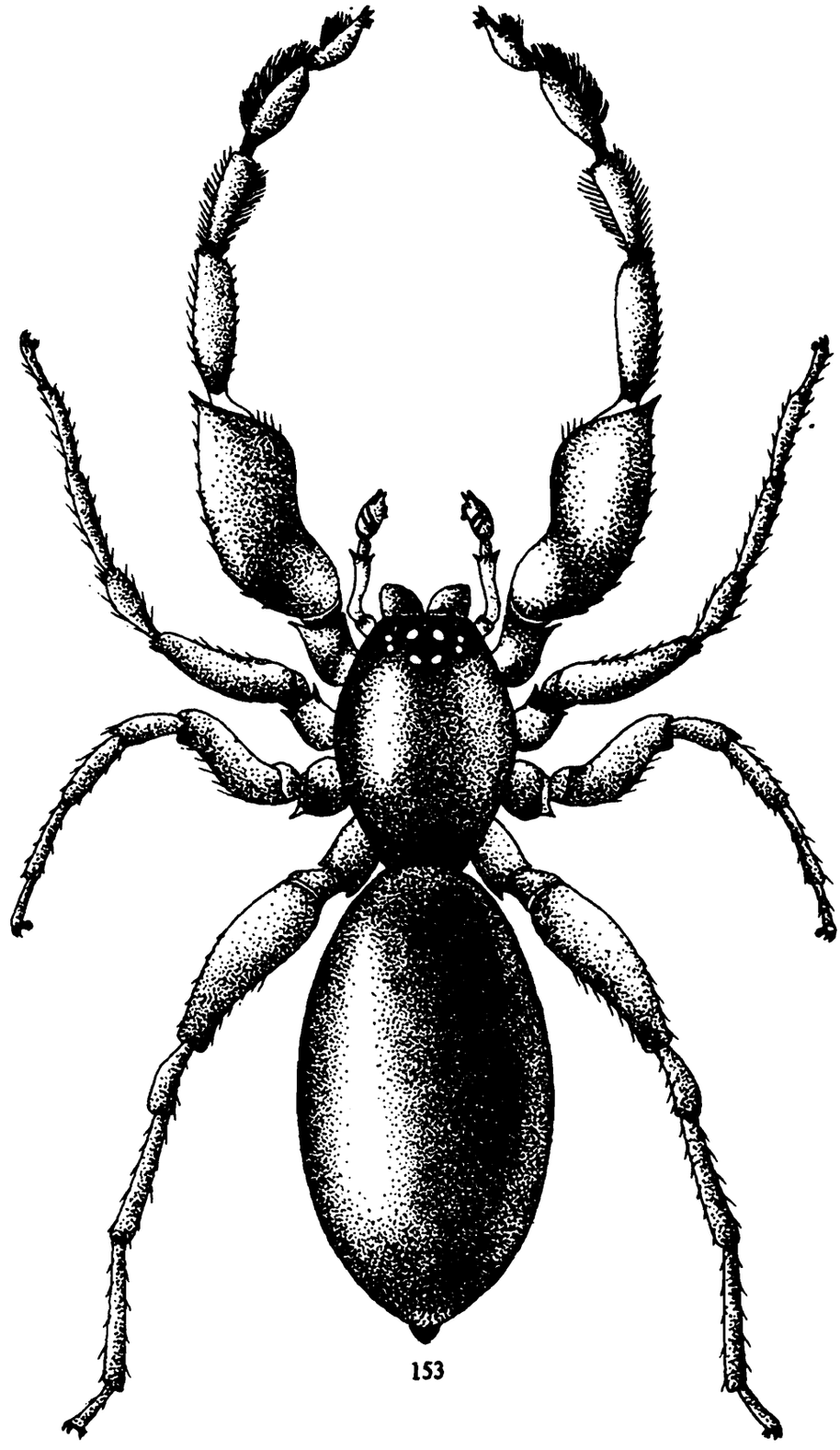

Fig. 153. Dorsal view of *Sarascelis raffrayi* Simon of the family Palpimanidae.

Only three species belonging to two genera are recorded so far from India which are given below.

Genus *Palpimanus*

155. *P. gibbulus* Dufour

156. *P. vultuosus* Simon

Genus *Sarascelis*

157. *S. raffrayi* Simon

FAMILY 19. HERSILIDAE

Fig. 154

The species of the family are very active hunting spiders, living on tree-trunks, old walls, or under stones and at most spinning a scanty web of irregular threads. Carapace as wide as long, with cephalic region elevated, narrow and defined by a deep semicircular sulcus; eyes of anterior and posterior lines strongly recurved, the anterior laterals standing high up half way between the anterior and posterior medians. Legs, except 3rd pair, very long and slender, armed with three claws. Posterior spinnerets very long, usually longer than the abdomen; colulus present.

Distribution : Africa; South Asia; Australia; South America.

Key to the genera of the family Hersilidae

1. Protarsi of I, II and IV legs bisegmented.....2

   Protarsi of I, II and IV legs undivided.....*Tama*

158. *T. variata* Pocock

159. *T. gravelyi* Sinha

2. Ocular quadrangle nearly parallel sides.....*Hersilia*

160. *H. savignyi* Lucas

161. *H. pectinata* Thorell

162. *H. clathrata* Thorell

163. *H. stevensi* Sinha

164. *H. kalimpongensis* Sinha

165. *H. moulmeinensis* Sinha

166. *H. fletcheri* Sinha

167. *H. celebensis* Thorell

168. *H. pallida* Kroneberg

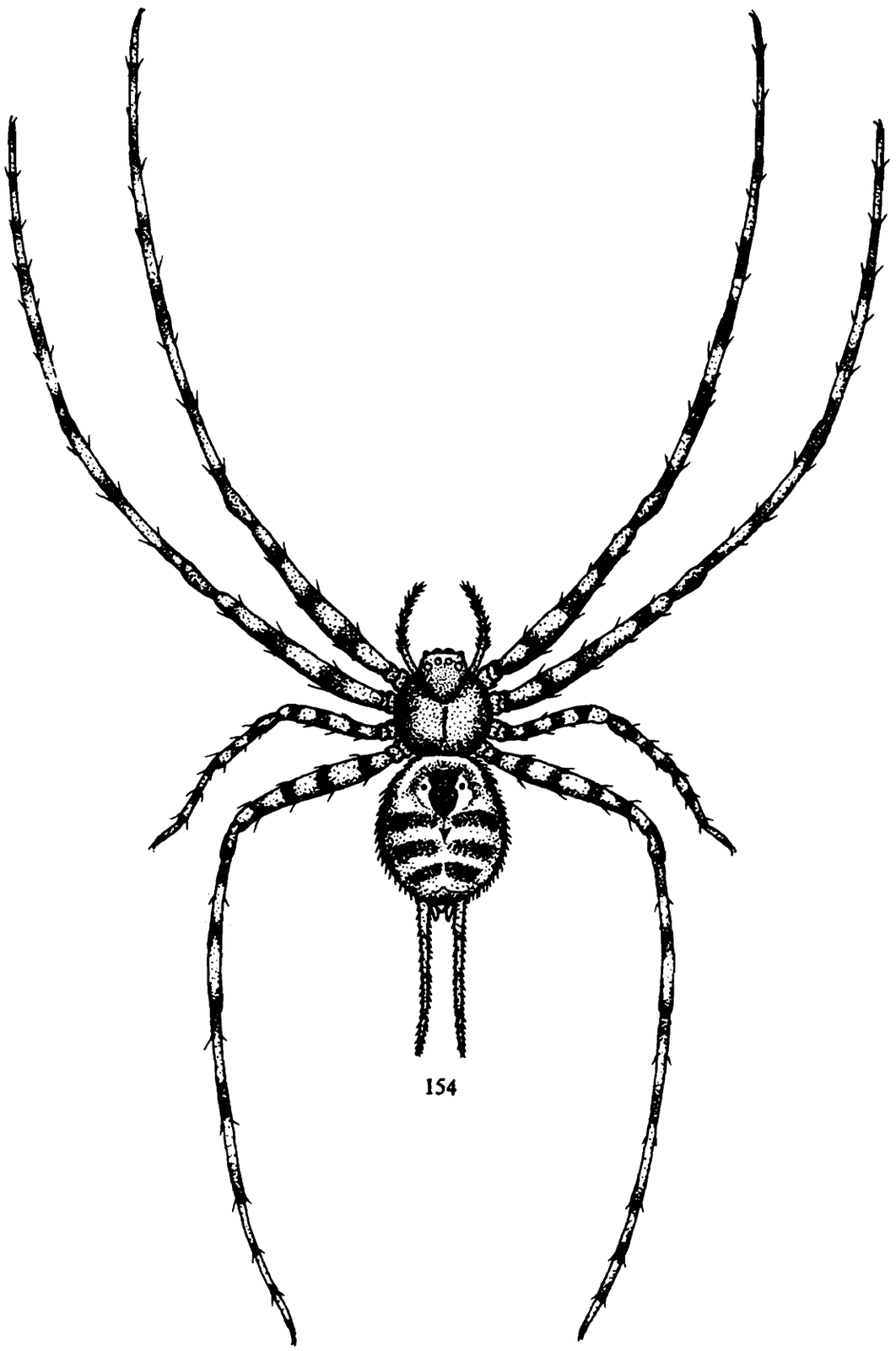

Fig. 154. Dorsal view of female *Hersilia savignyi* Lucas of the family Hersilidae.

Ocular quadrangle much wider in front than behind.....*Murricia*

169. *M. indica* Lucas

FAMILY 20. UROCTEIDAE
Fig. 155

These spiders live under stones where they spin a small saccular tent-like web of about five subradially arranged bands of silk, attached to the underside of it. Carapace transversely reniform, widely rounded in front and laterally, posteriorly emarginate; ocular group compact. Legs short and strong, spiny, subequal in length, tarsi armed with three claws. Abdomen large and depressed. Posterior spinnerets much longer than the anterior and anterior spinnerets short, subcylindrical, separated by a colulus; anal papillae very large and furnished laterally with fringe of long hairs.

Distribution : Mediterranean Region; China, Japan, South Africa, India.

Only single genus *Uroctea* recorded from our fauna.

170. *U. indica* Pocock

FAMILY 21. PHOLCIDAE
Fig. 156

The pholcid spiders having very long legs, build irregular webs in dark places, in which they hang with the back downwards. The tarsi of the legs are furnished with three claws. There are usually eight eyes. Sedentary spiders, spin in hollow trees, beneath overhanging rocks or in the corners of houses. The female caries her cocoon in her mandibles.

Distribution : Cosmopolitan.

Key to the genera of the family Pholcidae

1. Sternum posteriorly acuminate; mandible

armed with 2 teeth on the fang groove.....*Artema*

171. *A. atlanta* Walck.

Sternum broadly truncate posteriorly, mandible with one teeth on fang groove.....2

2. Abdomen short, oval, prominent posteriorly above the spinnerets.....*Crossopriza*

172. *C. lyoni* (Blackwall)

Abdomen long, cylindrical, not strongly prominent above spinnerets.....3

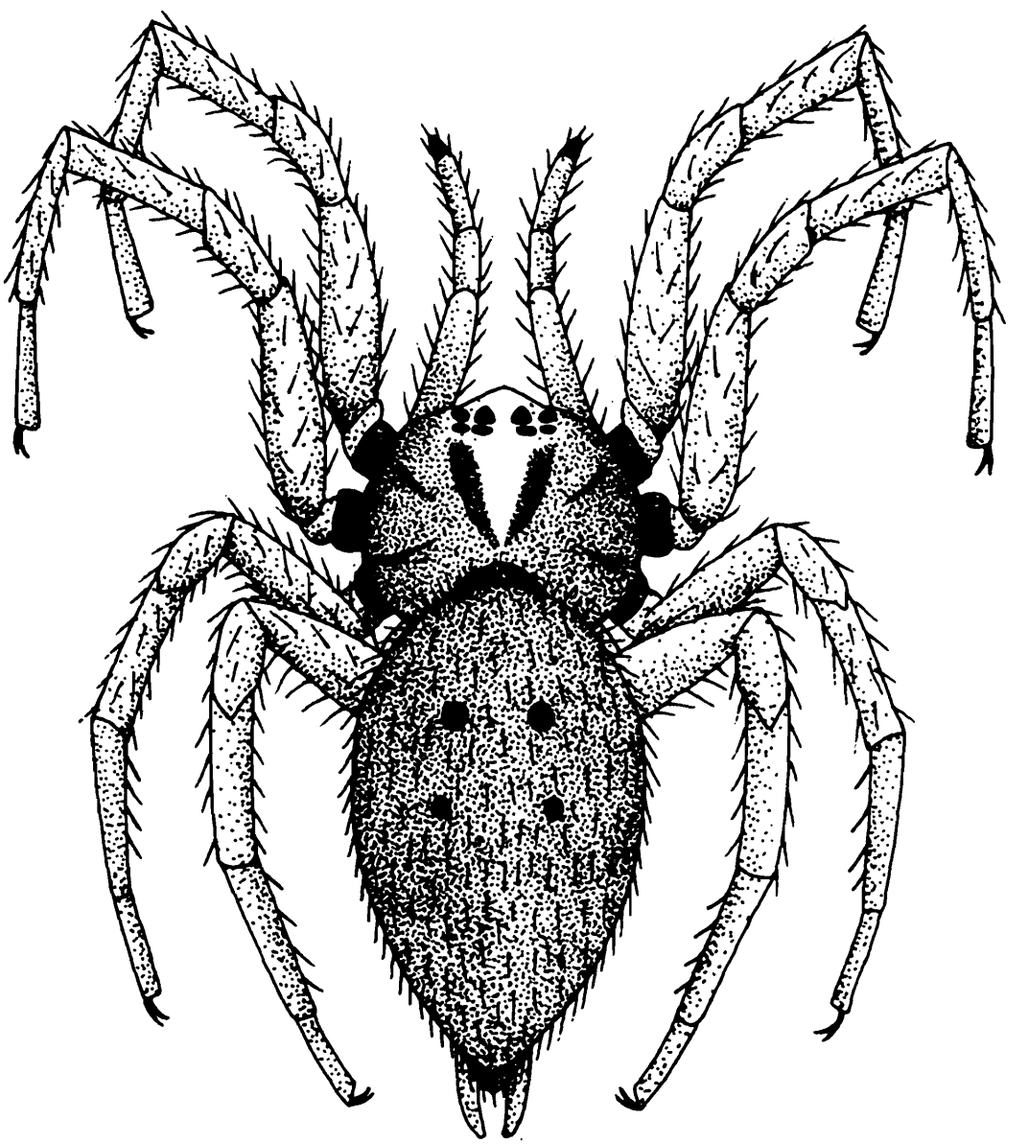

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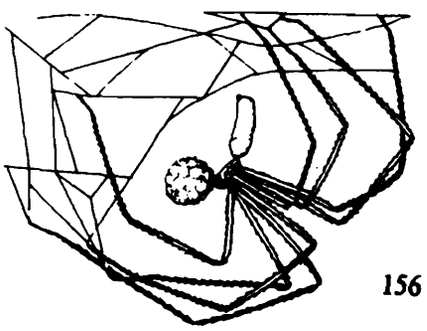
Fig. 155. Dorsal view of female *Uroctea indica* Pocock, family Urocteidae.



156

Fig. 156. Lateral view of female *Pholcus phalangioides* (Fuesslin) in her snare with egg-sac.

3. Abdomen long, more than twice as long as wide, and more than twice as long as cephalothorax. Femur I five or more times longer than carapace.....*Pholcus*

173. *P. kapuri* Tikader 174. *P. podophthalmus* Simon
174A. *P. phalangioides* (Fuesslin)

Abdomen very long, more than four times longer than wide.....*Smeringopus*

175. *S. elongatus* (Vinson)

FAMILY 22. SCYTODIDAE
(Spitting spider)
Fig. 157

The Scytodid spiders belong to that portion of the series of six eyed spiders in which there is only a single tracheal spiracle. A single genus *Scytodes* with twelve species, is represented in our country. The cephalothorax is high and subglobose behind and slopes forward.

These spiders normally live under stones or rubbles on the ground, where they spin a small irregular web.

Distribution : Tropical and sub-tropical parts of the world.

The following species under the genus *Scytodes* are represented from India.

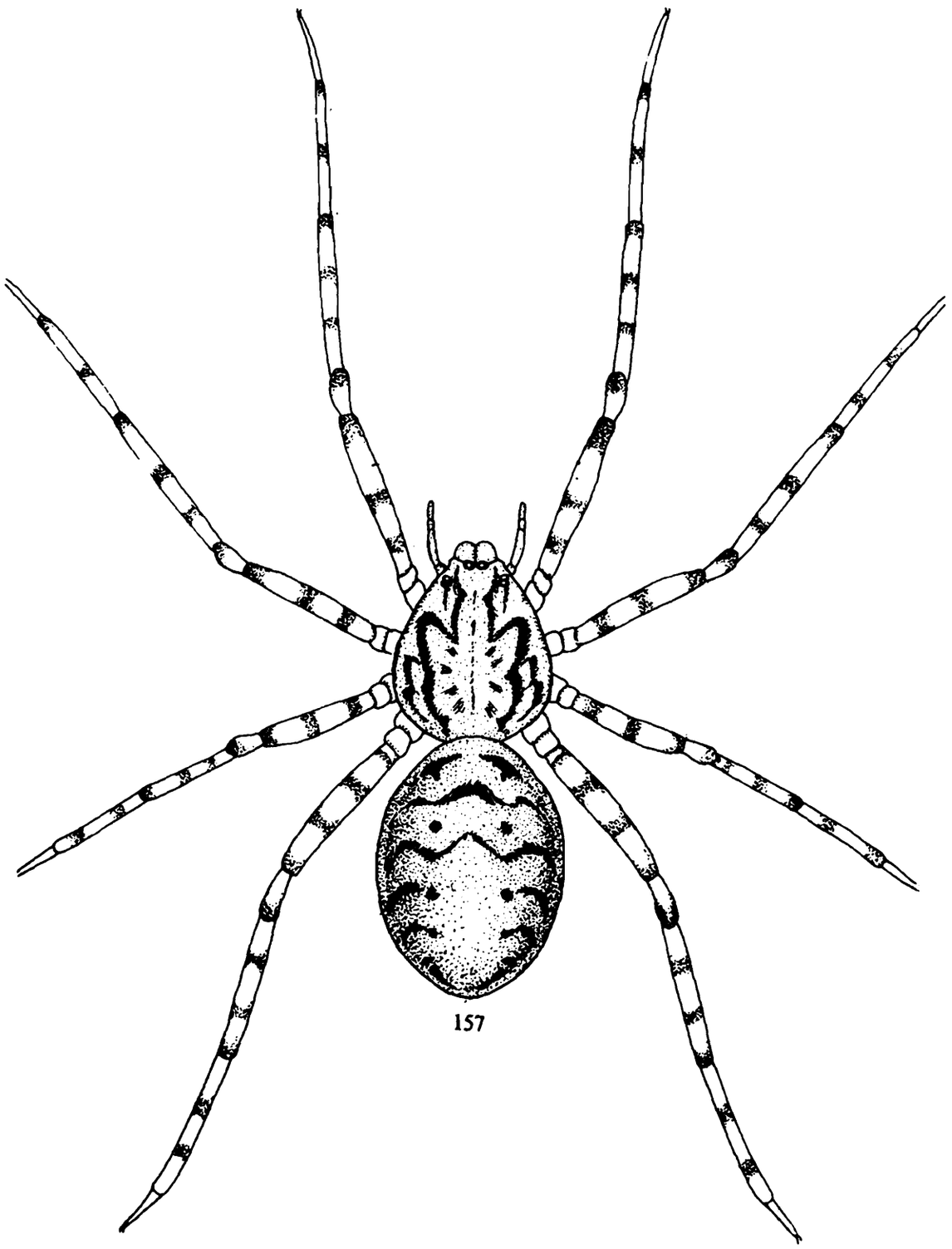


Fig. 157. Dorsal view of female *Scytodes thoracica* (Latreille) family Scytodidae.

176. *S. thoracica* (Latr.)
177. *S. fusca* Walckenaer
178. *S. gilva* (Thorell)
179. *S. pallida* Doleschall
180. *S. propinqua* Stoliczka
181. *S. semipullata* Simon
182. *S. sordida* Dyal
183. *S. stoliczkai* Simon
184. *S. univittata* Simon
185. *S. domestica* Doleschall
186. *S. mawphlongensis* Tikader
187. *S. kinsukus* Patel

FAMILY 23. LOXOSCELIDAE
Fig. 158

The members of this small family construct small irregular webs under logs, stones, etc., but they hide also in dark corners and under stored clothing, etc. The cephalothorax is low and depressed. Anterior row of eyes is strongly recurved. The palp of the male is rather simple. There is a single genus *Loxosceles* with a single species in our country.

Distribution India; North America.

188. *Loxoscelis indrabeles* Tikader

FAMILY 24. OONOPIDAE
Fig. 159

These are six-eyed spiders which resemble the family Dysderidae and Segestriidae in having four spiracles, a pair of lung slits and a pair of tracheal spiracles. But in this family the tracheal spiracles are very inconspicuous and difficult to distinguish because of the small sizes of all the species. The six eyes are usually closed together in a compact group. They live under stones, on the ground or under the bark of a tree.

Distribution : India, Sri Lanka, Japan, Burma, Java, Sumatra; Africa; S. Europe; S. America; N. America.

Following species under 3 genera are recorded so far from India.

