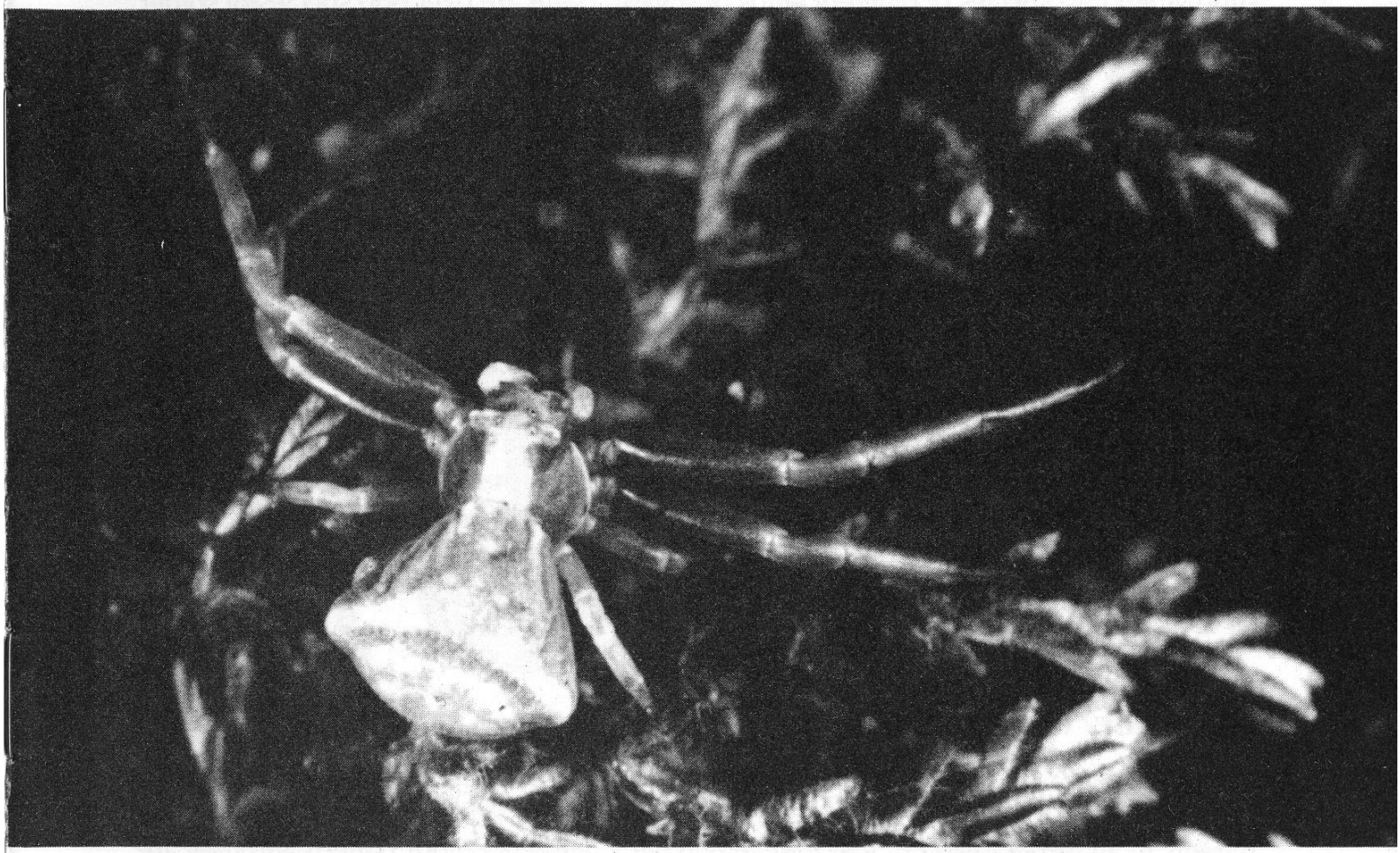
How to begin the study of

SPIDERS

by D. W. Mackie



Female crab spider, *Thomisus onustus*

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How to begin the study of Spiders

by D. W. MACKIE

The study of spiders can be an absorbing interest for naturalists of all ages. Spiders' habits differ considerably from those of insects, and their diversity in form and behaviour, even in a small country such as ours, is very great. Spiders belong to the class Arachnida, which they share, in this country, with the harvestmen, false-scorpions, ticks, mites, and one species of scorpion.

Spiders are classified by being divided into families (there are over thirty represented in this country) and these are again subdivided into genera and finally the genera are subdivided into species of different kinds of spider. There are over 600 species of spider recorded so far in the British Isles and this number is increasing by a few each year as species new to this country are found. Occasionally, species new to science are added to the list.

Spiders, which make an ideal study from the amateur's point of view, can be studied at home as well as in the field, occupy all habitats from the shore driftline to the top of the highest mountain and can be found at all seasons of the year, even in mid-winter.

