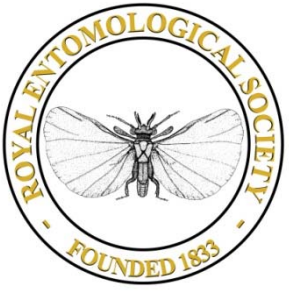
Royal Entomological Society



HANDBOOKS FOR

THE IDENTIFICATION

OF BRITISH INSECTS

To purchase current handbooks and to download out-of-print parts visit:
http://www.royensoc.co.uk/publications/index.htm

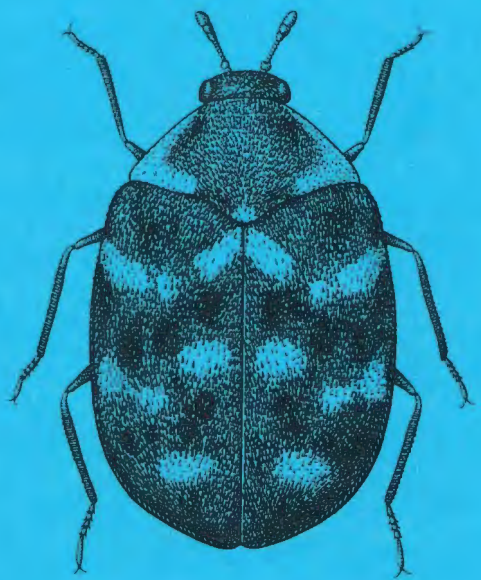
Handbooks for the Identification of British Insects
Vol. 5, Part 3

ADULTS AND LARVAE OF HIDE, LARDER AND CARPET BEETLES AND THEIR RELATIVES
(COLEOPTERA: DERMESTIDAE)

AND OF

DERODONTID BEETLES
(COLEOPTERA: DERODONTIDAE)

E. R. Peacock



ROYAL ENTOMOLOGICAL SOCIETY OF LONDON

Handbooks for the
Identification of British Insects

Vol. 5, Part 3

Editors: W.R. Dolling & R.R. Askew

ADULTS AND LARVAE OF HIDE, LARDER AND CARPET BEETLES AND THEIR RELATIVES
(COLEOPTERA: DERMESTIDAE)

AND OF

DERODONTID BEETLES
(COLEOPTERA: DERODONTIDAE)

By

Enid R. Peacock

Department of Entomology
British Museum (Natural History)
London SW7 5BD

1993
ROYAL ENTOMOLOGICAL SOCIETY OF LONDON

The aim of the *Handbooks* is to provide illustrated identification keys to the insects of Britain, together with concise morphological, biological and distributional information. The series also includes a *Check List of British Insects*.

Each part should serve both as an introduction to a particular group of insects and as an identification manual.

Details of handbooks currently available can be obtained from Publications Sales, The Natural History Museum, Cromwell Road, London SW7 5BD.

World List abbreviation: *Handbk Ident. Br. Insects*

First Published 1993 by The Natural History Museum, London

ISBN 0 901546 78 X

Photoset by Spottiswoode Ballantyne, Colchester, Essex
Printed in Great Britain by St Edmundsbury Press, Bury St Edmunds, Suffolk.

Contents

Contents—*continued*

Introduction

The family Dermestidae contains over 1000 species in about 50 genera and is represented in every zoogeographical region of the world. By far the greatest number of genera and species occurs in the Palaearctic Region and the smallest number in the Oriental Region.

Dermestid larvae feed mainly on animal material, but a few are able to live partly or wholly on vegetable material. Although sometimes found in numbers on vegetable material, they may be feeding on dead insects. In the wild they may occur in and around webs of spiders and caterpillars, in nests of insects, mammals and birds, on carrion or under bark. Sometimes the adults are found in the same habitats as the larvae and feed on the same materials e.g. *Dermestes* and *Thylodrias* spp., but in most cases the adults do not feed or, if they have access to flowers, may feed on pollen and nectar. However, in this case, they still might be found with the larvae, as they often mate and lay eggs before flying to flowers.

Some species live completely in the wild (usually rural species), others live partly in the wild but are often synanthropic, and some are completely reliant on man and are rarely found in the wild. The partly synanthropic species usually spend part of their life cycle near human habitation, then migrate into houses or commercial premises.

Many are pest species and are said to be cosmopolitan as they have been spread through commerce. With these species there is sometimes difficulty in establishing their original distribution. Some species from the tropics are now able to survive in colder climates in artificially heated conditions, although they are unlikely to become established out-of-doors. Some are known as pests of animal products in storerooms or as scavengers feeding on various remains in or near human habitations.

In Britain there are 38 species in 13 genera. About half of the British species occur only in artificial habitats, feeding on animal materials such as woollens, hides, dried meats, and a few on cereals etc. Most of the others may be encountered more or less frequently in such situations. The most important pests in this country are certain species of *Dermestes* (hide and larder beetles), *Trogoderma* [on imports] and *Anthrenus* (carpet and museum beetles). Some of these have been known to cause significant economic losses, Only 11 species are truly native to Britain and about half a dozen of these have only been encountered in open-air habitats here.

The family Derodontidae contains 22 species in 4 genera and is restricted to the temperate parts of the northern and southern hemispheres. One genus is known from New Zealand, Australia and Chile and the other three occur in the Holarctic Region. Only one species, *Laricobius erichsonii*, has been found in Britain (first record, 1971), and probably arrived by natural dispersal from continental Europe. This species originated in the Alps and Carpathian Mountains but has spread northwards in Europe, probably due to the extensive planting of conifers. It is now also established in N. America, after being introduced for biological control. Unlike some of its dermestid relatives, it is beneficial in its habits, having been successfully used as a biological control agent for woolly aphids on fir trees. Both adults and larvae of *Laricobius* feed on the eggs and adults of adelgid Homoptera. Other members of the family feed mostly on fungal material.

The superfamily Derodontoidea has been restored for the Derodontidae (Hammond & Barham, 1982), but its superfamily position is still under discussion. Until recently, it was grouped with the Dermestidae and two small non-British families, Nosodendridae and Jacobsoniidae, in the superfamily Dermestoidea (Crowson, 1955). Lawrence & Newton (1982), Ivie (1985, ms) and Lawrence & Britton (1991) have now synonymized the Dermestoidea (minus the Derodontidae)

with the Bostrichoidea. The Nosodendridae contains the single genus *Nosodendron* with about 50 species which are found in most forested areas of the world and the Jacobsoniidae (= Sarothriidae) is a small family with 6 genera and 9 species, all of which are under 2 mm in length and have a broad but scattered distribution.

Acknowledgements

This Handbook is based on the British Collections in the British Museum (Natural History), London, referred to in this work as BMNH. The Museum's name has recently been changed to 'The Natural History Museum'.

I am grateful to Mr A.A. Allen, Dr J. Lane, London School of Hygiene and Tropical Medicine and Mr H.R. Last for very kindly sending me data from specimens in their collections; to Mr R.G. Adams, ADAS, Central Science Laboratory, Slough, Mr K. Alexander, Biological Survey Team, National Trust, Dr N.J. Armes, Overseas Development Natural Resources Institute, Chatham, Dr R.G. Booth, CAB International Institute of Entomology, Mr M. Colvin, Terminex Pest Control Division, Crawley, Mr P.M. Hammond, BMNH, Mr C. Johnson, Manchester Museum, Mr M.J. Linnie, Trinity College, Dublin, Mr H. Mendel, Ipswich Museum, Dr J.P. O'Connor, National Museum of Ireland, Dr M.R. Shaw, Royal Museum of Scotland, and Dr I.D. Wallace, Merseyside County Museum, for data they supplied; to Dr L. Strong, Bristol Museum, who donated larvae of *Dermestes leechi* and Dr D.G.H. Halstead, ADAS, Central Science Laboratory, Slough, who provided me with larvae of *Globicornis nigripes* to study and also donated many species of adults and larvae from cultures.

I thank my colleagues from the CAB International Institute of Entomology, Dr M. Cox and Dr R. Madge who very kindly tested the larval and adult keys respectively and made helpful criticisms and suggestions. Thanks are also due to my colleagues, Mr P.M. Hammond and Mr R.T. Thompson and to Dr D.G.H. Halstead of ADAS, Slough who critically read the manuscript and offered many suggestions for improvement.

I am also grateful to my colleague, Mrs Judith Marshall, who drew my attention to the possibility that the spider, *Oecobius annulipes* Lucas, was feeding on the *Anthrenus* larvae in the BMNH, and for conducting the experiment proving her theory.

Some of the excellent habitus drawings were drawn by my colleague, Mr M. Kerley, to whom I am extremely grateful, and two of the larval drawings were adapted by the author from unpublished originals by Ms B. Hopkins, which are housed in the BMNH. All other drawings were done by the author unless otherwise indicated. I would like to thank the staff of the Electron Microscope Unit in the Museum for their help in producing the photographs.

Checklist

The following list updates that in Pope (Kloet & Hincks) (1977). Some 39 species in 14 genera are listed. Full synonymies are not given but, for the dermestid species, may be found in Mroczkowski's Catalogue (1968) and in later cited works.

Additions to Pope's list are: family Derodontidae, with its included genus *Laricobius* and species *L. erichsonii*; subfamily Thoractinae, with its included genus *Thorictodes* and species *Th. heydeni*; genus *Reesa*, with its species *R. vespulae*; genus *Orphinus*, with its species *O. fulvipes* (although it is only an occasional import); and the species *Dermestes leechi*, *Attagenus smirnovi*, *A. brunneus*, *Trogoderma variabile*, *Anthrenus coloratus* and *A. olgae*.

The subgenera of *Anthrenus* and *Dermestes* have been included as these are in common use. *Attagenus trifasciatus* (Fabricius) has been deleted as it has not been recorded in Britain since 1839 (Hinton, 1945). Various relevant synonyms have been added. *Globicornus* Berthold is a *nomen nudum* so has been omitted. The author's name 'De Geer' has been altered to this form rather than 'Degeer' (Gurney, 1956).

The dermestid genera have been grouped in their subfamilies which form easily recognizable units in both adult and larval stages, with the exception of *Ctesias serra* (Fabricius) which resembles members of the Megatominae in the adult stage and Anthreninae in the larval stage. The subfamily Thylodriadinae, authorship of which was claimed by Mroczkowski (1954), still has to be attributed to Semenov-Tian-Shanskii as, although he used an incorrect spelling, he was the original author of the family group name.

The symbol ° means that the species has been found out-of-doors in Britain and the symbol * denotes a pest species or one found on imports.

DERMESTOIDEA

DERMESTIDAE Latreille, 1807 [Watt, 1975]

THYLODRIADINAE Semenov-Tian-Shanskii, 1912
THELYDRIINI Semenov-Tian-Shanskii, 1912
THYLODRIINI Yakobson, 1913
THYLODRIADINAE Mroczkowski, 1954
THYLODRIIDAE Franciscolo, 1975

THYLODRIAS Motschulsky, 1839
**contractus* Motschulsky, 1839

THORICTINAE Wollaston, 1854
THAUMAPHRASTINAE Anderson, 1949

THORICTODES Reitter, 1875
THAUMAPHRASTUS Blaisdell, 1927
**heydeni* Reitter, 1875
karanisensis (Blaisdell, 1927)

DERMESTINAE Latreille, 1807

DERMESTES Linnaeus, 1758

S. DERMESTINUS Zhantiev, 1967
**carnivorus* Fabricius, 1775 (*erratim: carniforus* Fabricius, 1775)
*°*frischii* Kugelann, 1792
*°*maculatus* De Geer, 1774
vulpinus Fabricius, 1781
°*murinus* Linnaeus, 1758
°*undulatus* Brahm, 1790

S. DERMESTES s.s.
**ater* De Geer, 1774
cadaverinus Fabricius, 1775
*°*lardarius* Linnaeus, 1758
**leechi* Kalik, 1952

*°*haemorrhoidalis* Küster, 1852
peruvianus sensu auct. Brit. partim not Laporte de Castelnau, 1840
*°*peruvianus* Laporte de Castelnau, 1840
oblongus sensu auct. Brit. not Solier in Gay, 1849

ATTAGENINAE Laporte de Castelnau, 1840

ATTAGENUS Latreille, 1802
**brunneus* Faldermann, 1835
elongatulus Casey, 1900
**cyphonoides* Reitter, 1881
alfierii Pic, 1910
**fasciatus* (Thunberg, 1795)
gloriosae (Fabricius, 1798)
*°*pellio* (Linnaeus, 1758)
*°*smirnovi* Zhantiev, 1973
**unicolor* (Brahm, 1791)
megatoma (Fabricius, 1798)
piceus (Olivier, 1790) nec (Thunberg, 1781)

MEGATOMINAE Leach, 1815

TROGODERMA Dejean, 1821
**glabrum* (Herbst, 1783)
boron Beal, 1954
**granarium* Everts, 1898
khapra Arrow, 1917
**inclusum* LeConte, 1854
versicolor sensu auct. Brit. not (Creutzer, 1799)
**variabile* Ballion, 1878
parabile Beal, 1954

REESA Beal, 1967
*°*vespulae* (Milliron, 1939)

GLOBICORNIS Latreille, 1829
*°*nigripes* (Fabricius, 1792)
plantaris (Curtis, 1838)

MEGATOMA Herbst, 1792
*°*undata* (Linnaeus, 1758)

ANTHRENOCERUS Arrow, 1915
*°*australis* (Hope, 1843)

ORPHINUS Motschulsky, 1858
**fulvipes* (Guérin-Méneville, 1838)
brevicorne (Sharp, 1885)

CTESIAS Stephens, 1830
TIRESIAS Stephens, 1835
*°*serra* (Fabricius, 1792)

ANTHRENINAE LeConte, 1861

ANTHRENUS Müller, O.F., 1764
S. ANTHRENUS s.s.
**flavipes* LeConte, 1854
vorax Waterhouse, C.O., 1883
**pimpinellae* Fabricius, 1775
**scrophulariae* (Linnaeus, 1758)

S. ANTHRENODES Chobaut, 1898
*°*sarnicus* Mroczkowski, 1963

S. ANTHRENOPS Reitter, 1881
**coloratus* Reitter, 1881

S. FLORILINUS Mulsant & Rey, 1868
*°*museorum* (Linnaeus, 1761)
**olgae* Kalik, 1946

S. HELOCERUS Mulsant & Rey, 1868
*°*fuscus* Olivier, 1789
claviger Erichson, 1846

S. NATHRENUS Casey, 1900
*°*verbasci* (Linnaeus, 1767)
varius (Fabricius, 1775)

TRINODINAE Casey, 1900

TRINODES Dejean, 1821
°*hirtus* (Fabricius, 1781)

DERODONTOIDEA

DERODONTIDAE LeConte, 1861
LARICOBIUS Rosenhauer, 1846
°*erichsonii* Rosenhauer, 1846

Key to distinguish between adults of British Dermestidae and Derodontidae

1 Head either without ocelli or with one median ocellus (figs 1, 2). Elytra usually without striae. Tarsi clearly 5-segmented, segments not lobed below (fig. 3). Fore coxal cavities widely open behind (fig. 292). Hind coxae rarely extending to meet elytral epipleura. Length 1.0–12 mm ..... **Dermestidae** (p. 9)

— Head with 2 dorsal ocelli, close to inner margins of compound eyes. Elytra with distinct striae. Tarsi 5-segmented but appearing 4-segmented, as segment 4 is reduced. Segments 1–3 strongly lobed below. Fore coxal cavities only narrowly open behind (apparently closed). Hind coxae extending to epipleura. Length 1.5–2.5 mm. (figs 293–298). .... **Derodontidae: Laricobius erichsonii** Rosenhauer (p. 67)

Family Dermestidae

Biology

More than two dozen dermestid species are synanthropic and are either pests of animal products in store rooms or are scavengers feeding on food scraps in or around houses. Some of them have followed man and are fully cosmopolitan – *Trogoderma* Dej. (1 species), *Anthrenus* Müller (2 species), *Attagenus* Latr. (3 species), *Thorictodes* Reitter (1 species) and *Dermestes* L. (5 species). The original distribution of these species is not always clear as distributional records mainly refer to inhabited areas of the world. Some dermestids live partly in the wild whereas others are completely feral. In the wild they may occur in webs of spiders and caterpillars, in nests of ants, bees, wasps, mammals and birds, on carrion or under bark. Adults of *Anthrenus* and some other genera feed on pollen and nectar unlike those of *Dermestes* spp. which feed on the carcasses of vertebrates. Most of them are ready fliers.

Larval Dermestidae feed almost exclusively on materials of animal origin. There are some exceptions to this as a few species are able to live partly or wholly on vegetable materials. This is probably a secondary specialization that has been

acquired by a few members of the family. The family includes such well known household pests as the hide, leather and larder beetles (*Dermestes* spp.) and the carpet and fur beetles (*Anthrenus* spp. and *Attagenus* spp.) which feed on materials of animal origin. The last two damage carpets and upholstery as well as scientific collections of insects and vertebrates. The family also includes the khapra beetle (*Trogoderma granarium* Everts), a major pest of grain and cereal products, which feeds almost exclusively on vegetable material. A few species have also been known to damage books (author's observation and Hickin, 1985). In addition, *Dermestes* spp. may damage materials on which they do not feed when constructing their pupal chambers.

Dermestidae are notable in that most genera pupate within the last larval skin, which is split longitudinally dorsally. Sometimes the adult beetle also lies quiescent in the same skin for a few days before becoming active. The pupae of some genera possess dorsal protective organs known as gin-traps, e.g. *Dermestes*, *Attagenus*, *Trogoderma* and *Anthrenocerus*. Other genera are without these devices but are protected dorsally by a dense covering of setae, e.g. *Megatoma*, *Anthrenus* and *Trinodes*. For an account of gin-traps and of dermestid pupae generally, see Hinton (1946). *Dermestes* is the only genus in which the larvae bore into solid substances to construct a pupal chamber and then usually the last larval skin is cast and used, along with the larval débris, to block the entrance to the chamber. Larvae of other genera do not make cells, but pupate in the food material within the last larval skin. Pupae of *Attagenus* may partly or completely shed the skin.

Control

Domestic infestations

The only dermestid beetles likely to become household pests in Britain are certain species of carpet and fur beetles (*Anthrenus* and *Attagenus*) and hide beetles (*Dermestes*).

The first sign of carpet or fur beetle infestation in the home is often the appearance of adult beetles on window sills during the spring and summer months. If only one or two beetles are found then there is probably no cause for alarm as most households, particularly around London, support small numbers without there being noticeable damage. These beetles are able to live and complete their development in small amounts of fluff, dead flies etc. between the floorboards and under furniture so may not actually be damaging goods.

It is the larval stage (in *Anthrenus* spp., known as a 'woolly bear') which damages woollens, carpets etc. As the larva grows, it casts its skins and when fully grown pupates in the last skin (*Anthrenus* spp.), or partially or completely sheds the skin (*Attagenus* spp.). Emergence of the adult from the pupa may be followed by a short resting stage within the last larval skin (*Anthrenus* spp.) after which the adult emerges and searches for a mate. After mating, the female beetle lays eggs on some suitable material and will then become positively phototactic and is often to be found at a window. If it manages to escape it will fly to flowers where it will feed on pollen and nectar, may mate again and then either fly back indoors to lay more eggs or go to a bird's nest nearby. Often eggs are laid in birds' nests on the outsides of houses or in the attics (sometimes on a dead bird or rodent or on pipe-lagging) or even in disused chimneys. In birds' nests the larvae feed on feathers, dried insects or other animal material, and when they have exhausted this may migrate into the upper rooms of the house to continue their development in woollen or similar materials. Clean clothes are just as frequently attacked as soiled ones.

The best method of control in the home is by diligent searching and cleaning. Wardrobes, airing cupboards, drawers etc. should be emptied of clothes and bedding, which should be examined and then shaken outside. If any sign of infestation is

present (larval skins or holes in material), everything should be washed or dry-cleaned and the container thoroughly vacuumed or scrubbed out. Carpets and cracks between floorboards should be vacuumed and free standing furniture moved and the floor cleaned. Even furniture that seems to be touching the floor at the base (not raised on legs) should be moved as quite large colonies of *Anthrenus* have been found breeding under such furniture. Young larvae are small enough to crawl into very small cracks and will thrive best in an undisturbed environment. For this reason, fitted woollen carpets with felt underlays are a particular hazard. Upholstered furniture should be vacuumed and the undersides of carpets examined if possible. Washing will kill the eggs as they are unable to withstand high humidity.

Another method of controlling carpet beetles is by trapping (Wilson, 1940). This is achieved by leaving box traps on the floor containing cloth pads treated with fish meal, sardine or codliver oil or any strong-smelling animal material with some sticky fly paper placed in front of the bait. This method is apparently successful in attracting larvae, but may not be everyone's choice.

If a small infestation has been caused by a beetle flying in through the window and laying eggs, then it can be easily controlled once the source is discovered. If, however, the infestation is large or recurrent, it is possible that the larvae are gaining access to the house from outside nests or nests in the attic or a disused chimney, or even from a dead bird or rodent. This possiblility should be investigated; a bad infestation may need fumigation treatment by a specialist firm, although most small infestations can be dealt with quite easily by the householder.

Anthrenus verbasci is the only species of the genus in Britain which has been known to infest stored food products although they are not its preferred food. It is an unusual environment for the species but should be borne in mind if these carpet beetles are found in the kitchen, as the source could be a neglected packet of food. It is a wise precaution to keep stored food materials in containers with secure lids as this prevents the spread of an infestation should some infested food be brought into the house and will also prevent new infestations starting from beetles which may be already on the premises.

Dermestes spp. are the only other members of the family likely to be found in houses and, like carpet beetles, may originate from birds' nests where they sometimes live, although they are more frequently found on carrion in the wild. The two species which are most commonly found in domestic premises in this country are *D. haemorrhoidalis* and *D. peruvianus*. These species seem to have become adapted to living on food sources supplied by man and are rarely found in the wild, although *D. peruvianus* has been found in abundance in pigeons' nests. They thrive particularly well in towns where there are flats with rubbish chutes or hotels with low standards of hygiene and they travel from one domestic situation to another. As with carpet beetle infestations, diligent searching for, removal and destruction of the food source of the larvae should be a priority, although with this genus the adults feed on the same food material as the larvae. Similarly, food should be kept in containers with secure lids to prevent contamination. Insecticidal treatments or fumigation should only be used as a last resort in the home and in most cases should not be necessary.