Genus *Gamasomorpha*

189. *G. clypeolaris* Simon
190. *G. nigripalpis* Simon

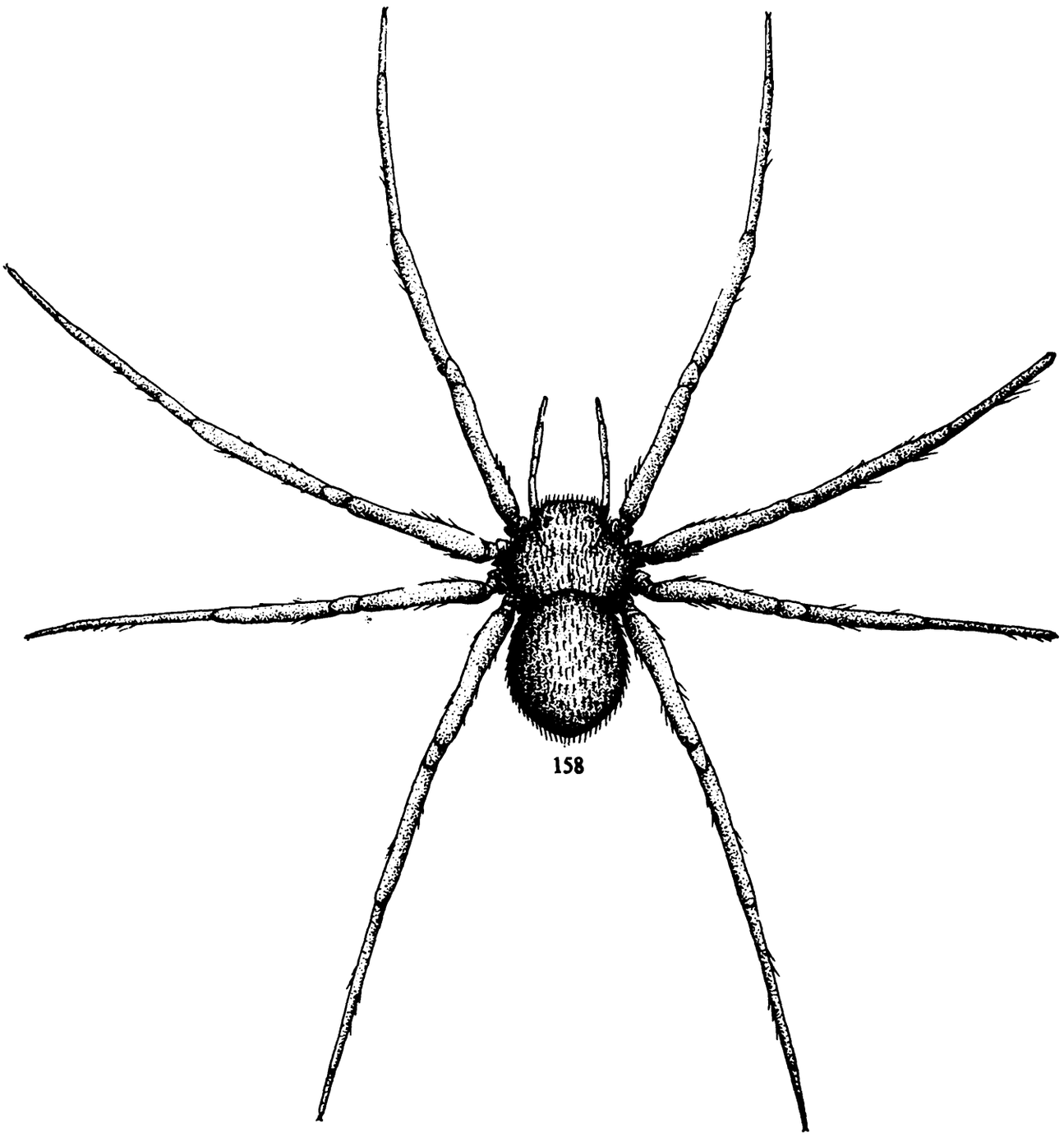


Fig. 158. Dorsal view of female *Loxoscelis indrabeles* Tikader of the family Loxosclelidae.

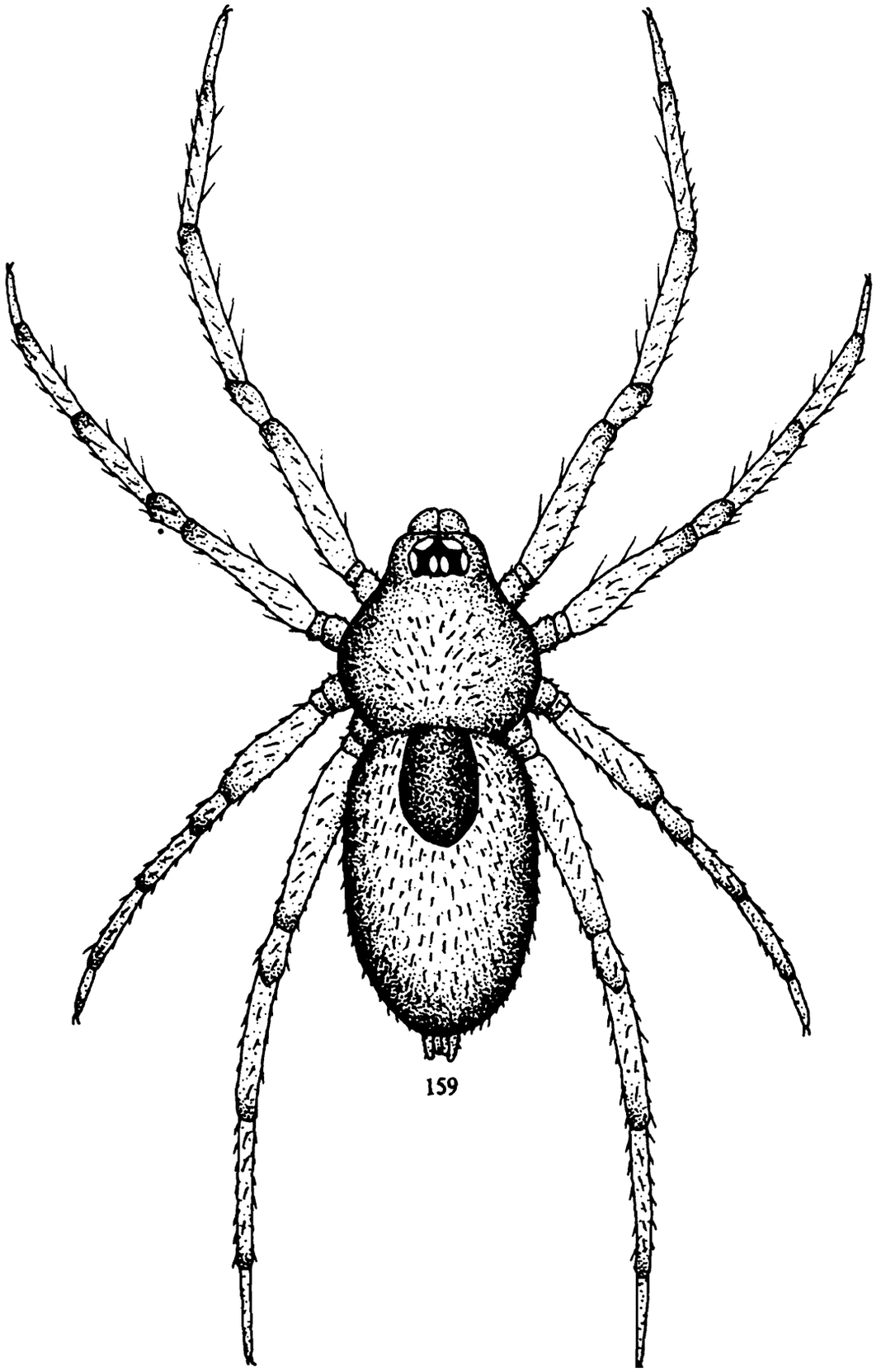


Fig. 159. Dorsal view of female *Ischnothyreus shillongensis* Tikader, family Oonopidae.

191. *G. taprobanica* Simon

Genus *Triaeris*

192. *T. khashiensis* Tikader
193. *T. poonaensis* Tikader & Malhotra
194. *T. manii* Tikader & Malhotra
195. *T. nagpurensis* Tikader & Malhotra
196. *T. nagarensis* Tikader & Malhotra

Genus *Ischnothyreus*

197. *I. shillongensis* Tikader
198. *I. deccanensis* Tikader & Malhotra

FAMILY 25. TETRABLEMMIDAE
Fig. 160

The spiders of this family are recognizable by the characters as cephalothorax broad, oval, rising above from all sides into a somewhat subconical form; presence of 4 large eyes but of unequal size and closely grouped round a circular form on the carapace; labium short, triangular; sternum large, truncated anteriorly, roundish posteriorly; abdomen oval, bears a series of plates (scutum), spinnerets 4 in number, united in a cluster and placed beneath the hinder extremity of the abdomen; and three tarsal claws, superior paired claws provided with a single row of teeth on each.

Distribution : Africa; Central America; Australia; India, Sri Lanka and Java.

Only one species under the genus *Tetrablemma* is known from India as follows.

199. *T. deccanensis* (Tikader)

FAMILY 26. SELENOPIDAE
Fig. 161

The members of this family have very flat bodies and are found under stones, and flattened against rocks along the cracks of which they run very rapidly. They are easily recognized by the arrangement

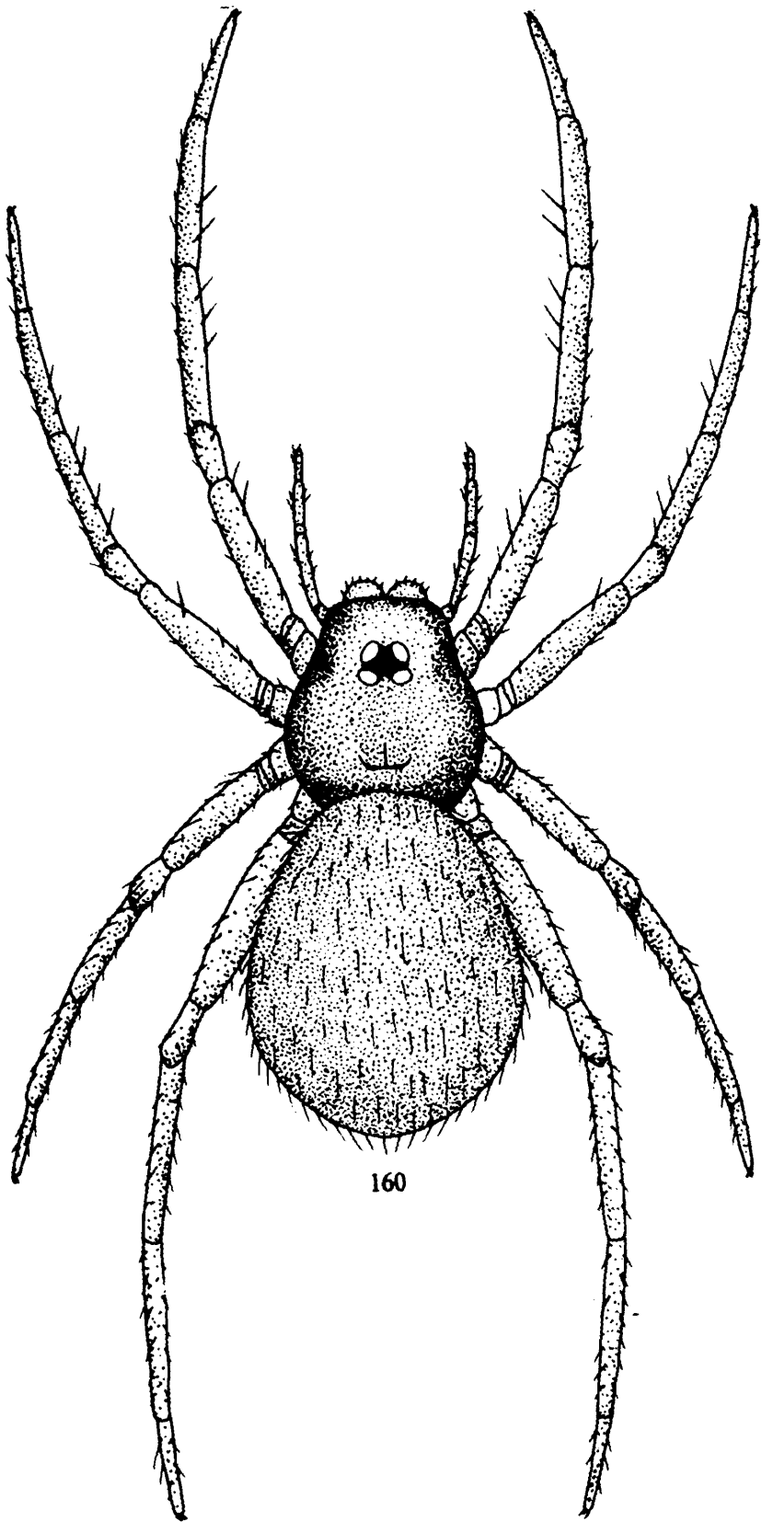


Fig. 160. Dorsal view of female *Tetrablemma deccanensis* (Tikader), family Tetrablemmidae.

of the eyes. They are having six eyes in the front row with the posterior median eyes moved forward laterally.

Distribution Tropical and subtropical countries of the world.

The only genus *Selenops*, is represented in India with six species.

200. *S. radiatus* Latreille
201. *S. shevaroyensis* Gravely
202. *S. montigenus* Simon
203. *S. danoli* Tikader
204. *S. sumitrae* Patel & Patel
205. *S. nilgirinus* Reimoser

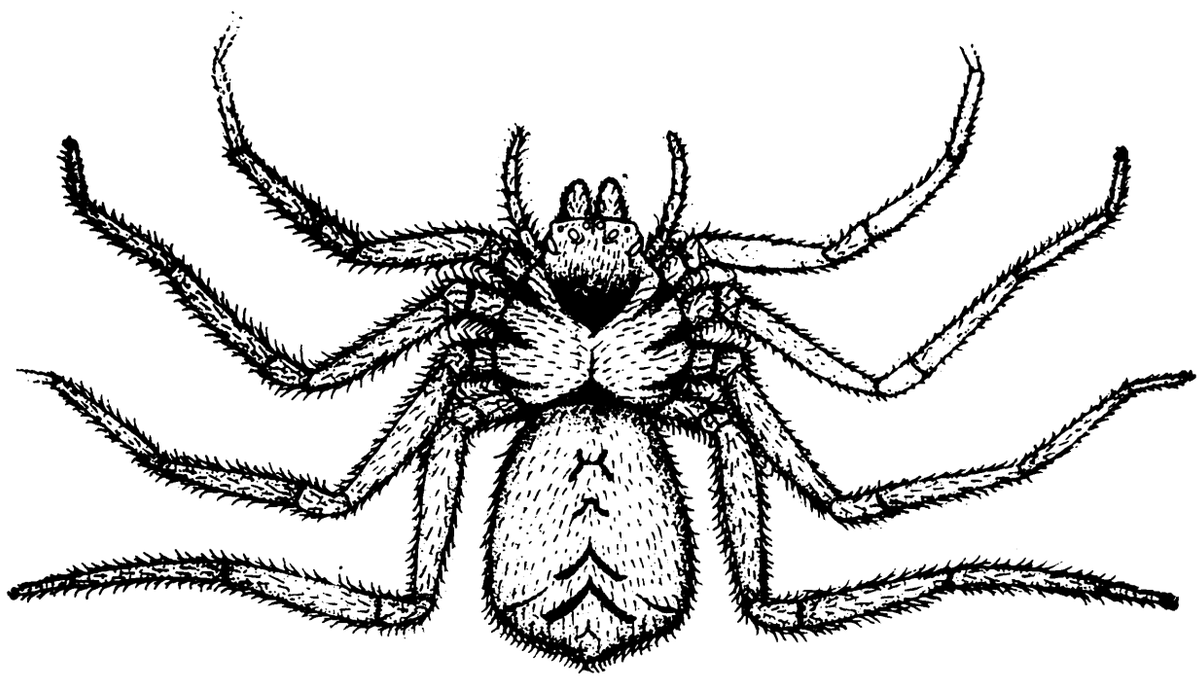


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Fig. 161. Dorsal view of female *Selenops radiatus* Latreille of the family Selenopidae.

FAMILY 27. LYSSOMANIDAE
Fig. 162

Previously the Lyssomanid spiders were included in the family Salticidae but they are sharply separated from Salticids in having the anterior lateral eyes placed behind the anterior medians. Thus they have four rows of eyes,each row consisting of two eyes, whereas salticids are provided with three rows of eyes–anterior row of four eyes, middle and posterior rows with two eyes.

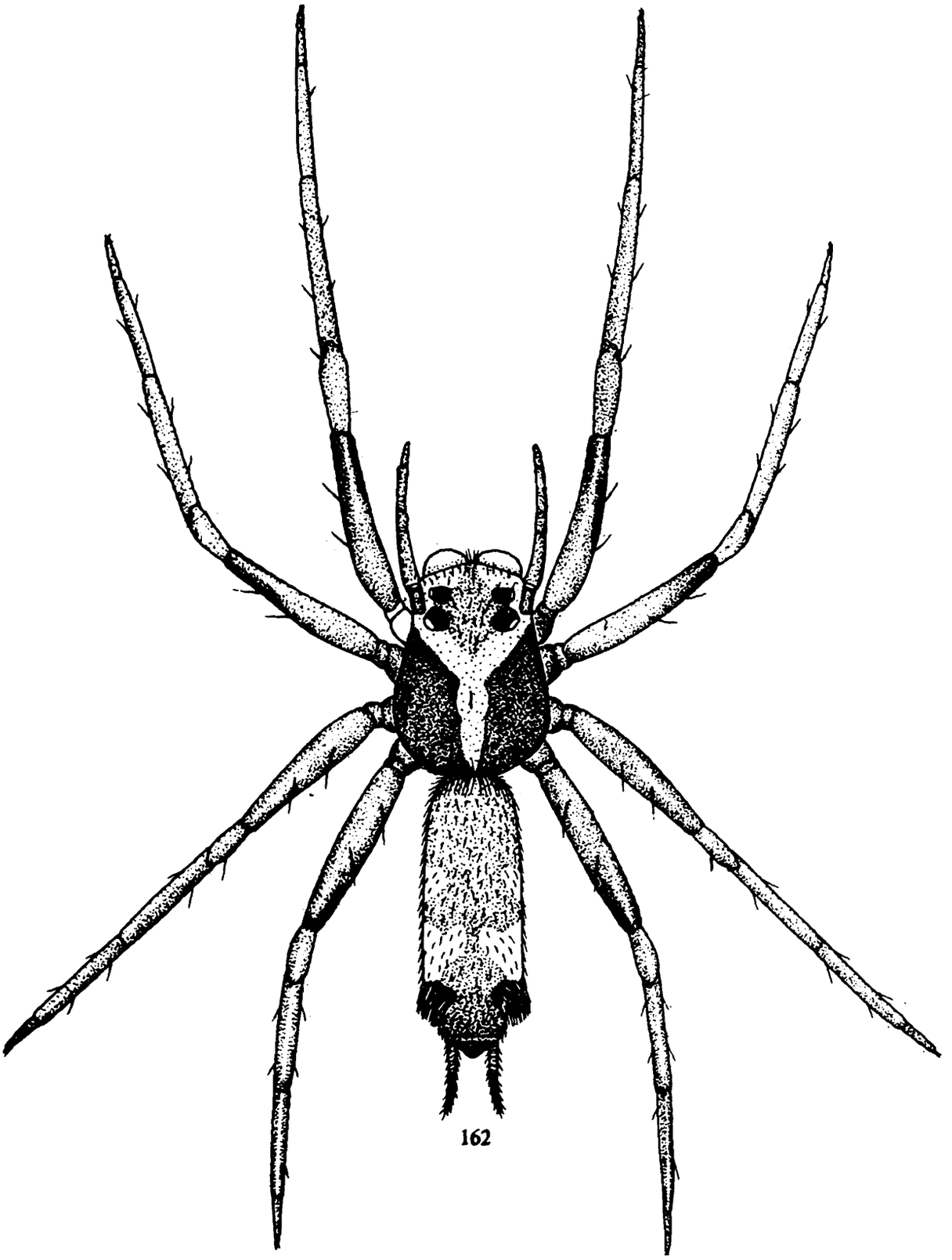


Fig. 162. Dorsal view of female *Lyssomanes andamanensis* Tikader, family Lyssomanidae.

Lyssomanid spiders are very rare in our Indian fauna, only 4 species belonging to three genera, have so far been recorded from India. These spiders are very active and apparently fearless.

Distribution : Africa; South America; North America; India, Burma, Sri Lanka.

The species represented from our country are given below.

Genus *Asamonea*
206. *A. tenuipes* (Cambridge)

Genus *Onomastus*
207. *O. patellaris* Simon

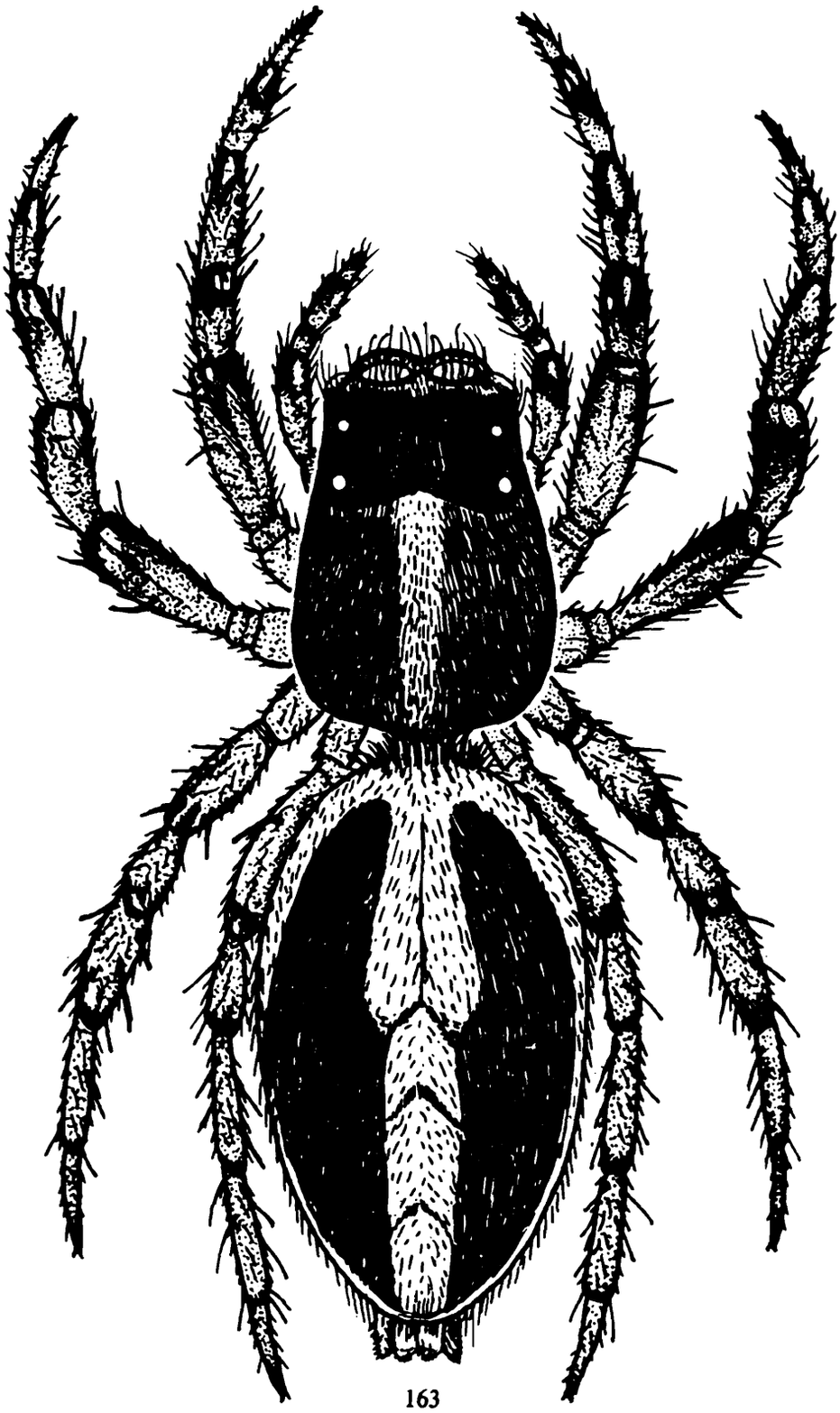
Genus *Lyssomanes*
208. *L. sikkimensis* Tikader
209. *L. andamensis* Tikader

FAMILY 28. SALTICIDAE
(Jumping-spiders)
Fig. 163

This is a very large family but our knowledge is very insufficient about them. The jumping spiders are of medium or small size, with a short body and stout legs which are furnished with two tarsal claws. They are common on plants, logs, fences, and walls of buildings. They attract attention by their peculiar appearance; their short, stout legs, bright colours, conspicuous eyes and their quick jumping movements being very different from those of other spiders. They make use of the visual sense to hunt their prey in broad daylight, and are common in sunny areas. The members of this family can be easily recognised by the peculiar arrangement of their eyes and the relative size of the different pairs of eyes and have the keenest vision of all spiders. They also display the remarkable courtship behaviour.