As spiders form a significant proportion of the leaf-litter and soil fauna, their distribution and relationships with other animals in the same habitat is of great importance, and it is becoming more and more evident that the ecological study of spiders can increase our knowledge of the pattern of food chains and other problems associated with the soil fauna. But even in the simple aspect of distribution, much work remains to be done and here the amateur can make a significant contribution by recording the species found in the various counties (or by the 10 km grid system), many of our counties being considerably under-recorded as far as spiders are concerned. Again, spiders can be kept in captivity in perfect health for long periods and much information regarding their habits can thus be revealed.

Life history and structure

Spiders have a simple life history, commencing with the laying of eggs by the female, protected in a silken cocoon. The eggs hatch into young spiders which resemble their parents in all respects except that they may have a different colour pattern and they are not sexually mature. The young spiders moult their skins (cuticle) at intervals as they grow until, at the final moult, the sexual organs are fully developed and they are then adult. In spiders, the body is divided into two parts; a hard sclerotised fore part, called the cephalothorax (Fig. 1, a), and a softer, distensible hind part, the abdomen (Fig. 1, b), which is joined to the cephalothorax by a narrow waist, the pedicel. At the rear of the abdomen, on the underside, are the spinnerets (Fig. 2, b) from which silk is emitted. Spiders use silk for a variety of purposes, including, in some species, the construction of webs for the capture of prey (Fig. 3). Eight legs are attached to the cephalothorax and there are also, at the front of the head, two sets of paired structures, the chelicerae (with the poison fangs) and the pedipalps (usually referred to simply as the 'palps'), which may be likened to the antennae of insects. In female spiders, the pedipalps are simple jointed appendages (Fig. 1, c), but in males, the tip of each pedipalp is swollen and bulb-shaped

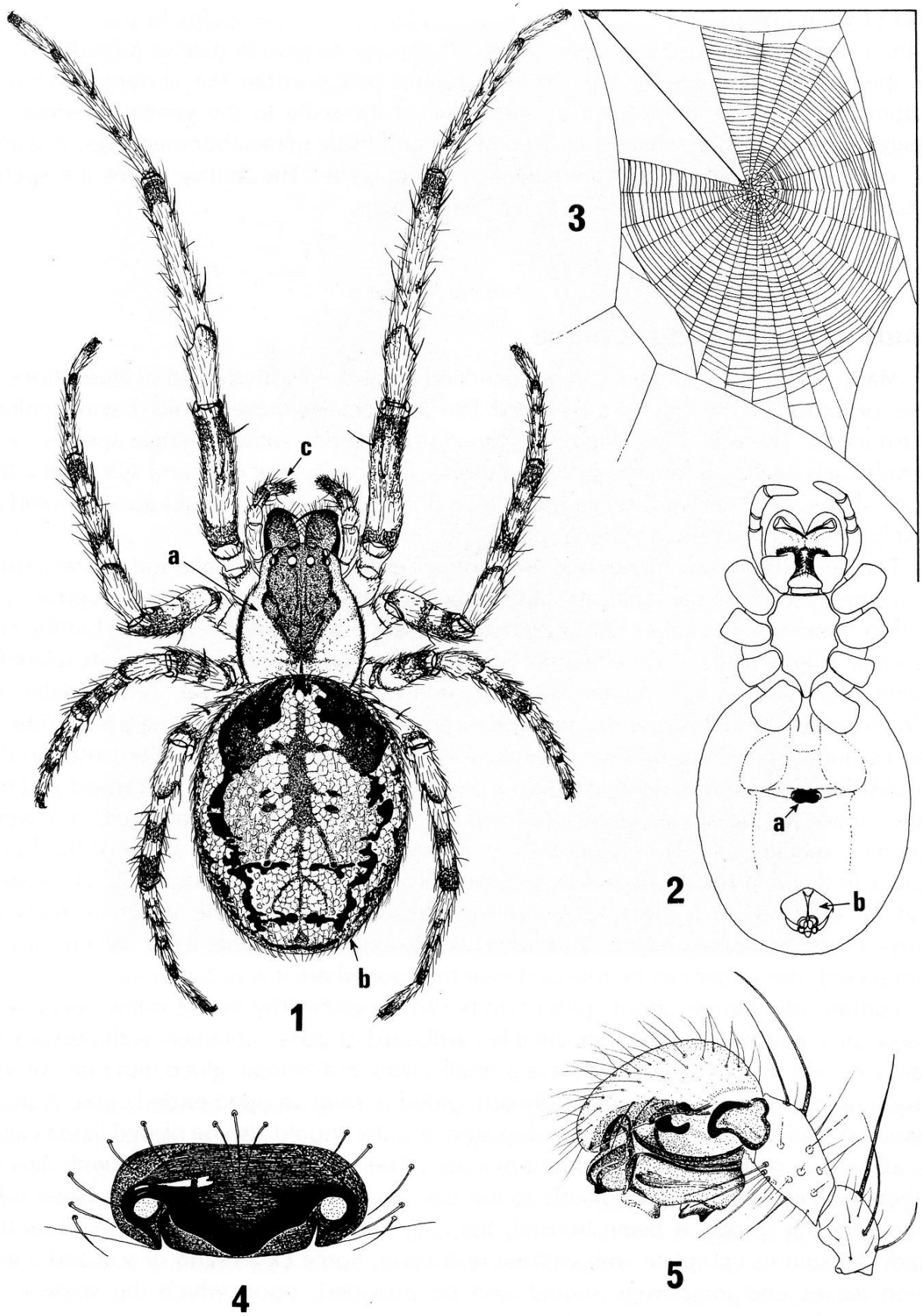


Fig. 1. *Zygiella x-notata* (Clerck), female — dorsal view. a — cephalothorax; b — abdomen; c — pedipalp. Fig. 2. ditto ventral view. a — epigyne; b — spinnerets. Fig. 3. Typical web of this species. Fig. 4. Enlarged view of epigyne. Fig. 5. Enlarged view of male pedipalp.