Infestations in museums

Methods of control which are used in the treatment of beetle infestations in insect, bird and mammal collections include low and high temperatures, fumigants (including slow-release Vapona strips) and moth-proofing solutions. *Freezing* is advocated as an efficient way to kill all stages of insect life: −18°C. for 48 hours should be sufficient in most cases (Crisafulli, 1980; Stansfield, 1989). *Anthrenus verbasci* eggs are known to be killed after only 2 hours at −18°C. and *Trogoderma* eggs are killed after 9 hours at −18°C., but eggs of these beetles in the middle of a sack of grain take 50–60 hours to die (Billings, 1984, unpublished report). In Finland, infested

drawers, plant specimens etc. have been kept in a deep freeze at −20°C. for at least a week to kill all stages of *Reesa* (Hämäläinen *et al.*, 1984). *Heat* is also a very reliable way of treating infested insect drawers or boxes. In the BMNH they are placed in a laboratory oven for 24 hours at 50°C. to kill *Anthrenus* and *Reesa* adults and larvae, although the insects seem to be dead after only 1 hour. *Trogoderma* spp., which are far less likely to be found in a British museum, have a far greater resistance to heat, and larvae have been known to survive for 8 days and adults for 6 days at 45°–50°C., 20–30% R.H. (Howe, 1952b).

In insect and plant collections and display cases containing mammals and birds, prevention of access is the best form of control. This means making sure collections are kept in good containers with well-fitting lids and that display cases are well sealed and, if necessary, with a slowly vaporizing insecticide installed. Small larvae are able to crawl through very small cracks. Naphthalene is a deterrent if used in a confined area; it has been shown that larvae are less likely to enter a drawer which contains this substance. Again, as in households, thorough cleaning of floors and behind and under furniture is advised, as reservoirs of larvae are able to survive there if undisturbed and are a potential source of infestation. Sticky window traps in these establishments are effective in catching adults. These consist of a sticky substance on strips of double-sided sticky tape which is placed along the base of the windows. Adults are caught on these and are prevented from escaping through the window. Unfortunately, experiments have shown that most females have already mated and laid eggs before reaching these traps. They are, however, prevented from further mating and egg-laying and, more importantly, their presence will help pinpoint an infestation. Light traps have also been used successfully in the BMNH for attracting adults of *A. sarnicus* in a dark store room (Armes, 1983). It was found that an ordinary light bulb (not a mercury vapour lamp) attracted the beetles, if the room were kept in total darkness day and night. Advice on eradication of museum pests and details of the possible dangers of chemical treatments is given by Edwards *et al.* (1981) and Pinniger (1989).

Infestations in industrial premises

Cargoes of infested products or heavy infestations in industrial premises are usually best dealt with by specialist firms.

In industrial premises, as in domestic premises, correct identification of the pest species is of paramount importance and this is usually best done by an expert, who can also provide details of habits and life-cycle. Goods should be examined on arrival and any with obvious infestations should be rejected. Everyone who manufactures, stores or trades in vulnerable commodities should ensure that the premises and stock are free from insect infestation. Every effort should be made to ensure strict hygiene and thorough cleanliness and goods should be wrapped or packaged in tough well-sealed containers, when practicable, to make them as insect-proof as possible. The first larval stages are very small and able to enter commodities through very small cracks in the packaging. Frequent subsequent examinations should also take place for signs of infestations. If the premises are kept clean and in good order, this lessens the risk of infestation and makes it possible to intercept one at an early stage. Thorough cleaning is also necessary in transport vehicles, ships' holds etc. Cleaning means more than sweeping away obvious debris, it means careful and frequent cleaning in inaccessible corners and cracks etc.

In some premises the routine spraying of a contact insecticide, which forms a surface film on the fabric of the storage and supporting dunnage, has proved effective. This remains on the surface when dry and will kill any wandering beetles.

The choice of insecticide depends on the species of pest beetle and the stock involved and whether the insect is on the stock or in the building structure. Some insecticides are more effective against one species than another and some fabrics etc.

could be damaged by the wrong insecticide which is why it is important, in most cases, to get specialist help. Shop keepers and wholesalers requiring advice should consult their local Public Health Inspector. Advice may also be obtained from the regional offices of the Ministry of Agriculture, Fisheries and Food or from the Ministry's Control Laboratory (see below) which has produced leaflets on the control of different species.

Infestations in stores are often caused by the reuse of sacks, and special methods of cleaning and heat treatment are used to sterilize them. Bands of contact insecticide are sometimes placed on the floor to prevent access by crawling insects. The most commonly used insecticides are fumigants or contact insecticides. Fumigants are poisonous gases and should be used only by qualified people. A contact insecticide will only kill those insects which touch it, and may be applied to surfaces in the form of liquid spray, dusting powder or smoke, or may be incorporated in 'whitewashing' material. Heat treatment is also used in some cases. Woollen carpets are sometimes 'moth-proofed', but this is a possible health hazard.

Since 1975, *Dermestes maculatus* and *D. lardarius* have become serious pests in deep-pit poultry houses (Jefferies, 1979; Armitage, 1986). These provide an ideal environment due to the warm conditions and ready availability of food. The accumulated droppings are especially favourable as they are undisturbed for long periods. The beetles in these situations often cause severe damage to structural timbers and insulating material. Also, the infested manure, when spread on fields, has resulted in heavy infestations in nearby houses. In poultry houses chemical control is impractical due to the chemical properties of the manure, and would necessitate regular and expensive treatments. The structure of the poultry houses can be sprayed with residual insecticide, but this does not stop the populations in the manure. Heat treatment or natural fermentation is a possible remedy.

Detailed information on control may be obtained from the Ministry of Agriculture, Fisheries and Food, ADAS Central Science Laboratory, Slough, Berks. 8L3 7HJ.

Natural enemies

Live larvae are eaten by other beetles e.g. *Tenebrio molitor* L., *Creophilus maxillosus* (L.), *Saprinus semistriatus* (Scriba), *Necrobia rufipes* (DeG.), *N. violacea* (L.), *Korynetes caeruleus* (DeG.) and *Tenebroides mauritanicus* (L.). They have also been known to be eaten by chickens. Dermestid larvae are frequently cannibalistic on pupae of their own species.

A few parasites have been recorded on dermestid larvae, but these have not proved to be an effective control except for hymenopterous parasites on certain species of *Anthrenus* and *Trogoderma* (Hinton, 1945; Mertins, 1982). In the USA it has been shown that *Anthrenus fuscus* is able to resist these parasites whereas *A. verbasci* is not (Mertins, 1982). Pseudoscorpions have also been known to attack *Anthrenus* spp.

A hitherto unreported natural method of control was accidentally discovered in the BMNH. A few *Anthrenus sarnicus* larvae had been found on the floor under furniture at intervals for some time. Then, no more were found but instead, several examples of a very small spider, *Oecobius annulipes* Lucas, were seen. In an attempt to prove what seemed a fairly unlikely assumption, a large, live larva of *A. sarnicus* was placed in a container with one of these small spiders. Within minutes the spider had spun a web around the larva, wrapping it up firmly so that it was completely helpless. It then proceeded to suck it dry through the web. (Observations by the author and Mrs J. Marshall.) This species of spider has only recently been discovered in Britain, in the BMNH (Ritchie, 1978), although it has a worldwide distribution.

Medical Importance of Dermestidae

Occasionally, infestations of dermestids can cause medical problems. The setae (hairs) on the larvae easily become detached and may produce urticaria and other allergic reactions including rhinitis and asthma. In the U.K., Rustin and Munro (1984) report papular urticaria in a two year old boy, resulting from an infestation of *Dermestes maculatus* De Geer, which occurred in the boy's home (and cot). They were unsure about the actual cause of the urticaria, believing that it could have been secondary to the irritant effect of the larval setae or due to allergic sensitivity to the protein content of the broken-off setae. *Dermestes* larvae can cause problems when infested cargoes are being unloaded. When a cargo of bone was being unloaded from a ship which had large quantities of larval skins and setae of *Dermestes frischii* Kugelann in its hold, the dockers developed itching of the skin, conjunctivitis and irritation of the respiratory passages (Loir & Legangneux, 1922).

Also, *D. undulatus* larvae have caused irritation and lesions to workers unloading cargo (Ahmed *et al.*, 1981). These authors also report a case of a museum curator who maintained a colony of *Dermestes* for cleaning skeletons and became allergic to them.

Anthrenus larvae apparently more rarely cause skin rashes, but a case of dermatitis occurred in a man in the USA over a period of five years due to hypersensitivity to an infestion of *A. verbasci* in his bedroom carpet (Ahmed *et al.*, 1981). A similar case was recorded by Cormia & Lewis (1948) involving *Anthrenus scrophulariae*. The spear-headed hairs of the larvae of *Anthrenus* spp. have also been known to cause pulmonary irritation when inhaled in large quantities.

Trogoderma larvae can also cause medical problems. In the USA, toxic symptoms (diagnosed as enteric canthariasis) developed in a child which was fed baby cereal that was later found to be infested with larvae of *T. ornatum* (Say) and in another child which had eaten cereal infested with *T. glabrum* (Herbst) (Okumura, 1967). The barbed larval hairs of this genus are left in great numbers in infested grain and may be a serious danger if swallowed (Morison, 1925). A a person who was studying the genus developed allergic symptoms after two years (Okumura, 1967).

Altogether the following 15 species have been cited in allergic responses by humans: *Anthrenus museorum* (L.), *A. flavipes* LeC., *Attagenus pellio* (L.), *A. unicolor* (Brahm) (and under its synonym *A. megatoma* (F.)), *Dermestes frischii* Kug., *D. lardarius* L., *Trogoderma angustum* Sol., *T. granarium* Everts, *T. versicolor* (Creutz.) (Bellas, 1982, 1984), *Dermestes maculatus* DeG., *D. undulatus* Brahm, *Anthrenus verbasci* (L.), *A. scrophulariae* (L.) and *Trogoderma glabrum* (Herbst) and *T. ornatum* (Say).

Several cases have also been received in the BMNH of *Attagenus unicolor* and *A. pellio* being suspected of causing bites and rashes.

Morphology of adult Dermestidae

(except *Thylodrias*, for which see p. 19)

With a few exceptions (e.g. figs 4, 7), adult Dermestidae are compact, ranging from nearly round to elongate-oval in shape. They vary in length from 1–12 mm. The body is nearly always moderately densely clothed with setae or scales which are sometimes conspicuously coloured and form distinctive patterns. The cuticle is black, brown, yellowish or reddish.

The head is deflexed and can usually be retracted into the prothorax; a median ocellus (see Goodman, 1970) is visible in all genera except *Dermestes* and some individuals of *Trinodes hirtus*. The antennae are usually clubbed and the segments vary in number from 5 to 11; the club is generally formed from the 2 or 3 apical segments but in some males of *Trogoderma* it is formed from all segments beyond the

second. The maxilla has a 4-segmented palp, including the palpiger, and the galea and lacinia are distinct. The labial palps are 3-segmented.

The pronotum is transverse, evenly convex, narrowest at the front and with the posterior angles acute (exceptions to some of these characters are *Thylodrias* and *Thorictodes* (figs 4, 5, 7). The hypomera are usually concave or have distinctly differentiated cavities for the reception of the antennae.

The elytra entirely cover the abdominal tergites and are confusedly punctate, without striae. The epipleura are generally distinct but may be feebly developed or even absent. Hind wings are present (except in *Thorictodes*, females of *Thylodrias* and some males of this genus).

There are 5 visible abdominal sternites (7 in *Thylodrias*), sometimes with a setal tuft (setiferous sex patch, Faustini & Halstead, 1982) on 2, 4, or 3 and 4. The legs are usually retractable and the femora are grooved to receive the tibiae when retracted. The ventral part of the body may have cavities to receive the legs so that, when the appendages and the antennae are retracted, the body appears smoothly oval (e.g. in *Anthrenus* spp.). The fore coxae are long, conical or subglobose, often contiguous or narrowly separated by a prosternal process; their cavities are widely open behind. The hind coxae are slightly separated and each is dilated to form a plate which meets the metepisternum obliquely or squarely, or extends half or all of the distance across its posterior margin. When the hind coxa extends half-way across the posterior margin of the metepisternum its lateral margin usually meets the metepimeron. The tarsal formula is 5-5-5.

In many cases *Thylodrias* does not have the above characteristics, so for its description see p. 19. This genus is so unlike any other dermestid that the relationship was not suspected until the discovery of its larva.

Morphology of larvae

The majority of dermestid larvae can be recognized on a superficial basis by their very hairy appearance and the fact that they have pigmented sclerotized plates dorsally and, when alive, are not curved when viewed from the side. They have well-developed 5-segmented legs (including the single claw) and may have unsegmented urogomphi on abdominal segment 9. Some possess hastisetae (spear-headed segmented setae) which are unique to the family and form conspicuous tufts on some of the posterior abdominal tergites. These setae readily become detached.

Major morphological characteristics of larval dermestids are as follows:

Body elongate, subcylindrical; obovate in cross-section; densely covered with long or short spinulate setae, sometimes with hastisetae or, more rarely, with simple or clubbed setae. Head hypognathous and subglobular, visible from above; epicranial and frontal sutures present; frons triangular; up to 6 ocelli present on each side; gula present; maxillary articulating areas small; labrum anteriorly emarginate, laterally rounded; epipharynx with a series of setae which get progressively larger and broader from the sides to the middle, middle setae similar or dissimilar to lateral setal series. Mandible sometimes with apical half distinctly more sclerotized than basal half, its apex rounded, dentate or pointed, and inner margin with or without a median or sub-basal membranous or sclerotized prostheca; many genera also have a sub-basal setal brush on or near inner margin. Maxillary palps 2 or 3-segmented; galea simple, densely setose; lacinia with 1 or more long, stout, slightly curved, sclerotized and pigmented apical spines; labial palps 2 or 3-segmented; ligula bilobed. Antennae 3-segmented, segment 2 with an accessory appendage (a usually small, conical process). Legs 5-segmented, with tarsus and claw fused into a single claw-shaped, terminal segment. Abdomen 8 to 10-segmented, urogomphi absent or present on segment 9, rigid when present.

Some species of *Anthrenus* (e.g. *sarnicus* (author's observation), *flavipes* and *scrophulariae*) possess a supra-anal organ bearing the long caudal setae. This is movable, enabling the larva to vibrate the setae rapidly as a defence against predators and parasites (Ma *et al.*, 1978). Observations by Ma *et al.* have shown that this organ is not present in *verbasci* and *fuscus* although long caudal setae are present. It is very large and well-developed in *Ctesias serra*. The body setae also seem to be a deterrent to predators and parasites, the spinulate setae help to keep the attacker away from the body and the hastisetae often become attached to the attacker and may give the victim time to escape while they are being cleaned off.

Experiments with two dermestid species (*Attagenus unicolor* (Brahm) and *Trogoderma variabile* Ballion) have shown that these species develop an elaborate meconium (tube) inside the larval midgut when the pupal cuticle has begun to form beneath that of the larva. This contains the faecal pupal material plus any gut parasites that may have been present and is defaecated by the adult a few days after emergence (Dunkel & Bousch, 1970).

Mertins (1982) differentiates between the larvae of *Anthrenus verbasci* and *A. fuscus* and comments on the resistance of the latter to hymenopterous parasites.

Important works in dermestid literature

A great deal has been written about the British Dermestidae since Hinton's (1945) excellent monograph which describes, in meticulous detail, the morphology and biology of the Dermestidae which were then known to be associated with stored products. His work did not, however, include keys to many of the species found 'in the wild' either in the adult or larval stages, nor did it key out all the 'pest' larvae to species. Since Hinton's work, many changes in nomenclature have been made and additional species have been found in Britain. Several papers have been produced dealing with small parts of the family but there is no comprehensive work covering all of the British species plus those likely to be imported. This Handbook aims to rectify this need. All indigenous and imported species are included together with a key to their larvae.

Hinton's (1945) monograph should still be consulted for morphological descriptions of stored product species and their biology, as his work contains more detail than it is possible to include here and has comprehensive references up to 1945 (some of the biological information in this Handbook has been extracted directly from Hinton's work rather than consulting the original cited works which are often very early or in foreign languages). Aitken's (1975) annotated list of stored products beetles found on imports in the United Kingdom, and Halstead's (1986) key to families of these pests are also useful works. Valuable studies on various genera of British Dermestidae since Hinton's work are listed below:- Adams (1978–1988) (*Reesa vespulae, Dermestes leechi, Anthrenus olgae*), Allen (1945–63) (records of species found out-of-doors), Bezant (1956–1965) (records of economic species: *Trogoderma, Anthrenocerus, Dermestes peruvianus, Dermestes haemorrhoidalis*), Blake (1958–1961) (*Anthrenus verbasci*), Burges (1957–1960) (*Trogoderma granarium*, biology), Coombs (1979–1983) (*Dermestes haemorrhoidalis and peruvianus*), Coombs & Woodroffe (1983) (*Anthrenus sarnicus*), Cornwell (1971) (pest damage), Crowson (1951–1987) (records, keys and biological data), Edwards (1969–1982) (*Anthrenus sarnicus, Reesa vespulae, Dermestes peruvianus and haemorrhoidalis*), Green (1979) (*Trogoderma* genitalia), Halstead (1981) (*Attagenus*, keys to unicolorous spp.), Halstead & Green (1979) (*Attagenus fasciatus, A. woodroffei*), Hinton (1945–1958) (*Anthrenocerus australis*), Howe (1952a) (*Attagenus unicolor*, egg output etc.), Jacob & Fleming (1981–1986) (*Dermestes lardarius, D. peruvianus*, biology, larval instars), Peacock (1976–1979) (*Dermestes* spp., *Attagenus*

spp.), Woodroffe (1954–1975) (*Globicornis nigripes*, *Anthrenus sarnicus*, *Dermestes* spp. etc. biological studies and records).

Mroczkowski's (1968) catalogue to the world Dermestidae has been an invaluable asset in the production of this Handbook, particularly for the worldwide distribution, and the classification used here has been based partly on his classification and partly on that of Rees (1943) who classified the North American Dermestidae according to larval characters.

Amongst the many other foreign authors whose work has been consulted in the preparation of this work are: Beal (1954–1985), who has written on many genera, but particularly on *Trogoderma* spp. (adults and larvae), *Anthrenus* spp., Attageninae, etc.; Rees (1943–1947), who produced keys to N. American larvae; and several writers on the East European Dermestidae e.g. Kalik (1946–1982), Mroczkowski (1951–1975) and Zhantiev (1976).

Crowson's (1955) work includes keys to the higher taxa and along with Lawrence's works (1982 and 1991, with Britton) gives detailed descriptions and biological information at superfamily and family level.

Several workers have produced illustrated keys to the families of larval Coleoptera including Böving & Craighead (1930), Van Emden (1942), Chu (1949) and Peterson (1960). A Royal Entomological Society Handbook which includes biological information and keys to families is in press (Marshall *et al.*).

One of the most useful early works on the dermestid larvae was by Rees (1943) in which he classified the family, basing his arrangement on the larval characters of the North American species and giving a key to the subfamilies and genera. He later (1947) reviewed some of the North American species of *Dermestes*. Korschefsky (1944) and Klausnitzer (1978) made keys to the dermestid larvae found in Germany and Hinton (1945) keyed some of the species found in stored products. Beal (1954, 1956, 1960) made detailed studies of certain larvae of North American Dermestidae, particularly those of *Trogoderma* and the Attageninae. Revisions of the family have also been made on the Polish fauna by Mroczkowski (1975) and on the Russian fauna by Zhantiev (1976).

None of these works included keys covering all of the British indigenous and imported species so an attempt has been made to rectify this here. Although most species have been studied by the author, a few were not available, so their inclusion is based on published descriptions.

Identification of adult Dermestidae

Dissection techniques

The separation of some species of *Trogoderma* and *Attagenus* by external characters alone can be extremely difficult. In such cases, dissection of the genitalia may be necessary for a definite identification.

The following procedure may be followed:-

(1) The beetle should be placed in near-boiling water for a few minutes to relax and soften it, so that handling will not damage it (this is not necessary if working with a fresh specimen). It should be tested at intervals for the degree of softness.

(2) When fully relaxed the abdomen can be removed under a low power stereo microscope. The beetle is placed on its back and, using two fine pins which can be inserted between the metasternum and the first abdominal segment, the abdomen can be prised away from the thorax.

(3) The abdomen is then placed in a 10% aqueous solution of potassium hydroxide which is brought to near-boiling point in a water bath or test tube for 5–15 minutes to clear away the soft tissues.

(4) After clearing, the abdomen is removed from the potassium hydroxide solution

and rinsed in distilled water for a few minutes.
(5) The abdomen is then placed in glycerine on a microscope slide and dissected under a low-power binocular microscope. The genitalia can be removed using a pair of fine pins and then covered with a cover slip for examination under a high-power microscope.
(6) The genitalia can then either be placed in glycerine in a microvial (care should be taken to ensure that the glycerine is in the base of the vial only, otherwise it tends to creep up the sides), or mounted on a card in a water soluble resin. Dimethyl Hydantoin Formaldehyde, dissolved in absolute or 80% alcohol has been used by the author for this purpose and been found to be very satisfactory as the resin hardens rapidly but is easily dissolved in water should the genitalia need to be removed at a later date for examination. This resin is currently available from Chemical Intermediates Company Ltd., Barnfields Industrial Estate, Leek, Staffordshire ST13 5QG (Tel. No.: 0782 504503). Either of the methods outlined above enables the dissected parts to be kept on the same pin as the specimen so seems preferable to a permanent slide preparation which will necessarily be separated from the specimen and may get lost.

Notes on the keys

A short key is given to the species which have been found in the wild in Britain, near the end of this work. This key is non-systematic and has been produced for the quick identification of specimens found in the field. Longer and more detailed keys form the main part of this work and include species which have been imported to Britain in stored products, species which are pests either in domestic or commercial premises and those which only occur out-of-doors and are of no economic importance. The key to *Anthrenus* includes all the known subgenera, including two which do not yet occur in Britain – *Ranthenus* Mroczkowski (1962) and *Solskinus* Mroczkowski (1951).

A low-powered stereo microscope is sufficient for seeing most of the characters used, but a higher-powered compound microscope is advised for some.

See figs 1–3 for labelled diagrams.