Distribution Cosmopolitan.

Genus *Myrmarachne*
210. *M. plataleoides* (Cambridge) 211 *M. orientales* Tikader



163

Fig. 163. Dorsal view of female *Plexippus paykullii* (Savigny & Audouin), family Salticidae.

212. *M. poonaensis* Tikader
213. *M. maratha* Tikader
214. *M. bengalensis* Tikader
215. *M. tristis* (Simon)
216. *M. manductor* (Westwood)
217. *M. lactas* (Thorell)
218. *M. himalayensis* Narayan
219. *M. incerta* Narayan
220. *M. paiva* Narayan
221. *M. ramunni* Narayan
222. *M. satarensis* Narayan
223. *M. uniseriatus* Narayan
224. *M. hidaspis* Caporiacco
225. *M. maxillosa* (C. L. Koch)
226. *M. opaca* (Karch)
227. *M. providus* (Peckham)
228. *M. roweri* Reimoser

Genus *Phidippus*

229. *P. punjabensis* Tikader
230. *P. indicus* Tikader
231. *P. pateli* Tikader
232. *P. yashodharae* Tikader
233. *P. khandalaensis* Tikader

Genus *Salticus*

234. *S. ranjitus* Tikader
235. *S. andamanensis* Tikader

Genus *Marpissa*

236. *M. ludhianaensis* Tikader
237. *M. decorata* Tikader
238. *M. dhakuriensis* Tikader
239. *M. calcuttaensis* Tikader
240. *M. bengalensis* Tikader
241. *M. mandali* Tikader
242. *M. andamanensis* Tikader
243. *M. kalapani* Tikader

Genus *Rhene*

244. *R. indicus* Tikader
245. *R. danieli* Tikader
246. *R. khandalaensis* Tikader
247. *R. decoratus* Tikader
248. *R. callida* Peckham
249. *R. callosa* (Peckham)
250. *R. flavicomana* Simon
251. *R. rubrigera* (Thorell)

Genus *Vicaria*

252. *V. diademata* Simon
253. *V. diatreta* Simon
254. *V. dimidiata* Simon
255. *V. elegans* Thorell
256. *V. formosa* Simon
257. *V. hassettii* (Thorell)
258. *V. minima* Reimoser
259. *V. sponsa* Simon

Genus *Icius*

260. *I. flavipes* Capariacco
261. *I. pseudoicoides* Caporiacco
262. *I. icioides* (Simon)

Genus *Euophrys*

263. *E. chiriatapuensis* Tikader
264. *E. salomonis* Caporiacco

Genus *Zygoballus*

265. *Z. pashanensis* Tikader
266. *Z. narmadaensis* Tikader

Genus *Harmochirus*

267. *H. lloydii* Narayan
268. *H. brachiatus* (Thorell)

Genus *Telamonia*
269. *T. accentifera* Simon
270. *T. peckhamia* Thorell
271. *T. vittata* (C. L. Koch)

Genus *Portia*
272. *P. albolimbata* (Simon)
273. *P. semifimbriata* (Simon)

Genus *Linus*
274. *L. fimbriatus* (Doleschall)
275. *L. albimanus* Simon

Genus *Cyrba*
276. *C. algerina* (Lucas)
277. *C. micans* Simon

Genus *Pilia*
278. *P. escheri* Reimoser
279. *P. saltabunda* Simon

Genus *Chrysilla*
280. *C. macrops* Simon
281. *C. reinhardtii* Thorell

Genus *Cosmophasis*
282. *C. miniaceomicans* (Simon)
283. *C. umbratica* Simon

Genus *Epocilla*
284. *E. aurantiaca* (Simon)
285. *E. xylina* Simon

Genus *Plexippus*
286. *P. redimitus* Simon
287. *P. paykullii* (Savigny & Audouin)

Genus *Sitticus*
288. *S. diductus* (O. P. Cambridge)
289. *S. pubescens* (Fabricius)

Genus *Maevia*
290. *M. himalaya* Tikader

Genus *Sandalodes*
291. *S. semicupreus* (Simon)

Genus *Colaxes*
292. *C. nitidiventris* Simon

Genus *Piranthus*
293. *P. casteti* Simon

Genus *Chalcotropis*
294. *C. pennata* Simon

Genus *Panysinus*
295. *P. grammicus* Simon

Genus *Heliophanus*
296. *H. kashmiricus* Caporiacco

Genus *Pseudicius*
297. *P. modestus* Simon

Genus *Aellurillus*
298. *A. quadrimaculatus* Simon

Genus *Langona*
299. *L. tigrina* (Simon)

Genus *Saitis*
300. *S. chaperi* Simon

Genus *Mogrus*
301. *M. fabrei* Simon

Genus *carrhotus*
302. *C. viduus* (C. L. Koch)

Genus *Evarcha*
303. *E. jucunda* (Lucas)

Genus *Ligurra*
304. *L. albostriata* (Thorell)

Genus *Stenaelurillus*
305. *S. lesserti* Reimoser

Genus *Thiania*
306. *T. oppressa* (Thorell)

Genus *Bianor*
307. *B. carli* Reimoser

Genus *Thyene*
308. *T. imperialis* (Rossi)

Genua *Zeuxippus*
309. *Z. histrio* Thorell

FAMILY 29. CTENIDAE
Fig. 164

This is a small family of spiders and closely allied to the family Clubionidae, but it differs in most cases from that family in the

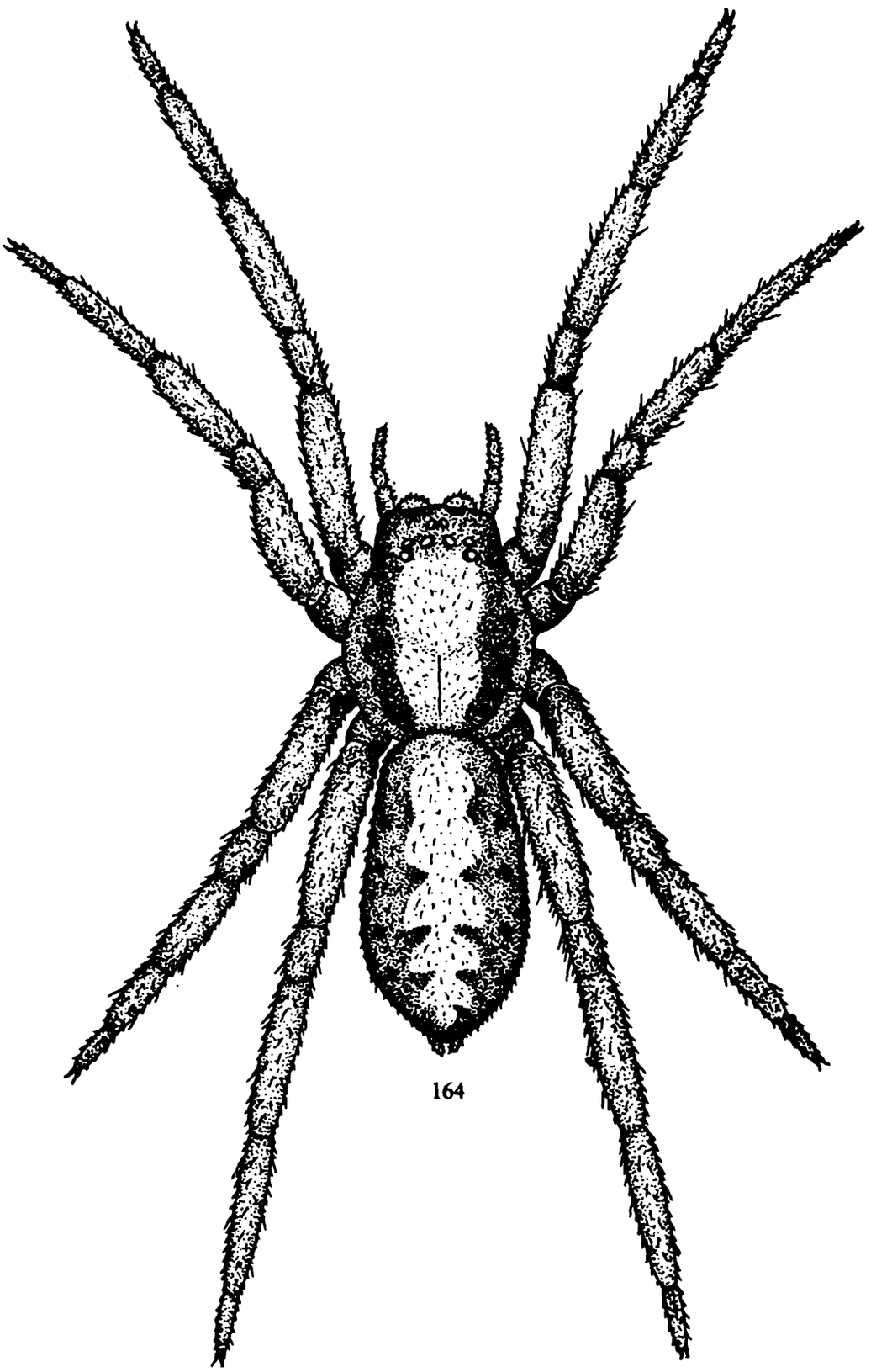


Fig. 164. Dorsal view of female *Ctenus smythiesi* Simon of the family Ctenidae.

arrangement of their eyes. They also differ from the clubionids in that, the truncate end of the endites is entirely clothed with very dense uneven hairs. Tarsi are provided with two claws. The eyes are in three rows, the anterior lateral eyes being opposite the posterior median eyes or nearly so. The members of this family wander about in search of their prey in forests at night. Some of the tropical species are very large. They make no web for dwelling, but some species appear to inhabit burrows in the ground.

Distribution : Tropical and sub-tropical parts of the world.

The only genus *Ctenus* with 13 species, reported from our country, are as follows :

310. *C. cochinensis* Gravely
311. *C. kapuri* Tikader
312. *C. meghalayensis* Tikader
313. *C. denticulatus* (Simon)
314. *C. ceylonensis* Camb.
315. *C. andamanensis* Gravely
316. *C. sikkimensis* Gravely
317. *C. indicus* Gravely
318. *C. trabifer* Thorell
319. *C. himalayensis* Gravely
320. *C. corniger* Cambridge
321. *C. smythiesi* Simon
322. *C. bomdilaensis* Tikader & Malhotra

FAMILY 30. THOMISIDAE
(Crab-spiders)
Fig. 165

The typical members of this family have a peculiarly crab-like appearance. Carapace and abdomen are usually short and broad, but some-what elongated in *Tibellus* and *Thanatus*. Eyes are small, and in two rows, particularly the posterior eyes are usually encircled with black rings, both rows are recurved. First two pairs of legs long and stout and frequently move sidewise as done by a crab but the legs are less laterigrade in the genera *Philodromus* and *Thanatus* and not at all in *Tibellus*. In one of the members of the genus *Oxyptila*, the integument is furnished with some characteristic clavate setae. Thomisid spiders spin no web; some species run swiftly and pursue their prey while others of slower gait, depending on their concealing colours lie in wait for the prey. They live chiefly on plants and foliages and in the winter hide themselves in the cracks under stones

and bark. Some species camouflage themselves in flowers and wait in ambush to attack on insects visiting the flowers for honey. These are brightly coloured, like the flowers where they inhabit, so that insects visiting these flowers may be within the reach of a spider before seeing it.

Two sub-families of Thomisidae are known so far from India, *viz.*, MISUMENINAE and PHILODROMINAE.

Distribution : Thomisid spiders are cosmopolitan in distribution.

Subfamily MISUMENINAE

In this subfamily the tarsi of the first and second pairs of legs are not furnished with scopulae in either sex. I and II pair of legs much longer than III and IV; the hairs of the body are filiform or rod-shaped or erect; and the upper margin of the furrow of the chelicera is without tooth.

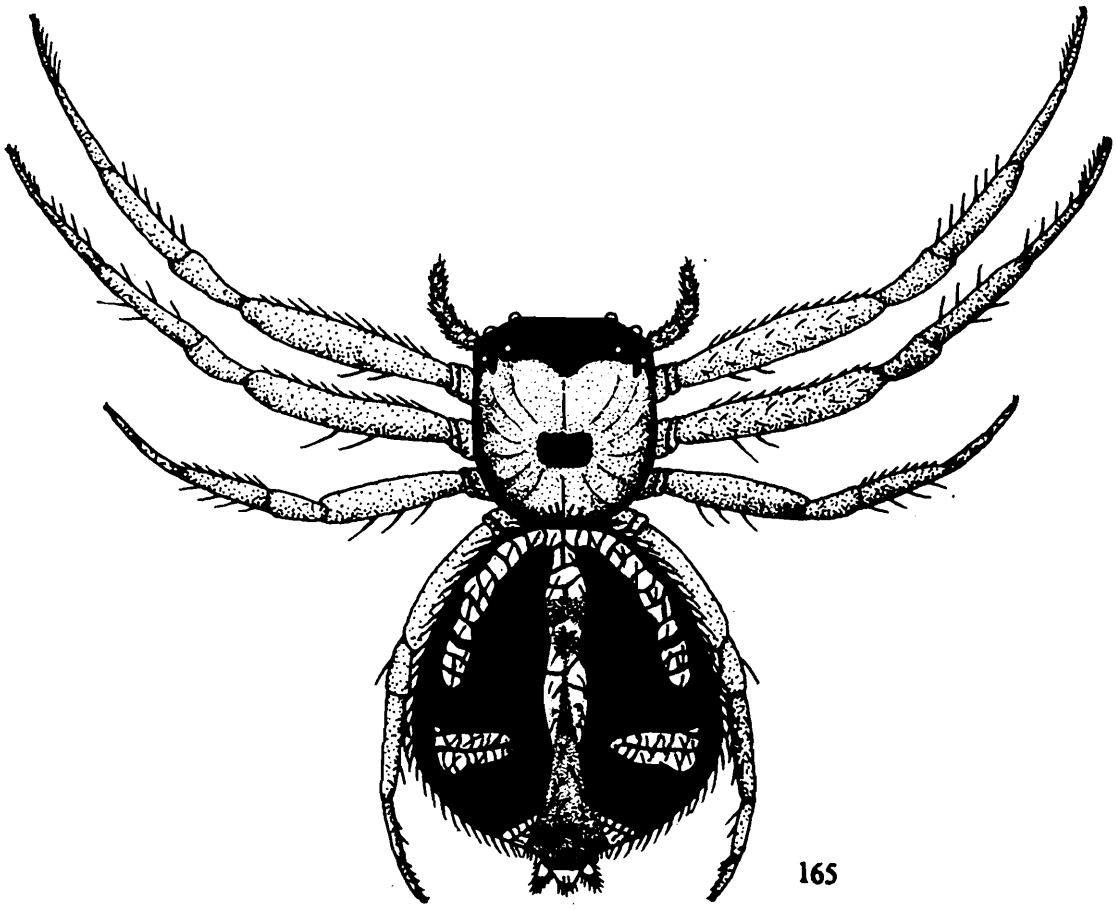


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Fig. 165. Dorsal view of female *Camaricus formosus* Thorell, family Thomisidae.

Key to the genera of the subfamily Misumeninae

1. Lateral eyes on strong conical protuberence.....2

   Lateral eyes not on conical protuberence.....3

2. Abdomen widened and truncated behind.....*Thomisus*

323. *T. sikkimensis* Tikader
324. *T. shivajiensis* Tikader
325. *T. pooneus* Tikader
326. *T. lobosus* Tikader
327. *T. katrajghatus* Tikader
328. *T. andamanensis* Tikader
329. *T. projectus* Tikader
330. *T. dhakuriensis* Tikader
331. *T. memae* Sen and Basu
332. *T. rishus* Tikader
333. *T. sorajail* Basu
334. *T. pugilis* Stoliczka
335. *T. bulani* Tikader
336. *T. shillongensis* Sen
337. *T. beautifularis* Basu
338. *T. cherapunjeus* Tikader
339. *T. elongatus* Stoliczka

   Abdomen long, lateral sides with longitudinal muscular corrugation.....*Runcinia*

340. *R. escheri* Reimoser
341. *R. chauhani* Sen and Basu
342. *R. roonwali* Tikader
343. *R. ghorpadei* Tikader

3. Abdomen broadened and truncated behind.....*Pistius*

344. *P. bhadurii* Basu
345. *P. gangulyi* Basu
346. *P. robusta* Basu
347. *P. sreepanchamii* Tikader
348. *P. kanikae* Basu
349. *P. kalimpus* Tikader
350. *P. barchensis* Basu
351. *P. roonwali* Basu

   Abdomen broadened but not truncated behind.....4

4. Integument clothed with some clavate setae.....*Oxyptila*

352. *O. khasi* Tikader
353. *O. manii* Tikader
354. *O. reenae* Basu
355. *O. maratha* (Tikader)
356. *O. amkhasensis* Tikader
357. *O. chandosiensis* Tikader

   Integument not clothed with clavate setae.....5

5. Cephalic region as wide as thoracic region.....*Camaricus*

358. *C. formosus* Thorell
359. *C. khandalaensis* Tikader

   Cephalic region narrower than the thoracic region.....6

6. Anterior eyes nearly equidistant.....*Misumena*

360. *M. menoka* Tikader
361. *M. horai* Tikader
362. *M. mridulai* Tikader
363. *M. indra* Tikader
364. *M. silveryi* Tikader
365. *M. annapurna* Tikader
366. *M. greenae* Tikader
367. *M. nicobarensis* Tikader
368. *M. decorata* Tikader

Anterior eyes not equidistant.....7

7. Body covered with conspicuous spines.....*Diaea*

369. *D. jaintious* Tikader
370. *D. bengalensis* Biswas & Majumdar

Body not covered with conspicuous spines.....8

8. Anterior median eyes closer to the lateral eyes than to each other.....*Xysticus*

371. *X. kamakhyai* Tikader
372. *X. hindusthanicus* Basu
373. *X. roonwali* Tikader
374. *X. shyamrupus* Tikader
375. *X. sikkimus* Tikader
376. *X. kashidi* Tikader
377. *X. mandali* Tikader
378. *X. minutus* Tikader
379. *X. sujatai* Tikader
380. *X. pynurus* Tikader
381. *X. jayantius* Tikader
382. *X. shillongensis* Tikader
383. *X. bengalensis* Tikader & Biswas
384. *X. himalayaensis* Tikader & Biswas
385. *X. kali* Tikader & Biswas
386. *X. khasiensis* Tikader

Anterior median eyes not closer to lateral eyes.....9

9. Tarsal claws of leg I with 6-12 teeth.....*Synaema*

387. *S. brunettii* Tikader
388. *S. decorata* Tikader
389. *S. mysorensis* Tikader

Tarsal claws of leg I without teeth.....10

10. Cephalothorax wider than long.....*Bomis*

390. *B. bengalensis* Tikader
391. *B. khajuriai* Tikader
392. *B. calcuttaensis* Biswas & Majumdar

Cephalothorax longer than wide.....11

11. Abdomen produced well beyond the spinnerets.....*Monaeses*

393. *M. parvati* Tikader 394. *M. mukundi* Tikader

Abdomen not produced beyond the spinnerets.....12

12. Abdomen high, with caudal tubercle.....*Tmarus*

395. *T. kotigeharus* Tikader 396. *T. pachpediensis* Tikader

Abdomen not high, without caudal tubercle.....13

13. Clypeus with a distinct, white transverse carina and carapace flat.....*Misumenoides*

397. *M. kripalaniae* Tikader 398. *M. deccanes* Tikader
399. *M. shulli* Tikader

Clypeus without white transverse carina carapace not flat.....14

14. Anterior lateral eyes larger than the median eyes.....*Misumenopes*

400. *M. khandalaensis* Tikader 401. *M. kumaonensis* Tikader
402. *M. andamanensis* Tikader

Anterior lateral eyes not larger than the median eyes.....15

15. Legs clothed with conspicuous spines.....*Pasias*

403. *P. puspagiri* Tikader 404. *P. marathas* Tikader

Legs not clothed with conspicuous spines.....16

16. Margin of clypeus with one row of small clavate hairs.....*Strigoplus*

405. *S. netravati* Tikader

Margin of clypeus without calavate hairs.....17

17. First pair of legs conspicuously robust.....*Regillus*

406. *R. elephantus* Tikader

First pair of legs not conspicuously robust.....18

18. Ant like spiders.....*Amyciaea*

407. *A. forticeps* (Cambridge)

Not ant like spiders.....*Platythomisus*

408. *P. bazarus* Tikader 409. *P. sudeepi* Biswas

Subfamily PHILODROMINAE

In this subfamily the tarsi of the first and second pair of legs are furnished with scopulae. Legs are approximately equal in length except in *Ebo*. The upper margin of the furrow of the chelicerae are armed with one or two teeth. These spiders are very active and pursue their prey with great rapidity. Most of the species live on plants; when at rest, the body is closely applied to the supporting objects, with the legs stretched out separately or in pairs.