and of great complexity (Fig. 5). The male spider uses his pedipalps to transfer sperm from a very small sperm web, spun for no other purpose than to receive a small droplet of sperm deposited on the web from a minute orifice under the abdomen. During mating the sperm is transferred by the palps of the male to the genital opening (or epigyne) of the female, which is situated on the underside of the abdomen (Figs. 2, a and 4), each palp being applied alternately to the epigyne. The female stores the sperm internally and subsequently uses it to fertilise her eggs.

Study in the field and at home

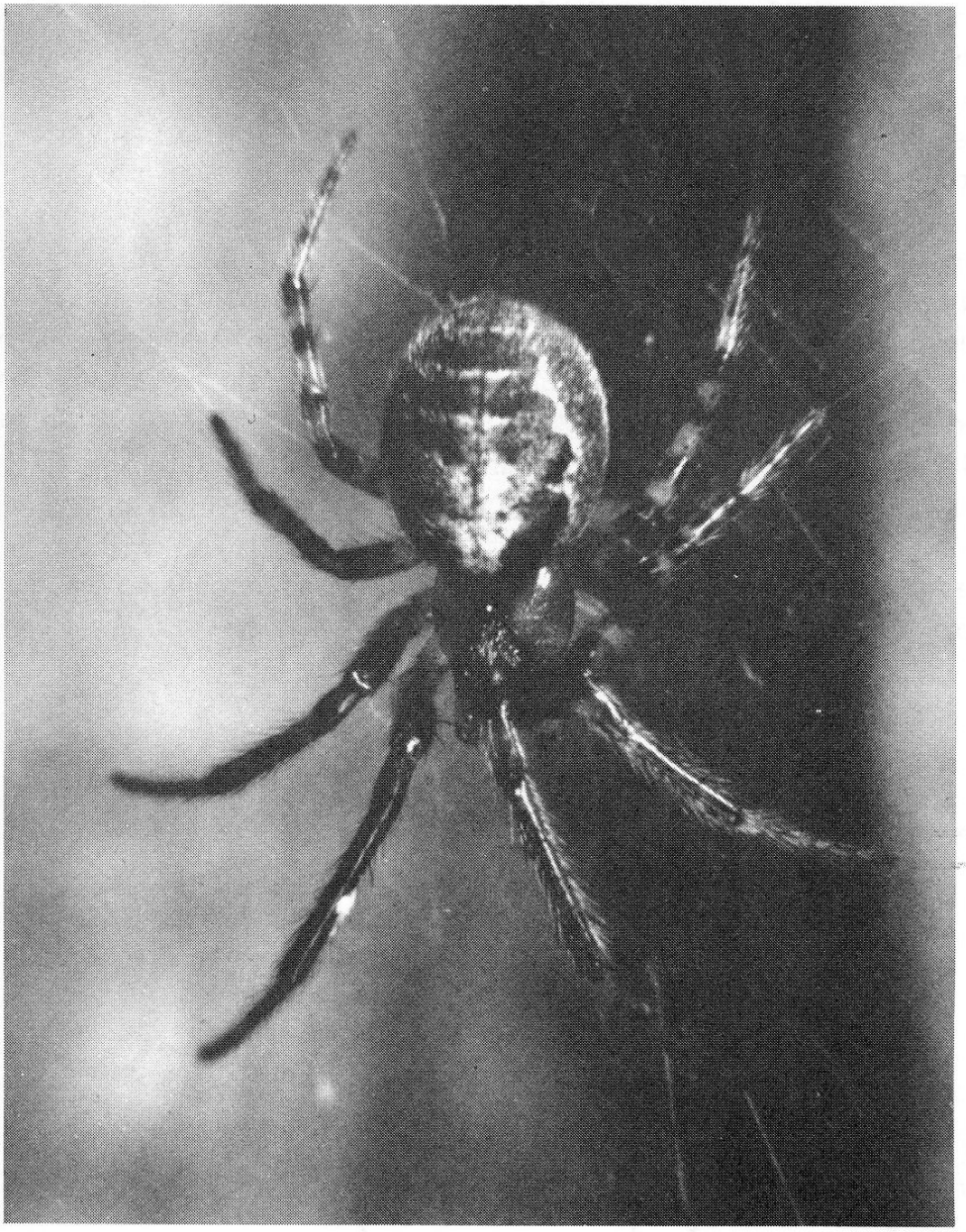
Many of the larger spiders can be identified in the field with the aid of illustrations in one or other of the books mentioned later, especially those books having colour illustrations. There is a fair degree of variation in colour within a single species, and details such as the abdominal pattern, number and position of eyes and spinnerets, the body shape, how the legs are held, and type of web, if present, should also be noted as a help towards determining which species one is examining.