Key to subfamilies

1 Antennae filiform, without an apical club. Elytra soft and strongly dehiscent at apex in male (fig. 4), absent in female (fig. 5). Hind wings normal or rudimentary in male, absent in female. Abdomen with 7 visible abdominal sternites, sternite 1 in male completely divided in middle. Length 2–5 mm. ..... **Thylodriadinae** (p. 19)

— Antennae clubbed. Elytra hard, present in both sexes, never noticeably dehiscent at apex. Hind wings well-developed or absent. Abdomen with 5 visible abdominal sternites. 2

2 Pronotum with a prominent sublateral carina on basal half of each side, subparallel to lateral margin (fig. 6). Dorsal setae very long, erect and coarse. Hind coxae extending laterally to inner margin of metepisternum (figs 8, 20). Length 1.9–2.5 mm ..... **Trinodinae** (p. 32)

— Pronotum without sublateral carinae. Dorsal surface either with recumbent or semierect short setae, with scales, or glabrous. Hind coxae usually extending partly across posterior margin of metepisternum (fig. 3) or not reaching it 3

3 Head without median ocellus. Fore coxae large and contiguous at apices (figs 3, 11). Length from 1.2 to 12.0 mm 4

— Head with median ocellus (fig. 2). Fore coxae not contiguous at apices, completely separated by prosternal process (figs 2, 12–19). Length usually less than 5.5 mm 5

4 Compound eyes, hind wings and scutellum present. Pronotum usually broadest posteriorly, posterior angles more or less acute. Hind coxae transverse and grooved to receive femora, extending laterally at least as far as outer edge of metasternum. Size larger, length 5.5–12 mm (figs 21–28, 50). ..... **Dermestinae** (p. 20)

— Compound eyes absent or very small. Hind wings and scutellum absent. Pronotum usually broadest anteriorly. Hind coxae rounded, not reaching outer edge of metasternum and not grooved to receive femora. Size smaller, length less than 3 mm (fig. 7) **Thorictinae** (p. 20)

5 Hind tarsi with segment 1 half or less than half as long as 2 (figs 68–71). Prosternum not forming a 'collar', therefore mouthparts free (fig. 9). Lamina of hind coxa either toothed or broadened, laterad to insertion of femur (fig. 12). (Figs 65–67) . . . . **Attageninae** (p. 23)

— Hind tarsi with segment 1 as long as or longer than 2. Prosternum forming a 'collar' under which mouthparts fit when head is retracted (fig. 10). Lamina of hind coxa with margins subparallel or gradually narrowed laterally (figs 13–19) 6

6 Dorsal surface pubescent, only rarely with a few scale-like setae among the normal ones. Ventral surface without scales. Antennal cavities not usually visible from front, sometimes shallow. Elytral epipleura broad and sharply defined, at least in anterior third. 5th visible abdominal sternite not emarginate apically. (Figs 88–93) . . . . . **Megatominae** (p. 25)

— Dorsal and ventral surface covered with flat scales. Antennal cavities always deep, sharply delimited near lateral anterior margin of pronotum and visible from front (fig. 18). Elytral epipleura narrow and feebly developed only at extreme base (fig. 2), absent elsewhere. 5th visible abdominal sternite broadly and deeply emarginate apically. (Figs 139–148) . . . . . **Anthreninae** (p. 30)

Subfamily Thylodriadinae

The Thylodriadinae has been the subject of controversy in recent years regarding its subfamily or family status (Franciscolo, 1975; Süss & Fogato, 1977–78), but in this work (as in other recent works, e.g. Lawrence (1982); Halstead (1986)) it is regarded as a subfamily of Dermestidae, mainly because of its larval characteristics and the ocellus on the head of the adult which occurs in few coleopterous families. Because of its appearance, it has in the past been considered to be a malachiid, a drilid or a cantharid.

This subfamily contains only one holarctic genus and species, *Thylodrias contractus* Motschulsky.

Genus **Thylodrias** Motschulsky

Thylodrias contractus Mots. is easily distinguished from other dermestids by its distinctive general appearance, its non-clubbed 9 or 10-segmented antennae and its larviform female (figs 4, 5). Detailed descriptions of the adult and larva are found in Süss and Fogato (1977–78).

— **Male** (fig. 4). Length 2–3 mm. Body narrow and delicate, mainly light yellowish-brown, abdomen dark brown, elytra very pale, semi-transparent, usually with opaque darker apices. Antennae appearing 10-segmented and longer than head and pronotum combined; with apparently 4 longer apical segments. Head with prominent ocellus. Head and pronotum densely, microscopically punctate with fine indistinct tubercles, from which arise long setae. Elytra not striate, sculptured like head but also with dense, very shallow, indistinct, oval to quadrate, very coarse punctures; not completely covering abdomen. Hind wings ranging from normal (fully developed and large) to vestigial. Front coxal cavities open behind. Prosternum convex and moderately long before coxae, 2nd visible abdominal sternite with a prominent median transverse setose gibbosity (setiferous sex patch). Front coxae contiguous, middle and hind coxae broadly separated, not excavated for the reception of the femora.

Female (fig. 5). Length 2–5 mm. Body broader, light to dark brown, larviform. Antennae 9-segmented and shorter than head and pronotum combined, with 3 longer apical segments. Head with less prominent ocellus. Hind wings and elytra absent. Coxae smaller than in male, all broadly separated. 1st visible abdominal sternite not divided in middle, 2nd without gibbosity . . . . . (The Odd Beetle) **contractus** Motschulsky (p. 44)

Synanthropic. An import only.

Subfamily Thorictinae

There are three genera in this subfamily. The largest, *Thorictus* Germar, contains around 140 species and is confined almost exclusively to the Mediterranean Region, with just a few species being found in parts of Africa, Atlantic Ocean Is, India, Burma, Philippine Is and Central Europe. Most species of *Thorictus* are found in ants' nests and are highly modified, but a few have been found in stored products (Aitken, 1975). A second genus, *Rhopalosilpha* Arrow, belongs here according to Crowson (1951) (it keys out to Dermestinae in the subfamily key in this Handbook but may be distinguished from this subfamily by its pronotum, which is broadest anteriorly). It was originally placed in the family Silphidae and contains one species from Iran. The third genus is *Thorictodes* Reitter (see below). The three genera are similar in shape when viewed from above although *Rhopalosilpha* is over 3 mm long. *Thorictus* is under 3 mm and *Thorictodes* is under 2 mm. In *Thorictodes* the eyes are almost non-existent, in *Thorictus* they are very small and in *Rhopalosilpha* they are normal. Only *Thorictodes* is found frequently on imports.

Thaumaphrastus karanisensis Blaisde!l [= *Thorictodes heydeni* Reitter] was moved from the Colydiidae to a new subfamily of the Dermestidae by Anderson (1949). He described the larva and adult in detail. Van Emden (1951) synonymized it with *T. heydeni* and mentioned that the type specimen was found in a plant gall which had been buried for 2,000 years in Egypt. Crowson (1951) and Beal (1959, 1961) placed the Thorictidae in the Dermestidae, the latter treating it as a tribe, the former as a subfamily. John (1961–67) separated *Thorictodes* from *Thorictus*, putting the former in the Dermestidae and leaving the latter in the Thorictidae. This policy was followed by Mroczkowski (1968) in his catalogue and by Aitken (1975), but the genera have since been reunited as Thorictinae, a subfamily of Dermestidae (Lawrence, 1982; Halstead, 1986).

Genus **Thorictodes** Reitter

Thorictodes contains 4 species, one each from Guyana, the Congo and India, and the fourth, *T. heydeni* Reitter, a widely distributed stored products pest.

— One species likely to be found in Britain. Body reddish-brown, shiny, narrow. Length under 2 mm (fig. 7). Compound eyes absent or very small. Pronotum broadest anteriorly. Antennal club consisting of 3 fused segments. ..... **heydeni** Reitter (p. 45)

Synanthropic. An import only. This species differs from most other dermestids in its non-transverse, non-grooved hind coxae, its non-retractile legs and its lack of a scutellum and hind wings.

Subfamily Dermestinae

This subfamily is represented in Britain by the genus *Dermestes* L. There are 10 species on the British List, of which 3 (*ater* De G., *carnivorus* Fabr. and *leechi* Kal.) only occur, as far as is known, under artificial conditions. One species, *frischii* Kug., is fairly regularly imported in cargoes but is not established here. Two species, *murinus* L. and *undulatus* Brahm occur in outdoor conditions only and others – *peruvianus* Lap. de Cast., *haemorrhoidalis* Küst., *maculatus*. DeG. and *lardarius* L. – occur in synanthropic situations as well as in the wild.

Dermestes is the sole representative of the subfamily on a worldwide basis, except for the monospecific genus *Montandonia* Jacquet from Romania. *Dermestes* itself is mainly a Palaearctic genus (of its 73 species, 45 are Palaearctic) but is represented in all the main zoogeographical regions of the world – Neotropical, Oriental, Ethiopian,

Palaearctic and Nearctic – except for the Australian region where it is introduced. It is not recorded from the South-African subregion. 5 species of *Dermestes* are regarded as cosmopolitan due to their synanthropic tendencies. Others may be synanthropic but are not cosmopolitan, despite their presence in storerooms or houses.

Genus **Dermestes** Linnaeus
(hide beetles)

Dermestes is easily distinguished from all the other British genera in the family by its large size (5.5–12.0 mm), its subparallel-sided, elongate shape and the lack of a median ocellus on the head. The antennae are 11-segmented, with a large, distinct 3-segmented club; sometimes the preceding segment forms a cupule. The body is densely pubescent, with the upper surface confusedly punctate, occasionally with weakly raised longitudinal ribs on the elytra. The prosternum has a short process which does not separate the fore coxae. The mouthparts are exposed – i.e. they do not abut against the prosternum when the head is retracted. The dorsal side is unicolorous brown or black, or with lighter patches and the ventral sometimes black, white, brown or golden, or with combinations of 2 colours. These colours are formed by the pubescence only, except in *D. carnivorus* which usually has lighter coloured cuticle on the anterior part of the elytra. In the other species, the cuticle is unicolorous brown or black dorsally and ventrally. The abdominal sternites sometimes have lateral impressed lines, the 1st always with at least part of a line or groove. The males have an unpunctured spot on visible sternite 4, or 3 and 4, with a posteriorly directed median setal tuft, or sex patch (fig. 3) (figured and photographed with its related pheromone gland by Faustini & Halstead, 1982). The hind coxae extend partly across the hind margin of the metepisternum. The first segment of the middle and hind tarsi is usually (not in *D. leechi*) only half as long as the second. The genus is divided into two subgenera.

Key to species

1 Abdominal sternites and metasternum with dense, recumbent whitish setae which almost conceal surface of cuticle; laterally with patches of black or brown setae. Lateral impressed lines, or grooves, on 1st visible abdominal sternite not reaching its hind margin (figs 29–33) (Subgenus **Dermestinus**) 2

— Abdominal sternites and metasternum with fine, recumbent yellowish-brown or dark brown setae which rarely conceal surface of cuticle; usually these are unicolorous but sometimes light and dark setae are arranged in a pattern; laterally sometimes with patches of brown setae. Lateral impressed lines, or grooves, of 1st visible abdominal sternite reaching its hind margin (figs 34–37, 49) (Subgenus **Dermestes** s. str.) 6

2 Apical margin of elytra with small teeth, apex produced into a large tooth at suture (fig. 43). Abdomen fig. 29. (Very variable in colour, cuticle usually black, sometimes red-brown, dorsal setae varying from all light whitish-grey to all black, usually with whitish setae at sides of pronotum forming a band but sometimes this extends across disc. Elytral setae usually black with scattered white setae (fig. 21). Length 5.5–10.0 mm ..... **maculatus** De Geer (p. 46)

Synanthropic. The commonest pest species of the genus found on imports to England, Scotland and Ireland, and a serious pest, mainly on animal products e.g. bones and hides, in commercial premises in England and Wales. Not a household pest. Quite rare out-of-doors, mainly S. England, in carrion.

— Apical margin of elytra smooth or with minute teeth, but apex not produced into a large tooth at suture 3

3 Pronotum with dense, whitish pubescence forming a broad, longitudinal band on each side and sometimes a narrow band anteriorly; pubescence on disc usually darker. Whitish pubescence on apical abdominal sternite reaching posterior margin either at sides or in middle (figs 22, 23) 4

— Pronotum uniformly coloured, without whitish lateral bands (figs 25, 26). Whitish pubescence on apical abdominal sternite not reaching posterior margin; apical sternite with mainly black pubescence (figs 32, 33) 5

4 Apical abdominal sternite with black pubescence at apex. Lateral impressed lines not present on sternites 2–5 (fig. 30). Male with 1 setal tuft. Lateral band on pronotum usually narrowing strongly posteriorly, interrupted by a darker spot of brown or golden setae near posterior margin (fig. 22). Elytral pubescence consisting of black and white setae interspersed, not in groups, with a few golden setae anteriorly. Elytral cuticle unicolorous. Head with patches of golden and white setae. Apices of elytra smooth, right angled at suture so that elytra meet in a smooth curve. Length 6.0–10.0 mm ..... **frischii** Kugelann (p. 47)

Synanthropic. A pest which is fairly frequently imported on animal material e.g. bones, dried fish etc., England, Ireland. Sometimes found in commercial premises in England, but is not a household pest. Very rarely found out-of-doors, mainly S. England, in carrion. Scotland (old records).

— Apical abdominal sternite with white pubescence at apex. All sternites with short lateral impressed lines (fig. 31). Male with 2 setal tufts. Lateral band on pronotum remaining broad throughout and without a dark spot posteriorly (fig. 23). Elytral pubescence dark anteriorly with a prebasal band of golden setae; remainder dark with occasional patches of white setae. Elytral cuticle usually lighter (reddish) in anterior half. Head with whitish setae like those at sides of pronotum. Apices of elytra with minute teeth, obtusely angled at suture so that elytra are separately rounded (fig. 44). Length 6.5–8.5 mm ..... **carnivorus** Fabricius (p. 48)

Synanthropic. An infrequent import, England, Ireland. A pest of both animal and vegetable products e.g. hides, nuts etc. Not found out-of-doors in Britain.

5 Head, pronotum and elytra uniformly covered with recumbent black and white setae arranged in groups forming patches. Golden patches usually also present on pronotum on each side of disc near middle of anterior margin, and on posterior angles; also on scutellum and sometimes on shoulders of elytra (fig. 25). Antennal club black. Abdomen fig. 32. Length 7.0–9.0 mm ..... **murinus** Linnaeus (p. 48)

Common and widespread throughout England in rural areas, as far north as Durham. Out-of-doors, in carrion. Wales. Ireland. Not a pest and not synanthropic in Britain, rarely imported.

— Head, pronotum and anterior margin of elytra covered with predominantly golden, 'wavy', recumbent setae with a few patches of black and white setae interspersed. Remainder of elytra with patches of black and white (and sometimes golden) setae (fig. 26). Antennal club dark reddish-brown. Abdomen fig. 33. Length 5.0–7.0 mm ..... **undulatus** Brahm (p. 48)

Rare. S. and S. E. England, near coast. Out-of-doors, in carrion. Wales (early records). Not a pest species.

6 Setae on anterior half of elytra forming a broad yellowish or greyish band (masking darker cuticle), with several small dark spots (fig. 27); remainder of elytra with black setae. Abdomen figs 34, 38. Length 7.0–9.0 mm ..... **lardarius** Linnaeus (p. 49)

Synanthropic. Widespread throughout England, but commonest in the south and around the London area. Scotland, Wales, Ireland. Only a minor household pest, but a nuisance in warehouses and food premises. Prefers animal material, but can survive on vegetable. More rarely, found out-of-doors in carrion, wasps' nests, wet birds' nests etc. A native of Britain but occasionally imported.

— Setae on anterior half of elytra not forming a yellowish or greyish band. Cuticle unicolorous brown or black, not masked dorsally by pubescence 7

7 Segment 1 of mid and hind tarsi about twice as long as 2 (fig. 48). Upper surface unicolorous dark red-brown to black, with short fine decumbent greyish-yellow pubescence which extends just beyond elytral apices to form a fringe. Abdomen figs 37, 42. Median lobe of aedeagus of male genitalia short; almost straight in side view (figs 55, 56). Wall of bursa copulatrix in female with about 15 darkly pigmented conical teeth (fig. 63). Length 7.0–8.5 mm ..... **leechi** Kalik (p. 50)

Synanthropic. An import only. A single specimen imported to Scotland, in bone grist. Also several found in inner wrappings of an Egyptian mummy in England.

— Segment 1 of mid and hind tarsi shorter than, or about the same length as 2 (fig. 47) . 8

8 Lateral impressed lines of 1st visible abdominal sternite strongly sinuous, curving strongly inwards anteriorly (figs 35, 39). Ventral side mainly with light golden setae but abdomen with regular patches of dark setae at lateral margins and sometimes at each side of midline, forming a symmetrical pattern which can be seen clearly only on clean specimens. Abdominal sternites 3 and 4 of male each with a setal tuft (fig. 35). Pronotum sometimes with a few scarcely discernible spots of golden setae. Elytral setae unicolorous, varying between light golden brown and dark brown (fig. 24). Fore coxae with trochantins concealed. Median lobe of male genitalia with short outwardly curved strongly chitinized processes at tip (figs 57, 58). Female bursa without chitinized structures. Length 7.0–9.0 mm ..... **ater** De Geer (p. 50)

Synanthropic. Common on imports only, England, Wales, Ireland. A pest on vegetable products e.g. copra, cocoa beans. Also found on animal material, e.g. bones, skins, dead insects.

— Lateral impressed line of 1st visible abdominal sternite almost straight (fig. 36). Ventral side with unicolorous setae (golden or light brown). Only abdominal sternite 4 of male with a setal tuft. Pronotal setae never forming spots. Elytral setae either uniformly pale yellow or with a mixture of dark and light setae. Fore coxae with trochantins narrowly exposed. 9

9 Elytra with a thick fringe of setae projecting beyond apices (some of these are on epipleura and some on dorsal surface of elytra) (fig. 45); side margins in anterior half not visible from above owing to the dense, long, coarse, semi-erect pubescence which is predominantly dark reddish-brown or black, usually with light yellowish setae scattered singly at intervals among the dark ones. Setae on head inclined towards a central point on crown (fig. 51). Metepimeron with a posteriorly-directed lateral spine (fig. 53). Abdomen figs 36, 40. Male genitalia as in figs 59, 60. Wall of bursa copulatrix of female with a chitinized shell-like structure (fig. 64). Length 6.0–9.5 mm. ..... **haemorrhoidalis** Küster (p. 51)

Synanthropic. Introduced in 1905 and imported at intervals since. Fairly widespread throughout England, but commonest in the south-east, particularly around the London area. Mainly in domestic premises, associated with animal products. Rare out-of-doors: S. England, in carrion, in wet and dry birds' nests.

— Elytra without a thick fringe of setae projecting over apices (setae on epipleura and dorsal surface of elytra near apices very short and recumbent) (fig. 46); side margins in anterior half usually visible from above; pubescence predominantly pale yellow, short, fine and recumbent. Setae on head inclined anteriad (towards mandibles) and inwards towards a central line between eyes (fig. 52). Metepimeron without a posterior lateral spine (fig. 54). Abdomen figs 36, 41. Male genitalia as in figs 61, 62. Female bursa sometimes with up to 6 elongate, widely spaced, lightly pigmented, cone-shaped teeth. Length 8.0–11.0 mm ..... **peruvianus** Laporte de Castelnau (p. 51)

Synanthropic. Introduced, but has become the commonest pest species of the genus throughout England in domestic premises. First authentic record, 1954. Usually associated with animal products but can live on vegetable material. Very few outdoor records – only in pigeons' nests in London.

Subfamily Attageninae

The subfamily Attageninae consists of four genera worldwide, of which two are monospecific, *viz, Sefrania* Pic (Algeria and Tunisia) and *Decamerus* Solier (Chile); one, *Novelsis* Casey, contains 10 spp. (N.W. America) while the largest, *Attagenus* Latreille, contains at least 163 species. *Attagenus* is the largest genus in the Dermestidae and most of its species come from the Palaearctic (81) and the Ethiopian (65) Regions. A few species occur in the Oriental (11) and Nearctic (8) Regions. The genus is absent from the Neotropical and Australian Regions and the Eastern Asiatic part of the Palaearctic Region, except for introduced or doubtfully assigned species.

3 species of *Attagenus* are synanthropic and may be regarded as fully cosmopolitan and 1 species is distributed throughout the Holarctic Region. These are storage pests which accounts for their distribution. In Britain the Attageninae are represented by species of the genus *Attagenus* only.

Genus **Attagenus** Latreille
(including carpet and fur beetles)

This genus is distinguished from all other British genera with ocelli, by its hind tarsi, in which the first segment is half, or less than half as long as the second (figs 68–71) (many *Dermestes* spp. also possess this character, but do not have ocelli). The species are broadly oval, pubescent, with 'free' mouthparts – i.e. not fitting against the prosternum when the head is retracted (fig. 9); the head has a median ocellus, the lamina on the hind coxa is broadened laterad to the femoral insertion (fig. 12). The antennal club is 3-segmented, with the apical segment usually more strongly elongate in the male than in the female (figs 78–83). The hypomeron is without a distinct antennal cavity.

Key to species

1 Elytra dark, with a distinct band or spots of light pubescence (figs 65, 66) 2
— Elytra appearing unicolorous, pubescence variable but if with light coloured setae then these are diffuse and do not form a distinct band or spots (these species all resemble *A. unicolor* (fig. 67)) 3

2 Elytra with a subbasal transverse band of light pubescence, usually across suture (fig. 65). Antennae fig. 78. Length 3.6–5.8 mm ....(The Tobacco Seed Beetle) **fasciatus** (Thunberg) (p. 52)
(Another species with this character, *A. woodroffei* Halstead & Green, is a household pest in Sweden, Finland and Denmark but so far has not been found in the U.K. (see Halstead & Green, 1979, for distinguishing characters)).
Synanthropic. An import only. A storage pest on animal and vegetable products e.g. furs, skins, oilcake, myrobalans, seeds.

— Elytra with 2 small distinct oval spots of white pubescence at middle of disc near suture and also with 2 or 3 small white spots at each side anteriorly (fig. 66). Antennae fig. 79. Length 3.7–6.0 mm . (The Two-spotted Carpet Beetle, or Fur Beetle) **pellio** (Linnaeus) (p. 53)
Synanthropic. The commonest species of the genus in Britain, occurring in the wild on flowers, feeding on pollen and nectar, and as a pest in households and commercial premises on wool, fur, cereals etc. England, widespread, but commonest in the south. Scotland, Wales and Ireland. Seldom imported.

3 Posteroventral carina of middle femur feebly produced and scarcely noticeable, anteroventral carina very prominent and razor-like (fig. 72). Prosternum either narrow in front of fore coxae (fig. 75), or wide but with posterior part very strongly vertical (fig. 74). (Cuticle bicolorous yellowish to reddish-brown and black or unicolorous yellowish to dark brown.) Length 2.3–4.2 mm 4
— Posteroventral and anteroventral carinae of middle femur similar to those on fore femur, of almost equal prominence (fig. 73). Prosternum wide in front of fore coxae, the posterior part only weakly vertical (figs 76, 77). (Cuticle yellowish or reddish brown to black, sometimes with pronotum darker than elytra). Length 2.8–5.0 mm 5

4 Prosternum wide but posterior part bent vertically to form a transverse, razor-like edge in front of fore coxae (fig. 74). Trochantins of fore coxae almost completely hidden. Segment 2 of anterior tarsus in male approximately equal to 5 (fig. 68). Hypomeron distinctly longitudinally concave in anterior third. Body cuticle unicolorous yellowish brown to dark brown, antennae (fig. 80) and legs paler brown. Bursa copulatrix in female as in fig. 84. Length 2.5–4.2 mm. ..... **cyphonoides** Reitter (p. 53)
Synanthropic. An import only. A storage pest on furs, skins, bones, cottonseed, oilcake, cereals etc.