Key to genera of the sub-family Philodrominae

1. Second pair of legs little longer than the first pair.....2

   Second pair of legs very much longer than the others.....*Ebo*

410. *E. bharatae* Tikader

2. Anterior lateral eyes nearer to the anterior median eyes than to the posterior median eyes.....*Philodromus*

411. *P. domesticus* Tikader
412. *P. assamensis* Tikader
413. *P. betrabatai* Tikader
414. *P. shillongensis* Tikader
415. *P. kendrabatai* Tikader
416. *P. devhutai* Tikader
417. *P. manikae* Tikader
418. *P. decoratus* Tikader
419. *P. mohiniae* Tikader
420. *P. bhagirathai* Tikader
421. *P. maliniae* Tikader
422. *P. durvei* Tikader
423. *P. chambaensis* Tikader
424. *P. barmani* Tikader
425. *P. tiwarii* Basu

   Anterior lateral eyes nearer to the posterior median eyes than to the anterior median eyes.....3

3. Posterior eyes strongly recurved.....4

   Posterior eyes not strongly recurved.....5

4. Cephalothorax much longer than wide. Posterior lateral eyes conspicuously removed behind.....*Tibellus*

426. *T. chaturshingi* Tikader
427. *T. poonaensis* Tikader
428. *T. elongatus* Tikader
429. *T. pashanensis* Tikader
430. *T. katrajghatus* Tikader
431. *T. pateli* Tikader

Cephalothorax not much longer than wide. Posterior lateral eyes not removed behind.....*Dieta*

432. *D. elongata* Tikader
433. *D. greenae* Tikader
434. *D. kapuri* Tikader

5. Posterior median eyes slightly nearer to each other than to laterals or equidistant and anterior lateral eyes not equidistant from the anterior medians and posterior medians.....*Thanatus*

435. *T. lanceolatus* Tikader
436. *T. dhakuricus* Tikader
437. *T. mandali* Tikader
438. *T. stripatus* Tikader

Posterior median eyes not nearer to each other than to the laterals and anterior lateral eyes equidistant from the anterior medians and posterior medians.....*Apollophanes*

439. *A. bangalores* Tikader

FAMILY 31. HETEROPODIDAE
Fig. 166

These are the giant crab-spiders, mostly tropical, and indigenous only to the warm regions of the world. Some authors use the name Sparassidae, but it is a junior synonym to Heteropodidae as the type genus–*Sparassus* is synonymised with the genus–*Olios* which is included in the family Heteropodidae. Likewise Easparassidae is not valid as it is also synonymised with Heteropodidae Platnick & Levi, 1973).

Heteropodid spiders are characterised by the presence of a soft trilobate membrane at the apex of metatarsus and the lower margin of fang furrow of chelicerae is distinct and armed with teeth. It is often seen that the female banana spider–*Heteropoda venatoria*

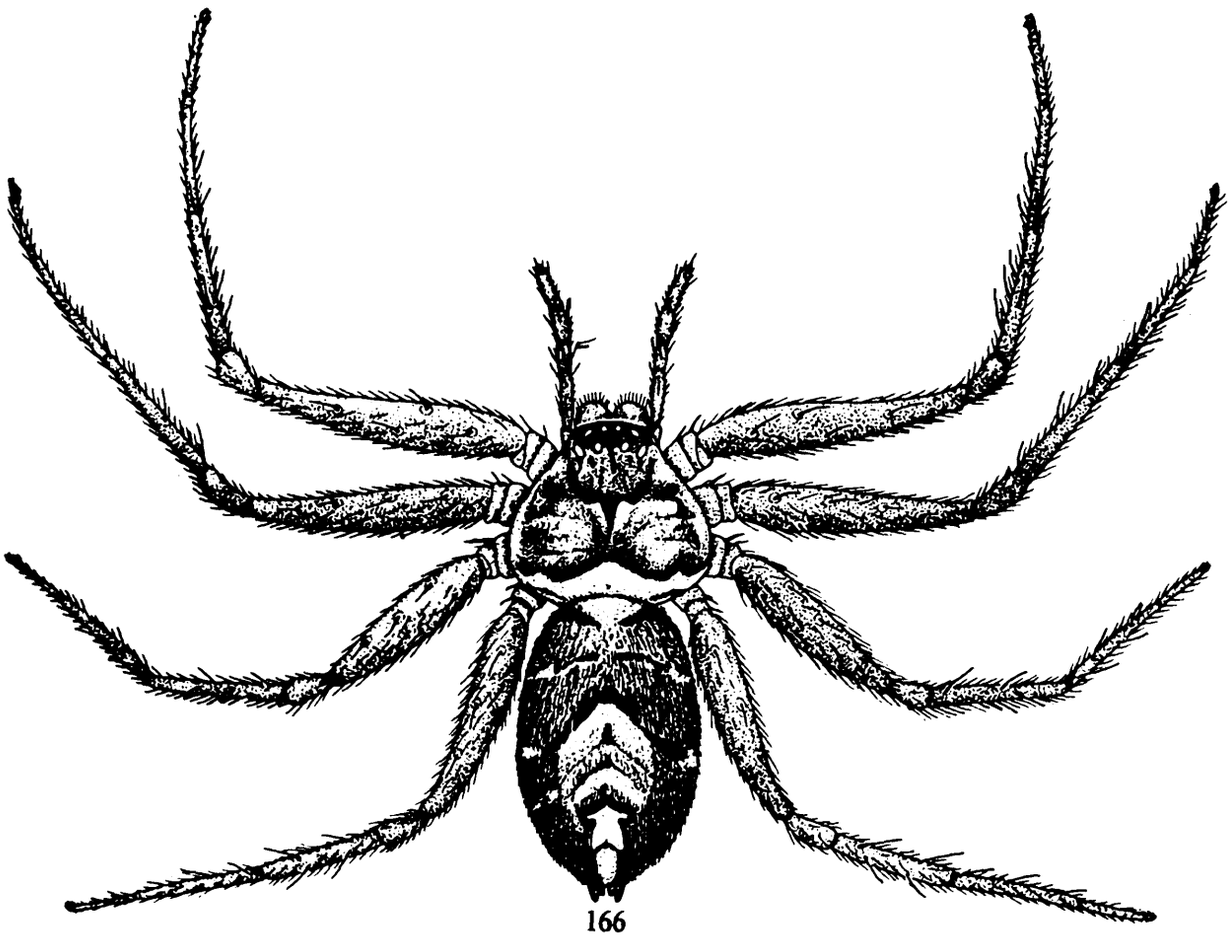

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Fig. 166. Dorsal view of female *Heteropoda venatoria* (Linnaeus) of the family Heteropodidae.

carries her egg-sac underneath the body by clasping it with pedipalps.

These spiders are found everywhere, inside fruit boxes, under stones, inside the houses in dark corners preferably in warm places.

Distribution : Tropical countries of the world.

In India 8 genera have been reported so far which contain nearly 65 species from different parts of the country.

Key to the genera of the family Heteropodidae

1. Posterior row of eyes recurved; lateral eyes prominent.....2

   Posterior row of eyes straight or procurved; lateral eyes not prominent and may be sessile.....5

2. Maxillae with distinct midlongitudinal crest; ocular quad squarish; inner margin of fang furrow armed with 5-6 teeth.....*Spariolenus*

440. *S. megalopis* Thorell
441. *S. petricola* Gravely
442. *S. tigris* Simon

Maxillae not crested; ocular quad not squarish; inner margin of fang furrow with less number of teeth.....3

3. Anterior row of eyes slightly procurved and much shorter than the posterior eye row; cephalic part of carapace much elevated and provided with a median depression; embolus of male palp encircles wholely the genital bulb.....*Torania*

443. *T. striatipes* (Leardi)
444. *T. gloriosa* Simon

Anterior row of eyes straight or procurved and more or less equally lengthed to the posterior eye row; cephalic part of carapace not elevated and without any median depression; embolus of male palp otherwise.....4

4. Ocular quad twice longer than wide and seems parallel sided; cephalic part separated from thoracic part by a distinct semicircular depression; femora provided with very long fringed bristles underneath.....*Pandercetes*

445. *P. celatus* Pocock
446. *P. decipiens* Pocock

Ocular quad less than twice longer than wide and narrow in front than behind; cephalic part slightly depressed in front; femora not provided with fringed bristles.....*Heteropoda*

447. *H. venatoria* (Linnaeus)
448. *H. altithorax* Strand
449. *H. emarginativulva* Strand
450. *H. fabrei* Simon
451. *H. hampsoni* Pocock
452. *H. lentula* Pocock
453. *H. malitiosa* Simon
454. *H. merkarensis* Strand
455. *H. minuscula* Reimoser
456. *H. nilgirina* Pocock
457. *H. pedata* Strand
458. *H. phasma* Simon
459. *H. prompta* (O. P. Cambridge)
460. *H. robusta* Fage
461. *H. rufognatha* Strand
462. *H. sexpunctata* Simon
463. *H. sikkimensis* Gravely
464. *H. smythiesi* Simon
465. *H. subplebeja* Strand
466. *H. veiliana* Strand
467. *H. warthiana* Strand
468. *H. leprosa* Simon

469. *H. kandiana* Pocock
470. *H. bhaikakai* Patel & Patel
471. *H. andamanensis* Tikader
472. *H. nicobarensis* Tikader

5. Cephalothorax larger than broad and much higher posteriorly; eye region smaller; anterior lateral eyes more than twice larger than anterior medians; eyes of anterior row close to each other.....*Panaretus*

473. *P. nirouensis* Simon

Cephalothorax otherwise and not much higher posteriorly; eye region not smaller; anterior lateral eyes otherwise; eyes of anterior row not close to each other.....6

6. Carapace narrow anteriorly and convex posteriorly but abruptly sloping down; anterior lateral eyes much larger than anterior medians; labium truncated at the apex.....*Palystes*

474. *P. flavidus* Simon
475. *P. kochi* Simon

Carapace not narrow anteriorly and posteriorly otherwise; anterior lateral eyes smaller than anterior medians; labium not truncated at the apex.....7

7. Cephalic part of carapace remarkably higher than the thoracic part; labium rounded at the apex; tibia I armed with 2 pairs of inferior spines; spinnerets without any membranous stalk and without chitinous ring.....*Olios*

476. *O. lamarcki* (Latreille)
477. *O. admiratus* (Pocock)
478. *O. fugax* (Cambridge)
479. *O. fuligineus* (Pocock)
480. *O. hampsoni* (Pocock)
481. *O. iranii* (Pocock)
482. *O. milleti* (Pocock)
483. *O. obesulus* (Pocock)
484. *O. patagiatus* (Simon)
485. *O. phipsoni* (Pocock)
486. *O. pyrozonis* (Pocock)
487. *O. rosettii* (Leardi)
488. *O. rotundiceps* (Pocock)
489. *O. stimulator* (Simon)
490. *O. striatus* (Blackwall)
491. *O. tarandus* (Simon)
492. *O. tener* (Thorell)
493. *O. wroughtoni* (Simon)
494. *O. xerxes* (Pocock)
495. *O. ferox* (Thorell)
496. *O. puncipes* Simon
497. *O. sensilis* Simon

Cephalothorax longitudinally convex; labium truncated at the apex; tibia I armed with 5-7 pairs of inferior spines; spinnerets supported on a

membranous stalk and strengthened by a hairy chitinous ring.....*Thelcticopis*

498. *T. ajax* Pocock
499. *T. bicornuta* Pocock
500. *T. maindroni* Simon
501. *T. rufula* Pocock
502. *T. serambiformis* Strand
503. *T. virescens* Pocock
504. *T. canescens* Simon

FAMILY 32. CLUBIONIDAE
Fig. 167

This is a large family of two-clawed hunting spiders,commonly encountered on foliage or on the ground where they may make tubular retreats on rolled up leaves, under stones, in litter, etc. There is little difference between the sexes though the males are slightly smaller, often with long and narrow chelicerae and somewhat slender legs.

Distribution : Cosmopolitan.

Following species under different genera have been reported so far from India.

Genus *Trachelas*

505. *T. costatus* Cambridge
506. *T. fronto* Simon
507. *T. oreophilus* Simon

Genus *Chiracanthium*

508. *C. pelasgicum* (C. L. Koch)
509. *C. adjacens* Cambridge
510. *C. approximatum* Cambridge
511. *C. conflexum* Simon
512. *C. conspersum* (Thorell)
513. *C. inornatum* Cambridge
514. *C. imcomptum* (Thorell)
515. *C. trivittatum* Simon
516. *C. vorax* Cambridge
517. *C. indicum* Cambridge
518. *C. saraswatii* Tikader
519. *C. danieli* Tikader
520. *C. nalsarovarensis* Patel & Patel
521. *C. sadanai* Tikader
522. *C. murina* Thorell
523. *C. melanostoma* (Thorell)
524. *C. himalayensis* Gravely
525. *C. trivialis* (Thorell)
526. *C. insigne* Cambridge

Genus *Clubiona*

527. *C. delectrix* Cambridge
528. *C. acanthocnemis* Simon
529. *C. hysgina* Simon
530. *C. nilgherina* Simon
531. *C. pogonias* Simon
532. *C. andamanensis* Tikader

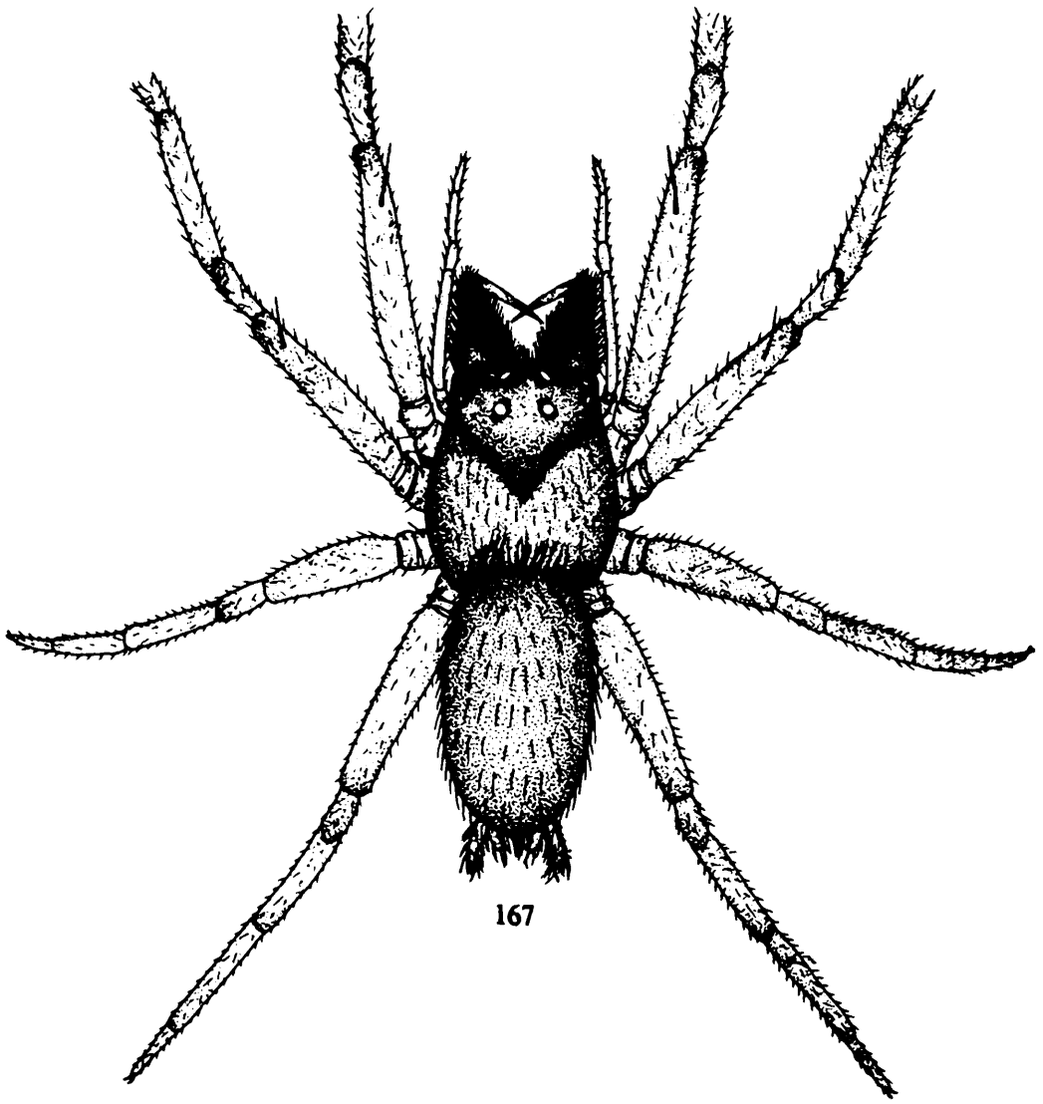


Fig. 167. Dorsal view of female *Chiracanthium danieli* Tikader, family Clubionidae.

533. *C. nicobarensis* Tikader
534. *C. pashabhaii* Patel & Patel
535. *C. ludhianaensis* Tikader
536. *C. concinna* (Thorell)
537. *C. analis* Thorell
538. *C. melanothele* Thorell
539. *C. filicata* Cambridge
540. *C. drassodes* Cambridge

Genus *Anyphaena*

541. *A. soricina* Simon

Genus *Corrina*

542. *C. gulosa* (Thorell)

Genus *Matida*

543. *M. incurvata* Reimoser

Genus *Simalo*

544. *S. castaneiceps* Simon
545. *S. percomis* Simon

Genus *Aetius*

546. *A. decollatus* Cambridge

Genus *Apochinomma*

547. *A. dolosum* Simon

Genus *Coenoptychus*

548. *C. pulcher* Simon

Genus *Corinnomma*

549. *C. fufofuscum* Reimoser

Genus *Shingius*

550. *S. barkudensis* Gravely
551. *S. bilineatus* Simon
552. *S. caniceps* Simon
553. *S. kambakamensis* Gravely
554. *S. longipes* Simon
555. *S. nilgiriensis* Gravely

Genus *Tolophus*

556. *T. submaculatus* Thorell

Genus *Castianeira*

557. *C. flavipes* (Gravely)
558. *C. zetes* (Simon)
559. *C. tinae* Patel & Patel
560. *C. indica* Tikader
561. *C. albopicta* (Gravely)
562. *C. himalayensis* (Gravely)
563. *C. quadrimaculata* (Reimoser)

Genus *Oedignatha*

564. *O. albofasciata* Strand
565. *O. carli* Reimoser
566. *O. dentifera* Reimoser
567. *O. escheri* Reimoser
568. *O. lesserti* Reimoser
569. *O. microscutata* Reimoser
570. *O. procerula* Simon
571. *O. scrobiculata* Thorell
572. *O. tricuspidata* Reimoser
573. *O. uncata* Reimoser

FAMILY 33. GNAPHOSIDAE
Fig. 168

The family Gnaphosidae formerly known as Drassidae, are those spiders which have eight heterogenous eyes arranged in two rows. The gnaphosid spiders are generally dull coloured or black, living under stones, amongst leaves or the roots of grasses or heather, normally occur only inside houses. These spiders spin a tubular retreat under stones or in rolled leaves, from which they

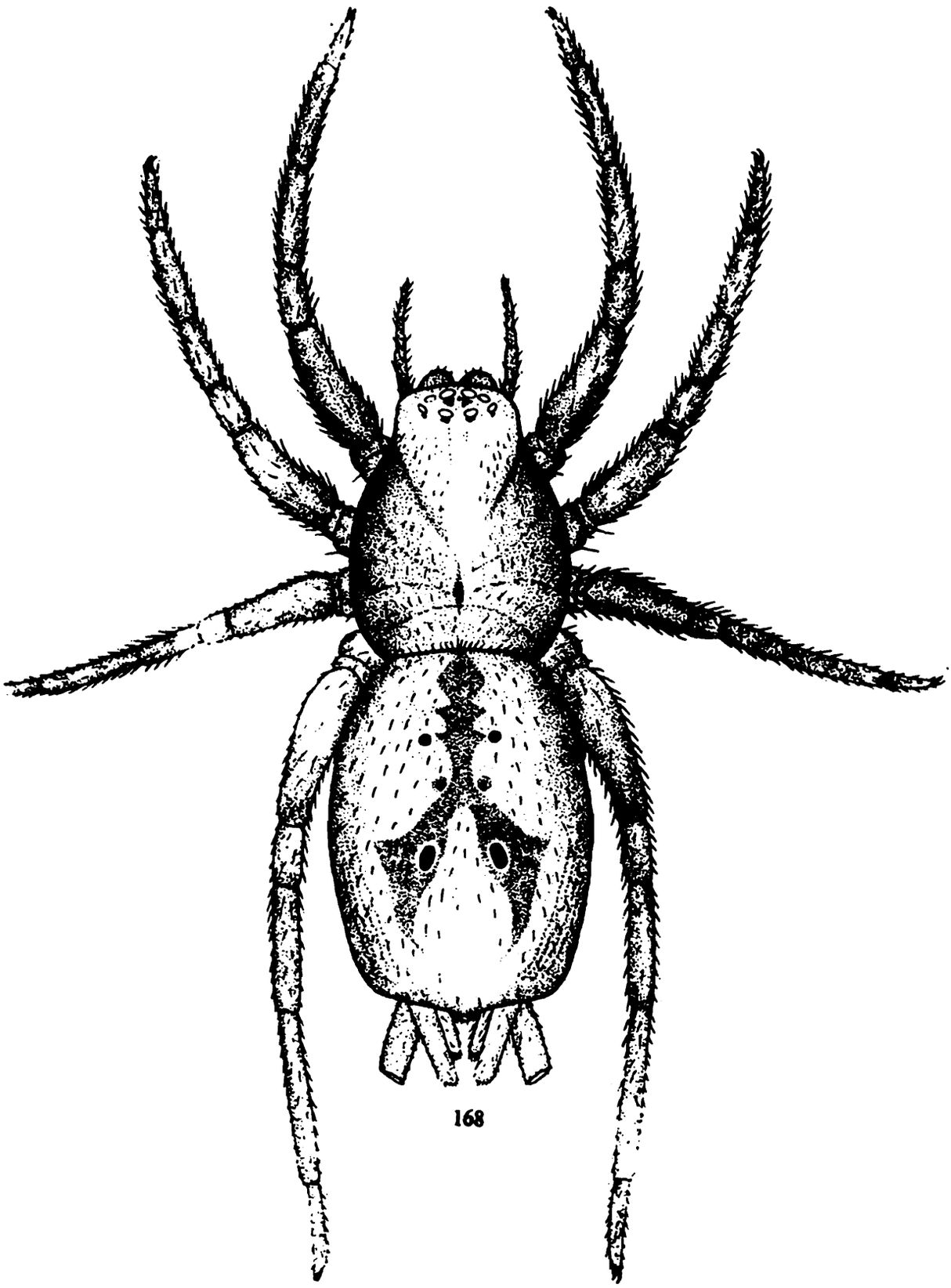


Fig. 168. Dorsal view of female *Drassodes luridus* (O. P. Cambridge) of the family Gnaphosidae.

emerge to hunt. Most of these spiders are nocturnal in habit. Cephalothorax, broad or attenuated in front, is marked with a fovea. Anterior median eyes are generally distinctly darker than the rest; posterior medians are irregular in shape. Abdomen is usually long and narrow behind. Labium is longer than broad, reaching beyond the mid point of maxillae. Legs rather long and bear spines. The tarsi bear scopulae and are provided with two pectinate claws and claw tufts.