This field study also enables one to become familiar with the habits and characteristic movements so that a particular species can be recognised when seen again. A great deal of information on the habits of our common spiders has still to be recorded, but the first essential is to be certain of the identity of the species concerned and to learn its scientific name. Very few of our spiders have common names, such as the 'Zebra spider' or 'Water spider', and it is essential to become familiar with the scientific names of most of the common species so that we can take full advantage of the descriptions used in the books dealing with the identification of species. A notebook should be carried and full notes made of the spider being observed — and of any web it has spun, if a web-spinning species. In this connection it is a great help towards the study of the living spider in the field to use a hand lens, preferably one of ×10 magnification. The spider can be captured in a clean glass tube of suitable size, but one which restricts its movements to some extent, and then examined through the lens. When this is completed, the spider can be released near the spot where it was captured.

Further information about spider habits can be gained by taking a few specimens home alive and housing them in suitable cardboard or glass containers with perspex or gauze covers. Each cage should have a small cardboard 'retreat' glued into one corner. This 'retreat' is simply a strip of cardboard folded to form an open-ended cube. A small glass dish with a piece of cotton wool soaked in water should also be placed in the cage, as all spiders need a varying amount of water. The specimens can be fed with flies or other small insects of a size suitable to the size of spider. Where one of the larger orb-web spinning spiders is being housed, the cage should be large enough to allow the spider to spin its complete web without restriction. Some clean sand or soil and a few dead leaves and long twigs should also be provided, upon which the spider can construct the framework of its web.

Observations which can be made on captive spiders include growth, mating, egg-laying, construction of egg-cocoons, and web spinning; also the laying down of trail lines in the case of wolf and other hunting spiders which do not spin web snares. The capture of prey, moulting and a number of other activities can all be observed.

After the beginner has studied and become more familiar with the larger spider



Female *Zygiella x-notata*

species and is able to identify them with some degree of success, he may wish to extend his identifications to some of the more difficult species which require the use of a microscope. This work should not be undertaken unless one is prepared to carry out some serious study of spiders and can devote considerable time to this study. Again, a limited number of specimens should be collected, preferably in glass tubes (filled with 70% alcohol) and each tube should have a slip of paper placed inside on which is noted (in pencil) details of date, locality and habitat of the spiders in that particular tube.

Further field work

As many of our British spiders are quite small, ranging down to about 1 mm in body length, it is not possible to identify all specimens in the field; only the well-marked larger

species can be so identified. It is thus necessary to collect a few representative specimens of the spiders and take them home for final identification. Collecting can be carried out in all habitats and the usual means are by hand-searching through the grass roots, sweeping herbage with a stout sweep net, sweeping the bark of trees with a hand-brush into an inverted umbrella, shaking or beating branches over a sheet or inverted umbrella, or sifting through leaf and stem litter over a light-coloured sheet spread on the ground. In winter, one can collect samples of leaf-litter or moss in plastic bags to take home, where the litter is sorted out, a handful at a time, in a white enamelled tray and any spiders that emerge collected. The small specimens can easily be picked up by the use of a small camel-hair brush repeatedly dipped into a tube of spirit and thereby transferred to a tube of 70% alcohol for preservation. However, one might prefer to collect all specimens alive and put them singly in small corked tubes, 4 × 1 cm for most specimens but with a few wider tubes for the larger spiders. A 'pooter' or aspirator (Fig. 6) is a very useful tool for the spider collector, especially for sucking up smaller species, as this reduces the chances of damaging the specimens when they are being picked up.