— Prosternum narrower, not bent to form a razor-like edge (fig. 75). Trochantins of fore coxae largely exposed. Segment 2 of anterior tarsus in male about half as long as 5 (fig. 69). Hypomeron almost flat in anterior third. Cuticle of elytra yellowish brown (female) to reddish brown (male); that of head, pronotum, scutellum and ventral side black or very dark brown. Antennae (fig. 81) and legs light brown. Bursa copulatrix as in fig. 85. Length 2.3–4.0 mm. ..... **smirnovi** Zhantiev (p. 54)

Synanthropic. Rare. S. E. England (introduced). First recorded in 1978, but now well established in a small area in and around London. Recorded from domestic premises and a museum. Found out-of-doors in the same area, on or near privet.

5 Antennal club in male with apical segment 2.8–3.4 times length of first 2 segments combined; club in male and apical segment in female darker than remainder of antenna (fig. 82); ratio of apical antennal segment of male to body length 1:7.9–11.8. Cuticle reddish brown to black. Female bursa copulatrix with convergent struts always obvious and inner edge sclerotized (fig. 86). Length 2.8–5.0 mm. Fig. 67 ....(The Black Carpet Beetle) **unicolor** (Brahm) (p. 54)

Synanthropic. Few British records, so not regarded as a serious pest. Recorded from domestic and commercial premises in the north, south and midlands of England on wool, fur and skins etc., also in mills and bakeries etc. Scotland. Sometimes imported on flour, oilcakes, bones etc.

— Antennal club in male with apical segment more elongate, 3.0–4.2 times length of first 2 segments combined; sometimes unicolorous with remainder of antenna (yellowish brown to dark brown, terminal segment only occasionally darker) (fig. 83); ratio of apical antennal segment of male to body length 1:5.7–8.4. Cuticle yellowish or reddish brown to black. Female bursa copulatrix with convergent struts poorly defined and without sclerotized edges (fig. 87). Length 2.9–5.0 mm .....**brunneus** Faldermann (p. 55)

Synanthropic. S. England (recently introduced). London, in commercial premises, infesting felt and carpets.

Subfamily Megatominae

According to Mroczkowski's (1968) classification, there are 27 genera in the Megatominae. An additional genus was described in 1986 (Kalik). The subfamily is widespread throughout the world, with most genera in the Palaearctic (11) and Australian (9) Regions. It is least well represented in the Oriental Region (4 genera). These figures only include indigenous genera. Seven genera may be found in Britain, although *Orphinus fulvipes* (Guérin-Méneville) has been only tentatively included because it is not a frequent import.

This subfamily is distinguished by the following characters in combination: median ocellus present on head; prosternum well-developed forming a 'collar' which covers or abuts against mouthparts when head is retracted (fig. 10); antennae 9–11 segmented with a 2–8 segmented club; segment 1 of hind tarsi not shorter than 2 (fig. 120); body pubescent or occasionally with patches of scale-like setae on dorsal surface only.

Key to genera

1 Body usually broad (figs 88,92, 93). Antennal cavity usually very well-defined (figs 104–111, 115–117), surface smoother and less strongly setose than prosternum; either finely shagreened or smooth, shiny and finely striate (in some females, only shiny anteriorly, remainder granulate); defined posteriorly by a strong carina which does not always reach lateral margin. Mesosternum deeply divided by sulcus at posterior margin. Middle coxae quite far apart, metasternal process broad 2

— Body more elongate (figs 89–91). Antennal cavity represented by a less well-defined depression in the hypomeron with a uniformly granulate or punctate surface, similar to that of prosternum; usually broadly open behind but sometimes with a narrow, thread-like carina posteriorly (figs 112–114). Mesosternum with median sulcus usually becoming very shallow or obsolete posteriorly. Middle coxae closer together, metasternal process narrower 5

2 Apical antennal segment broader and longer than penultimate. Club 2-segmented, preceding segment forming a cupule; very large, circular and flattened in male; smaller, oval and convex in female (fig. 103). 1st visible abdominal sternite with very strong, posteriorly-subparallel postcoxal lines, continuous to hind margin. Prosternum and antennal cavities similar to those of *Trogoderma* .....**Orphinus** Motschulsky (p. 29)

— Antennae not as above. Postcoxal lines (see fig. 2), if present, rarely continuous to hind margin of sternite, but if so prosternum and antennal cavities different 3

3 Antennal club 3–8 segmented, sometimes scarcely differentiated (figs 94–97); segments joined more or less symmetrically along a central axis; penultimate segment subequal in length to preceding segment. If club 3-segmented, then shorter than length of preceding 8 segments combined. Anterior margin of prosternum straight or evenly arcuate (figs 104–111). Fig. 88 ..... **Trogoderma** Dejean (p. 26)

— Antennal club with 3 large segments, abruptly differentiated; the segments joined eccentrically, penultimate segment shorter than preceding segment; club at least as long as preceding 8 segments combined (figs 101, 102). Anterior margin of prosternum strongly emarginate medially (figs 115–117) 4

4 Hypomeron with antennal cavity confined to anterior half, visible from front; posterior elevated part nearly as broad as cavity (fig. 115). Antennal club about as long as preceding 8 segments combined in both sexes (fig. 102). Metasternum and 1st visible abdominal sternite with very strong postcoxal lines (fig. 121). Dorsal aspect: fig. 92. .... **Anthrenocerus** Arrow (p. 29)

— Hypomeron with antennal cavity extending diagonally throughout its length (figs 116–117), not visible from front. Antennal club of female about as long as preceding 8 segments combined, that of male twice as long, with segments large and subtriangular, giving club a serrate appearance (fig. 101). Metasternum and 1st visible abdominal sternite without postcoxal lines. Dorsal aspect: fig 93 ..... **Ctesias** Stephens (p. 29)

5 Antennae with 2–3 segmented, abruptly differentiated club (figs 99, 100); cavity distinctly and broadly open behind (figs 113, 114). Antennal segments 3–5 quadrate or sometimes weakly elongate. Pronotum strongly convex, mat and very closely and heavily punctured (fig. 118). Elytral setae either uniformly brown or black and white 6

— Antennae with 4–5 segmented, gradually differentiated club (fig. 98); antennal segments 3–5 strongly elongate; cavity appearing broadly open behind but with a fine thread-like, incomplete, carina extending from its inner side (fig. 112). Pronotum only weakly convex, shiny and finely punctured. Elytral setae mainly dark brown except for a prebasal diagonal yellow band (fig. 89). ..... **Reesa** Beal (p. 29)

6 Antennae 9–10 segmented, with club subcircular in male (fig. 119), more elongate in female (fig. 99). Dorsal aspect: fig. 90. ..... **Globicornis** Latreille (p. 29)

— Antennae 11 segmented, with an elongate club in both sexes (fig. 100). Dorsal aspect: fig. 91 ..... **Megatoma** Herbst (p. 29)

Genus **Trogoderma** Dejean

Trogoderma Dejean is one of the largest genera of the Dermestidae comprising 124 species, of which the majority inhabit the Australian (60 species) and Neotropical (31 species) Regions. A few species occur in the Palaearctic and Nearctic Regions. The genus is absent from the Oriental and Ethiopian Regions except for a couple of doubtfully named species from each and an introduced species. A species was recently described from the Cape Verde Is (Kalik, 1986).

There are no truly indigenous species of *Trogoderma* in Britain, but 4 species are occasionally found on stored products; *T. granarium* Everts and *T. inclusum* LeConte, said to be almost cosmopolitan, and *T. glabrum* (Herbst) and *T. variabile* Ballion which occur throughout the Holarctic Region.

To distinguish *Trogoderma* from other genera of the Megatominae, see key, p.00 and the following characters in combination:-usually broadly oblong-oval in shape and strongly pubescent, without scales; antennae 9–11 segmented with a 3–8 segmented club of which the penultimate segment is subequal in length to the preceding segment and the length of the apical 3 segments together is less than the length of the preceding 8 segments combined; antennal segments 3–6 not elongate; antennal cavity distinct in both sexes, usually completely margined behind by a narrow carina, shiny and somewhat striate throughout its length in the males and

usually open and granulate posteriorly in the females; females usually with shorter antennae than males, in repose only occuping anterior half of cavity; mesosternum deeply divided by a sulcus into which prosternal process fits.

Key to species

1 Body black (or dark brown in teneral specimens); cuticle sometimes with vague reddish areas at the shoulders, elytral apices and sides of pronotum, but never with any transverse bands. Dorsal setae mainly black, with white and yellow setae forming spots on pronotum and 2 to 4 fine, sinuate, indistinct, interrupted, transverse bands on elytra. Antennal club 5 to 7-segmented in male, 5-segmented in female (fig. 95). Eyes moderately prominent and weakly emarginate. Form broad (fig. 123). (Postcoxal lines present on 1st visible abdominal sternite). Tergites 9 and 10 in male as in fig. 130. Male genitalia, fig. 126. Genital sclerites in female bursa copulatrix insignificant (fig. 134), approximately equal in length to corrugated part of spermatheca (see fig. 138). Length 2.0–4.0 mm. . . . . .**glabrum** (Herbst) (p. 55)

Synanthropic. An import only. On products such as rice, flour, cottonseed meal, grain. Not a very important pest, but is able to produce severe infestations.

— Body brown or black and brown. Cuticle bicolorous or, if unicolorous, other characters not as above. Form sometimes more elongate (figs 88, 124, 125). Postcoxal lines present or absent. 2

2 First visible abdominal sternite with postcoxal lines (fig. 122). Cuticle bicolorous, mainly black or dark brown. (Elytra with a definite pattern (fig. 124), dark brown with reddish brown transverse bands and spots indicated by lighter areas in the cuticle, with 1 or 2 longitudinal stripes joining the 1st 2 transverse bands (if pattern is reduced, anterior band is usually retained); dorsal setae black or dark brown on dark cuticular patches and white or yellow on lighter parts of cuticle. Lighter cuticular patches on pronotum usually present in females. Antennal club 6 to 8-segmented in male, 4 to 5-segmented in female (fig. 97). Eyes rather flattened and distinctly emarginate. Tergites 9 and 10 in male as in fig. 131. Male genitalia, fig. 127. Genital sclerites in female bursa copulatrix large (fig. 135), approximately twice length of corrugated part of spermatheca. Length 2.0–5.0 mm.) . . . . . .(The Large Cabinet Beetle) **inclusum** LeConte (p. 56)

Synanthropic. Usually on imports such as rice, flour, cottonseed, dried fruit etc. Occasionally found in manufacturing premises, but is only a minor pest as it rarely attains sufficient numbers to do serious damage.

— First visible abdominal sternite without postcoxal lines 3

3 Cuticle usually light reddish brown, sometimes head and/or pronotum and spots on elytra dark brown to black; elytra unicolorous or vaguely mottled without a clearly defined pattern. Dorsal setae yellowish with brown setae on darker parts of cuticle (fig. 88). Antennae 9 to 11-segmented; club 3 to 5-segmented in male, 3 to 4-segmented in female (fig. 94). 9th and 10th tergite in male as in fig. 132. Male genitalia, fig. 128. Serrate sclerites in female bursa copulatrix small (fig. 136), not longer than corrugated part of spermatheca. Length 1.7–3.0 mm. . . . . (The Khapra Beetle) **granarium** Everts (p. 56)

Synanthropic. Mainly imported. One of the most serious storage pests in hot conditions. Previously a serious pest in maltings and granaries in England, but rarely occurs now and is probably no longer established in Britain. A few records occur, mainly from S. England, on dried insects, stored grain, cereals, oilseeds etc. Ireland.

— Cuticle usually mainly dark brown; elytra bicolorous, dark brown to black with yellowish to reddish brown bands or spots in a definite pattern (fig. 125). Dorsal setae black or dark brown (ventral yellowish), with spots and bands of yellowish setae. Antennae always 11-segmented; club 5 to 8-segmented in male and with 4 or more segments in female (fig. 96). 9th and 10th tergites in male as in fig. 133. Male genitalia, fig. 129. Genital sclerites in female bursa copulatrix large and with many teeth (fig. 137), approximately twice as long as corrugated part of spermatheca (fig. 138). Length 2.0–4.0 mm. **variabile** Ballion (p. 57)

Synanthropic. Usually an import. England (introduced, 1978), infestations found in a few manufacturing premises, on milk powder, grain, seeds, cereals etc. Scotland: in museum, on bird skins and skull.

Genus **Reesa** Beal

This is a monospecific genus indigenous to and widely distributed in the Nearctic Region. It has become widespread in Europe and has recently been recorded from New Zealand.

— Body mainly dark brown; head and pronotum black and shiny, elytra dark brown at base, graduating to light brown at apices. Pubescence ranging from black to light brown but with prebasal diagonal yellowish bands on elytra, not reaching median suture (fig. 89). These lighter bands are sometimes also indicated in the cuticle. Antennae short and slender, with a weakly differentiated 4 to 5-segmented club. Antennal cavity shallow, not well-defined; mat. Length 2.0–4.0 mm .....
.....(Museum Nuisance [Finland]) **vespulae** (Milliron) (p. 57)

Synanthropic. Rare. A recent introduction (1977). England: Essex, London, Lancashire, Yorkshire, Northumberland. Scotland: Dunfermline, Perth, Fifeshire. Mainly in universities and museums, in seeds and insect collections. Not yet a household pest. A few collected out-of-doors in London.

Genus **Globicornis** Latreille

This genus contains 25 species of which 5 occur in the Neotropical Region (though it is possible that these are wrongly determined) and the remainder in the Palaearctic Region, chiefly the Mediterranean Subregion, but with some species fairly widely distributed in Europe. The commonest species, *Globicornis nigripes* (F.), occurs throughout the whole of Europe and the Caucasus, and is the only species of the genus on the British list.

Globicornis is distinguished from *Megatoma* by its 9 or 10-segmented antennae with a subcircular club; from *Trogoderma*, *Ctesias* and *Anthrenocerus* by its lack of a well-defined antennal cavity and from *Reesa* by the form of the antennae and the lack of a posterior carina to the antennal cavity.

— A single British species. Body dark brown with uniform, fine, dark brown setae (fig. 90). Pronotum mat. Underside figs 15, 113. Length 2.3–3.0 mm **nigripes** (Fabricius) (p. 58)

Very rare, an endangered species. S. England. On flowers, grass and foliage. Not synanthropic.

Genus **Megatoma** Herbst

This genus contains 21 species which occur in the Palaearctic and Nearctic Regions. There are 2 species listed in the Australian Region but their generic attribution is doubtful. Only 1 species, *Megatoma undata* (L.), which is found in Europe and Siberia, is present in Britain.

Megatoma is distinguished from *Globicornis* by its 11-segmented antennae with a more elongate club, from *Trogoderma*, *Ctesias* and *Anthrenocerus* by its lack of a well-defined antennal cavity and from *Reesa* by the form of the antennae and the lack of a posterior carina to the antennal cavity.

— A single British species. Body black with black setae and white scale-like setae in groups forming lateral patches and a small median spot on pronotum and two bands on elytra. Pronotum mat. Underside: figs 16, 114. Length 3.6–5.0 mm. (fig. 91) .....
.....**undata** (Linnaeus) (p. 59)

Fairly widespread. Mainly S. England, but with some records from the midlands, the north. Wales and Scotland. An outdoor species: on or under bark (particularly of dead trees), on walls of barns, on flowers, in nests or burrows of other insects, in spiders' webs. Not a pest, not synanthropic.

This species is easily distinguished from other British dermestids by its distinctive appearance (fig. 91), which may provide camouflage against lichen-covered bark. It seems to resemble the common jumping or zebra spider, Salticus scenicus *Clk. with which it is often found.*

Genus **Anthrenocerus** Arrow

This genus contains 20 species which are endemic to the Australian Region. One of these, *A. australis* (Hope), has been introduced into Europe (Britain and the Netherlands). It was first found in Britain in 1933 and is now established here (Hinton, 1945, Solomon & Adamson, 1955).

Anthrenocerus differs from *Globicornis*, *Reesa* and *Megatoma* by its very sharply defined antennal cavity, from *Trogoderma* by its large, well differentiated, 3-segmented antennal club and from *Ctesias* by the strong postcoxal lines on the metasternum and 1st abdominal sternite and the anterior position of the antennal cavity.

— Body brown or black, elytral setae mainly brown but with sinuate white transverse bands (fig. 92). White setae also present on pronotum, metasternum and metepisternum, ventral setae mainly golden. Length 2.0–3.4 mm ....(The Australian Carpet Beetle) **australis** (Hope) (p. 59)

Synanthropic. Rare (introduced). Mainly S. England, but recorded also as far north as Durham. Scotland. In commercial or domestic premises and occasionally imported. Not an important domestic pest. Only 1 outdoor record.

Genus **Orphinus** Motschulsky

Orphinus Motschulsky is a large genus of about 55 species occurring mainly in the Australian, Oriental and Ethiopian Regions.

This genus may be distinguished by its 2-segmented antennal club which is very large, circular and flattened in the male; smaller, oval and convex in the female. *Orphinus fulvipes* Guérin-Méneville is the only species of the genus likely to be imported to Britain.

— Prosternum and antennal cavities similar to those of *Trogoderma*. Cuticle and pubescence uniformly reddish-brown, legs and antennae slightly lighter. Antennae: fig. 103. Length 1.7–3.5 mm ..... **fulvipes** Guérin-Méneville (p. 60)

Synanthropic. Rare. An occasional import only.

Genus **Ctesias** Stephens

Ctesias Stephens is a small genus with a very wide distribution. It contains 9 species whose areas of distribution are small and not adjacent. There are 7 species in the Palaearctic Region, 1 in the Ethiopian and 1 in the Nearctic. One species, *Ctesias serra* (F.), occurs throughout the whole of Europe and in Finland and is established in Britain.

Ctesias differs from *Globicornis*, *Reesa* and *Megatoma* in its very sharply defined antennal cavity, from *Trogoderma* in its large, well differentiated antennal club and from *Anthrenocerus* by the position of the antennal cavity and the lack of postcoxal lines on the metasternum and 1st visible abdominal sternite.

— One British species. Body, including setae, dark brown to black, shiny; legs and antennae reddish-brown (fig. 93). Length 3.6–5.0 mm. .....**serra** (Fabricius) (p. 60)

Widely distributed throughout most counties in England, extending north to Cumberland and west to Somerset. Wales. Scotland. Has become more common in recent years probably due to tree diseases. Occurs where there are rotting trees, particularly oak and elm in old parks, ancient woodlands, etc. Adults under or on bark, at sap, on vegetation under old trees, rarely seen.

Subfamily Anthreninae

There are two genera in this subfamily, the one with the largest and most widespread worldwide distribution being *Anthrenus* Müller, with 114 species, the majority of which (80) occur in the Palaearctic Region; 2 are almost cosmopolitan. Species are present in all the main regions of the world except for the Neotropical Region (which has only introduced cosmopolitan species). 9 species have been found in Britain, either on imports or as natives. The other genus in the subfamily, *Neoanthrenus* Armstrong has few species (6) and only occurs in the Australian subregion.

Genus **Anthrenus** Müller
(carpet beetles; larvae = woolly bears)

Anthrenus can be distinguished from all other British genera in the family by the dense covering of scales instead of setae on the dorsal and ventral surfaces and the emarginate apex of the apical sternite. Members of this genus are usually small (under 5 mm) and broad, with deep, sharply delimited antennal cavities which are visible from the front. Worldwide, the species are grouped in 8 subgenera, 6 of which are represented in the British fauna. This genus includes some of the more serious household and museum pests as well as some harmless outdoor species.

Key to subgenera and species

1 Antennae 11-segmented with a 3-segmented club (figs 153–155, 161). Abdomen with postcoxal lines on 1st visible sternite (figs 151–152). 2

— Antennae 4 to 10-segmented with club variable (figs 156–160). Abdomen without postcoxal lines on 1st visible sternite 5

2 Inner margin of eye evenly convex (fig. 149). Dorsal scales elongate (fig. 163). Antennal cavity occupying about half lateral margin of hypomeron (fig. 150). Length 1.7–3.2 mm (fig. 139) (Subgenus **Nathrenus**) (The Varied Carpet Beetle) **verbasci** (Linnaeus) (p. 61)
Dorsum with a variegated pattern consisting of golden-yellow and black and white scales. Synanthropic. The commonest pest species of the genus in Britain, well-known as a domestic pest, particularly in S. E. England. A native, long-established species. Wales, Scotland, Ireland (1 record). Usually a pest of woollen goods but occasionally (rarely) of stored food products. In the wild is found in nests of birds and mammals, often in or around habitations. Adults seen on flowers, feeding on pollen and nectar, or at windows if indoors. Occasionally imported.

— Inner margin of eye with a small emargination (fig. 162). Dorsal scales broadly oval (figs 168–170). Antennal cavity occupying only about a third of lateral margin of hypomeron (fig. 150a) (Subgenus **Anthrenus s.str.**) 3

3 Pronotum with dorsal rim of antennal cavity not or only very slightly dilated. Apical abdominal sternite not divided by a broad band of black or dark brown scales only, sometimes with black and golden, but usually with a narrow median line or irregular triangular patch of golden or brown scales. Abdominal sternites 2–5 with a patch of golden scales at each side, sometimes with 1 or 2 black scales (fig. 151). Elytral scales broadly obovate, more or less evenly rounded posteriorly (fig. 168). Typical dorsal habitus as in fig. 143, usually with mostly bright yellow/golden and white scales, and a few black; less often, with nearly all white scales (fig. 144). (Antennal club with segment 1 distinctly shorter than 2 (fig. 153)). Length 2.0–3.5 mm (The Furniture Carpet Beetle) **flavipes** LeConte (p. 62)
Synanthropic. An import only. A pest on various animal materials e.g. wool, bones, fur, feathers, but has also been known to damage vegetable products e.g. paper.