Distribution : All over the world.

Key to the genera of the family Gnaphosidae

1. Inner margin of cheliceral fang furrow with a keeled lamina.....2

   Inner margin of cheliceral fang furrow smooth, or with one or more distinct teeth or denticles.....4

2. Inner margin of chelicera with a wide serrated lamina. Posterior row of eyes much longer than the anterior, with the medians nearer to each other than to the laterals. Maxillae rounded.....*Gnaphosa*

574. *G. kailana* Tikader
575. *G. poonaensis* Tikader
576. *G. pauriensis* Tikader & Gajbe
577. *G. harpax* (Cambridge)
578. *G. jodhpurensis* Tikader & Gajbe
579. *G. stoliczkae* Cambridge

   Inner margin of chelicera without serrated lamina. Posterior row of eyes slightly longer than the anterior, with the medians nearer to the laterals than to each other. Maxillae not rounded.....3

3. Inner margin of chelicera with two or three translucent laminae. Posterior median eyes rectangular in shape.....*Eilica*

580. *E. tikaderi* Platnick
581. *E. platnicki* Tikader & Gajbe

   Inner margin of chelicera with a broad keel or a narrow lamina. Posterior median eyes oval in shape.....*Callilepis*

582. *C. rukminae* Tikader & Gajbe
583. *C. rajasthanicus* Tikader & Gajbe

584. *C. lambai* Tikader & Gajbe 585. *C. chakanensis* Tikader
586. *C. bangalorensis* Tikader

4. Carapace with no fovea. Anterior spinnerets close to each other. Spiders clothed with squamiform hairs.....*Micaria*

587. *M. saharanpurensis* Tikader

Carapace with a fovea. Anterior spinnerets well apart from each other. Spiders not clothed with squamiform hairs.....5

5. Chelicera remarkably narrow, bearing no teeth, but provided with an angular projection apically inside.....*Phaeocedus*

588. *P. mosambaensis* Tikader 589. *P. haribhaiius* Patel & Patel
590. *P. poonaensis* Tikader 591. *P. nicobarensis* Tikader

Chelicera remarkably broad, bearing teeth, without any angular projection apically inside.....6

6. Posterior row of eyes very strongly procurved, as nearly semicircular.....7

Posterior row of eyes not strongly procurved.....8

7. Inner margin of furrow of chelicera with one tooth. Bulb of palpus of male with a stout median apophysis.....*Scopodes*

592. *S. maitraiae* Tikader & Gajbe 593. *S. pritiae* Tikader
594. *S. kuljitae* Tikader

Inner margin of furrow of chelicera without tooth. Bulb of palpus of male simple, with no true apophysis.....*Megamyrmecion*

595. *M. ashae* Tikader & Gajbe

8. Eyes of posterior row nearly equal in size and equidistant from each other.....*Scotophaeus*

596. *S. mundulus* (Cambridge) 597. *S. nigrosegmentatus* (Simon)
598. *S. merkaricola* Strand 599. *S. madalasae* Tikader & Gajbe
600. *S. rajasthanus* Tikader 601. *S. domesticus* Tikader

602. *S. poonaensis* Tikader 603. *S. simlaensis* Tikader
604. *S. chahanius* Patel & Patel

Eyes of posterior row not equal in size and not equidistant from each other.....9

9. Tibia IV with two or more median dorsal spines.....10

Tibia IV with a single median dorsal spine or with none.....14

10. Posterior median eyes much larger than the posterior laterals and closer to laterals than to each other. Inner margin of chelicera without tooth.....*Liodrassus*

605. *L. mandae* Tikader & Gajbe

Posterior median eyes not much larger than the posterior laterals and closer to each other than to posterior laterals. Inner margin of chelicera with tooth or teeth.....11

11. Inner margin of furrow of chelicera with a single tooth.....*Geodrassus*

606. *G. sirmourensis* Tikader & Gajbe

Inner margin of furrow of chelicera with two or three teeth.....12

12. Eye rows widely separated; posterior median eyes much nearer to each other than to the laterals.....*Drassodes*

607. *D. phagduaensis* Tikader
608. *D. carinivulvus* Caporiacco
609. *D. parvidens* Caporiacco
610. *D. rubicundulus* Caporiacco
611. *D. singulariformis* Roewer
612. *D. villosus* (Thorell)
613. *D. astrologus* (Cambridge)
614. *D. cambridgei* Roewer
615. *D. cerinus* Simon
616. *D. delicatus* (Blackwall)
617. *D. heterophthalmus* Simon
618. *D. luridus* (Cambridge)
619. *D. macilentus* (Cambridge)
620. *D. omissus* (Cambridge)
621. *D. tibialis* Caporiacco
622. *D. andamanensis* Tikader
623. *D. malodes* Tikader
624. *D. gangeticus* Tikader & Gajbe
625. *D. oppenheimeri* Tikader
626. *D. sagarensis* Tikader
627. *D. lubrica* (Simon)
628. *D. ferrugineus* (Blackwall)
629. *D. deoprayagensis* Tikader & Gajbe
630. *D. sitae* Tikader & Gajbe

631. *D. gujaratensis* Patel & Patel
632. *D. meghalayaensis* Tikader & Gajbe
633. *D. indraprastha* Tikader & Gajbe
634. *D. singularis* Caporiacco
635. *D. himalayensis* Tikader & Gajbe
636. *D. pashanensis* Tikader & Gajbe

Eye rows close together; posterior median eyes otherwise.....13

13. Eye rows close together but equidistantly separated with each other; posterior median eyes well separated, being only a little further from the laterals than from each other.....*Sosticus*

637. *S. nainitalensis* Gajbe
638. *S. dherikanalensis* Gajbe
639. *S. solanensis* Gajbe
640. *S. sundargarhensis* Gajbe
641. *S. poonaensis* Tikader

Eye rows close together but less separated at the lateral sides as the posterior row slightly procurved to the straight anterior row; posterior median eyes are equidistant to the laterals.....*Talanites*

642. *T. tibialis* Caporiacco

14. Upper margin of furrow of chelicera unarmed, or provided with a keel, or with three teeth, rarely more; the lower margin unarmed or with but a single tooth, bulb of male palpus with no apophyses, at most with one or several small teeth near base of embolus.....15

Upper margin of furrow of chelicera with three to six distinct teeth, the lower margin provided with two or three, or rarely with only one; bulb of male palpus with one or more apophyses.....18

15. Posterior row of eyes more or less recurved.....16

Posterior row of eyes more or less procurved, or sometimes straight.....17

16. Tibia III with a median dorsal spine; carapace without distinct median furrow.....*Sergiolus*

643. *S. singhi* Tikader & Gajbe
644. *S. poonaensis* Tikader & Gajbe
645. *S. meghalayensis* Tikader & Gajbe

Tibia III with no median dorsal spine; carapace with a distinct median furrow.....*Poecilochroa*

646. *P. barmani* Tikader
647. *P. sedula* (Simon)

17. Lower margin of furrow chelicera smooth without any tooth; anterior median eyes usually obviously smaller than the laterals. Posterior median eyes slightly larger than the laterals.....*Nodocion*

648. *N. solanensis* Tikader & Gajbe

Lower margin of furrow of chelicera with one tooth or nodule; anterior median eyes usually as larger as or larger than the laterals. Posterior median eyes always well separated from each other and smaller than or at most as large as the laterals.....*Herpyllus*

649. *H. bicolor* (Simon)
650. *H. goaensis* Tikader

18. Upper margin of furrow of chelicera with three teeth, the lower margin provided with two, all well developed. Posterior median eyes large and oblique, typically close together but well separated from the laterals.....*Haplodrassus*

651. *H. smythiesi* (Simon)
652. *H. tehriensis* Tikader & Gajbe
653. *H. sataraensis* Tikader & Gajbe
654. *H. dumdumensis* Tikader

Upper margin of furrow of chelicera provided with two to three small teeth or nodules, or rarely the upper margin armed with only three weak teeth and the lower margin with only one. Posterior medians are different.....19

19. Posterior row of eyes straight or slightly procurved; the eyes are equidistant; the medians are small or slightly larger than the laterals.....*Zelotes*

655. *Z. sindi* Caporiacco
656. *Z. chandosiensis* Tikader & Gajbe
657. *Z. poonaensis* Tikader & Gajbe
658. *Z. nainitalensis* Tikader & Gajbe
659. *Z. surekhae* Tikader & Gajbe
660. *Z. shantae* Tikader
661. *Z. sajali* Tikader & Gajbe
662. *Z. baltoroi* Caporiacco
663. *Z. naliniae* Tikader & Gajbe
664. *Z. nasikensis* Tikader & Gajbe

665. *Z. mandae* Tikader & Gajbe
666. *Z. desioi* Caporiacco
667. *Z. pseudopusillus* Caporiacco
668. *Z. kusumae* Tikader
669. *Z. mandlaensis* Tikader & Gajbe
670. *Z. ashae* Tikader & Gajbe
671. *Z. sataraensis* Tikader & Gajbe
672. *Z. jabalpurensis* Tikader & Gajbe
673. *Z. choubeyi* Tikader & Gajbe
674. *Z. hospitus* (Simon)
675. *Z. nilgirinus* Reimoser
676. *Z. pexus* (Simon)
677. *Z. univittatus* (Simon)

Posterior row of eyes otherwise; the eyes are differently arranged; the median eyes are otherwise.....20

20. Posterior row of eyes procurved; posterior medians are very close with each other; Posterior medians larger than the posterior laterals.....*Drassyllus*

678. *D. mahabalei* Tikader
679. *D. khajuriai* Tikader & Gajbe
680. *D. ratnagiriensis* Tikader & Gajbe

Posterior row of eyes slightly recurved; posterior medians considerably separated from each other; Posterior medians slightly smaller than the posterior laterals.....*Scotophinus*

681. *S. maindroni* Simon

FAMILY 34. PRODIDOMIDAE
Fig. 169

Spiders of the family Prodidomidae are very rare and generally are found under stones or in other dark and dry places. These spiders are slow in movement except those belonging to the genus–*Zimiris* which are very fast.

The prodidomids are two clawed and eight eyed spiders. Eyes are in three rows, anterior median eyes are dark. Chelicerae are robust and provided with very long and slender fangs. Tarsal claws are smooth.

Distribution : Africa, Australia, South America, North America, Far-east countries and Indian sub-continent.

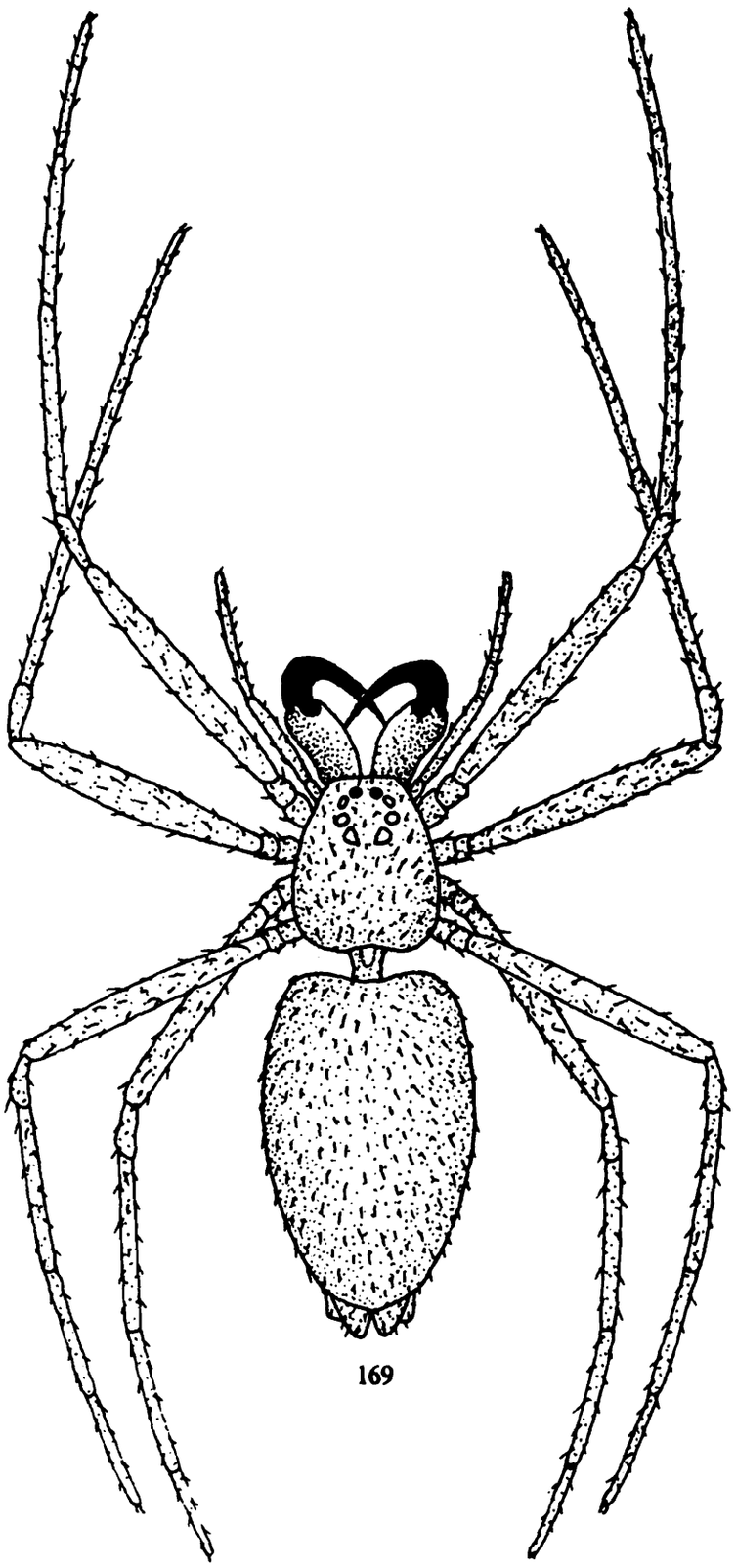


Fig. 169. Dorsal view of female *Prodidomus chéperi* (Simon), family Prodidomidae.

Key to the genera of the family Prodidomidae

1. Anterior lateral eyes roundish in shape; chelicerae strongly divergent; cheliceral fangs very long and thin; fangs cross each other when closed.....*Prodidomus*

682. *P. chaperi* (Simon)

Anterior lateral eyes angular in shape; chelicerae moderately divergent; cheliceral fangs small and medium strong; do not cross each other when closed.....*Zimiris*

683. *Z. indica* Simon

FAMILY 35. HAHNIIDAE
Fig. 170

These are small spiders which build delicate sheet webs without retreats, usually near water on the ground or in moss, rarely in dry places between or under stones. The webs are so delicate that they are generally invisible unless covered with dew. They are sharply distinguished from the Agelenidae and other spiders by the arrangement of the six spinnerets, which are arranged in a single transverse row. Tracheal spiracle away from the spinnerets at least one-third of the distance of epigastric furrow.

Distribution : Colder parts of the world.

The only Indian genus *Hahnia* is reported so far from our fauna.

684. *H. maindroni* Simon
685. *H. alini* Tikader
686. *H. mridulae* Tikader

FAMILY 36. OXYOPIDAE
(The Lynx-spiders)
Fig. 171

The lynx-spiders are so called because they chase their prey with great rapidity over grass and the foliage of trees and shrubs; they even jump from branch to branch like the salticid spiders. The legs are long, with three tarsal claws but without scopulae, the

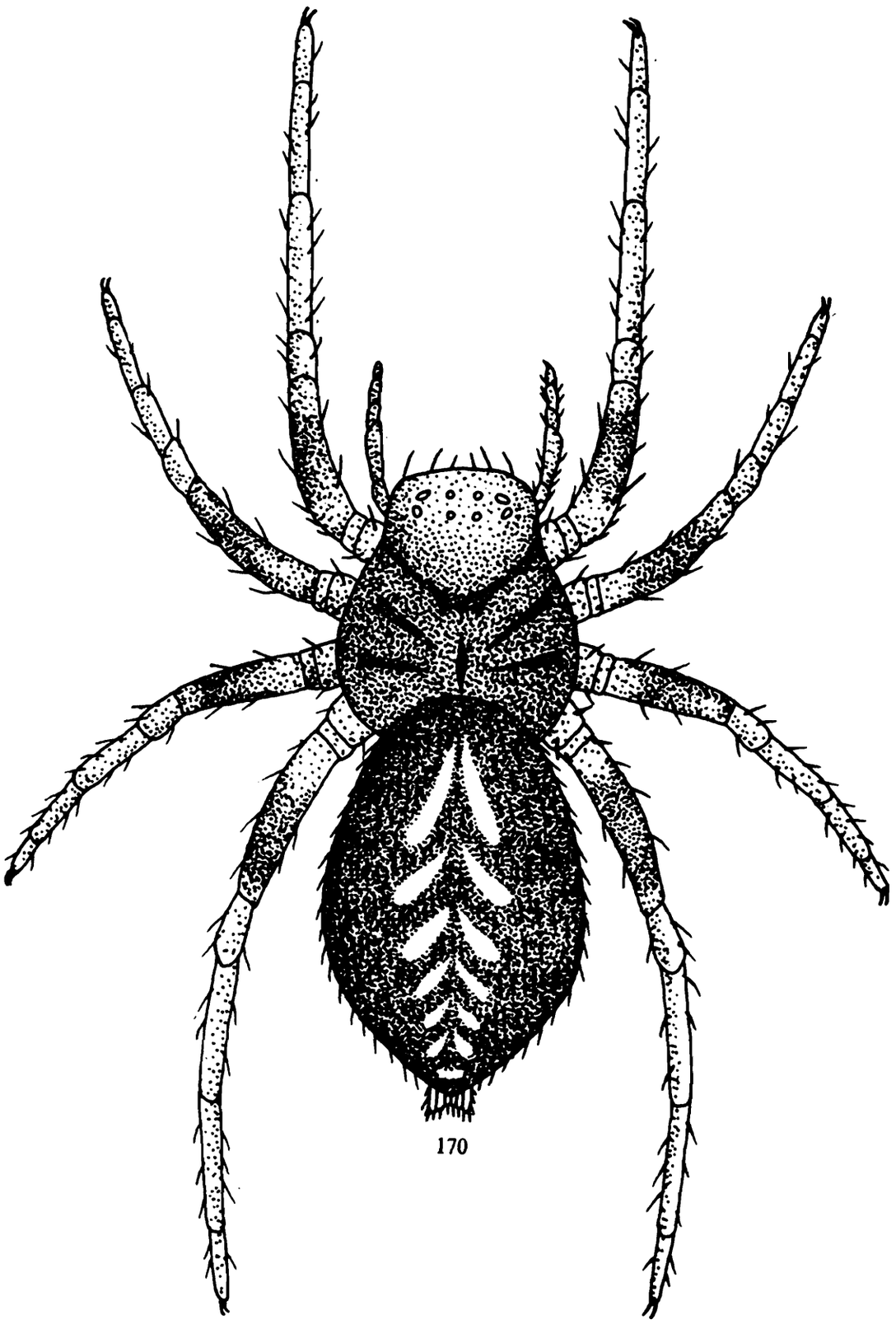
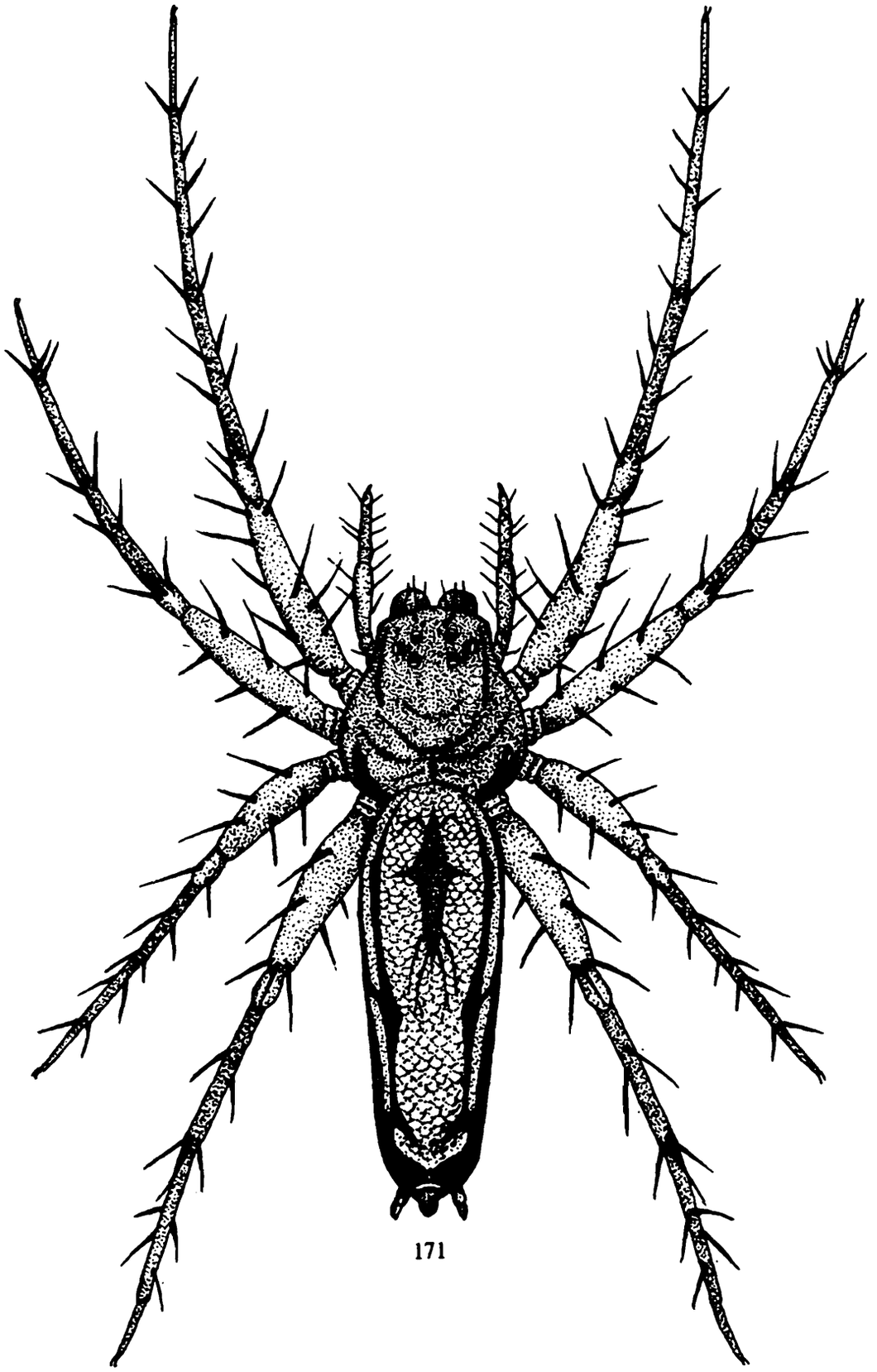


Fig. 170. Dorsal view of female *Hahnia alini* Tikader of the family Hahniidae.