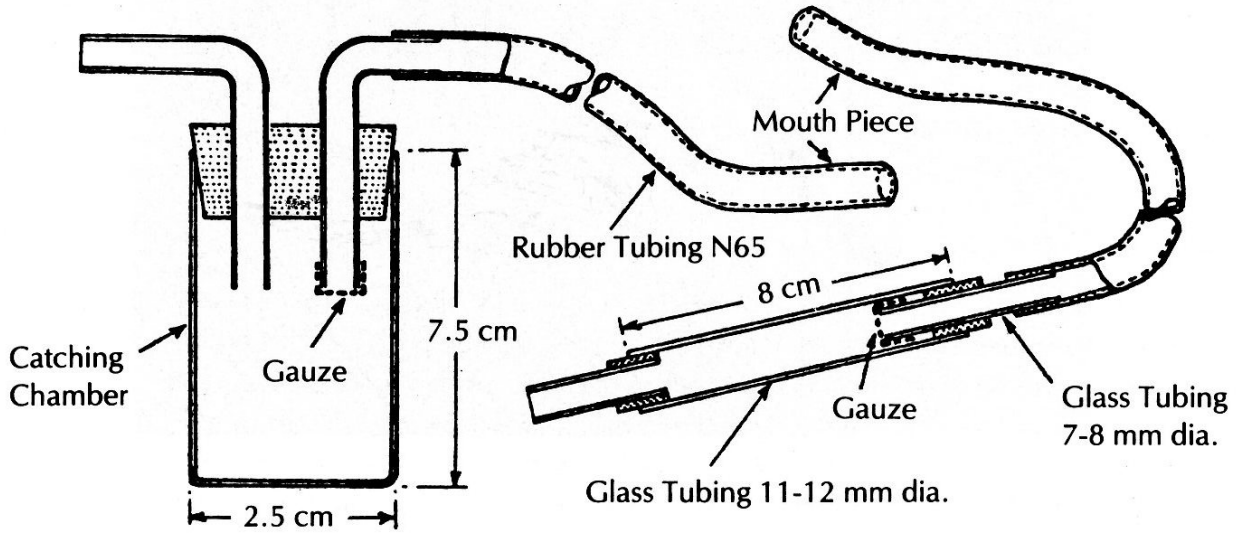
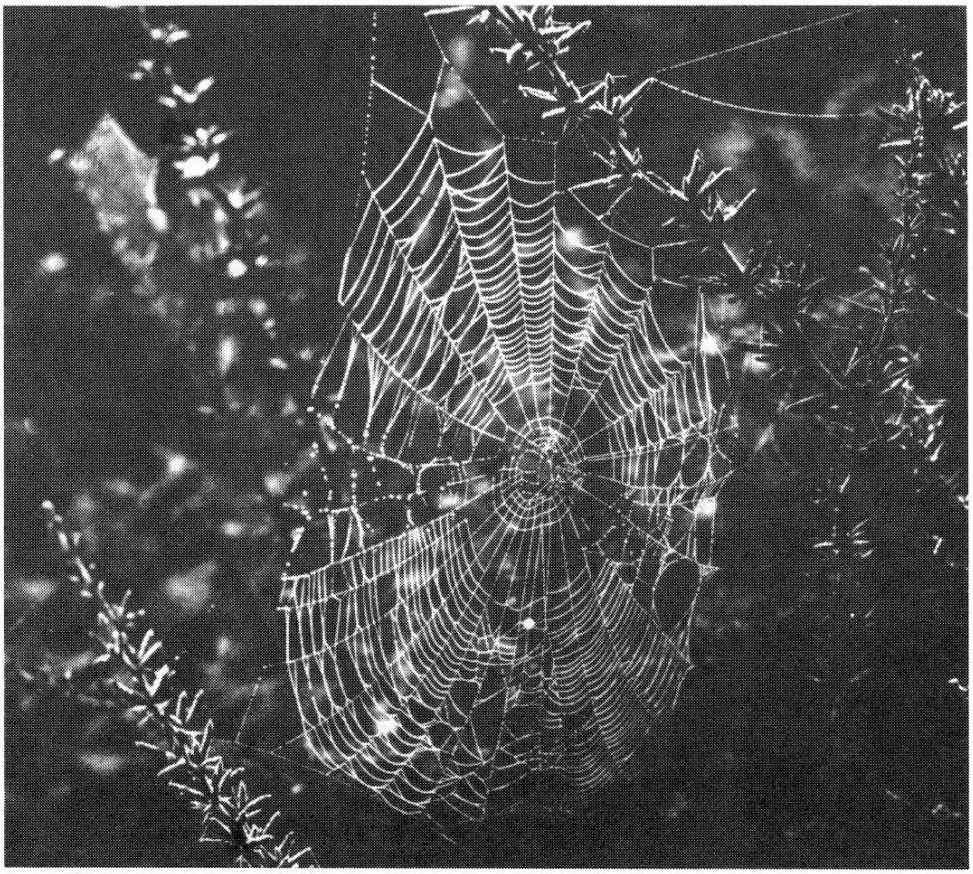


Fig. 6.

It is necessary when collecting live spiders to limit them to one to a tube as all spiders are carnivorous and if more than one is placed in a tube, you will find that the larger specimens will have killed or damaged the smaller ones. If at all possible, only adult spiders should be collected, as it is extremely difficult to identify with any certainty those that are immature; the latter may, however, be reared to maturity in captivity. A little experience and the use of a hand lens will soon enable one to recognise adults in the field. By using the lens, one can see if the epigynes of the females are showing clearly on the underside of the abdomen and are sclerotised. With males, the pedipalps should be clearly developed at the swollen end and not still enclosed in a skin membrane as they are when immature.