— Pronotum with dorsal rim of antennal cavity moderately strongly to strongly dilated and visible from above. Apical abdominal sternite almost completely divided by a broad band of black or dark brown scales, sometimes with a few pale scales along anterior margin. Abdominal sternites 2–5 with a patch of black scales at each side (fig. 152). Elytral scales mostly narrower and subtruncate posteriorly (figs 169–170). Typical dorsal colour patterns as in figs 145, 146 4

4 Posterior 3/4 of pronotum with a patch of pale scales at each side enclosing, or nearly enclosing, a small, oval, distinctly darker patch (fig. 145). Elytral scales, fig. 169. Segment 1 of antennal club with length subequal to or longer than 2 (fig. 154). Sides of elytra strongly rounded. Length 2.0–4.5 mm ..... **pimpinellae** Fabricius (p. 63)

Dorsal scales a mixture of black, white and orange, typical pattern as in fig. 145, but subject to variation. Synanthropic. An import only. Not a major pest – found on dried fish, woollens, horse-hair, stored products etc.

— Posterior 3/4 of pronotum with a patch of pale scales at each side not enclosing a darker patch (fig. 146). Elytral scales, fig. 170. Segment 1 of antennal club distinctly shorter than 2 (fig. 155). Sides of elytra usually subparallel in anterior half. Length 2.0–3.8 mm ....(Common Carpet Beetle, Buffalo Moth, Old-fashioned Carpet Beetle [USA], Buffalo Carpet Beetle [Canada]) **scrophulariae** (Linnaeus) (p. 63)

Dorsal pattern variable, but typically as in fig. 146. Scales mainly black and white but with a sutural orange strip. Synanthropic. A rare import only. England, Wales, Scotland. Mainly on animal products.

5 Antennae 4 to 8-segmented 6

— Antennae 9 or 10-segmented 10

6 Antennae 4 or 5-segmented (6, in females of some foreign species); club 1-segmented. 7

— Antennae 7 to 8-segmented; club 1 or 2-segmented 8

7 Antennae 4-segmented ..... [Subgenus **Ranthenus** (Kazakhstan)]

— Antennae 5-segmented (fig. 160) (6 in females of some foreign species). Dorsal habitus as in fig. 141; scales predominantly black, lighter ones white or orange-brown; pattern variable. Elytral scales, fig. 166. Length 1.7–2.8 mm. (Subgenus **Helocerus**) **fuscus** Olivier (p. 64)

One of the commonest British species. Widespread throughout England, but commonest in the south. Wales. An outdoor, principally rural species, rarely a pest. Mainly around spiders' webs, or in nests of insects and mammals, in outbuildings, sheds, barns, walls etc. Adults seen on flowers.

8 Antennae 7-segmented .....[Subgenus **Solskinus** (USSR, N. China, Morocco)]

— Antennae 8-segmented (figs 158, 159) (7-segmented in females of some non-British species) (Subgenus **Florilinus**) 9

9 Scales of elytral disc triangular (fig. 165); on elytra black and white/yellow; on head nearly all blackish-brown; on pronotum mostly black on disc, white in middle posteriorly and at sides; on abdominal sternites whitish with patches of black or yellow scales near lateral margins of sternites 3–5. Antennae, fig. 158. Length 2.7–3.1 mm. (fig. 142) ....(The Museum Beetle) **museorum** (Linnaeus) (p. 64)

Occurs in the wild in England, mainly in the south-east, but a few records from northern, western and midland areas. Wales. Rural distribution, often with A. fuscus, *but less common than that species. In accumulations of dead insects near spiders' webs. Rarely occurs as a pest.*

— Scales of elytral disc more parallel-sided (fig. 167); on elytra white/yellow and brown/grey; on head and pronotum mostly white (fig. 147); on abdominal sternites all white. Antennae, fig. 159. Length 1.7–2.8 mm ..... **olgae** Kalik (p. 65)

Synanthropic. Rare, a recent introduction (1984). S. E. England (2 localities), in house and museum.

10 Antennae 9-segmented in both sexes, segments 4–6 elongate (fig. 157). Scales of dorsum broadly obovate (fig. 171). Visible abdominal sternites 2–5 with small patches of dark scales at sides; sternite 1 with whitish scales, 2–5 with anterior scales yellow and posterior scales whitish. Length 1.8–2.5 mm. (fig. 148) (Subgenus **Anthrenops**) ....**coloratus** Reitter (p. 65)

Elytra scales forming three transverse white bands, separated by darker scales ranging from light yellow to dark brown. Occasionally imported since 1944. Not established in Britain. S. E. England (2 recent records), 1983, 1984, in museum.

— Antennae usually 10-segmented in both sexes (in some males, appearing 9- segmented as 6 and 7 may be partly fused), segments 4–6 less elongate (fig. 156). Scales of dorsum broadly triangular (fig. 164). Abdominal sternites uniformly covered with greyish-white scales. Length 2.6–3.2 mm. (fig. 140) (Subgenus **Anthrenodes**) ....(The Guernsey Carpet Beetle) **sarnicus** Mroczkowski (p. 65)

Dorsal scales usually predominantly light grey, but with some black ones typically forming a square or rectangle across elytral suture; a few orange-brown scales sometimes present. Synanthropic. Rare. England: London (introduced, 1963). Recorded also from Kent, Lancashire, Middlesex, Wiltshire. Scotland. In private houses, commercial premises and museums. A pest on woollens and bird, mammal and insect collections. Out-of-doors on flowers and in birds' nests (sparrow, pigeon).

Subfamily Trinodinae

The subfamily Trinodinae contains the genus *Trinodes* (19 species) (see below), the Nearctic genus *Apsectus* (8 species) and the oriental genus *Evorinea* (5 species) which is represented in Sri Lanka, India, China, Japan, Vietnam, the Philippines, Sulawesi and the Mariana and Caroline Islands.

This subfamily is easily distinguished from other members of the Dermestidae by its small size (1.9–2.5 mm), its long erect setae and the longitudinal, sublateral carina and/or furrow at each side of the pronotum in the posterior half. It also differs from the other subfamilies by its hind coxae, which abut against the inner edge of the metepisternum instead of extending laterally beyond the inner edge and meeting the metepimeron. All the coxae are separated from each other.

Genus **Trinodes** Dejean

There are 19 described species of *Trinodes*, 4 of which occur in the Ethiopian Region, 7 in the Palaearctic and 8 in the Oriental Region. The genus is represented in Britain by one species – *Trinodes hirtus* (F.).

Trinodes is distinguished from the other genera (*Evorinea* and *Apsectus*) in the subfamily by its strong prosternal process which fits into a notch in the mesosternum (Peacock 1978). (The other genera have an extension of the mesosternum fitting into the prosternum). The prosternum has distinct antennal grooves.

— A single British species. Body dark reddish-brown, with very long erect and sub-erect stout setae. Pronotum with a prominent sublateral carina on basal half of each side, subparallel to lateral margin (fig. 6). Ocellus either absent or not clearly visible. Length 1.9–2.5 mm. ..... **hirtus** (Fabricius) (p. 66)

Rare. An outdoor species, listed as a Grade 1 Old Forest Indicator. Recent records from S. and E. England. In or near spiders' webs, under loose bark, in old decayed wood (mainly oak, but also elm and poplar), on flowers and foliage. Not a pest species.

A short key to the species of adult Dermestidae likely to be found 'in the wild' in Britain

1 Pronotum with a prominent sublateral carina on posterior half of each side, subparallel to lateral margin (fig. 6). Dorsal surface with very long, coarse erect and sub-erect setae. (Ocellus not obvious. Length 1.9–2.5 mm.) ..... **Trinodes hirtus** (Fabricius) (p. 66)

Rare, listed as a Grade 1 Old Forest Indicator. Recent records from S. and E. England; in or near spiders' webs, under loose bark, in old decayed wood (mainly oak, but also elm and poplar), on flowers and foliage.

— Pronotum without sublateral carinae. Dorsal surface with short, more recumbent setae or scales 2

2 Head without ocellus. Length 5.5–12 mm. **(Dermestes)** 9

— Head with ocellus (fig. 2). Length less than 6 mm 3

3 Body covered with recumbent scales which, unless rubbed off, completely obscure cuticle (figs 139–142). Apical abdominal sternite with small median emargination (fig. 2) **(Anthrenus)** 15

— Body with setae which do not completely obscure cuticle, only rarely with small patches of white 'scale-like' setae dorsally, but never ventrally. Apical abdominal sternite without small median emargination 4

4 Mouthparts free – well below level of prosternum and not able to fit into it (fig. 9). Segment 1 of middle and hind tarsi much smaller than 2 (figs 68–71) **(Attagenus)** 5

— Mouthparts at about the same level as front of 'collar-like' prosternum and able to fit into it when head is retracted (fig. 10). Segment 1 of middle and hind tarsi about as long as 2 (fig. 120) 6

5 Middle of each elytron, near suture, and posterior part of pronotum within hind angles and in front of scutellum, with distinct white spots (fig. 66). Length 3.7–6.0 mm ..... **Attagenus pellio** (Linnaeus) (p. 53)

The commonest species of the genus in Britain. Widespread in England, but commonest in the south. Scotland, Wales and Ireland. On flowers, in birds' nests etc.

— Head, pronotum and underside dark brown to black. Legs, antennae and elytra light brown. Length 2.4–3.7 mm ..... **Attagenus smirnovi** Zhantiev (p. 54)

Rare. S. E. England (recently introduced). A few found in S. W. London, on or near privet.

6 Elytral setae mainly black or brown, but with some white setae forming interrupted bands or patches (figs 91, 92) 7

— Elytra with yellowish-brown to black setae, never with white setae 8

7 Length 3.5–6.0 mm. Pronotum mat, with very large contiguous rimmed punctures, much larger than those on disc of elytra. Hypomeron without distinct antennal cavities (fig. 114). 1st visible abdominal sternite without postcoxal lines. Cuticle usually black or very dark brown. Setae mainly dark but with 2 distinct, incomplete, zig-zag bands of white setae on elytra, a large patch at each side of pronotum posteriorly and a small one in middle. Other scattered white setae also present (fig. 91) ..... **Megatoma undata** (Linnaeus) (p. 59)

Fairly widespread. Mainly S. England, but with some records from the midlands, the north, Wales and Scotland. On or under bark (particularly of dead trees), on walls of barns, on flowers, in nests or burrows of other insects, in spiders' webs.

— Length 2.0–3.4 mm. Pronotum shiny, with minute sparse punctures, not larger than those on disc of elytra. Front of hypomeron with very distinct, deep antennal cavities (fig. 115). Metasternum and 1st visible abdominal sternite with diagonal postcoxal lines. Cuticle of elytra brown; head and pronotum darker; legs and antennae reddish-brown. White setae forming at least 3 indistinct, incomplete, zig-zag bands on elytra and some patches on pronotum (fig. 92) ..... **Anthrenocerus australis** (Hope) (p. 59)

Rare (introduced). S. E. England: London, 1 outdoor record. Worcestershire: in sparrows nests in roof of manufacturing premises.

8 Hypomera with very well-defined, bordered, elongate, deeply concave antennal cavities, with impunctate, microsculptured surface, extending diagonally for entire length of hypomeron (figs 116–117). Dorsal surface very shiny, with fine setae and minute punctures (fig. 93). Usually uniformly brown, with legs and antennae lighter, or head and pronotum slightly darker. Length 3.6–5.0 mm ..... **Ctesias serra** (Fabricius) (p. 60)

Widely distributed throughout most counties in England, extending north to Cumberland and west to Somerset. Wales. Scotland. Has become more common in recent years probably due to tree diseases. Occurs where there are rotting trees, particularly oak and elm in old parks, ancient woodlands, etc. Adults under or on bark, at sap, on vegetation under old trees, rarely seen.

— Hypomera without well-defined antennal cavities; surface at most weakly hollowed but not differentiated (fig. 113). Head and pronotum dull; punctures very large, rimmed and contiguous (fig. 118). Colour dark brown becoming lighter towards eytral apices. Tarsi and middle antennal segments light brown. Length 2.8–3.0 mm. (fig. 90) ..... **Globicornis nigripes** (Fabricius) (p. 58)

Very rare, an endangered species. S. England. On flowers, grass and foliage.

9 Elytra with band of light yellowish or greyish-brown pubescence in anterior half, enclosing 3 dark spots on each side (fig. 27). Remainder of elytra with dark brown to black setae ..... **Dermestes lardarius** Linnaeus (p. 59)

Widespread throughout England, but commonest in the south and around the London area. Scotland, Wales, Ireland. In carrion, wasps' nests, wet birds' nests etc.

— Elytral pubescence not as above 10

10 Ventral side with dense covering of white or very light grey pubescence, obscuring cuticle; with patches of black setae at sides of abdominal sternites (figs 29, 30, 32, 33) ... 11

— Ventral side with fine covering of sparse golden pubescence, not obscuring cuticle (fig. 36) 14

11 Pronotum with setae on disc the same colour as those at sides; without a band of whitish setae at sides and front (figs 25, 26) 12

— Pronotum with mainly dark setae on disc and with a broad band of whitish setae along each side joined by a narrow anterior band (figs 21, 22). 13

12 Pronotum with predominantly golden or reddish setae forming an undulating pattern. Elytra mainly with mixed black and white setae, but with a few golden setae anteriorly (fig. 26). Antennal club dark reddish-brown ..... **Dermestes undulatus** Brahm (p. 48)

Rare. S. and S. E. England, near coast, in carrion. Wales (early records).

— Pronotum with mixed fine black and white setae, giving a mottled effect, with a small spot of golden setae on each side of disc and on anterior margin. Elytra with similar black and white setae (fig. 25). Antennal club black ..... **Dermestes murinus** Linnaeus (p. 48)

Common and widespread throughout England in rural areas, as far north as Durham, in carrion. Wales. Ireland.

13 Elytral apices each with a sutural spine and series of small teeth (figs 21, 43). Pronotum with lateral band of whitish setae complete to posterior margin ..... **Dermestes maculatus** De Geer (p. 46)

Not common, but often occurs in large numbers. Mainly S. England, but some records from the north. In carrion.

— Elytral apices smooth, without spines or teeth. Pronotum with lateral band of whitish setae interrupted posteriorly by a patch of dark setae (fig. 22) ..... **Dermestes frischii** Kugelann (p. 47)

Very rarely found out-of-doors, mainly S. England, in carrion. Scotland (old records).

14 Dorsal pubescence uniformly short, pale golden-yellow, recumbent, not projecting beyond apex of elytra in a fringe (figs 28, 46). Metepimeron without a posteriorly-directed lateral spine (fig. 54). ..... **Dermestes peruvianus** Laporte de Castelnau (p. 51)

Very rare out-of-doors. S. E. England: London, in pigeons' nests.

— Elytral pubescence predominantly black or dark brown, with mixed light brown or golden setae; forming a distinct fringe at apex of elytra (fig. 45). Metepimeron extending into a posteriorly-directed lateral spine (fig. 53) .... **Dermestes haemorrhoidalis** Küster (p. 51)

Very rare out-of-doors. S. England, in carrion, in wet and dry birds' nests.

15 Dorsal scales narrow and elongate (fig. 163); yellow, white and black forming a variegated pattern of zig-zag transverse bands on elytra (fig. 139). Antennae 11-segmented with a 3-segmented club (fig. 161). Abdomen with postcoxal lines on 1st visible sternite; ventral scales mainly white but with large dark patches at sides of visible sternites 2–5 and at apex of apical sternite. Length 1.7–3.0 mm ..... **Anthrenus verbasci** Linnaeus (p. 61)

One of the commonest species of the genus in Britain, particularly S. E. England. A native, long-established species. Wales, Scotland, Ireland (1 record). In the nests of birds and mammals, often in or around habitations, on flowers.

— Dorsal scales triangular (figs 164–166). Antennae 5 to 10-segmented (figs 156, 158, 160). Abdomen without postcoxal lines; ventral scales mainly light grey, with or without black patches at sides of sternites 16

16 Dorsal scales (fig. 164) mainly grey, sometimes with some white and pale yellowish ones among them, usually with some black ones forming patches on disc and shoulders of elytra (fig. 140). Antennae 9 or 10-segmented (fig. 156). Scales on abdominal sternites entirely light grey. Length 2.6–3.2 mm. ..... **Anthrenus sarnicus** Mroczkowski (p. 65)

Very rare out-of-doors. S. E. England: London (introduced, 1963). On flowers and in birds' nests (sparrow, pigeon).

— Dorsal scales mainly black, elytra sometimes with transverse zig-zag bands of grey or grey and yellow scales. Antennae 5 to 8-segmented. Scales on abdominal sternites forming black patches at sides 17

17 Elytra with light bands variable, sometimes almost obsolete, but at other times distinct. Antennae 5-segmented, club 1-segmented (fig. 160). 5th visible abdominal sternite with apical patch of black scales. Length 1.7–2.8 mm. (fig. 141) **Anthrenus fuscus** Olivier (p. 64)

One of the commonest British species. Widespread throughout England, but commonest in the south. Wales. Principally a rural species. Around spiders' webs, in nests of insects and mammals, in outbuildings, sheds, barns, walls etc., on flowers.

— Elytra with indistinct light bands due to scattered light scales. Antennae 8-segmented, club 2-segmented (fig. 158). 5th abdominal sternite without an apical patch of black scales. Length 2.7–3.1 mm. (fig. 142) ..... **Anthrenus museorum** (Linnaeus) (p. 64)
England – mainly the south-east, but a few records from northern, western and midland areas. Wales. Rural distribution, often with A. fuscus, *but less common than that species. In accumulations of dead insects near spiders' webs, on flowers.*

Identification of larval Dermestidae

Notes on the keys

The keys to larvae should serve to identify to genus all the species dealt with here, whichever instar they are in, but mature or nearly mature larvae are needed for specific identifications of *Anthrenus* and *Dermestes* as these differ markedly between the instars. In fact the differences between the instars are frequently greater than those between the species in mature larvae, so an identification key to include the earlier instars would necessitate a separate major study and breeding programme.

It is not always easy to tell if a larva is nearing maturity but if a series is present then the largest and most strongly pigmented larva should be chosen for identification. If pupae are present within the last larval skin, then this skin may be used for identification. Retrorse tubercles are characteristic of most, but not all, mature *Dermestes* larvae but are also present in the earlier instars of some species.

The characters separating the species are difficult to see with a stereoscopic microscope, although with practice it may be possible in some cases. To see the characters easily it may be necessary to make a temporary slide mount of the larva, and to view it under a compound microscope. Temporary mounts can be made by heating the larva for about 30 minutes in a weak solution of KOH, then mounting it on a slide in glycerine and covering with a cover slip. If the antennae are not protruding the head should be gently squeezed until they are exserted to their maximum length.

In order to see the antecostal suture of abdominal segment 8 it is usually necessary to remove the hastisetae on one side of segment 7. The abdomen should be extended so that a fold in the intersegmental membrane is not mistaken for the suture. A true antecostal suture is interrupted at the midline so it can be distinguished from a fold in the membrane which appears unbroken across the median longitudinal line. It sometimes appears as a line or weak ridge and seems to be in a similar position to the anterior transverse ridges of the tergites in *Dermestes* spp.

To observe the epipharynx, it is best to remove the labrum, to which the epipharynx is attached, and mount it ventral side uppermost on a slide. Alternatively the entire head or body can be mounted with the mandibles removed or pulled apart.

The larva of *Orphinus fulvipes* (Guérin-Méneville) has been included in the key, although it is only an occasional import.

The author was able to examine larvae of most species, but examples of the following were not available, so their inclusion is based on published descriptions:- *Anthrenus pimpinellae*, *A. scrophulariae*, *Dermestes undulatus*, *D. leechi* (only hind part examined) and *Thoractodes heydeni*.