171

Fig. 171. Dorsal view of female *Oxyopes shewta* Tikader family Oxyopidae.

trochanters are not notched like Pisauridae and Lycosidae. The eyes are eight in number, dark in colour and unequal in size, the anterior median eyes being very small. The anterior row of eyes is strongly recurved, the posterior row is procurved, so that there may appear to be four rows of eyes of two each.

Distribution : Temperate and tropical countries of the world.

There are two genera represented in our fauna.

Key to the genera of the family Oxyopidae

1. Eyes of the posterior row slightly procurved; fang groove of mandible unarmed.....*Peucetia*

687. *P. elegans (Blackwall)*
688. *P. graminea* Pocock
689. *P. viridana* (Stoliczka)
690. *P. procera* Thorell
691. *P. prasina* Thorell
692. *P. choprai* Tikader
693. *P. latikae* Tikader
694. *P. harishankarensis* Biswas

Eyes of the posterior row very strongly procurved; fang groove of mandible weakly armed.....*Oxyopes*

695. *O. armatipalpis* Strand
696. *O. gemellus* Thorell
697. *O. indicus* (Walck.)
698. *O. lepidus* (Blackwall)
699. *O. travancoricola* Strand
700. *O. jubilans* Cambridge
701. *O. lineatus* Latreille
702. *O. hindostanicus* Pocock
703. *O. longinquus* Thorell
704. *O. praedictus* Cambridge
705. *O. rejectus* Cambridge
706. *O. ryvesii* Pocock
707. *O. wroughtoni* Pocock
708. *O. ratnae* Tikader
709. *O. subhadrae* Tikader
710. *O. sakuntalae* Tikader
711. *O. sunandae* Tikader
712. *O. sitae* Tikader
713. *O. sikkimensis* Tikader
714. *O. shewta* Tikader
715. *O. pandae* Tikader
716. *O. assamensis* Tikader
717. *O. chittrae* Tikader
718. *O. sushilae* Tikader

FAMILY 37. THERIDIIDAE
(Comb-footed spiders)
Fig. 172

The members of this very large family, build irregular snares, from the threads of which they suspend themselves in an inverted position while waiting for their prey. These spiders have eight eyes

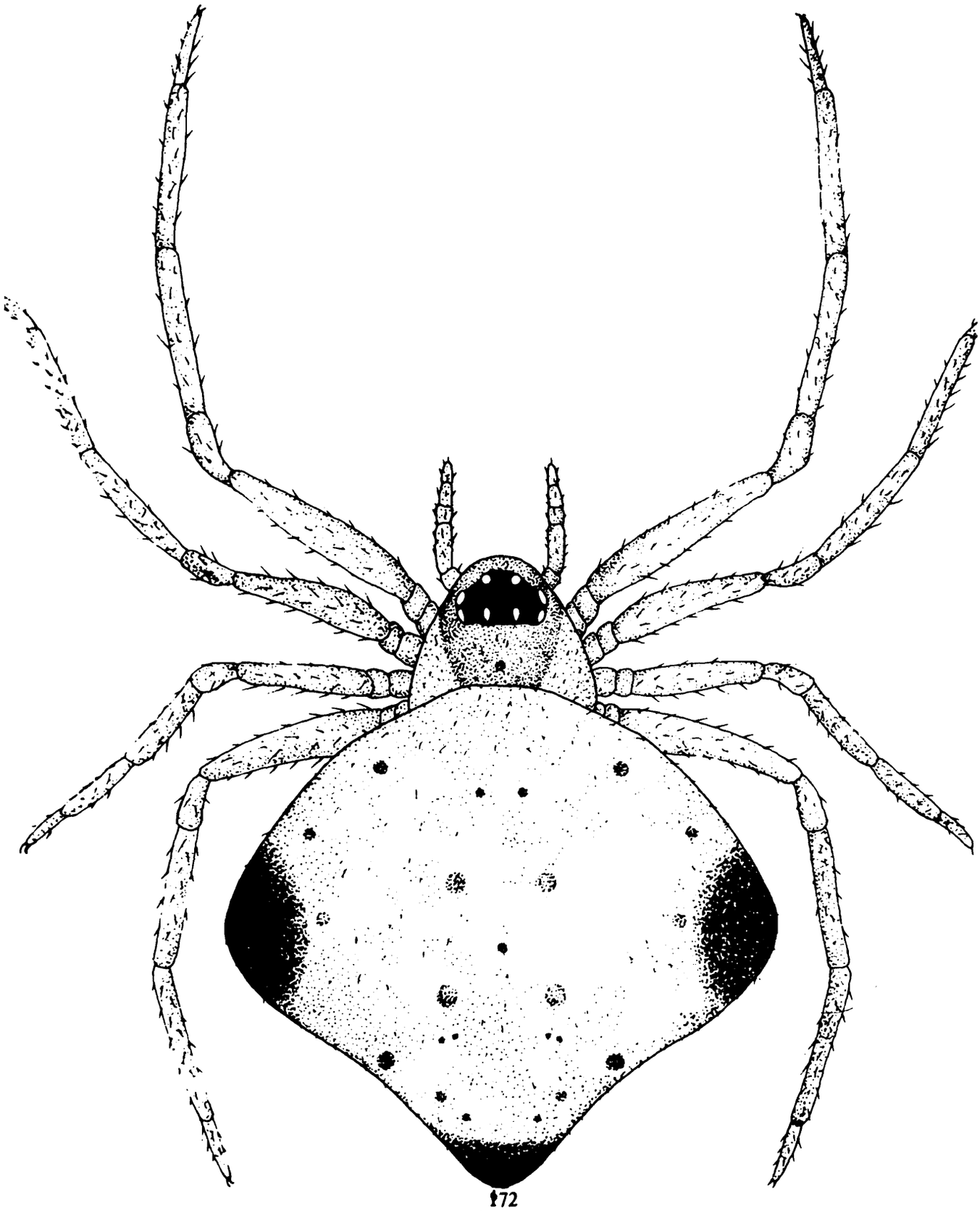


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Fig. 172. Dorsal view of female *Theridula angula* Tikader of the family Theridiidae.

and three tarsal claws. They are distinguished from other eight eyed and three clawed spiders, in fact from all other spiders, by the presence on the tarsus of the 4th pair of legs, a distinct comb, consisting of a row of strong curved and toothed setae.

Distribution : Cosmopolitan.

Following species under different genera have been reported from India.

Genus *Aroyrodes*

719. *A. scintillulanus* O. P. Cambridge
720. *A. cyrtophore* Tikader
721. *A. jamkhedes* Tikader
722. *A. gouri* Tikader
723. *A. dipali* Tikader
724. *A. ambalikai* Tikader
725. *A. gazedes* Tikader
726. *A. gazingensis* Tikader
727. *A. projectus* Tikader
728. *A. carnicobarensis* Tikader
729. *A. andamanensis* Tikader
730. *A. chiriatapurensis* Tikader
731. *A. projeles* Tikader

Genus *Theridion*

732. *T. maindroni* Simon
733. *T. nilgherinum* Simon
734. *T. spinosissimum* Caporiacco
735. *T. melanum* Hahn
736. *T. leucophaeum* Simon
737. *T. subitum* Cambridge
738. *T. subvittatum* Simon
739. *T. confuscum* Cambridge
740. *T. expallidatum* Cambridge
741. *T. incertum* Cambridge
742. *T. manjithar* Tikader
743. *T. indica* Tikader
744. *T. tikaderi* Patel

Genus *Ariamnes*

745. *A. pavesii* Leardi
746. *A. simulans* Cambridge

Genus *Enoplognatha*

747. *E. caricis* (Fickert)

Genus *Euryopis*

748. *E. nubila* Simon

Genus *Lithyphantes*

749. *L. albomaculatus* (De Geer)
750. *L. alboclathratus* Simon

Genus *Moneta*

751. *M. grandis* Simon

Genus *Propostira*

752. *P. ranii* Bhattacharya
753. *P. quadrangulata* Simon

Genus *Rhomphea*
754. *R. ornatissima* Dyal

Genus *Ulesanis*
755. *U. maindroni* Simon

Genus *Asagena*
756. *A. phalerata* (Panzer)

Genus *Teutana*
757. *T. rufoannulata* Simon

Genus *Latrodectus*
758. *L. hasselti* Thorell

Genus *Argyrodina*
759. *A. argentata* (Cambridge) 760. *A. fissifrons* (Cambridge)

Genus *Meotipa*
761. *M. picturata* Simon

Genus *Achaea*
762. *A. quadripunctata* Simon

Genus *Tomoxena*
763. *T. dives* Simon

Genus *Theridula*
764. *T. angula* Tikader

Genus *Achaearanea*
765. *A. budana* Tikader 766. *A. durgae* Tikader
767. *A. diglipuriensis* Tikader

FAMILY 38. AGELENIDAE
(Funnel-Web weavers)
Fig. 173

Most of the spiders of this family Agelenidae spin sheet like or platform like webs with a tube or funnel leading from the centre of one edge. Over the upper side of these webs the spiders run, in an upright position, seize the prey and retire with it to the funnel retreat. They are three-clawed, almost always eight eyed, sedentary spiders. They differ from the related family Clubionidae in the number of tarsal claws and in lacking scopulae on the tarsi. The hind spinnerets are very long

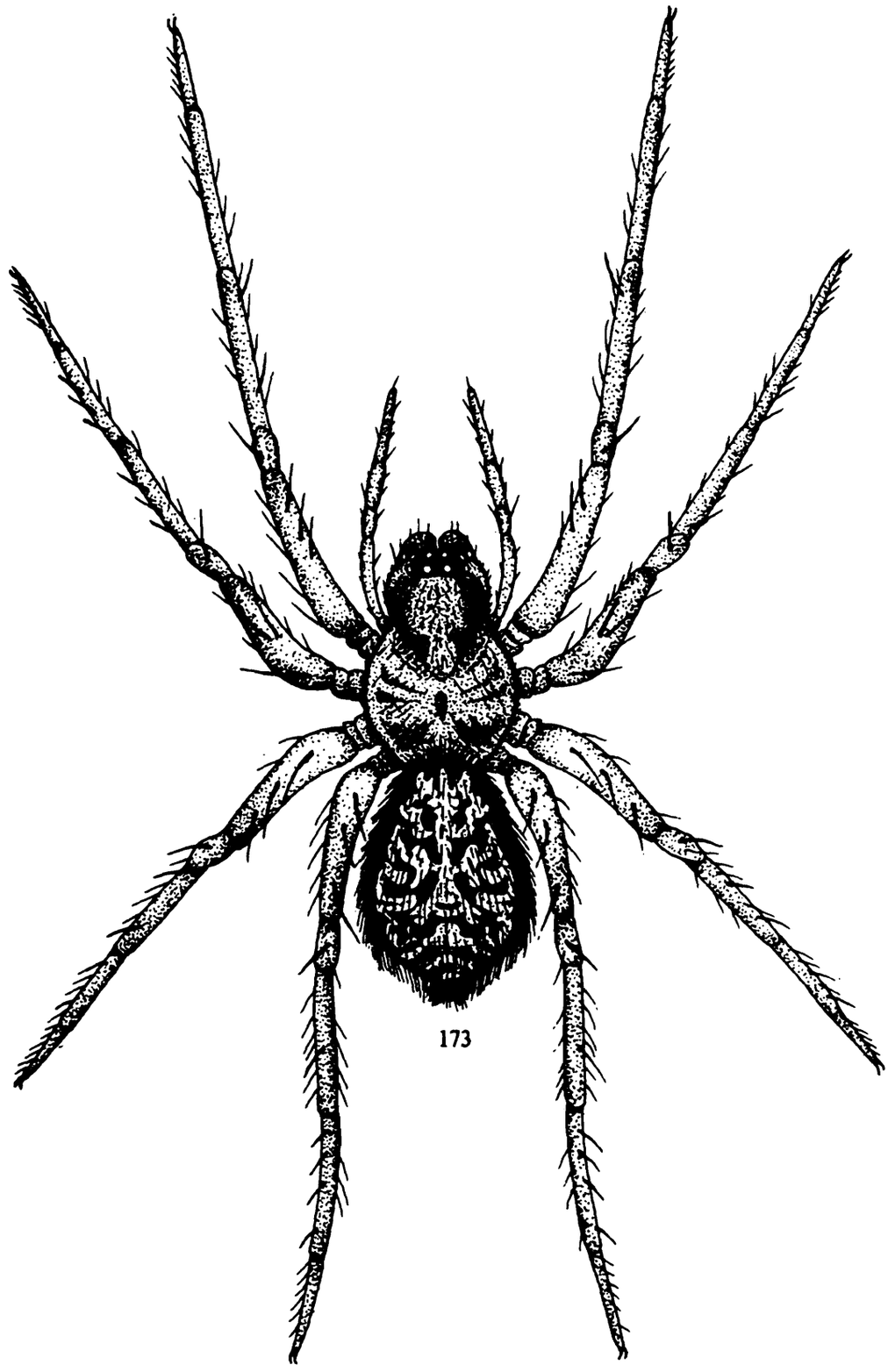

Fig. 173. Dorsal view of female *Tegenaria chhanguensis* Tikader of the family Agelenidae.

Distribution : All over the world.

Following Agelenid species have been represented from our fauna.

Genus *Agelena*

768. *A. inda* Simon
769. *A. gautami* Tikader
770. *A. satmila* Tikader
771. *A. barunae* Tikader

Genus *Tegenaria*

772. *T. domestica* Clerck
773. *T. chhanguensis* Tikader
774. *T. lunakensis* Tikader

Genus *Cedicus*

775. *C. bucculentus* Simon

Genus *Desis*

776. *D. inermis* Gravely
777. *D. gardineri* Pocock

Genus *Malthonica*

778. *M. psechrina* Simon

Genus *Coelotes*

779. *C. simplex* Cambridge
780. *C. tegenarioides* Cambridge

FAMILY 39. LYCOSIDAE
(The Wolf-spiders)
Fig. 174

The Lycosidae are hunting spiders which chase their prey. Due to this reason the typical genus is named as *Lycosa.* The term–*Lycosa* is used for 'Wolf' in Greek word. The carapace is narrow in front and high; the eyes of the posterior line are strongly recurved, typically large, those of the anterior line being as a rule much smaller and close set. Maxillae is not inclined inwards and labium quite is short. Legs are spiny, usually short and strong; tarsi are with three claws and no ungual tufts.

Distribution : Cosmopolitan.

Key to the genera of the family Lycosidae

1. Posterior spinnerets distinctly longer than the anterior, with apical segment conical and as long as the basal. Anterior row of eyes little wider

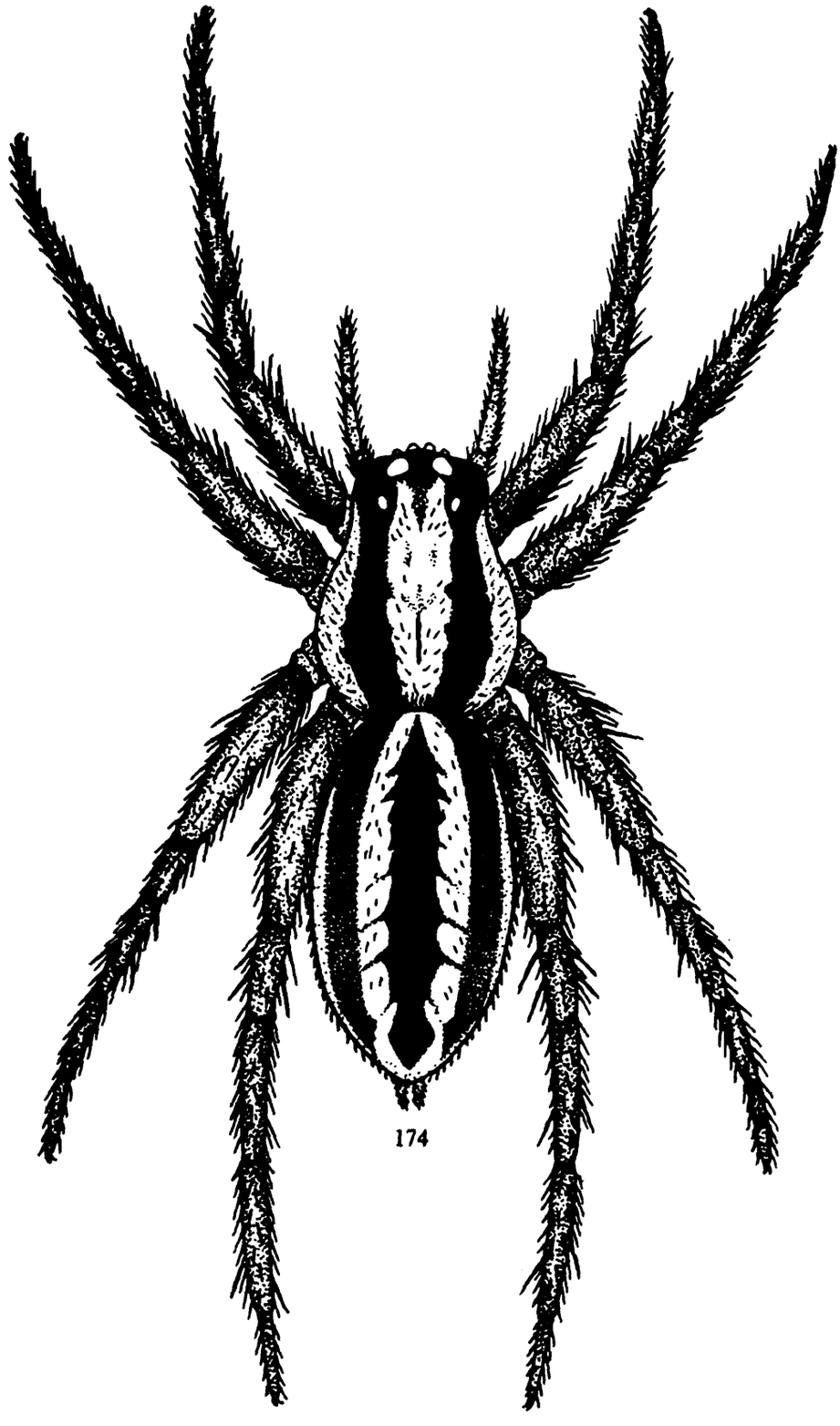

Fig. 174. Dorsal view of female *Lycosa mahabaleshwarensis* Tikader & Malhotra of the family Lycosidae.

than the second row. Sternum generally provided with mid-longitudinal dark marking.....*Hippasa*

781. *H. greenalliae* (Blackwall)
782. *H. loundesi* Gravely
783. *H. himalayensis* Gravely
784. *H. olivacea* (Thorell)
785. *H. mahabaleshwarensis* Tikader & Malhotra
786. *H. lycosina* Pocock
787. *H. madraspatana* Gravely
788. *H. partita* (Cambridge)
789. *H. agelenoides* (Simon)
790. *H. holmerae* Thorell
791. *H. madhuae* Tikader & Malhotra
792. *H. pisaurina* Pocock
793. *H. nilgirensis* Gravely
794. *H. pantherina* Pocock

Posterior spinnerets at most only slightly longer than the anterior and apical segment hemispherical and very short. Anterior row of eyes shorter than the second row. Sternum without longitudinal marking.....2

2. Clypeus from side vertical. Fourth metatarsus longer than or as long as tibia and patella IV together.....3

Clypeus from front slanting. Fourth metatarsus shorter than tibia and patella IV together.....4

3. Cephalic region somewhat abruptly elevated from thoracic region. Superior claws long and slender and toothed only at the base.....*Evippa*

795. *E. sohani* Tikader & Malhotra
796. *E. banarensis* Tikader & Malhotra
797. *E. rajasthaneus* Tikader & Malhotra
798. *E. solanensis* Tikader & Malhotra
799. *E. praelongipes* (Cambridge)
800. *E. shivajii* Tikader & Malhotra
801. *E. rubiginosa* Simon
802. *E. kronebergi* Roewer
803. *E. concolor* (Kroneberg)

Cephalic region not much elevated from the thoracic region. Superior claws not long and slender and toothed all-over the length of claw.....*Pardosa*