Orb web of *Araneus diadematus*

Identification and recording

Identification of the specimens collected can be carried out by reference to some of the books mentioned later, but some form of higher magnification is necessary. A microscope giving magnifications of between ×20 and ×150 is adequate. The lower magnification is useful for sorting through material when the contents of a tube are tipped out, and the higher magnification is sometimes required for critical examination of certain characters. A stereoscopic (binocular) microscope is the best instrument for studying spiders. A good second-hand monocular microscope can often be obtained at a reasonable price, but the reversed image can be irritating when trying to manipulate specimens in view. The spiders are examined, submerged in 70% alcohol, in a small flat dish and can be held in any desired position if a layer of fine sand or fine glass beads (80 mesh, as used in gas chromatography) is placed in the bottom of the dish. Specimens under the microscope are illuminated from above by some form of top lighting. An ordinary desk lamp with a 'bulls-eye' condenser will do, but much better illumination is obtained by using a high-intensity lamp purchased from microscope dealers. A 12 volt, 50 watt halogen lamp (quartz-mercury) used for car spotlights or slide projectors may also be used. It can be fed from a 12 volt transformer with an output of some 4 amps. Good top lighting is very important, particularly at the higher magnifications, and the light should be focussed by means of a condenser or an additional lens so that a spot of intense light (and inevitably some heat) is directed on to the specimen. In recent years, high intensity fibre-optic lighting systems have become popular; they allow very bright illumination without heating the specimen.

Identification is carried out mainly by the shape and form of the epigyne in the female and of the developed end of the palp in the male, but there are a number of other features which assist identification, such as the shape and markings on the cephalothorax and abdomen, and the number and positions of the eyes. Most spiders have eight simple eyes located at the fore end of the head (Fig. 1), but a few families have six eyes only and such things can all help in placing the spider into the correct family. When identifying spiders of the family Linyphiidae, which includes the 'Money spiders', considerable use is made of the number and position of the leg spines and of the long, sensory hairs called trichobothria (Fig. 7).

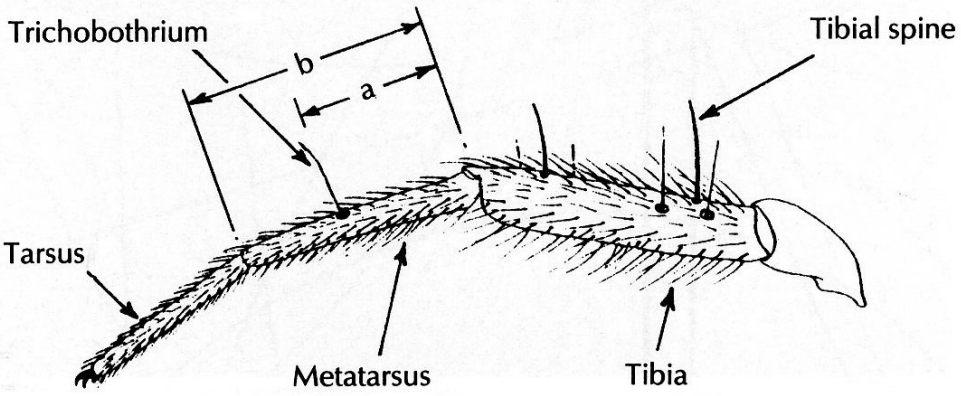


Fig. 7. Spines and hairs on a spider's leg. The leg is clothed in short hairs. The trichobothrium is a long fine hair, rising almost vertically from the centre of a small circle on the dorsal side of the leg and its position is expressed as a decimal fraction ($^a/_b$). Spines are much stouter than hairs and appear on dorsal, ventral and lateral surfaces of the leg.

When commencing the job of identifying specimens brought home from a collecting expedition, live specimens should first be sorted out using a hand lens. Immatures should be released (or placed in rearing cages) and the remainder placed in tubes containing 70% alcohol. By keeping all specimens collected from one locality or habitat in one tube, with a paper label inside the tube giving date and locality, each batch can be left indefinitely until the opportunity arises to carry out the final identification. After final identification to species level, labels for each species (Fig. 9) can be written in waterproof black drawing ink which will not run in alcohol even if immersed soon after being written. After identification, the spiders can be stored (Fig. 8) in small 4 × 1 cm tubes in 70% alcohol. In the days before polythene closures became available (when there was a considerable risk of specimens completely drying out, due to the alcohol evaporating through cork stoppers), the practice was to add 5% glycerine to the alcohol in order to prevent complete dessication. The risk of losing specimens through evaporation of alcohol, and the fire risk of alcoholic collections, can be eliminated by fixing the specimens in 70% alcohol and then storing them in a solution of 1% propylene phenoxytol in water. The spiders are placed in separate tubes, one species only to each tube, with a final label giving species name, locality, date, and collector's initials.

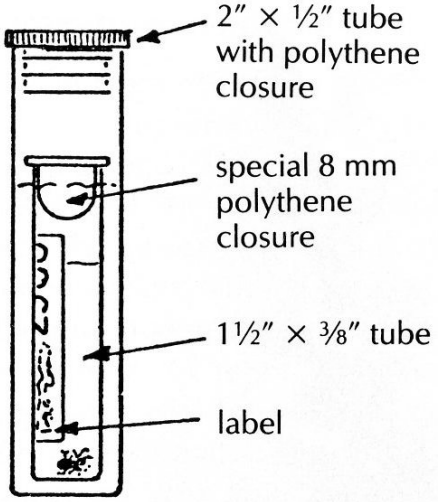


Fig. 8.