Key to genera

(When only one species occurs in a genus, no attempt has been made to separate the specific and generic characters, so specific characters may be present in the generic key)

1 Abdominal segment 9 with 2 urogomphi (figs 172–176) 2
— Abdominal segment 9 without urogomphi 3
2 Mature larvae bristly and very large; length usually 10–17 mm. (figs 172–175). Long spinulate setae arranged in 8 obliquely transverse series across abdominal tergites. Abdominal segment 10 sclerotized and cylindrical and used as a pygopod. Mandible with 3 large, acute apical teeth, a small pointed prostheca and a brush of setae on inner edge near base (fig. 193). Epipharynx fig. 210. ..... **Dermestes** (p. 38)
— Mature larvae very small; length about 2 mm. (fig. 176). Abdominal tergites with simple setae, with a pair of very short clubbed setae near mid-dorsal line on thoracic tergites and abdominal tergites 1–8; segment 10 reduced and membranous. Mandible with 2 large, acute apical teeth, without a basal brush of setae (fig. 194). Epipharynx fig. 208 .....
..... **Thorictodes** (p. 38)
3 Dorsal surface without hastisetae (spear-headed, segmented setae) (figs 177–182) (these sometimes fall off, so a careful search should be made for traces of them); with either mainly recumbent (figs 179–181) or clubbed setae (fig. 182) or with spinulate setae emerging only from transverse membranous areas of each tergite (except on pronotum) (fig. 177–178) 4
— Dorsal surface with hastisetae (figs 273–281) (often these fall off, but usually at least one or two can be seen); also with long spinulate setae emerging from sclerotized parts of tergites (figs 183–190) 6
4 Body with mostly erect or sub-erect setae (figs 177, 178, 182). Mature larva small; length less than 7 mm.; sclerotized dorsally, mainly membranous ventrally. Abdomen without a caudal brush of long, slender setae. Mandible without a brush of setae on inner edge near base and without a prostheca (fig. 195) 5
— Body with mostly recumbent pubescence (figs 179–181). Mature larva large; length over 10 mm.; elongate, cylindrical; strongly sclerotized dorsally and sometimes ventrally. Abdomen with a caudal brush of extremely long, slender setae, usually longer than half body length. Mandible with a brush of setae on inner edge near base and with a pointed, membranous prostheca (fig. 196). Epipharynx fig. 211 ..... **Attagenus** (p. 40)
5 Posterior margin of tergites with coarse, very close, sub-erect, club- shaped setae, forming a fringe which is rarely longer than the length of one tergite (fig. 182). Remaining setae fine and recumbent. Tergites brown, completely sclerotized, without dorsal line. Antennal segment 2 much narrower and shorter than 1 (fig. 202); accessory appendage arising from basal third of 2 and extending only to middle of 3. Epipharynx fig. 207 **Thylodrias** (p. 37)
— Posterior margin of tergites without club-shaped setae. Tergites with scattered, erect black setae which are frequently longer than the length of one tergite; no recumbent setae present; strongly sclerotized and brown or grey each side of a very fine, light- coloured, membranous median dorsal line; with a sclerotized strip along anterior and posterior margin of tergite, enclosing a transverse membranous area on each side from which most of the very long black setae arise (figs 177–178). Antennal segment 2 nearly as long and broad as 1 (fig. 203); accessory appendage arising from apex of 2 and extending almost to apex of 3. Epipharynx fig. 209. ..... **Trinodes** (p. 44)
6 Frons with small, but distinct median anterior tubercle. (Abdominal segment 7 with tufts of hastisetae emerging from membranous areas in the postero-lateral part of tergite; segment 8 with hastisetae.) Epipharynx with 6 papillae in 2 separate sensory cups (fig. 219).
..... **Orphinus** (p. 52)
— Frons without median tubercle. Tufts of hastisetae either emerging from membranous areas in the postero-lateral part of tergite 7, in which case segment 8 is without hastisetae, or from sclerotized parts of tergite 7. Epipharynx with 6 or fewer papillae grouped together in 1 sensory cup (except for *Anthrenocerus australis* which has 2 sensory cups) 7
7 Abdomen with posterior margins of tergites 4 (or 5)–7 sinuate or emarginate towards sides, with either 3 or 4 tufts of hastisetae at each side emerging from these membranous emarginations; segment 8 without tufts of hastisetae (figs 183–187, 191) 8
— Abdomen with posterior margins of tergites 4–7 not sinuate or emarginate towards sides; the tufts of hastisetae emerging from distinctly sclerotized postero-lateral part of these tergites; segment 8 with tufts of hastisetae (figs 188–190, 192) 9

8 Abdomen with posterior margins of tergites 5–7 sinuate and emarginate towards sides, with 3 pairs of tufts of hastisetae emerging from an entirely membranous area in the emargination (figs 183–185). Body not constricted at abdominal segments 1–3, usually widening evenly from pronotum, broadest at abdominal segments 2–5. Abdominal sternites either membranous or sclerotized. Epipharynx, fig. 220 ... **Anthrenus** (p. 43)

— Abdomen with posterior margin of tergites 4–7 sinuate towards sides, with 4 pairs of tufts of hastisetae (some very long) emerging from membranous areas (figs 186–187). Thoracic tergites sometimes with spots or patches. Body sub-oblong, constricted at abdominal segments 1–3, which are each shorter than 4. Abdominal sternites with strongly sclerotized shiny median strip. Epipharynx fig. 218. ..... **Ctesias** (p. 43)

9 Antenna with segment 2 about twice as long as 3 (figs 204–206). 10

— Antenna with segment 2 not more than half as long again as 3 (figs 282–286) 12

10 Thoracic tergites with distinctly darker brown patches at sides, sometimes extending to middle on 2 and 3 (meso and metanotum) (fig. 188). Sclerotized parts of abdominal tergites uniformly light brown. Antecostal sutures distinct on disc of tergites but becoming fainter and disappearing at sides, particularly on abdominal tergites 6–8. Length 5–10 mm. Basal struts of heads of hastisetae of caudal tufts short, about one-sixth as long as head (fig. 197). (Pretarsal setae on ventral side of claw equal, as in fig. 201.) Epipharynx fig. 216. ..... **Megatoma** (p. 42)

— Thoracic tergites unicolorous, without dark patches at sides. Antecostal sutures distinct and darkened on disc of tergites and even more so at sides, forming a strongly curved ridge, even on abdominal tergites 6–8. Length less than 6 mm. Basal struts of heads of hastisetae of caudal tufts longer, about one-fourth as long as head (figs 198, 199) 11

11 Head, pronotum, posterior parts of abdominal tergites and thoracic tergite 2 and 3 light brown. Anterior parts of abdominal tergites and thoracic tergites 2 and 3 with a strongly differentiated, dark brown transverse strip adjacent to the weakly sinuate antecostal suture. Thoracic sternites and ventral side of coxae with very fine, long setae. Pretarsal setae of ventral side of claw equal, as in fig. 201. Epipharynx, fig. 215 **Globicornis** (p. 42)

— Anterior margins of tergites not darker than remainder (exceptionally the anterior margin may be darkened in the abdominal tergites, but if so the thoracic tergites are uniformly coloured). Antecostal sutures on tergites more or less straight. Thoracic sternites and sublateral part of some abdominal sternites with very stout, long, erect setae. Pretarsal setae of ventral side of claw unequal, as in fig. 200. Length 5 mm. Epipharynx, fig. 217 ..... **Anthrenocerus** (p. 42)

12 Acrotergites with numerous very fine spinulate setae (figs 287–290). Abdominal tergites 5 or 6–8 with dense lateral tufts of hastisetae (usually extending to midline), remaining abdominal tergites usually with a only a few of these setae laterally. Tergites with erect, stout spinulate setae and many recumbent finer spinulate setae on disc; also with a distinct fringe of fine or stout setae on posterior margin (figs 189–190). Tergites usually yellowish or pale brown but if dark brown then acrotergites also dark brown and sclerotized; anterior transverse ridge (antecostal suture) not always well defined. Pretarsal setae, on ventral side of claw, distinctly unequal (fig. 200). Antennal segment 2 either without setae or with 1 seta (figs 283–286). Epipharynx, figs 212–213 ..... **Trogoderma** (p. 41)

— Acrotergites without setae and not usually strongly pigmented (fig. 291). Abdominal tergites 1–8 with dense lateral tufts of hastisetae, usually extending to midline and obscuring posterior margin of tergite; with a few erect, stout spinulate setae but without recumbent spinulate setae or a posterior fringe (thoracic tergites also lack a posterior fringe of spinulate setae). Tergites very strongly sclerotized and pigmented; dark brown; anterior transverse ridge prominent. Pretarsal setae almost as long as claw and subequal (fig. 201). Antennal segment 2 with at least 1 seta (fig. 282). Epipharynx fig. 214 .. **Reesa** (p. 42)

Genus **Thylodrias** Motschulsky

— A single species. Body brown, with club-shaped setae (fig. 182). Length less than 7 mm. For other characters, see generic key. ..... **contractus** Motschulsky (p. 44)

Synanthropic. An occasional import, not established in Britain. A household pest, and pest of insect collections abroad.

Genus **Thorictodes** Reitter

— A single species likely to be found in Britain. Abdominal segment 9 with 2 urogomphi (fig. 176). Very small, about 2 mm long. For other characters, see generic key ..... **heydeni** Reitter (p. 45)

Synanthropic. An import only. A pest of stored cereals and their products.

Genus **Dermestes** Linnaeus

Key to species

1 Urogomphi, on abdominal segment 9, backwardly directed; either straight or curved caudally and downwards (figs 221–224, 230–231). (Tergites with median longitudinal dorsal line either narrow or absent) (fig. 173) 2

— Urogomphi, on abdominal segment 9, with apices curved anteriorly and upwards, anterior surface concave in outline in side view (figs 225–229) 6

2 Urogomphi almost straight in side view (fig. 221). Abdominal tergites 4–9 without retrorse tubercles (see figs 172, 234) but instead, each with a row of about 30 short erect setae immediately posterior to anterior transverse ridge (in immature larvae of other species, the setae are much fewer than 30). Tibiae each with a stout spine (fig. 243) on dorsal apex of posterior face. (Head without tubercles). Length 14–17 mm .... **ater** De Geer (p. 50)

Synanthropic. Common on imports only. A pest on vegetable products e.g. copra, cocoa beans. Also found on animal material, e.g. bones, skins, dead insects.

— Urogomphi curved caudally and downwards in side view (figs 222–224, 230–231). Abdominal tergites 4–9 with a row of retrorse tubercles (fig. 234) (sometimes very small), immediately posterior to anterior transverse ridge. Tibiae each with a slender seta on dorsal apex of posterior face (tibia of *leechi* not examined) 3

3 Abdominal tergites 4–8 with a transverse series of very numerous short normal setae immediately posterior to the row of retrorse tubercles (figs 230–233) (these setae are also present on 2 and 3 although the retrorse tubercles are not). Length not known (only incomplete larvae examined) ..... **leechi** Kalik (p. 50)

Synanthropic. Very rare. An import only. A single adult, in bone grist, also several larvae found in inner wrappings of an Egyptian mummy.

— Abdominal tergites 4–8 with sparse short erect normal setae posterior to the row of retrorse tubercles (figs 236, 238), or with a transverse series of very numerous, short ramous setae (fig. 234) 4

4 Head without frontal tubercles (fig. 245). Abdominal tergites 3–8 with a row of short, erect, ramous setae just posterior to the row of retrorse tubercles (best seen on tergites 5–7); dense fringe of normal setae on posterior margin of tergites 3–9 consisting of fine, rather erect setae of similar length and thickness (fig. 234); retrorse tubercles well-developed on tergites 4–10 with small acute processes apically (fig. 240), usually about 7 retrorse tubercles on each side of mid line on tergites 6 and 7. Urogomphi smooth and almost glabrous in basal half (figs 222, 235). Anterior transverse ridge on abdominal tergite 9, immediately anterior to urogomphi, sinuate dorsally, but not laterally. Abdominal sternites with a posterior fringe on each with several very long setae amongst the others – at least as long as 2 sternites; sclerotized area similar to *D. peruvianus*. Length 12–15 mm. (fig. 173) ..... **lardarius** Linnaeus (p. 49)

Synanthropic. Widespread throughout England, but commonest in the south and around the London area. Scotland, Wales, Ireland. Only a minor household pest, but a nuisance in warehouses and food premises. Prefers animal material, but can survive on vegetable. More rarely, found out-of-doors in carrion, wasps' nests, wet birds' nests etc. A native of Britain but occasionally imported.

— Head with a tubercle on each side of frons near anterior margin (fig. 245) (sometimes obscure). Abdominal tergites 3–8 without a row of ramous setae posterior to the retrorse tubercles; fringe of normal setae on posterior margin of abdominal tergites consisting of well spaced, alternately stout and very short slender setae. Usually about 8–11 retrorse tubercles on each side of mid line on tergites 6 and 7. Urogomphi wrinkled and with a few stout setae in basal half 5

5 Urogomphi very broad at base (figs 223, 237), close together, not separated by as much as their basal width. Anterior transverse ridge immediately anterior to urogomphi straight dorsally. Retrorse tubercles on abdominal tergites 3–10 large, conspicuous and bilobed apically (figs 236, 241), each bearing a seta which is longer and thicker on the tubercles on tergites 9 and 10 than on those on the other tergites, with about 11 retrorse tubercles per side on tergites 6 and 7. Tubercles on head conical and distinct (fig. 246). Pubescence long and dense. Sclerotized area on apical 5 sternites (6–10) well developed, the membranous middle part of the 6th abdominal sternite not wider than the length of one sternite; posterior fringe on each abdominal sternite with several long setae, each about the length of 2 sternites. Length 12–14 mm. ..... **haemorrhoidalis** Küster (p. 51)

Synanthropic. Introduced in 1905 and imported at intervals since. Fairly widespread throughout England, but commonest in the south-east, particularly around the London area. Mainly in domestic premises, associated with animal products. Rare out-of-doors: S. England, in carrion, in wet and dry birds' nests.

— Urogomphi narrower at base (figs 224, 239) and further apart, separated by about their basal width. Anterior transverse ridge immediately anterior to urogomphi distinctly sinuate dorsally and laterally. Retrorse tubercles either absent or small and inconspicuous, particularly on tergites 9 and 10, usually absent on 10; when present there are usually 8 or 9 per side on abdominal tergites 6 and 7 and they are neither bilobed nor with apical processes (figs 238, 242). Tubercles present on head but often flattened and obscure (fig. 247), sometimes only distinguishable by their slightly darker colour. Pubescence shorter and much less dense. Sclerotized area well developed on apical 4 sternites only and posterior fringe on each sternite short – about the length of 1 sternite. Length 14–17 mm. ..... **peruvianus** Laporte de Castelnau (p. 51)

Synanthropic. Introduced, but has become the commonest pest species of the genus throughout England in domestic premises. Usually associated with animal products but can live on vegetable material. Very few outdoor records – only in pigeons' nests in London.

6 Tergites with a broad median longitudinal yellowish dorsal line, sometimes becoming narrower posteriorly (fig. 174) 7

— Tergites with only a narrow pale median longitudinal line (as in fig. 173) (sometimes with broader yellow patches in between tergites on *murinus*) 9

7 Tibiae with one or two setae on apical margin of posterior face between long dorsal seta and ventral spine (fig. 244). Usually 3 anterior abdominal spiracles free (not attached to sclerotized pigmented area of tergite). Retrorse tubercles very small and insignificant on abdominal tergite 4 (fig. 252) (smaller than those on tergite 9), becoming progressively larger posteriorly, reaching maximum development on abdominal tergite 8 (fig. 251). Unpigmented area at sides of pronotum with an insignificant linear pigment spot (fig. 248). Length 15–17 mm ..... **frischii** Kugelann (p. 47)

Synanthropic. A pest which is fairly frequently imported on animal material e.g. bones, dried fish etc., England, Ireland. Sometimes found in commercial premises in England, but is not a household pest. Very rarely found out-of-doors, mainly S. England, in carrion. Scotland (old records).

— Tibiae without supplementary setae on apical margin of posterior face between long dorsal seta and ventral spine. Usually only 1 or 2 anterior abdominal spiracles free. Retrorse tubercles large and distinct on abdominal tergite 4 (subequal in size to those on 9) (figs 253, 255) 8

8 Sides of pronotum with a large unpigmented area containing one or two oval pigment spots (fig. 249). Usually 2 anterior abdominal spiracles free (surrounded by a small unpigmented area). Retrorse tubercles apically rounded, with acute wart-like processes (figs 226, 253). Ocelli large, ventral pair nearly as close together as dorsal (fig. 254). Length 14–16 mm ..... **maculatus** De Geer (p. 46)

Synanthropic. The commonest pest species of the genus found on imports to England, Scotland and Ireland, and a serious pest, mainly on animal products, e.g. bones and hides, in commercial premises in England and Wales. Not a household pest. Quite rare out-of-doors, mainly S. England, in carrion.

— Sides of pronotum with only a narrow unpigmented area along lateral margin and with a pigment spot in an oblong unpigmented area enclosed in the pigmented area (fig. 250). Usually only 1 abdominal spiracle free, others joined to pigmented areas. Retrorse tubercles bilobed apically, each lobe with acute processes (figs 227, 255). Ocelli smaller, ventral pair more widely spaced (fig. 256) ..... **carnivorus** Fabricius (p. 48)

Synanthropic. An infrequent import, England, Ireland. A pest of both animal and vegetable products e.g. hides, nuts etc. Not found out-of-doors in Britain.

9 Abdominal tergites 4 (or 6)–9 with well-developed retrorse tubercles. Urogomphi about three times as long as broad, much more slender than in *D. maculatus*; a straight line connecting the apex with the hind end of base cuts anterior outline (fig. 228). (Pronotum with narrow unpigmented (yellowish brown) area at lateral margin, without pigment spot. Anterior 2 abdominal spiracles free. Acrotergites very strongly pigmented and sclerotized. Head with a tubercle on each side of anterior part of frons. Ocelli small (compared to *D. maculatus*); ventral pair nearly as widely spaced as middle. Abdominal sternites with basal sockets of setae strongly pigmented, appearing as raised brown spots.) Length 12–15 mm ..... **murinus** Linnaeus (p. 48)

Common and widespread throughout England in rural areas, as far north as Durham. Out-of-doors, in carrion. Wales. Ireland. Not a pest and not synanthropic in Britain, rarely imported.

— Abdominal tergites without retrorse tubercles (according to Korschefsky (1944)). Urogomphi (fig. 229) about twice as long as broad, about as stout as those of *D. maculatus*; a straight line connecting apex with the hind end of base not cutting anterior outline. Length less than 10 mm ..... **undulatus** Brahm (p. 48)

Rare. S. and S. E. England, near coast. Out-of-doors, in carrion. Wales (early records). Not a pest species.

Genus **Attagenus** Latreille

Key to species

1 Abdominal sternite 8 almost entirely covered with very wide, subrectangular, flattened, recumbent, scale-like setae, with about 12 longitudinal ribs (fig. 257) (only visible under a high magnification). Other sternites and tergites with both broadly lanceolate and linear setae. Acrotergites with some broad scale-like setae, with about 5 longitudinal ribs ... **pellio** (Linnaeus) (p. 53)

Synanthropic. The commonest species of the genus in Britain; occurring in the wild in the nests of birds and mammals, near spiders' webs etc., and as a pest in households and commercial premises on wool, fur, cereals etc. England, widespread, but commonest in the south. Scotland, Wales and Ireland. Seldom imported.

— Abdominal sternite 8 with lanceolate and/or linear setae (figs 258–259). Acrotergites with slender setae, usually with not more than 3 longitudinal ribs between margins 2

2 Antennal segment 2 bearing at least 12 setae (fig. 260). .... **fasciatus** (Thunberg) (p. 52)

Synanthropic. An import only. A storage pest on animal and vegetable products e.g. furs, skins, oilcake, myrobalans, seeds.

— Antennal segment 2 either without setae or with 2–3 short setae near apex (figs 261–262) (segment 1 (basal) densely setose) 3

3 Antennal segment 2 with 2–3 short setae near apex (fig. 261); head with yellowish brown setae, tergites with dark brown setae ..... **cyphonoides** Reitter (p. 53)

Synanthropic. An import only. A storage pest on furs, skins, bones, cottonseed, oilcake, cereals etc.

— Antennal segment 2 without setae (fig. 262) 4

4 Some setae of abdominal sternite 8 flattened, recumbent, weakly sclerotized and broadly lanceolate with 7–12 ribs between margins (fig. 258) (linear setae also present) ..... **brunneus** Faldermann (p. 55)

Synanthropic. S. England (recently introduced). London, in commercial premises, infesting felt and carpets.

— All setae of abdominal sternite 8 subcylindrical, strongly sclerotized, linear or narrowly lanceolate with no more than 4 ribs between margins (fig. 259) 5

5 Spiracular sclerites (at posterior corners of abdominal tergites) (see figs 179, 181) each with 3 prominent setae (fig. 263). Abdominal sternites 2–9 each with an irregular row of about 6 stouter, more erect setae. Tergites yellowish brown with light yellowish brown lanceolate and linear setae on disc. Caudal setae short (about length of 3 abdominal segments) . **smirnovi** Zhantiev (p. 54)

Synanthropic. Rare. S. E. England, recently introduced, but now well established in a small area in and around London. Recorded from domestic premises and a museum; on carpet, in fluff on floor, on dried insects.

— Spiracular sclerites each with 4–8 prominent setae (fig. 264). Abdominal sternites 2–9 without stouter setae. Tergites reddish brown with dark brown, short, lanceolate setae on disc. Caudal setae long (about length of 6 abdominal segments)**unicolor** (Brahm) (p. 54)

Synanthropic. Few British records, so not regarded as a serious pest. England: north, south and midlands, on wool, fur, skins etc. also in mills and bakeries etc. Scotland. Sometimes imported on flour, oilcakes, bones etc.

Genus **Trogoderma** Dejean

Key to species

1 Setae of basal antennal segment almost completely encircling segment, not grouped on inner and inner-dorsal side of segment; some extending to apex of segment 2, or beyond, when antenna is fully extended (figs 283, 284, 286). Erect spinulate setae on discs of tergites stout and fairly smooth, particularly at their apices, not 'feathery' 2

— Setae of basal antennal segment grouped on inner and inner-dorsal side of segment leaving outer and most of ventral side glabrous; rarely attaining apex of segment 2 when antenna is fully extended (fig. 285). (Tergites light creamy yellow, very rarely light brown; with very sparse hastisetae on disc of thoracic and anterior abdominal tergites. Abdominal tergite 1 with stout, erect spinulate setae forming a rather sparse median transverse, almost single row (fig. 287). Erect spinulate setae of tergites 'feathery' and tapering. Spinulate setae on abdominal tergites 7 and 8 much finer and longer than those on 1. Median brush of setae on segment 9 fine and very long, about as long as 4 abdominal segments. 8th abdominal tergite with a very faint antecostal suture, only visible under very high magnification. Hastisetae as in fig. 189a. Epipharynx with 6 sensory papillae (fig. 212) ..... **variabile** Ballion (p. 57)

Synanthropic. Usually an import. England (introduced), rare. Infestations found in a few manufacturing premises, on milk powder, grain, seeds, cereals etc. Scotland: in museum, on bird skins and skull.

2 Antennal segment 2 usually with a single seta (fig. 284). Abdominal tergite 8 with antecostal suture absent, or present but interrupted. (Tergites uniformly creamy yellow to medium brown. Erect spinulate setae on abdominal tergite 1 stout and dense, forming an almost double transverse median row (fig. 288), but those on abdominal tergites 7 and 8 at least as stout and even denser. Median brush of setae of segment 9 about as long as 2 or 3 abdominal segments. Hastisetae as in fig. 189b. Epipharynx with 4 sensory papillae as in fig. 213). ..... **granarium** Everts (p. 56)

Synanthropic. Mainly imported. One of the most serious storage pests, in hot conditions. Previously a serious pest in maltings and granaries in England, but rarely occurs now and is probably no longer established in Britain. A few records occur, mainly from S. England, on stored grain, cereals, oilseeds etc. Ireland.

— Antennal segment 2 without setae (figs 283, 286). Abdominal tergite 8 with antecostal suture (see fig. 192) present and continuous (except at median longitudinal line) 3

3 Tergites creamy yellow to light brown, without darker areas. Abdominal tergite 1 with very sparse, stout erect smooth spinulate setae forming a single median transverse row, not usually occurring near median longitudinal dorsal line (fig. 289). Posterior fringe of stout setae on prothoracic tergite very sparse (compared to anterior fringe). Posterior fringes on other tergites consisting mainly of fine spinulate setae with very few stout setae. Tergites (except for apical 3 or 4) with very sparse hastisetae on disc. Hastisetae as in fig. 189c. Epipharynx with 6 sensory papillae ..... **inclusum** LeConte (p. 56)

Synanthropic. Usually on imports such as rice, flour, cottonseed, dried fruit etc. Occasionally found in manufacturing premises, but is only a minor pest.

— Tergites usually dark brown (in teneral specimens creamy yellow with darker sides or with indistinct darker patches). Anterior abdominal tergites with very dense, stout erect spinulate setae forming 2 or 3 confused transverse rows and occurring quite close to median longitudinal dorsal line (fig. 290). Posterior fringe of stout setae on prothoracic tergite very dense (almost as dense as anterior fringe). Posterior fringes on other tergites consisting of many stout and fine setae. Most tergites with fairly dense hastisetae (fig. 189). Hastisetae as in fig. 189d. Epipharynx usually with fewer than 6 sensory papillae (fig. 213). (Head dark brown, often with darker patches. Apical tergites lighter in colour particularly where the hastisetae emerge. Acrotergites usually distinctly sclerotized and brown.) . . . . . **glabrum** (Herbst) (p. 55)

Synanthropic. An import only. On products such as rice, flour, cottonseed meal, grain. Not a very important pest, but is able to produce severe infestations.