804. *P. minutus* Tikader & Malhotra
805. *P. timida* (Simon)
806. *P. pusiola* (Thorell)
807. *P. atropalpis* Gravely
808. *P. mukundi* Tikader & Malhotra
809. *P. altitudus* Tikader & Malhotra

810. *P. birmanica* Simon
811. *P. mysorensis* (Tikader & Malhotra)
812. *P. kupupa* (Tikader)
813. *P. amkhasensis* Tikader & Malhotra
814. *P. oakleyi* Gravely
815. *P. burasantiensis* Tikader & Malhotra
816. *P. songosa* Tikader & Malhotra
817. *P. rhenockensis* (Tikader)
818. *P. shyamae* (Tikader)
819. *P. heterophthalmus* (Simon)
820. *P. sutherlandi* (Gravely)
821. *P. leucopalpis* Gravely
822. *P. annandalei* (Gravely)
823. *P. sumatrana* (Thorell)
824. *P. fletcheri* (Gravely)
825. *P. chambaensis* Tikader & Malhotra
826. *P. tatensis* (Tikader)
827. *P. ladakhensis* Tikader
828. *P. alii* Tikader
829. *P. nicobarica* (Thorell)
830. *P. partita* Simon
831. *P. thalassica* (Thorell)
832. *P. tridentis* Caporiacco

4. Third pair of legs longer than the first pair.....*Ocyale*

833. *O. atalanta* Audouin

Third pair of legs shorter than the first pair.....5

5. Labium wider than long. Anterior lateral and posterior median eyes pearly white.....*Flanona*

834. *F. puellula* Simon

Labium longer than wide. Anterior lateral and posterior median eyes not pearly white.....6

6. Tibia IV dorsally with the proximal spine usually thinner or more drawn out than the distal one, sometimes reduced to a bristle.....7

Tibia IV with the two dorsal spines about equally stout.....8

7. Carapace hirsute (hairy) and tarsus I without a dorso-basal thin, long bristle.....*Trochosa*

835. *T. punctipes* (Gravely)
836. *T. himalayensis* Tikader & Malhotra
837. *T. stictopyga* Thorell

Carapace glabrous or nearly so and tarsus I with a dorso-basal bristle which is drawn out thin and fine at the end and is much longer than the hairs and trichobothria.....*Arctosa*

838. *A. himalayensis* Tikader & Malhotra
839. *A. indicus* Tikader & Malhotra
840. *A. maratha* Tikader & Malhotra
841. *A. khudiensis* (Sinha)
842. *A. mulani* (Dyal)
843. *A. lesserti* Reimoser

8. Anterior row of eyes straight or slightly procurved. Anterior median eyes never smaller than the anterior laterals.....*Lycosa*

844. *L. himalayensis* Gravely
845. *L. tista* Tikader
846. *L. bistriata* Gravely
847. *L. chaperi* (Simon)
848. *L. kempi* Gravely
849. *L. choudhuryi* Tikader & Malhotra
850. *L. poonaensis* Tikader & Malhotra
851. *L. masteri* Pocock
852. *L. madani* Pocock
853. *L. phipsoni* Pocock
854. *L. wroughtoni* Pocock
855. *L. goliathus* Pocock
856. *L. shillongensis* Tikader & Malhotra
857. *L. nigrotibialis* Simon
858. *L. carmichaeli* Gravely
859. *L. prolifica* Pocock
860. *L. indagatrix* Walckenaer
861. *L. geotubalis* Tikader & Malhotra
862. *L. iranii* Pocock
863. *L. barnesi* Gravely
864. *L. mackenziei* Gravely
865. *L. moulmeinensis* Gravely
866. *L. quadrifer* Gravely
867. *L. pictula* Pocock
868. *L. yerburyi* Pocock
869. *L. fuscana* Pocock
870. *L. mahabaleshwarensis* Tikader & Malhotra
871. *L. lambai* Tikader & Malhotra
872. *L. carli* (Reimoser)
873. *L. catula* Simon
874. *L. subinermis* Simon
875. *L. leucostigma* Simon
876. *L. punctipes* Gravely

Anterior row of eyes strongly procurved. Anterior median eyes smaller than the anterior laterals.....*Venonia*

877. *V. himalayensis* Gravely

FAMILY 40. PISAURIDAE
Fig. 175

The pisaurid spiders are very remarkable for their maternal devotion and care for the youngs. These spiders are commonly called Nursery-web Weavers. The members of the Pisauridae are characterised by the presence of a semicircular and broader notch in the spical margin of the lower side of the trochanters of the legs. In

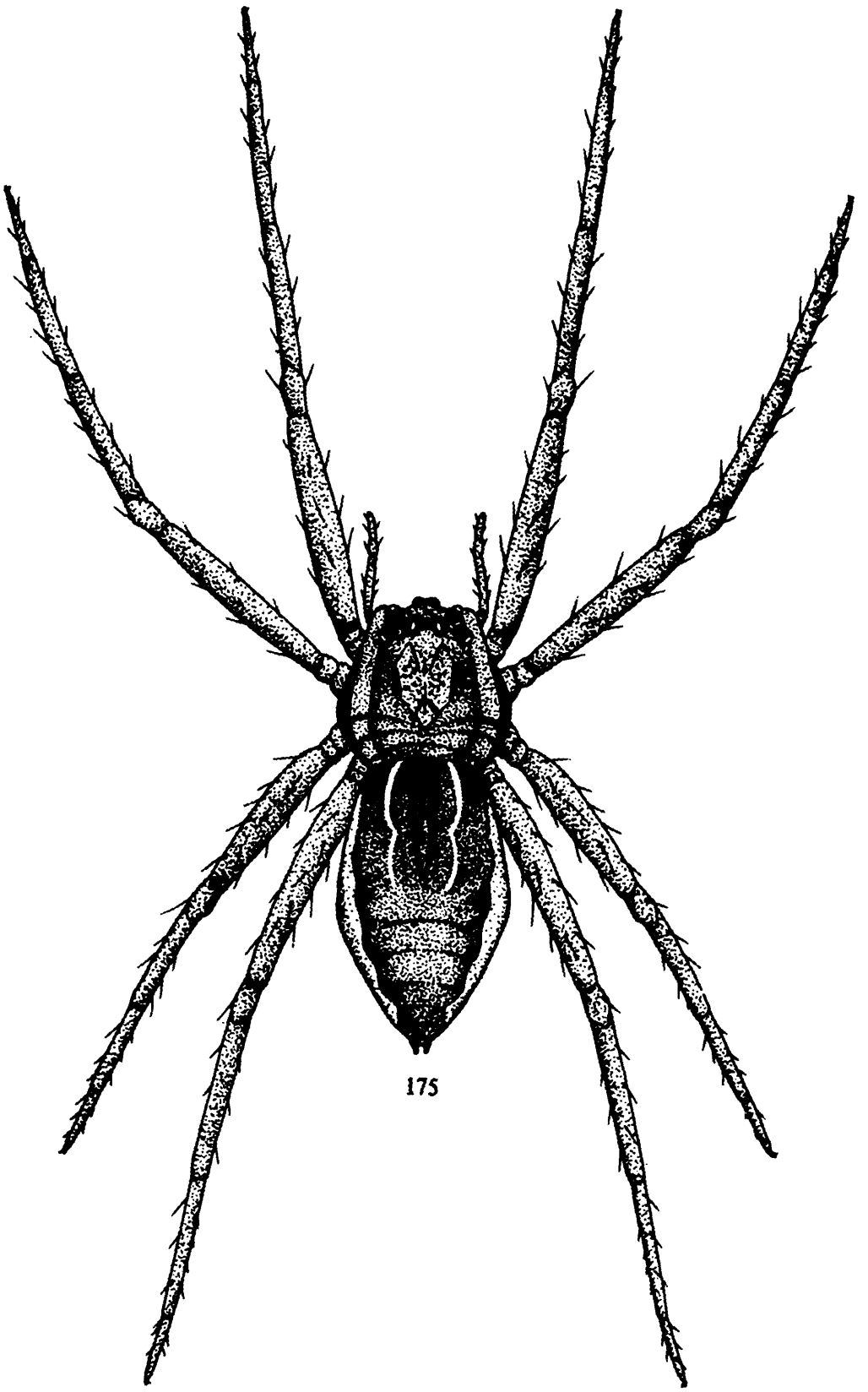

Fig. 175. Dorsal view of female *Pisaura gitae* Tikader of the family Pisauridae.

this respect they resemble the family Lycosidae, in which the trochanters are notched in a similar manner. The pisaurids differ from the lycosids in that the tibia of the male palp is furnished with an external apophysis.

The females of the Pisauridae make an egg-sac composed of a single piece, and carry it under the body, holding it by the chelicerae; those of the Lycosidae make the egg-sac which is composed of two valves; and drag it after them, attached to the spinnerets. Just before the eggs are hatched, the mother fastens the sac to some leaves, build a nursery web around it and stands nearby to guard the nursery.

Distribution : All over the world.

Following species under different genera have been reported so far from India.

Genus *Tinus*
878. *T. sikkimus* Tikader

Genus *Pisaura*
879. *P. gitae* Tikader
880. *P. dentifasaiata* (Cambridge)

Genus *Euprosthenops*
881. *E. ellioti* (Cambridge)

Genus *Perenthis*
882. *P. sindica* (Simon)

Genus *Dendrolycosa*
883. *D. gracilis* Thorell
884. *D. stauntoni* Pocock

Genus *Hygropoda*
885. *H. longimana* (Stoliczka)

Genus *Nilus*
886. *N. marginatus* (Simon)
887. *N. spadicarius* (Simon)

Genus *Stoliczka*
888. *S. insignis* Cambridge

Genus *Thalassius*
889. *T. cinctus* (Thorell)

Genus *Eucamptopus*

890. *E. coronatus* Pocock

FAMILY 41. TETRAGNATHIDAE
Fig. 176

These are very long, cylindrical spiders; often build complete web near the vicinity of water. The webs are provided with open hubs and having relatively a few radii and few spirals. Tetragnathid spiders have maxillae and labium long or very long, projecting and chelicera very long mainly in male and armed with many teeth. Legs very long and slender. Abdomen long, sub-cylindrical. Many species, very similar in general appearance and habits, are represented in the Indian fauna.

Distribution : Tropical, temperate and subarctic countries of the world.

Two genera with a few species have been reported from India.

Key to the genera of the family Tetragnathidae

1. Abdomen long and narrow, usually two or three times as long as wide.....*Tetragnatha*

891. *T. gracilis* (Stoliczka)
892. *T. geniculata* Karsch
893. *T. mandibulata* Walckenaer
894. *T. bengalensis* Walckenaer
895. *T. cochinensis* Pocock
896. *T. delumbis* Thorell
897. *T. foliferens* Hingston
898. *T. foveata* Karsch
899. *T. iridescens* Stoliczka
900. *T. paradisea* Pocock
901. *T. parvula* Thorell
902. *T. viridorufa* Gravely
903. *T. ceylonica* Cambridge
904. *T. tenera* Thorell
905. *T. fletcheri* Gravely
906. *T. listeri* Gravely
907. *T. sutherlandi* Gravely
908. *T. moulmeinensis* Gravely
909. *T. mackenziei* Gravely
910. *T. andamanensis* Tikader

Abdomen long and narrow, produced beyond the spinnerets into a pointed tail.....*Eucta*

911. *E. isidis* (Simon)
912. *E. javana* Thorell

FAMILY 42. ARANEIDAE (=ARGIOPIDAE)
Fig. 177

This is a very large family with probably the maximum number of species known from our country. Many workers prefer to use the

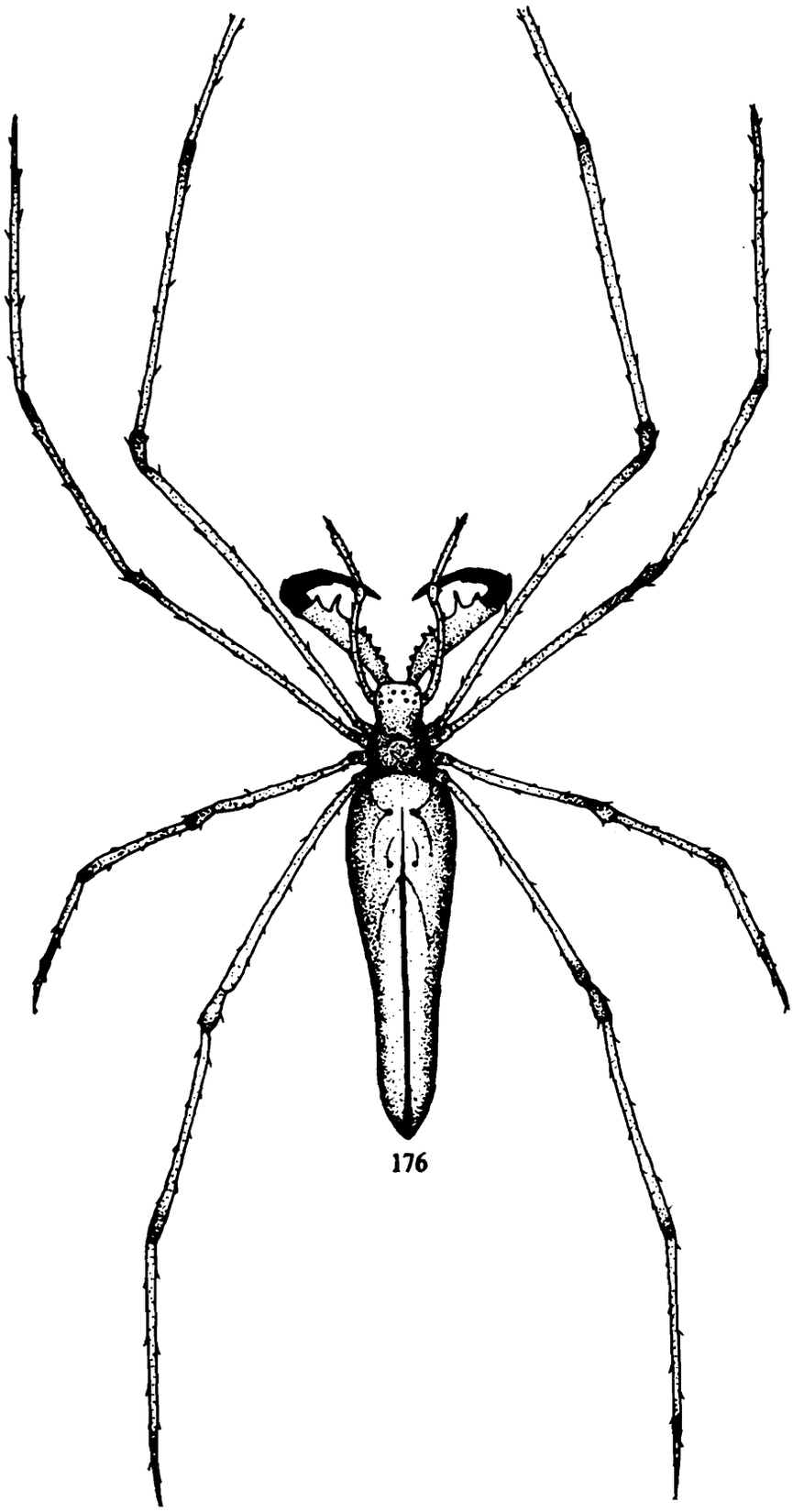

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Fig. 176. Dorsal view of female *Tetragnatha mandibulata* Walckenaer, family Tetragnathidae.

name of the family as Argiopidae but according to the law of priority the family name Araneidae is retained. Almost all of our species spin snares in the form of an orb, while some construct a retreat at a distance from the snare and others remain at the centre of the orb-web in upside down position and wait quietly for their prey. In this book the mechanism of construction of orb-web has been discussed in detail in an other chapter. The araneid spiders are provided with three tarsal claws and auxilary foot claws, and no trichobothria on the femora and tarsi; eyes, homogeneous are eight in number and in two rows; epigastric furrow is nearly straight and a prominent boss is present on the chelicerae. Abdomen is variable in size, may be simple or provided with tubercles and spine like structures and six spinnerets. Many araneids show a considerable sexual dimorphism, the males are much smaller than females, provided with special clasping spines or spurs on the legs and differ even in shape of the cephalothorax as well as abdomen. The males are not as frequently seen as the females.

Distribution : Cosmopolitan.

Key to the sub-family and genera of the family Araneidae

1. Spinnerets situated on an elevated circular space surrounded by a thick flange in the form of a ring; abdomen hard, flattened dorsally and provided with conical humps and spines.....Sub-family GASTERACANTHINAE, and Genus *Gasteracantha*

913. *G. geminata* (Fabricius)
914. *G. mammosa* C. L. Koch
915. *G. unguifera* Simon
916. *G. kuhlii* C. L. Koch
917. *G. diadesmia* Thorell
918. *G. hasseltii* C. L. Koch
919. *G. remifera* Butler
920. *G. dalyi* Pocock
921. *G. arcuata* (Fabricius)
922. *G. sororna* Butler
923. *G. frontata* Blackwall
924. *G. clavigera* Giebel
925. *G. taeniata* (Walckenaer)
926. *G. lunata* Guerin

Spinnerets not surrounded by thick flange in the form of a ring; abdomen not hard.....2

2. Epigastric plates without transverse furrows; chelicerae with rudimentary boss.....Sub-family METINAE....3

Epigastric plates provided with transverse

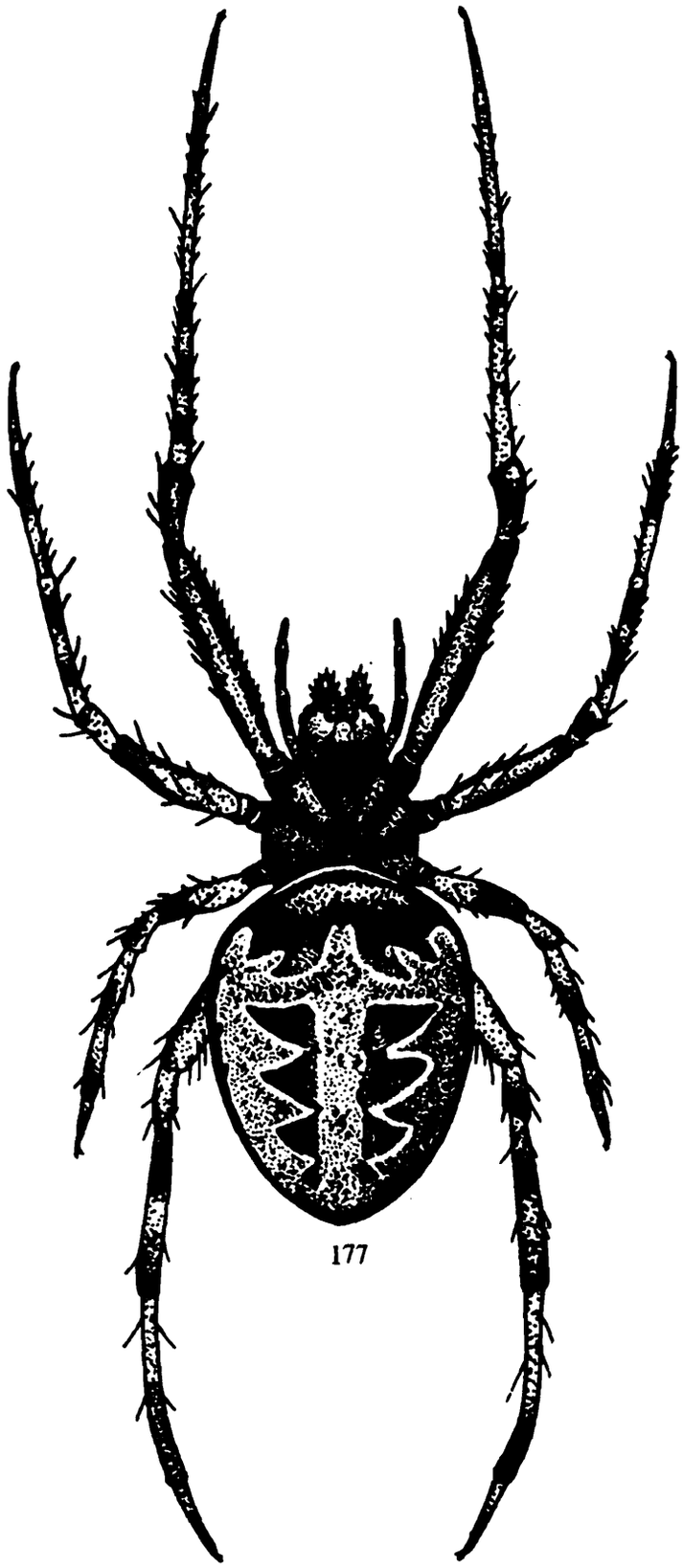


Fig. 177. Dorsal view of female *Neoscona nautica* (L. Koch), family Araneidae (= Argiopidae).

furrows; chelicerae usually having well developed boss.....4

3. Femora IV with a double fringe of hairs on the prolateral surface of the basal half; abdomen ornamented with silvery bands or spots; thoracic furrow deep but not long.....*Leucauge*

927. *L. bengalensis* Gravely
928. *L. dorsotuberculata* Tikader
929. *L. fastigata* (Simon)
930. *L. decorata* (Blackwall)
931. *L. tessellata* (Thorell)
932. *L. celebesiana* (Walckenaer)
933. *L. ventralis* (Thorell)
934. *L. culta* (O. P. Cambridge)
935. *L. pondae* Tikader
936. *L. nicoborica* (Thorell)
937. *L. rubrotrivittata* Simon
938. *L. tristicta* (Thorell)
939. *L. argentata* (Cambridge)
940. *L. beata* (Pocock)

Femora IV not so fringed; abdomen having no silvery pigmentation; thoracic furrow deep and long, often trifid posteriorly.....*Meta*

941. *M. simlaensis* Tikader
942. *M. mixta* Cambridge

4. Tarsus and metatarsus together longer than patella and tibia.....5

Tarsus and metatarsus together not longer than patella and tibia.....Sub-family ARANEINAE...9

5. Labium longer than wide; abdomen two and one-half to three times as long as wide; tarsus IV not provided with sustentaculum.....Sub-family NEPHILINAE...6

Labium wider than long; abdomen not longer than two and one-half times of its width; tarsus IV provided with sustentaculum.....7

6. Carapace with cephalic region convex and elevated; abdomen elongated or oval, non-lobate.....*Nephila*

943. *N. malabarensis* (Walckenaer)
944. *N. maculata* (Fabricius)
945. *N. robusta* Tikader
946. *N. clavata* L. Koch
947. *N. kuhlii* Doleschall.