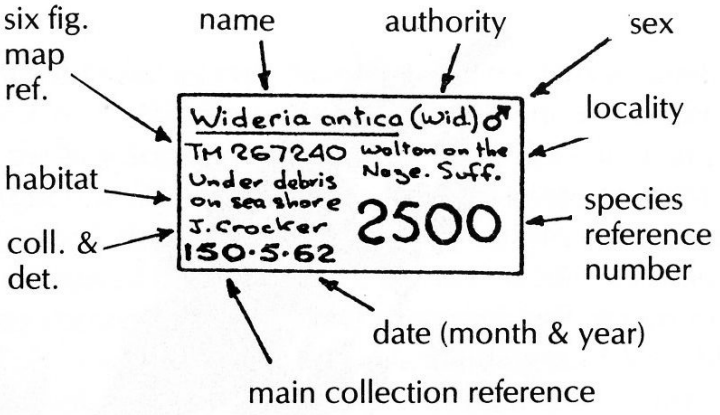


Fig. 9.

Spiders do not make a pretty collection as do many insect orders, so the temptation to over-collect is not present. However, it is useful to have a few tubes of each species, from different localities, to which one can refer later should difficulties arise in the identification of new specimens being added.

The individual tubes can be stored in long drawers with a tray of perforated or expanded metal raised up from the floor of the drawer so that the tubes stand upright. Another method is to use ½" plywood in the bottom of the drawers with a series of holes drilled in the plywood to take the tubes. The older method of storage is to dispense with the tube corks, plugging the tubes with cotton wool; the tubes are then placed upside-down in round jars filled completely with alcohol. This method certainly prevents most of the alcohol evaporation, but it is difficult to locate a particular tube when it is wanted for reference, and quick reference is an important aspect of any collection.

Whilst some spiders are easily identified, the beginner will find that other species, in various families, present a considerable challenge. Fortunately it is possible to ask some more experienced worker to verify one's identifications, and there has always been a very friendly exchange of experience and help among members of the British Arachnological Society, both amateurs and professionals alike, who work actively on spiders.

A complete record of all specimens collected, with full data as to locality, habitat, date and any further notes should be kept on a card index, with a card for each species, and this will be invaluable later when one starts to put one's experiences down on paper. A national Spider Recording Scheme, organised jointly by the British Arachnological Society and the Biological Records Centre, is now in operation and printed cards are available for the detailed recording of species and habitats.

Simple ecological work

A logical step after one is over the first hurdles of identification is to attempt some simple ecological work by selecting a suitable area or habitat, for example one's own garden, or a small area of woodland near one's home, or a marshy area with a pool, and see how many spider species are located within this area. Note which type of habitat

Uloborus walckenaerius

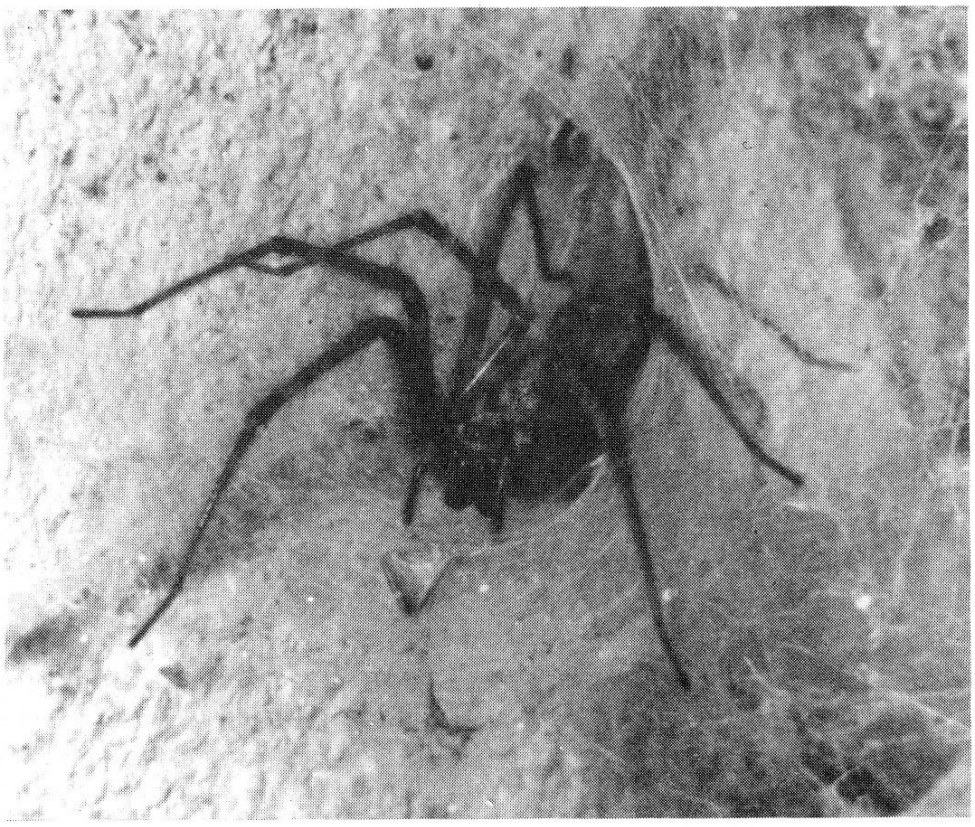
each species prefers, which are the most numerous or dominant species in each habitat; note their season of maturity and record any habits such as courtship, egg-laying or web spinning. A note could also be made of food preferences, by examining webs or silken resting cells under stones, and any other factors such as temperature or humidity which appear to affect their lives.