Genus **Reesa** Beal

— A single species. Light brown. Similar to *Trogoderma*, but without setae on acrotergites (fig. 291) and with pretarsal setae subequal (fig. 201). Length about 6.5 mm. See also generic key . . . . . **vespulae** (Milliron) (p. 57)

Synanthropic. Rare, a recent introduction. N. and S. England. Scotland. Pest of insect collections and plants, particularly seeds. Out-of-doors, London.

Genus **Globicornis** Latreille

— A single British species. Similar to *Trogoderma*, but with antennal segment 2 about twice as long as 3 (fig. 205), anterior parts of most tergites darker brown and pretarsal setae equal. See also generic key . . . . . **nigripes** (Fabricius) (p. 58)

Very rare, an endangered species. S. England. Under loose bark and in old decayed wood. Not synanthropic.

Genus **Megatoma** Herbst

— A single British species. Similar to *Trogoderma*, but with dark brown patches at sides of thoracic tergites (fig. 188). For other characters, see generic key. Length 5–10 mm. . . . . **undata** (Linnaeus) (p. 59)

Fairly widespread. Mainly S. England, but also the midlands, the north, Wales and Scotland. Under bark and in wood (particularly of dead trees), in nests or burrows of other insects, in spiders' webs.

Genus **Anthrenocerus** Arrow

— A single British species. Similar to *Globicornis*, but thoracic tergites, at least, not darkened anteriorly and pretarsal setae unequal. See also generic key . . **australis** (Hope) (p. 59)

Synanthropic. Rare (introduced). Mainly S. England, but also as far north as Durham. Scotland. In commercial or domestic premises and occasionally imported. Not an important domestic pest. On woollens, hair, stored food products etc. Only 1 outdoor record.

Genus **Orphinus** Motschulsky

— A single species likely to be found in Britain. General appearance similar to that of *Trogoderma*, but with a small but distinct median anterior tubercle on frons, and hastisetae emerging from membranous areas on some of the abdominal tergites. Length about 5 mm. For other characters, see generic key . . . . . **fulvipes** (Guérin-Méneville) (p. 60)

Synanthropic. Rare. An occasional import only, on commodities such as nuts, cocoa beans, flour, rice and ginger.

Genus **Ctesias** Stephens

— A single British species. Body sub-oblong but constricted at abdominal segments 1–3 and with very long tufts of hastisetae on membranous areas of abdominal tergites 4–7 (figs 186–187). Length about 7.0 mm. For other characters, see generic key ..... **serra** (Fabricius) (p. 60)

Widely distributed throughout most counties in England, extending north to Cumberland and west to Somerset. Wales. Scotland. Under loose webby bark or in rotting trees, in insect galleries and around spiders' webs. In old parks, ancient woodlands etc.

Genus **Anthrenus** Müller

Key to species

1 Abdominal sternites sclerotized, often appearing a shiny very pale yellowish-brown. Body often with broad dorsal median longitudingal lighter band. Spinulate setae (sometimes also tergites) dark brown or black (fig. 184). Heads of hastisetae of caudal tufts either broadly triangular (fig. 279) or very elongate and constricted near middle (figs 280, 281). Body hastisetae with small cylindrical heads (fig. 281b) 7

— Abdominal sternites entirely membranous, unpigmented so appearing white. Body without dorsal longitudinal lighter band, at most with fine dorsal line. Spinulate setae and tergites yellowish-brown to dark brown. Heads of hastisetae variable but rarely as above (figs 273–278) 2

2 Abdominal tergite 5 (first one with caudal tufts) without an antecostal suture on disc, occasionally with vestiges of one laterally and medially (fig. 191). Tergites either a uniform shade of brown or varying from very light to darker brown or greyish. Basal antennal segment without setae (figs 265–266) 3

— Abdominal tergite 5 with fine antecostal suture (very faint in *olgae*), best seen from the side as a weak ridge. Tergites uniformly light brown. Basal antennal segment almost always with setae (figs 267–270) 4

3 Tergites unevenly pigmented, light and dark brown or greyish: pronotum and at least sides of meso- and metathoracic tergites and abdominal tergite 5 dark reddish-brown or grey. Abdominal tergite 1 usually light coloured; 2–4 usually pale on disc, darker at sides; 6–7 dark, at least laterally (figs 183, 185). Head light brown even when tergites are dark. Abdominal tergite 5 sometimes with a remnant of the antecostal suture laterally, anterior to caudal tuft; its posterior emargination symmetrically and broadly curved and extending about half the width of one side of tergite, much more extensive than that on tergite 6 (fig. 191). Hastisetae as in fig. 273. Length 4.0–4.5 mm ..... **verbasci** (Linnaeus) (p. 61)

Synanthropic. The commonest pest species of the genus in Britain, well-known as a domestic pest, particularly in S. E. England. A native, long-established species. Wales, Scotland, Ireland (1 record). Usually a pest of woollen goods or museum collections, but occasionally (rarely) of stored food products. In the wild, found in nests of birds, insects and mammals, often in or around habitations. Occasionally imported.

— Tergites evenly pigmented, brown. Abdominal tergite 5 without traces of an antecostal suture; its posterior emargination asymmetrically curved, similar to 6. Hastisetae as in fig. 274. Length 3.3 mm. (only 1 specimen examined) ..... **coloratus** Reitter (p. 65)

Synanthropic. An occasional import. Not established in Britain. S. E. England: 2 recent records, in museum.

4 Antennal segment 2 elongate; length more than 5 times width at narrowest part (fig. 270). Body large. Hastisetae as in fig. 275. Length 5.0–6.0 mm **sarnicus** Mroczkowski (p. 65)

Synanthropic. Rare (introduced). England: London, Kent, Lancashire, Middlesex, Wiltshire. Scotland. In private houses, commercial premises and museums. A pest on woollens and bird, mammal and insect collections. In birds' nests (sparrow, pigeon).

— Antennal segment 2 less elongate: length less than 5 times width at narrowest part (figs 267, 269). Body smaller 5

5 Tergites light brown or yellowish. Coxae without dark patches. Antennal segment 2 about 3 times width at narrowest part (figs 267–268) 6

— Tergites dark brown. Coxae with distinct dark patches. Antennal segment 2 about 4 times width at narrowest part (fig. 269). (Setae very long and fine, dark on disc of tergites, but paler laterally and towards head. Head dark brown. Hastisetae as in fig. 266). Length about 4.0–5.0 mm ..... **museorum** (Linnaeus) (p. 64)

Occurs in the wild in England, mainly the south-east, but a few records from northern, western and midland areas. Wales. Rural distribution, in accumulations of dead insects near spiders' webs. Rarely a pest.

6 Spinulate setae on tergites mainly fine, long and light-coloured, particularly laterally. Head usually darker than tergites. Setae on basal antennal segment varying in number from 0 to 3, usually fairly short (fig. 267). Hastisetae as in fig. 277. Length about 3.0–4.0 mm .. .. **fuscus** Olivier (p. 64)

One of the commonest British species. Widespread throughout England, but commonest in the south. Wales. An outdoor, principally rural species, rarely a pest. Mainly around spiders' webs, or in nests of insects and mammals. In outbuildings, sheds, barns etc.

— Spinulate setae on tergites mainly short, stout and black. Head light yellowish-brown. Setae on basal antennal segment usually 2 in number and very long and stout (fig. 268). Caudal tufts and heads of hastisetae on tergites black, strongly contrasting with the light brown tergites. Hastisetae as in fig. 278. Length about 3.7 mm ..... **olgae** Kalik (p. 65)

Synanthropic. Rare, a recent introduction. S. E. England (2 localities), in house and museum.

7 Heads of hastisetae of caudal tufts not more than 4 times the length of preceding segment (fig. 279). (Tergites dark brown or black, often with a broad light longitudinal stripe) ..... **pimpinellae** Fabricius (p. 63)

Synanthropic. An import only. Not a major pest. Found on dried fish, woollens, horse-hair, stored products etc.

— Heads of hastisetae of caudal tufts very long, at least 6 times the length of preceding segment (fig. 280–281). (Anterior abdominal tergites with numerous hastisetae of a different kind (fig. 281(b)). Antennal segment 2 five times as long as broad and five times as long as apical segment (figs 271–272). Dorsal setae very long and dark chocolate brown (fig. 184)) 8

8 Heads of hastisetae of caudal tufts about 0.17 mm. long, about 12 times as long as basal width (fig. 280) ..... **scrophulariae** (Linnaeus) (p. 63)

Synanthropic. A rare import only. England, Wales, Scotland. Mainly on animal products.

— Heads of hastisetae of caudal tufts about 0.10 mm. long, about 8 times as long as basal width (fig. 281). (Body with broad light median longitudinal band dorsally.) .... **flavipes** LeConte (p. 62)

Synanthropic. An import only. A pest on various animal materials e.g. wool, bones, fur, feathers, but has also been known to damage vegetable products e.g. paper.

Genus **Trinodes** Dejean

— A single British species. Greyish, with long, stout, erect, black setae (figs 177–178). Length about 3 mm. For other characters, see generic key ..... **hirtus** (Fabricius) (p. 66)

Rare, recent records from S. and E. England only. In or near spiders' webs, under loose bark, in old decayed wood. Not synanthropic.

Distribution and biology of Dermestidae

Detailed locality lists are given only for the rarer species. When Wales, Scotland and Ireland are not mentioned, this is because no records have been obtained for them.

Genus **Thylodrias** Motschulsky

Thylodrias contractus Motschulsky (the Odd Beetle) (figs 4, 5). This species has been recorded from Canada, USA, the Hawaiian Islands, Egypt, Germany, Italy, N. Russia, Finland, Sweden, Denmark, Trieste, Astrakhan, Transcaucasia, the Turkmen SSR, the Uzbek SSR. Its country of origin seems to be somewhere in Central Asia.

It is synanthropic which explains its scattered distribution and is a fairly frequent immigrant to Britain although not established here. Three larvae have been found in the BMNH, London, in letter files, far from any possible food source, and in the Lichen Section of the Botany Department (1984, 1985, 1986). A live adult female was found on a desk in the Manchester Museum (Hincks, 1950), probably introduced in a parcel from abroad. A larva was sent into the BMNH from Kent: Sidcup, in 1985, from a cargo.

Although it has been seen only rarely in Britain, it has potential pest status here as it has recently become a very serious pest of insect collections in the Zoological Museum in Finland (Hämäläinen & Mannerkoski, 1984) and has been recorded in private insect collections in Helsinki. It has also been established there as a household species since 1977. In domestic premises, larvae have mostly been seen in dust under floors, on walls, in crevices and cracks and feeding on dead insects and other organic material. In some countries it has been known to infest stored products and to feed on animal matter or materials containing animal protein. It has caused considerable damage to silk clothing in a shop in the USA and has been found in foodstuffs and in private houses in Italy. Both the adults and larvae are harmful to commodities although the larval damage is more important.

The life-cycle may take about a year, but the larvae are said to be able to live for three or four years without food.

Genus **Thorictodes** Reitter

Thorictodes heydeni Reitter (fig. 7). This species has been recorded from a wide range of countries including Egypt, Algeria, France, Spain, Turkey, Africa, India, Pakistan, Java, Burma, USA, Guadeloupe, S. Mariana Is and Mexico. It is occasionally introduced into Britain in cargoes of food.

It is a pest of stored cereals and their products and has been brought into Britain in cereals, oilcake, rice, pulses, bones, fishmeal etc. It was intercepted in Britain as early as 1925 in Worcestershire and later in London. The adults of the species have been seen to feed on broken wheat grains and the larvae on wheat flour or the small fragments left after the feeding of other insects (Chatterji & Sarup, 1959). The earliest known specimen was found in a plant gall which had been buried for 2,000 years in Egypt (Van Emden, 1951).

At 27°C. and 65% R.H. the life cycle takes 45 to 55 days.

Genus **Dermestes** Linnaeus

Dermestes spp. (hide beetles) feed on animal matter or material containing animal proteins which are necessary for their full development. They are carnivorous but also partly predacious and cannibalistic. Both the adults and larvae feed on the same substances but most of the damage is usually done by the larvae. A high humidity is necessary for pupation.

In natural conditions they are found in nests of birds (chiefly sparrow), where they feed on insect remains, feathers, dead birds etc., or nests of insects (e.g. bees and wasps), where they feed on the dead bees and wasps and possibly also on honey and pollen. They are also found on dead and partly dried bodies of fish, birds and mammals. They have been known to attack live moth eggs and caterpillars and, when present in sufficient numbers, the larvae have been known to attack live ducklings, young pigeons and chickens.

Under artificial conditions some species of *Dermestes* are serious pests of stored products or cargoes and have been known to attack the following products:- skins,

furs, leather, bones, dog-biscuits, dried fish, horns, feathers, bristles, glue. Preserved specimens and evidence of damage have also been found in Egyptian mummies.

Dermestes spp. can cause immense damage, not only by feeding on commodities but by soiling them with their faeces and cast skins. Much damage is also done by mature larvae which will bore into almost any nearby compact substance in order to construct a pupal chamber. In this way they have seriously damaged materials they do not use for food, e.g. woodwork, plastic insulating materials, fibreboard, cork, books, cardboard, stored tobacco, tea, linen, cotton, woollens, salt, sal-ammoniac, plaster moulds, flexible asbestos, lead of fuses and cables, mortar and stonework of walls.

Some species of *Dermestes* (e.g. *D. maculatus*) are of use for cleaning skeletons in museums (Hall & Russell, 1933; Meeuse, 1965). They completely remove the flesh from the bones without destroying delicate structures. They have also been found useful in estimating the ages of corpses as they are first attracted to them after 3–6 months (Smith, 1986) when the latter are in the third or butyric stage of decomposition. In nature they assist in the destruction of animal remains.

Dermestes maculatus De Geer (Leather, Hide, or Skin Beetle) (fig. 21). Cosmopolitan.

This is the commonest species of *Dermestes* found in cargoes imported into Britain (Aitken, 1975). Most infested imports are from the Oriental Region, followed by the Neotropical and Ethiopian Regions; by far the largest number of records is from animal products. Although it is has been found out-of-doors in Britain, it can only survive during the mildest winter conditions in this country (Solomon & Adamson, 1955) and probably relies for its survival on artificial heating in buildings (Bezant, 1965). It has not become a household pest here although it is a pest in some commercial premises.

In Britain it is found comparatively rarely in the wild, but when it occurs there it is often in large numbers. It certainly seems to have become established here, in spite of its intolerance to cold. *Records gathered are as follows*:- Bedfordshire: Northill, 1945 (MacKechnie Jarvis); Berkshire: Windsor Forest, viii. 1936, in numbers on old oak and in carcases; Cheshire: Macclesfield, Walker Barn, 1935; Hampshire/Surrey: Deadbrook Farm, viii. 1941–43, in carrion (Duffy); Huntingdonshire: Monks Wood, 1968 (Welch); Kent: Darenth Wood, on dead dog, 1966 (Philp), Swanley Wood, iv–vi, 1933, in dead bird, Farningham Wood, iv. 1933, in carcases, Hoo Peninsula, vii. 1954, in sheepskins hung over rails (Allen); Lancashire, on carrion on shore, before 1908 (Dutton *et al.*), common and widespread before 1930 (Lawson, 1930); London: South Kensington, v. 1952, in grounds of BMNH, Stoke Newington, ii. 1988, in moss (Jones); Oxfordshire: Marston, iv. 1949, on dry carrion trap and under dead hedgehog; Somerset, before 1906; Suffolk: Lowestoft, 1897, Thetford Heath, ix. 1981, in dry rabbit (Mendel); Sussex: Newhaven, v. 1984, in dead sea bird at bottom of cliffs (Hyman); S. E. Yorkshire, vii. 1948, on porpoise (J. S.), also records by Donisthorpe and Moore. *Some of the following records may refer to outdoor localities but are without bionomic data so this is not known*:- Cambridge, 1914; Durham: Newcastle (Bold); Kent: Isle of Sheppey, Maidstone, 1984; Leicestershire, vii. 1905; London, v. 1860; ii. 1884; vii. 1962; Northumberland: Twizzell, before 1871 (Selby); Oxfordshire, iv. 1924; Surrey: Esher; Sussex: Gatwick, 1986; Yorkshire: Dewsbury, iii. 1938.

The following were *imports* intercepted at:- Aberdeenshire: Aberdeen, 1931; Cumberland: Carlisle; Kent: Crayford, vii. 1943, 1953, Sidcup, 1985; London, x., xii. 1935; v. 1936; 1983; 1986; ix., x. 1987; Sussex: Littlington; Warwickshire: Coventry, ix. 1931; Yorkshire: Leeds, vii. 1953, The following records are from *commercial premises*:- Cheshire: Acton Bridge, 1919, in bone-crushing works; Chilterns, x. 1986, in deep pit poultry house (since 1975, it has been found in 48 deep pit poultry houses from Northumberland to Hampshire, with a few sites in E. Wales (Jefferies), also in 2 piggeries); Devon: Exeter, before 1867, in bone mill, Cullompton, x. 1987, in plant

dealing with waste from poultry processing; Kent: Isle of Sheppey, x. 1893, in bone house honeycombing woodwork, Queenborough, ix. 1905; x. 1914, in glue and chemical works, Tunbridge Wells, 1986; Lancashire, in skin yards, before 1908; London, iii. 1900, soap factory in bone store, swarming and damaging roof timbers; Nottinghamshire: Retford, in bone works, before 1916; Sussex: Alfriston, in bones factory. Wales and Scotland: see above. Ireland: Antrim: Belfast, before 1902 (Orr); Dublin Docks, in tobacco, 1927 (O'Mahoney).

D. maculatus is known to feed on a wide variety of animal materials with a high protein content e.g. fur, hide, bones, carcases, skins, ham, bacon, egg albumen, cheese, dog biscuits, dried fish (not salted) etc. Animal material is an essential constituent of its diet. It cannot be reared on wheat germ alone (Woodroffe, 1965). The larva of the species is notorious for boring into substances on which it does not feed in order to construct its pupal chamber. Because of this habit it has caused immense damage to materials such as timber, cork, plaster, lead, linen and cotton. It has been found to be of great use in museums for cleaning skeletons (Meeuse, 1965).

For the life cycle see Hinton (1945); Bellamare & Brunelle (1950); Paul *et al.* (1963); Azab *et al.* (1972a). The length of the life cycle may be as short as 3 weeks or as long as several years, depending on the conditions. The most rapid development occurs at about 28° to 30°C. Access to food and water is essential for egg-laying. There are usually from 5 to 6 overlapping generations a year. The life span of the adult is from 40 days at 28.2°C. to 189 days at 21.5°C.

Copulation takes place several hours after emergence; eggs are deposited in darkness, usually in crevices; females may lay from about 13 to 650 eggs depending on temperature; the incubation period is from 2–10 days; the larval period is from 24 days (at 32°C.) to 96 days (at 19.4°C.); larva becomes quiescent for 2–11 days prior to pupation; pupal period is from 5–33 days (Azab *et al.*, 1972a,b).

Dermestes frischii Kugelann (fig. 22). This species is widely distributed throughout the warmer regions of the world and is frequently imported into Britain. Most infested imports are from the Oriental Region, followed by the Australasian, Ethiopian (=Afrotropical) and Neotropical Regions and the Mediterranean area. The largest number of records is from animal products.

It is the third commonest species of the genus to be imported (Aitken, 1975). It is sometimes found in commercial premises, but is not known as a household pest. It has very rarely been found out-of-doors here, although the larvae are able to survive winter conditions (Solomon & Adamson, 1955). The (sometimes presumed) *outdoor* records are as follows:- England: Hampshire: New Forest, 1862 (Crotch), Hampshire/Surrey, Deadbrook Farm, 1941–43, in carrion (Duffy); Kent: Pegwell Bay, 1872 (Sharp), Port Victoria, 1948, in dead bird (Allen); Surrey: Forest Hill, 1869 (Champion); Yorkshire: Scarborough, 1869 (Wilkinson). Scotland: Corstaphine Hills, 1865 (Sharp): Aberlady, 1866 (Sharp).

Records from *imports or commercial premises* were discovered in:- Cheshire: Acton Bridge; Cumberland: Silloth, 1953; Kent: Queenborough, 1920; Lancashire: before 1930, Blackburn, 1983; London 1952–1987; Surrey: Croydon, 1986; Yorkshire: Hull. This species was found, in Bristol in company with *Dermestes leechi*, in the inner wrappings of a 3000 year old Egyptian mummy (Strong, 1981). Ireland: Dublin Port, in Nigerian cacao beans, 1951 (O'Mahoney).

Like *D. maculatus*, *D. frischii* needs animal material in its diet and cannot be reared on wheatgerm (Woodroffe, 1965). Similarly its larva is notorious for boring into substances on which it does not feed, in order to construct its pupal chamber. In this way it has damaged timber, cork and mortar and cloth bales. It has been imported into Britain in carcases, bones, bone meal, skins, dog biscuits, cuttle fish shells, ispaghula husks and cacao. It has been found associated with smoked meat, carrion, dried fish, etc.

For the life cycle see Amos (1968). Amos found that the shortest life cycle was 26 days at 35°C. and 90% R.H., but the highest survival rate was at 25°C. and 75% R.H. Development was possible within the range 20° to 35°C. and from 30% to 90% R.H. Salt in the diet retards development, reduces oviposition and increases mortality, hence salting and drying helps preserve fish against attack from this species. The adults live for about 10–55 days at 30°C.

Dermestes carnivorus Fabricius (fig. 23). According to Mroczkowsky (1968) this species is almost cosmopolitan. Hinton (1945) gives its distribution as N. and S. America, Europe, India. Aitken (1975) records it also in imports from Burma, Thailand, Pakistan and S. Africa.

As far as is known it is not found in the wild in Britain. Its records are:- England: Coventry, vii. 1931 (Donisthorpe), ix. 1931, pupae in piece of American ash wood (Saunt); London, before 1931, sometimes found in numbers in meat stores etc. Ireland: Dublin, in dried fish air bladders from Hong Kong. It has been imported into Britain in both animal and vegetable commodities. It is a casual import, certainly not as frequently imported as the two preceding species. It has been recorded on hides, bales of dried skins, dried fish, fishmeal, bones, brazil nuts, grain residues, oilcake, groundnut cake, in bales of raw tobacco (larvae, which possibly could have been in this product in order to pupate) etc.

Dermestes murinus Linnaeus (fig. 25). This species is found in Europe (including Britain) and the USSR.

In Britain this species is not synanthropic (except for a record from a bone crushing works in Cheshire (Tomlin, 1920), although in other countries it has shown synanthropic tendencies; it is not considered to be of economic importance nor is it often imported in stored products. In England it lives out-of-doors and is fairly common and generally distributed in rural areas, often occurring in large numbers on dead animals and birds e.g. squirrel, rabbit, mole, rat, fox, stoat, rook, magpie, gull, pheasant, kittiwake, puffin, fulmar and crow. Records indicate that it is widespread throughout England:- from Kent and Sussex to Devonshire, then northwards from Herefordshire to Lancashire and Durham and south again to Norfolk, Suffolk and Essex. Wales: Glamorgan, Merionethshire, Pembrokeshire. Ireland: Antrim: Belfast; Dublin. BMNH records are from 1856 onwards. The species is found from March to October but is most plentiful in May and June.