Carapace flat; abdomen flat dorsally, lobate literally.....*Herennia*

948. *H. ornatissima* (Doleschall)

7. Posterior row of eyes strongly procurbed; anterior lateral eyes smaller than posterior laterals.....Sub-family ARGIOPINAE...8

   Posterior row of eyes nearly straight or recurved; lateral eyes subequal.....Sub-family ARANEINAE...9

8. Eyes of anterior row evenly spaced; or medians closer to laterals than to each other; adult female smaller than 6 mm; tibia I of male curved and bearing strong spines.....*Gea*

   949. *G. corbetti* Tikader
   950. *G. spinipes* C. L. Koch

   Eyes of anterior row not evenly spaced or medians closer to each other than to laterals; adult female larger than 9 mm.; tibia I of male straight and unmodified.....*Argiope*

   951. *A. lalita* Sherriffs
   952. *A. arcuata* Simon
   953. *A. shillongensis* Sinha
   954. *A. aemula* (Walckenaer)
   955. *A. catenulata* (Doleschall)
   956. *A. pradhani* Sinha
   957. *A. kalimpongensis* Sinha
   958. *A. anasuja* Thorell
   959. *A. pulchella* Thorell
   960. *A. macrochoera* Thorell
   961. *A. taprobanica* Thorell

9. Abdomen wider than long.....10

   Abdomen longer than wide.....13

10. Carapace armed with a few tubercles; ocular quad situated on an elevation.....11

    Carapace unarmed; ocular quad not situated on any elevation.....12

11. Ocular quad narrower in front than behind; abdomen globular with a prominence on each side of dorsum; abdominal tubercles not provided with tufts of long hairs; tibiae and metatarsi flat dorsally.....*Caerostris*

    962. *C. paradoxa* (Doleschall)

    Ocular quad wider in front than behind; abdomen triangular with a prominence on each side of dorsum; abdominal tubercles provided with tufts of long hairs; tibiae and metatarsi not flat dorsally.....*Ordgarius*

963. *O. sexspinosus* (Thorell) 964. *O. hobsoni* (Cambridge)

12. Integument of abdomen leathery; dorsum of abdomen strongly convex; epigyne provided with short blunt scape.....*Cyrtarachne*

965. *C. biswamoyi* Tikader 966. *C. bengalensis* Tikader
967. *C. inequalis* Thorell 968. *C. raniceps* Pocock
969. *C. gravelyi* Tikader 970. *C. promilai* Tikader
971. *C. sundari* Tikader 972. *C. schmidi* Tikader
973. *C. avimerdaria* Tikader 974. *C. invenusta* Thorell
975. *C. pallida* Cambridge

Integument of abdome not leathery, provided with numerous tubercles; dorsum of abdomen not strongly convex; epigyne with no scape.....*Pasilobus*

976. *P. kotigeharus* Tikader

13. Carapace strongly convex, anteriorly roundish; cephalic region strongly elevated than thoracic region; abdomen provided with a few tubercles.....*Chorizopes*

977. *C. congener* Cambridge 978. *C. frontalis* Cambridge
979. *C. stoliczkae* Cambridge 980. *C. khanjanes* Tikader
981. *C. bengalensis* Tikader 982. *C. anjanes* Tikader
983. *C. calciope* (Simon)

Carapace may or may not convex and anteriorly narrowing; cephalic region and elevated than thoracic region; abdomen may or may not with tubercles.....14

14. Ocular quad situated on a distinct projection from cephalic region; lateral eyes widely separated from each other.....*Poltys*

984. *P. bhabanii* (Tikader) 985. *P. pogonias* Thorell
986. *P. illepidus* C. L. Koch 987. *P. nagpurensis* Tikader

Ocular quad not situated on any projection; lateral eyes closely situated.....15

15. Carapace flat with distinct thoracic furrow; abdomen anteriorly very high and provided with atleast one pair of shoulder humps.....*Cyrtophora*

988. *C. moluccensis* (Doleschall) 989. *C. bidentata* Tikader

990. *C. feae* (Thorell)
991. *C. cicatrosa* (Stoliczka)
992. *C. citricola* (Forskal)
993. *C. ksudra* Sherriffs
994. *C. unicolor* (Doleschall)

Carapace not flat, thoracic furrow may or may not distinct; abdomen anteriorly not high and shoulder humps may or may not present.....16

16. Posterior median eyes very close, nearly touching; carapace provided with a U-shaped junction between cephalic and thoracic region.....*Cyclosa*

995. *C. bifida* (Doleschall)
996. *C. mulmeinensis* (Thorell)
997. *C. fissicauda* Simon
998. *C. moonduensis* Tikader
999. *C. confraga* (Thorell)
1000. *C. spirifera* Simon
1001. *C. hexatuberculata* Tikader
1002. *C. neilensis* Tikader
1003. *C. insulana* (Costa)
1004. *C. simoni* Tikader
1005. *C. hibophora* (Thorell)
1006. *C. micula* (Thorell)
1007. *C. oatesii* (Thorell)
1008. *C. tuberascens* Simon
1009. *C. walckenaeri* (O. P. Cambridge)
1010. *C. albisternis* Simon
1011. *C. quinquaguttata* (Thorell)

Posterior median eyes not very close; carapace not having any U-shaped junction between cephalic and thoracic region.....17

17. Abdomen more than twice longer than wide.....18

Abdomen less than twice longer than wide.....19

18. Abdomen a little pointed mid-longitudinally over the carapace and no caudal projection; ventral side of abdomen with a white median longitudinal band framed by black.....*Larinia*

1012. *L. chloris* (Savigny & Audouin)
1013. *L. phtisica* (L. Koch)
1014. *L. melanosticta* Thorell
1015. *L. guadrinotata* Simon

Abdomen not pointed mid-longitudinally but provided with a pair of very prominent shoulder humps, thus bifurcated anteriorly and a caudal projection, at the tip of which having three tubercles; ventral side of abdomen dirty brown.....*Arachnura*

1016. *A. angura* Tikader
1017. *A. melanura* Simon

19. Carapace with cephalic region bulging behind the ocular area, also provided with granules;

anterior row of eyes procurved; epigyne with short beak like scape.....*Parawixia*

1018. *P. dehaanii* (Doleschall)

Carapace with cephalic region not bulging and no granules; anterior row of eyes recurved; epigyne may or may not provided with scape; when present, not beak like.....20

20. Cephalic region brownish black than light coloured thoracic region and provided with very few hairs; dorsum of abdomen with distinct folium.....*Zygeilla*

1019. *Z. melanocrania* (Thorell) 1020. *Z. indica* Tikader & Bal

Cephalic region otherwise with more hairs; dorsum of abdomen with or without distinct folium.....21

21. Thoracic groove transverse; epigyne with distinct scape, often wrinkled, not provided with any lateral lobes.....*Araneus*

1021. *A. bilunifer* Pocock
1022. *A. pahalgaonensis* Tikader & Bal
1023. *A. anantnagensis* Tikader & Bal
1024. *A. panchganiensis* Tikader & Bal
1025. *A. himalayaensis* Tikader
1026. *A. bituberculatus* (Walckenaer)
1027. *A. mitifica* (Simon)
1028. *A. nympha* Simon
1029. *A. cucurbitinus* Clerck
1030. *A. apiculatus* (Thorell)
1031. *A. camilla* (Simon)
1032. *A. cruciatus* Simon
1033. *A. cribatus* Simon
1034. *A. decentellus* Strand
1035. *A. hirsutulus* (Stoliczka)
1036. *A. myrrheus* Simon
1037. *A. sponsus* (Thorell)

Thoracic groove longitudinal; epigyne with unwrinkled scape and provided with one or two pairs of lateral lobes.....*Neoscona*

1038. *N. nautica* (L. Koch)
1039. *N. chrysanthusi* Tikader & Bal
1040. *N. bengalensis* Tikader & Bal
1041. *N. mukerjei* Tikader
1042. *N. rumpfi* (Thorell)
1043. *N. lugubris* (Walckenaer)
1044. *N. molemensis* Tikader & Bal
1045. *N. elliptica* Tikader & Bal
1046. *N. excelsus* (Simon)
1047. *N. laglaizei* (Simon)
1048. *N. poonaensis* Tikader & Bal
1049. *N. sinhagadensis* (Tikader)

1050. *N. theis* (Walckenaer)
1051. *N. shillongensis* Tikader & Bal
1052. *N. odites* (Simon)
1053. *N. pavida* (Simon)
1054. *N. achine* (Simon)

FAMILY 43. LINYPHIIDAE
(The Sheet-web Weavers)
Fig. 178

This family includes a large number of common species but unfortunately in our country very little information is known about these spiders. The linyphid spiders are small in size and lead secluded life. Most species construct a fine snare usually with a platform or a dome, as well as an irregular portion. The linyphids lack the serrated comb like bristles on the tarsi of the 4th leg, which is the characteristic feature of the family Theridiidae. This sheet-web weavers belong to the series of three clawed, eight eyed, sedentary spiders.

Distribution The colder parts of the world.

The following species are recorded so far from India.

Genus *Linyphia*
1055. *L. albipunctata* Cambridge
1056. *L. consanguinea* Cambridge
1057. *L. perampla* Cambridge
1058. *L. straminea* Cambridge
1059. *L. urbasae* Tikader
1060. *L. sikkimensis* Tikader
1061. *L. nicobarensis* Tikader

Genus *Lepthyphantes*
1062. *L. bhudbari* Tikader
1063. *L. lingsoka* Tikader
1064. *L. rudrai* Tikader

Genus *Emenista*
1065. *E. bisinuosa* Simon

Genus *Labulla*
1066. *L. nepula* Tikader

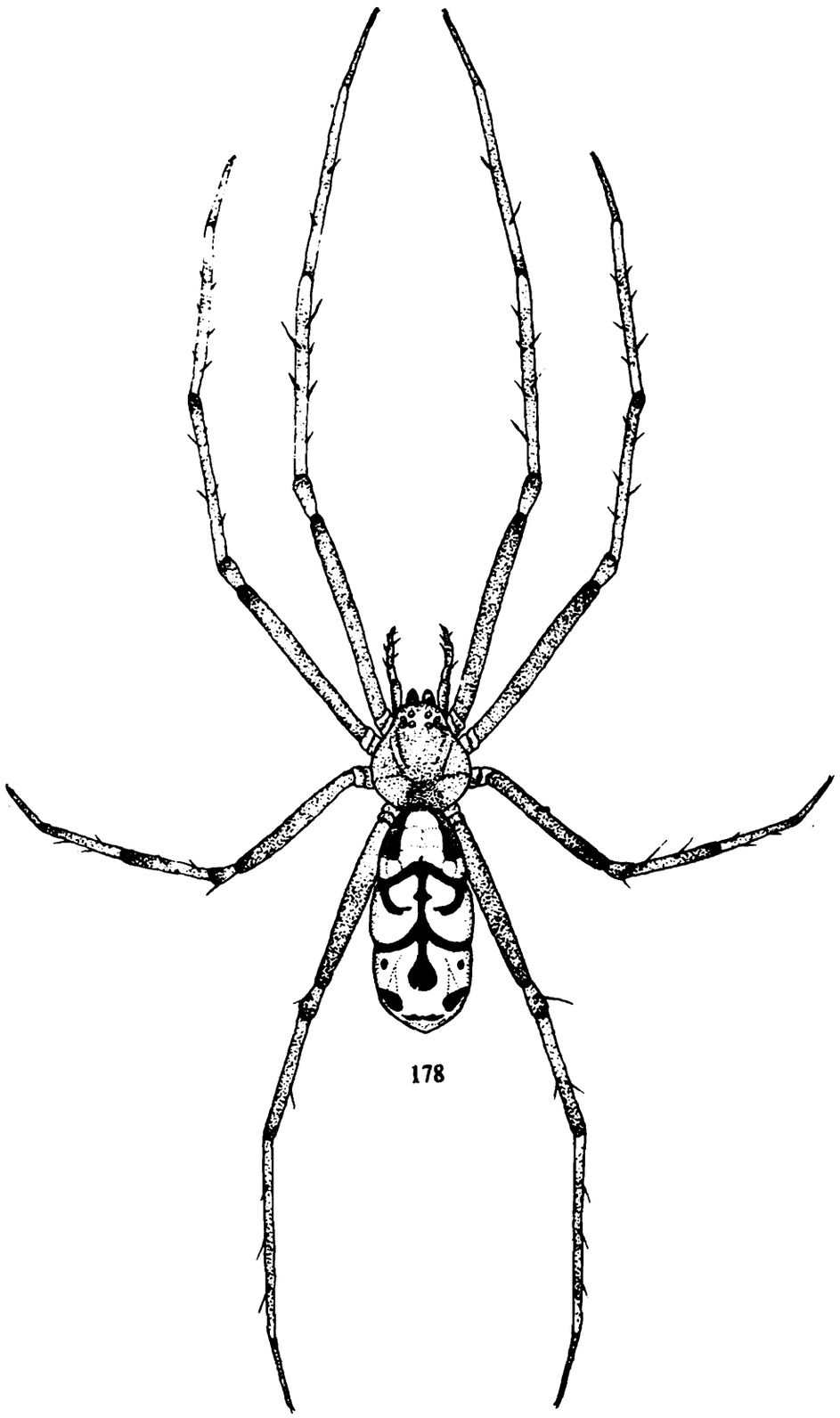


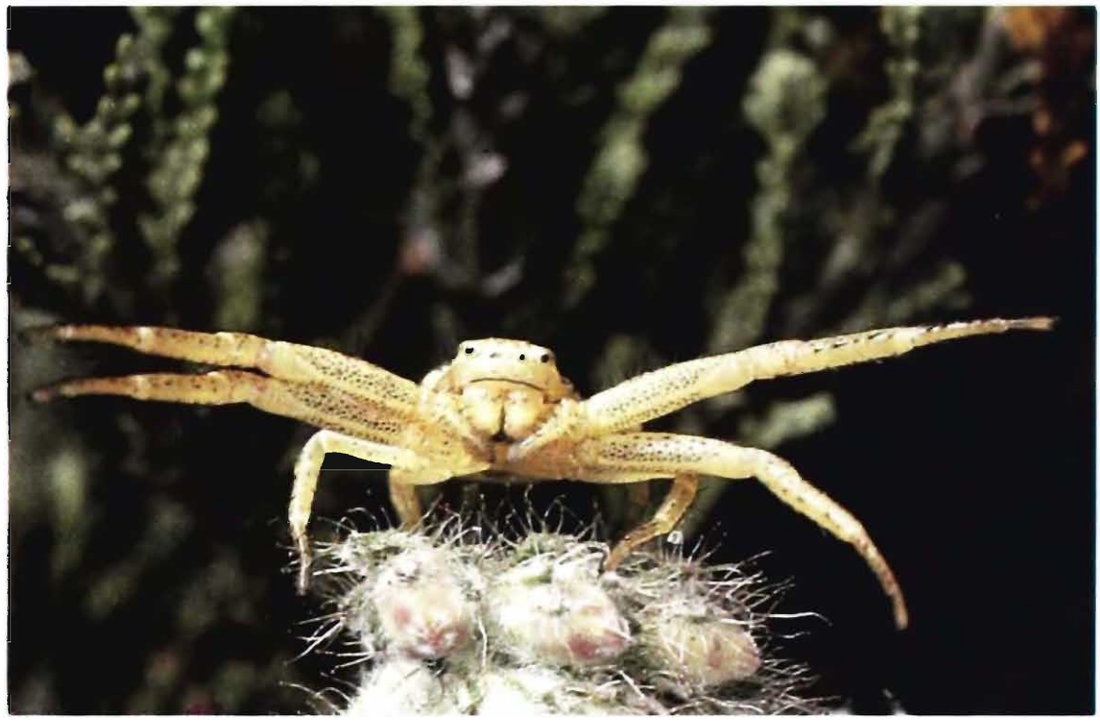
Fig. 178. Dorsal view of female *Linyphia urbasae* Tikader, family Linyphiidae.

PLATE I

Clubionidae spider on the leaf.

Argyrodes sp. associated with Nephila

PLATE II

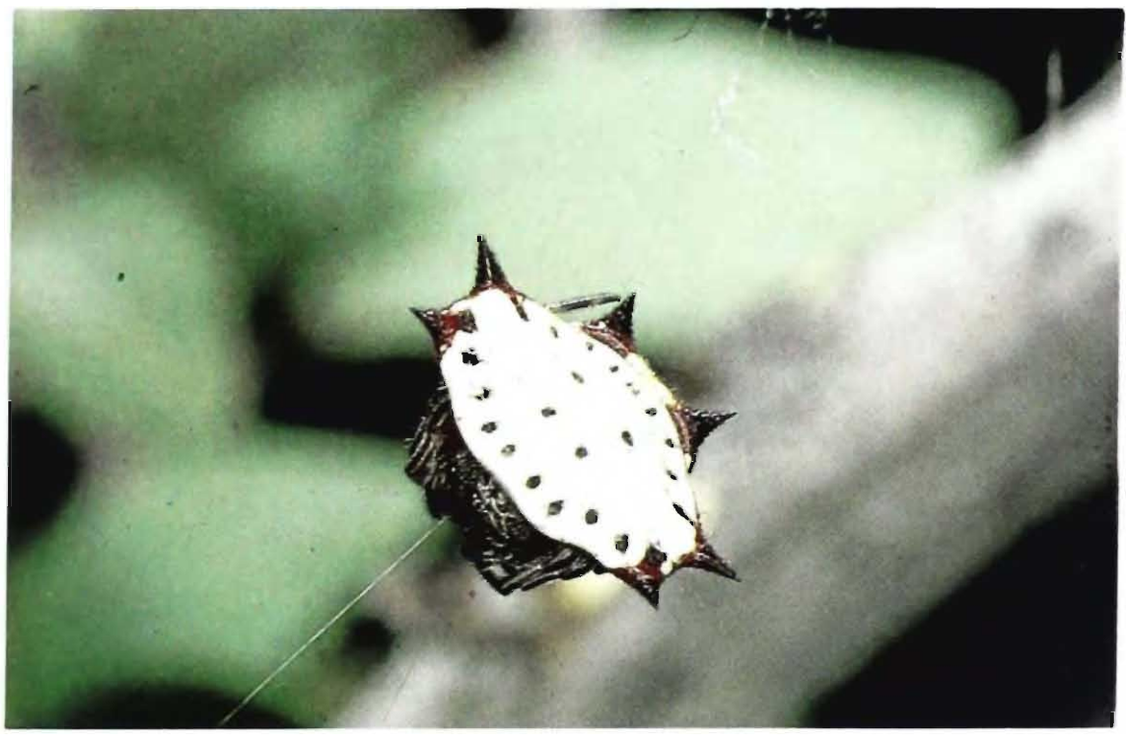


Xysticus spider on the defensive posture.

Pardosa spider with her egg case.

PLATE III

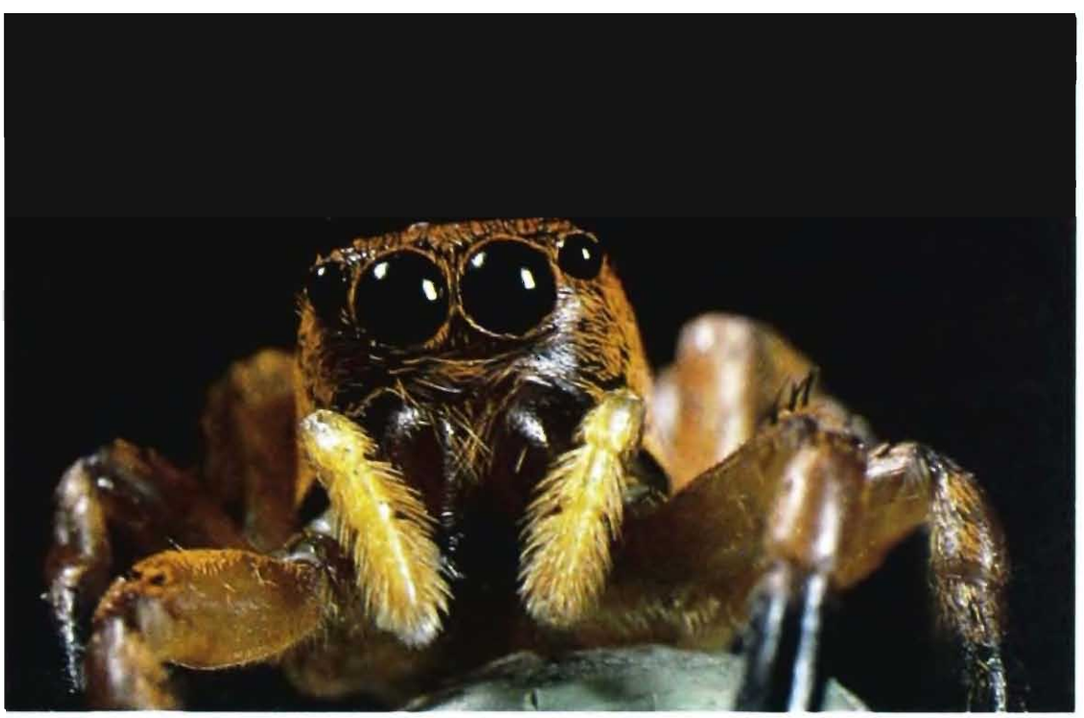
Dolomedes sp. with egg case.



Gastracantha sp. on the web.

PLATE IV

Ant-like spider (Salticidae) on the leaf.



Front view of Salticidae spider.

PLATE V

Avicularia spider on the ground.

Psectirus sp. with egg case.

PLATE VI

Latrodectus sp. Male and female.

Web of *Araneus* sp. with dew drops.

PLATE VII

Oxypidae spider on the flower shoot.

Hyptiotes sp. on her simple web.

PLATE VIII

Loxosceles spider on the ground.

Lyssomanes sp. on the upper surface of a leaf.

PLATE IX

Lycosa sp. with her youngs on her back.

Typical jumping spider on a leaf.

PLATE X

Thomisidae spider on the leaf.

Pholcus sp. with egg case on her irregular web.

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ALPHABETICAL INDEX

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The author is also writing-*Birds of Bharatpur*, *Endemic Birds of India* with coloured illustrations. Dr. Tikader has a hobby of wildlife and nature photography and majority of the photographs used in these books are by him.

Dr. Tikader was the Director of the Zoological Survey of India.