Population counts of the numbers of individual species within a given area can also be made, either by counting webs or taking small turf samples of a definite size and sorting out the spiders found there. Simple pitfall trapping can also be carried out by sinking plastic beakers in the ground up to lip level and having an inch or so of a mixture of alcohol and glycerine or diluted 'anti-freeze' in the bottom. Adding a drop of detergent to the mixture will ensure that the spiders sink. Such traps should be visited regularly, say weekly, the specimens in the trap removed for identification and the trap renewed. If trapping is carried out at different months of the year, one can determine not only which species frequent the area, but at which times they are most numerous or attain maturity. With pitfall trapping the catch is indiscriminate and will include a wide range of other invertebrates; co-operation with other naturalists makes best use of the animals caught. Bark traps in the form of corrugated cardboard can be wrapped around tree trunks and left for a few weeks; then removed, taken home in a polythene bag and examined by peeling off the outer layers of cardboard. This allows sampling of the distinctive spider fauna of tree trunks without levering up and damaging of the bark — a most reprehensible practice. Artificial birds nests, in the form of wood shavings or straw wrapped in chicken wire, may be placed in the higher branches of trees, removed after a few weeks and the colonising spiders extracted. All such work, no matter how simple or elementary, helps towards our further knowledge of spider life and there are hundreds of problems awaiting elucidation.

Literature available

For many years, the main books used for species identification were the two volumes of *British Spiders* by G. H. Locket and A. F. Millidge, and a third volume by Locket, Millidge and P. Merrett, published by the Ray Society in 1951 (Vol. I), 1953 (Vol. II) and 1974 (Vol. III). These three volumes describe all the British species known up to 1974, and the genital organs and other structural details of all species are illustrated to aid identification. Vol. III also has a set of maps of the counties of the British Isles showing the distribution of every spider species recorded up to 1974, prepared and drawn by P. Merrett. (A reprinted edition of Vols. I and II within a single binding and Vol. III separate, can be purchased at the bookshop in the British Museum (Nat. Hist.), Cromwell Road, London SW7 5BD.) More recently a new three-volume work has appeared, *The Spiders of Great Britain and Ireland,* by M. J. Roberts, published by Harley Books. Vols. 1 and 2 (1985 and 1987) describe, and illustrate the genitalia of, all the British species known up to 1987; Vol. 3 (1985) is devoted entirely to colour plates in which over 300 species are illustrated, greatly enlarged, as they appear under the microscope.

A very useful book, particularly in the field, is *The Country Life Guide to Spiders of Britain and Northern Europe,* by Dick Jones (1983, Hamlyn); it contains excellent colour photographs and is an inexpensive guide to many of our commoner species. For more general reading, one cannot do better than by studying W. S. Bristowe's *The World of Spiders* (1958) in the New Naturalist series by Collins Ltd.; although out-of-print, it is available in most libraries and fairly easy to obtain second-hand. Another useful book,



Female *Tegenaria gigantea* in web

with a self-explanatory title, is *Keeping Spiders, Insects and other Land Invertebrates in Captivity* by F. Murphy (reprinted 1985, Bartholomew).

There are also many papers and articles on spiders published in various journals, usually dealing with some specific aspect of spider biology, and here the Bulletins and Newsletters of the British Arachnological Society, which are sent to members three times annually, cater for this admirably. The British Arachnological Society (membership address below) is the sole organisation in this country dealing with all aspects of the study of spiders and other arachnids, and organises special field weeks, and weekends, at various field centres and other locations. This allows less experienced members the opportunity to work with experienced arachnologists, both in the field and in the laboratory; such weeks help the beginner over the initial difficulties of collection and identification. The Society has large libraries of both reprints and photographic slides and is establishing a reference collection of specimens; all of these are available on loan to members.

There are probably fewer than one hundred people working actively on spiders in this country at the present time, and because of this scarcity of workers, our knowledge of spider distribution, habitats and ecology is less than for most other groups of invertebrates of comparable size. Very little is known of the habits and day-to-day activities of many of our common spiders and there is no doubt that anyone looking for a new and absorbing interest, whatever their age, would find spider study both fascinating and rewarding.

Acknowledgements

David Watson Mackie died in August 1984. His role in the formation of the British Arachnological Society was a crucial one and his personal contribution in the early years was enormous. This article was first published in *Countryside* magazine in 1967. A revised edition was published as a booklet by the British Arachnological Society in 1978. Further slight revision has been undertaken in publishing this 2nd edition of the booklet.

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Further information about the British Arachnological Society can be obtained from the Membership Treasurer, Mr. S. H. Hexter, 71 Havant Road, Walthamstow, London E17 3JE.