In Italy it has been recorded in houses, warehouses and museums, and as a pest of silkworm cocoons. It is recorded as being associated with stored products in the USSR but not as an important pest. It has been recorded in Germany in hides, skins and furs. In Finland it is a fairly common native species and the following useful information is recorded by Hämäläinen & Mannerkoski (1984). It lives on carrion of mammals, birds and fish, which can be in different stages of decay, from fresh to very old, with little more than bones left. The larvae are also found in the nests of predatory birds where they feed on prey remnants and they have been observed to pupate on bark at the base of pine trees. Only exceptionally has the species been found indoors in Finland and in one case is reported to have damaged food and clothing. Adults are observed throughout the summer there, but mainly in May and June and larvae are recorded from mid-summer to autumn. Larval development is completed during the summer in Finland and the beetles spend the winter in hibernation.

Dermestes undulatus Brahm (fig. 26). This species is distributed throughout the entire Holarctic Region (Mroczkowski, 1968). It has very occasionally been found on stored products abroad (USSR, Germany), but is not a pest species in Britain.

It lives in the wild in England, but is now very rare, although, according to Mendel (pers. comm.), it is not uncommon along the Suffolk coast. It is found on dead animals e.g. rabbits, fish, shellfish, birds. Records are almost exclusively from localities on the

south and south-east coast of England:- Suffolk: Aldeburgh; Bawdsey, 1980 (Mendel); Brandon; Felixstowe, 1987 (Williams). Essex: Southend. Kent: Deal; Dungeness, 1961 (Halstead), 1968 (Clarke); Folkestone; Isle of Sheppey; Whitstable. Sussex: Brighton; Camber; Eastbourne; Hove; Pevensey; Rye; Shoreham. Hampshire: Hayling Island, 1968 (Jerrard); Isle of Wight; New Forest. Dorset: Charmouth: Chesil Bank/Beach; Morden; Portland; Weymouth. Devon: Seaton; Slapton. Wales: Swansea, before 1829 (Dillwyn) and before 1913 (Tomlin). The first record of this species in the BMNH collection is 1866 and the last 1968, the above mentioned records being before 1940 unless otherwise stated. However, it has been collected as recently as 1987 (Allen, pers. comm.). It is found between March and September, but most records are for April.

Dermestes lardarius Linnaeus (the Larder or Bacon Beetle) (fig. 27). This species has a cosmopolitan distribution (Mroczkowski, 1968).

It is occasionally imported, but is a native of Britain and used to be regarded as the principal pest species of the genus in this country. In recent years, however, it has been superseded, particularly around the London area, by *D. peruvianus* and *D. haemorrhoidalis*. It is widespread throughout England. Although commonest in the south of England, around the London area, it is found more frequently in the north and Scotland than the two above-mentioned species. Wales: Swansea, Cardiff, before 1913. Ireland: Antrim: Belfast; Fermanagh: Tempo; Dublin, before 1900. Recent records in Dublin are from houses, shops, restaurants, a bakery, a chocolate factory, in biscuits, cooked in curry and pupating in chocolate (O'Connor, 1981, 1984, pers. comm.). It is only a minor household pest, but is a nuisance in warehouses and food premises, especially butchers' shops, whereas *D. peruvianus* and *D. haemorrhoidalis* are mainly found in private houses, offices, hotels, hospitals etc. invariably associated with canteens or kitchens (Edwards, 1976). It has also been recorded as a pest in deep pit poultry houses (Jefferies, 1979; Armitage, 1986) and a survey of these showed that it was causing damage to wooden pillars, and was also in pigeon lofts above.

Both adults and larvae of this species will feed on almost any animal substance which is dry or in the process of decomposition, but unlike most other synanthropic species of *Dermestes* it can survive on vegetable materials and is the only species of the genus which has been successfully reared on a diet of wheat germ alone (Woodroffe, 1965).

It has been known to damage skins, furs, bones, hair, leather, dried fish, fish meal, horn, feathers, bacon, ham, sausages, cheese, dog biscuits, silk worm cocoons and also, as is the case with the other pest species of the genus, has damaged materials on which it does not feed in order to construct its pupal chamber e.g. timber, cork, vegetable fibres, books (Verdcourt, 1982, Hickin, 1985), lead and mortar. In warehouses and on vegetable materials, it probably maintains itself partly on the remains of dead insects. Abroad, it has damaged insect and mammal collections (Hämäläinen & Mannerkoski, 1984).

In the wild it is frequently found in large numbers in wet birds' nests e.g. pigeon (Woodroffe, 1961; Hockin, 1980; Armes, pers. comm.) which often provide access to domestic or commercial premises. It has also been found in bat dung in an attic. The larvae have been known to kill young pigeons, chicks and ducklings. They are also found on corpses (e.g. hedgehogs, moles, jackdaws) and in wasps' nests and are cannibalistic, a factor which reduces their numbers in certain circumstances. Both adults and larvae are seen at all times of the year, although adults are most commonly seen between May and July.

In temperate climates there is usually one generation a year. The life cycle is dealt with in detail in Hinton (1945). The optimum temperature for development is 18°–20°C. and in favourable conditions the life cycle can take from 2 to 3 months between 18°–25°C; 30°C. is near the upper limit for complete development (Jacob & Fleming,

1981). These authors discovered that although a few viable eggs may be laid without access to water, water is necessary for good egg production and long adult life. The adults live from a few weeks to a year or more. Their active life under laboratory conditions can be up to 280 days (Jacob & Fleming, 1982). Out-of-doors or in unheated buildings the winter is passed in the adult stage in hibernation. In spring and summer the adult becomes active and flies.

Dermestes leechi Kalik (fig. 50). Its distribution is:- India, USSR, Egypt, Sebayir I., Pakistan, Scotland (imported).

In 1978 a single specimen was imported to Scotland (Glasgow) from Pakistan (Karachi) in bone grist (Adams, 1980). This is the first British record and also the first record of the species occurring in stored products. It has also been found preserved in the untouched inner wrappings of a 3,000 year old Egyptian mummy in the Bristol Museum (Strong, 1981), although it was thought at the time to be *D. ater* and was later reidentified by Adams (pers. comm.). The larvae and cast skins were in the flesh of the mummy and the adults in the wrappings. The bandages showed tunnelling near the body, but there were no holes or traces of beetles in the outer layers of bandages.

In the USSR *D. leechi* has been found in burrows, on dry corpses of small mammals and in birds' nests (Zhantiev, 1976; Adams, 1980).

Dermestes ater De Geer (fig. 24). This species is cosmopolitan, according to Mroczkowski (1968), but although it is very widespread throughout the world – N. America, Germany, USSR, Egypt, Seychelles, Hawaii, East Indies, New Guinea, the South Seas, Japan, Australia, Ghana, Jamaica – it is not normally found in Britain, except on imports.

It is a pest species which is regularly imported to Britain from the tropics but is not established here. A brown variety was common in domestic premises in Finland from 1900 to 1939 especially in dwellings where the cockroach *Blattella germanica* (L.) occurred (Hämäläinen & Mannerkoski, 1984), perhaps indicating that this species could become established in the U.K.

Apart from *D. maculatus* this is the commonest species of *Dermestes* found on imported cargoes (Aitken, 1975). Ministry Records between 1957 and 1969 showed that it was imported mainly on copra and cocoa beans (Aitken had evidence to suggest that a cross infestation from copra to cocoa had taken place in these cases), but rarely on animal products. It therefore differs strongly from *D. maculatus* and *D. frischii*, of which the reverse is true. It was mainly imported fom the Australasian and Oriental Regions. Recent records are Suffolk: Ipswich, 1979 (H. Mendel), associated with copra from the Seychelles, and Derbyshire where it was seen feeding on dead cockroaches in a breeding colony of cockroaches. The food material had been obtained from abroad. Wales: Cardiff, in ship. Ireland: Dublin Docks, in cacao beans from the Gold Coast, 1950 (O'Mahoney) and Nigeria, 1950 (J. W. Moore).

This species is known to feed on all kinds of materials of animal origin e.g. smoked meat, dried fish, bones, hides, skins, cheese etc. as well as being capable of predation on other insects. It has also been imported on tobacco, egg albumen and butter beans. Woodroffe (1965, 1966) was partly successful in rearing it on wheat germ; the apparently normal adults obtained laid few eggs most of which failed to hatch and the one or two larvae produced soon died on this diet. He grouped *D. ater* with *D. peruvianus* and *D. haemorrhoidalis* as being partially successful at breeding on a vegetable diet. The Ministry Records above suggest that the species feeds on copra although it may, in this instance, also be feeding on dead insects. In tropical countries it has been found in the wild on carcases of birds, mammals, fish and crabs.

At 27°–28°C. on a diet of fish meal with drinking water, the life cycle takes about 6 weeks. The absence of drinking water retards larval development (Roth & Willis, 1950).

Dermestes haemorrhoidalis Küster (the Black Larder Beetle, or Hide Beetle) (similar in appearance to *D. peruvianus* (fig. 28), but with longer, darker pubescence). This species is distributed throughout most of Europe. Ministry Records between 1957 and 1969 show that it has been imported into Britain in cargoes from Argentina, Peru, South Africa and Portugal in bone meal, fish meal and skins (Aitken, 1975). It has been recorded in a tannery at Wigan in skins imported from Sweden (Bezant, 1963) and in the cargo hold of a ship from Penang (BMNH records). It is a household pest in Denmark (Hämäläinen & Mannerkoski, 1984). As it was formerly confused with *D. peruvianus*, its geographic range is not known for certain although it seems to be widespread.

In Britain it was first found in Liverpool in 1905 (misidentified as *D. peruvianus*) (Peacock, 1976) and in 1932 more examples were found in London, so it seems to have been here since the beginning of the century whereas *D. peruvianus* is probably a more recent introduction. In England, *D. haemorrhoidalis* is found most frequently south of a line from the Wash to the Severn Estuary, and particularly in S.E. England and around the London area. This is supported by records kept from 1954–1962 (Bezant, 1963) and by the specimens received in the BMNH for identification between 1983 and 1987 (25 records, 18 from London). In the last few years this species and *D. peruvianus* have become more common than *D. lardarius*, particularly in domestic premises (Edwards, 1976 and BMNH records). In Huntingdonshire it has been found infesting museum specimens (e.g. head of a Giant Petrel) (Welch, 1972).

The records of this species having been found in the wild in Britain are few:- Berkshire: Windsor Park, in dried jackdaw hanging in a bush, 1986 (Mendel). Herefordshire: Moccas Park, 1948, in or under a dead bird (Lloyd). Kent: Charlton, at m.v. light, 1987 (Allen). London: Blackheath, flying to light, 1959–1973 (Allen): Shepherd's Bush. Sussex: Brighton, 198?, in fulmar's nest. Bezant (1963) said that there were indications that it might be breeding in pigeons' nests in London. It has been found in wet and dry (mainly the latter) birds' nests, summer and autumn, 1977 (Hockin, 1980). Adults of the species appear mostly in spring and summer.

Madel (1941) deals with the biology of this species. It is usually found associated with animal products although Woodroffe (1965) was partially successful in rearing it on wheat germ alone. It has been found in poppy seeds.

Experiments have been done to show the length of life cycle under variable conditions of temperature and relative humidity (Coombs, 1979; Jacob & Fleming, 1984). The latter authors concluded that 20°C. was the optimum temperature for longevity of adults and egg production, the adults can live actively for up to 327 days at 17.5°C. and the oviposition period is about 7 months at 20°C. They found that eggs did not hatch at under 15°C. or over 32.5°C. and the total development period of the larva and pupa is from 38 days at 30°C. to 104 days at 20°C. Drinking water was given.

Dermestes peruvianus Laporte de Castelnau (Peruvian Larder Beetle, or Hide Beetle) (fig. 28). The distribution of this species is:- Peru, Argentina, Bolivia, Chile, Mexico, USA, Finland (imported), Europe (introduced). Ministry records of imports between 1957 and 1969 (Aitken, 1975) have all been from S. America, from which it is thought the species originated (in fish meal and cottonseed cake). This species was formerly confused with *D. haemorrhoidalis* so its geographic range is not known for certain. Hinton (1945) was unaware that Madel (1941) had distinguished the two species although he suspected two species might be involved owing to the variation in the material he examined.

It is now established in Britain and has become the commonest pest species of the genus in the country. Early records of the species in Britain (Liverpool) turned out to be *D. haemorrhoidalis* (Peacock, 1976), so the first authentic record of it in this country is in 1954 from Yorkshire (Bezant, 1963). Records kept by Bezant (1963) from 1954 to

1962 indicated that the species was more common north of a line from the Wash to the Severn Estuary and *D. haemorrhoidalis* was commoner south of this line. He had most records from Lancashire, others from Yorkshire, Leicester, Glasgow, Birmingham and one from London. Records kept by Edwards (1976) showed the species to be commoner south of a line through Liverpool, Manchester, Barnsley and Grimsby. Of adults received for identification at the BMNH between 1983 and 1987, mainly between the months June to March, 60 out of 67 were from the London area. This could partly be due to the fact that people sent them to be identified locally.

The first authentic record of this species 'in the wild' is:- London, 1980 (South Kensington), larvae found in large numbers in a pigeon's nest in the S. W. Tower of the BMNH in company with *Anthrenus* and other pest species. Adults were subsequently found in numbers during x., xii. 1981, ii. 1982, ii. 1984, in pigeons' nests and guano, on or in buildings in London: SW7 (BMNH, Science Museum, Geology Museum) and WC1, during a survey by N. J. Armes. Large numbers of *Dermestes* larvae were also found on each occasion, but were not identified to species. Records by Allen (1960) were later found to be *D. haemorrhoidalis* (Allen, 1963).

Coombs (1979) has worked on its biology. Earlier biological work could be unreliable due to the confusion of the species with *D. haemorrhoidalis*. It is usually associated with animal products, although Woodroffe (1965) was partially successful in rearing it on wheat germ alone, which shows that it can live on vegetable material.

Coombs (1979) found that eggs of *D. peruvianus* hatched over the range 10–30°C. Development was completed between 15° and 30°C., taking about 300 days at 15°C. and about 60 days at 25°C., 80% relative humidity. The longest lived adult lived for 300 days (provided with drinking water). Few eggs were found except at 20°C. and 25°C., 80% r.h. At 20°C. 75 eggs were laid over a period of 300 days. Coombs suggested that egg-cannibalism is a probable cause of the low productivity of *D. peruvianus* females. He showed that this species and *D. haemorrhoidalis* were able to develop at 25°C. at relative humidities of 40–80% when fed on a diet of fishmeal, wheat-germ, yeast and cholesterol.

Genus **Attagenus** Latreille

During the larval stage most species of *Attagenus* feed on a wide variety of dried proteinaceous materials. The most common habitats for the larvae are birds' and rodents' nests, but they may also be found in bees' and wasps' nests and spiders' webs. Adults usually fly to flowers if they have the opportunity, where they may feed on pollen and nectar, but mating may occur without flight and without feeding or drinking. Successive generations may therefore be produced without access to an outdoor environment. Some of the species of this genus have become household pests in this country, others may be imported in products from abroad.

Attagenus fasciatus (Thunberg) (the Tobacco Seed Beetle) (fig. 65). This species is widely distributed throughout the warmer regions of the world, where it occurs in the field and is also associated with stored products, both in domestic premises and food stores (Halstead & Green, 1979).

It was first found in Britain in Glasgow in 1943 (Hinton, 1943a) in a cargo from India and has since been regularly imported. Between 1957 and 1969, it was the commonest species of the genus to be found on imports (Aitken, 1975). It was found mainly in Indian cargoes, particularly on oilcake and myrobalans and seeds. Other records are from Spain, Egypt, Hawaii, Barbados, Jamaica, Malawi, Nigeria. It is imported in animal and vegetable products, but on the latter it may be scavenging on other insects. There is no evidence to show that it occurs in Britain other than in

imported goods (there are some adults and larvae in the BMNH collection from Ashford, Kent, ix.1969, but they are without bionomic data).

In the tropics it is a household pest, feeding in the larval stage on wool, fur, skins and other material of animal origin and is also found in mills and warehouses where it probably feeds on the remains of grain insects. For biology see Hinton (1945), Patel & Chari (1977).

Attagenus pellio (Linnaeus) (the Two-spotted Carpet Beetle, or Fur Beetle) (fig. 66). Distribution cosmopolitan (Mroczkowski, 1968).

This is the commonest species of the genus in Britain, occurring in the wild and as a household and warehouse pest. It frequently occurs in commercial premises and sometimes causes damage in large clothing stores. It is fairly common throughout Britain and although it is found as far north as the lowlands of Scotland: Fife: Leven, 1843, it is regarded as a pest mainly in the southern half of England and Wales (Parkin & Woodroffe, 1965; Cornwell, 1971). Wales: Llandaff, Swansea, before 1913; Carmarthen, 1983. Ireland: Armagh, Donegal, Dublin, Foyle district, Killarney, Limerick, Tipperary. It is seldom imported.

In the larval stage *A. pellio* feeds on wool, fur, skins, dried insects and other materials of animal origin. It is also sometimes found in warehouses on cereals and other vegetable materials where it may maintain itself partly on the dried remains of other insects (Hinton, 1945). It is able to subsist on food which has become unsuitable for other insects, and has been found to be the sole surviving species in an empty granary after grain insects and vegetable feeders had died out (Coombs & Woodroffe, 1963). In the wild the larvae usually develop in birds' nests (e.g. pigeon, wagtail and jackdaw), where they feed on feathers, droppings and the remains of other insects. Most household and warehouse infestations originate from this source. They have also been collected from bat roosts and dove cotes, where the larvae were feeding on droppings, and from a rotten oak bough. They are often found on or around spiders' webs in farm buildings. The adult beetles fly readily and feed on the nectar and pollen of flowers, although it is not necessary for them to feed in order to lay viable eggs. Out-of-doors they are most common in May but can be seen from March to September. Remains of these beetles have been collected in an archaeological excavation of a pit in London, dated as pre-1740 (Girling, 1984).

Under optimum conditions the life cycle can take as little as 6 months, but under less favourable conditions it can take 2 or 3 years (Parkin & Woodroffe, 1965). The developmental temperature range is between 15° and about 30°C. (Blake *et al.*, 1968). In Sweden pupation takes place in the autumn, the adults emerging after 2 weeks, when they hibernate for the winter months and become active in the spring (Hämäläinen & Mannerkoski, 1984). Adults often live actively for more than three months. As the life cycle usually extends for more than a year, larvae can be found throughout the year.

Attagenus cyphonoides Reitter. Distribution:- Palaearctic, Oriental, Afrotropical and Nearctic Regions (Halstead, 1981).

This species has only been found in Britain on imported products e.g. cottonseed, gum arabic, bones, oilcake and myrobalans. It has been intercepted on imports from Pakistan, Iraq, Egypt, Sudan, Nigeria and India.

In Central Asia it occurs in birds' nests (particularly sparrows'), wasps' and bees' nests and in Kazakhstan it has damaged raw furs and skins, woollen articles, cereal products and zoological collections (Sokoloff, 1973). It has also been found damaging animal products and in residues in farm stores and houses etc. (not in Britain) (Halstead, 1981).

In Central Asia one generation is produced a year. At 22°–25° C., 45–50%, R. H., the fertilized female starts laying eggs 3 days after pupation. It lays 80–90 eggs over 4–5 days then dies shortly afterwards. Larval development takes 6–7 months, the pupal phase lasts 8–10 days, the larva hibernates, pupating in the spring. According to Zhantiev (1976) the adult beetles do not feed.

Attagenus smirnovi Zhantiev. Distribution:- Afrotropical and Palaearctic (introduced) Regions:- Kenya, Ethiopia, USSR, Norway (Ottesen, 1985), Sweden, Finland, Denmark, Britain. It was described in 1973 from the USSR but seems to be indigenous to Kenya where it is known to breed in birds' nests and bats' roosts and where it is also found in residues in farm stores and warehouses. It has also been found in stored products in Ethiopia. It was first found in Moscow in 1961 and has since become a widespread and destructive pest in the USSR feeding on materials of animal origin, mostly those containing keratin (wool products, furs, hides, feathers etc.). It has also occurred in Denmark since 1963. In the Palaearctic Region it is restricted to centrally heated premises.

As far as is known, in Britain, this species has only been found within a small area in and near London. It was first found in 1978 breeding in a flat in Kensington, S. W. London (Peacock, 1979) and has since been found in different flats in the same area from 1980 to 1986. Other records are:- Kent: Chatham, 1980, in building; C. London, 1986, in the Museum of London; Berkshire: ADAS, Slough, 1986; N. London: Islington, 1988, in flat; Bloomsbury, 1989 in nurses' home; W. 14 in the Victoria and Albert Museum store; Middlesex: Harrow, 1989, in house; C. London, 1989. It has also been found in the Entomology Department of the BMNH from 1981–1989 in small numbers. In the latter case the species was living in fluff on the floor although a little damage was done to some dried insects. Indoors the adults were commonest in March and September but were seen throughout the year. Adults were found out-of-doors in the museum grounds in July and August 1983 and June 1984 on or near privet.

According to Zhantiev (1976), the adults do not feed and the larvae feed on dry substances of animal origin.

In the USSR one generation a year is produced in heated premises and flight occurs from April-May (Zhantiev, 1976). Under optimal conditions (24°C., 70–80% R.H.) the life cycle can be completed in 113 days and the adults can live 20 days; under these conditions the life cycle may be as follows: incubation period 10 days, larval period 3 months, pupal period 8–13 days. Females lay an average of 33.7 eggs – maximum 93 (Zhantiev, 1976). The larvae take longer to develop at lower temperatures.

Attagenus unicolor (Brahm) (the Black Carpet Beetle) (fig. 67). This species is widely distributed and is possibly cosmopolitan but the records are often erroneous owing to its confusion with similar species.

It was first recorded in Britain in 1868 but records of established infestations in this country are few, so it is not considered to be a serious pest here. It is found in synanthropic situations. Cornwell (1971) gives 23 records from British premises during ten years, including larvae and adults from private houses. His records were mostly from the Midlands, 1 from Scotland and 6 from South East England. Solomon and Adamson (1955) show that this species is able to survive winter conditions in Britain. It has been recorded from mills in Newcastle, Manchester Liverpool, Oldham, Reddish and Lincoln, a bakery in Edinburgh and in an office building in Bristol where it was found breeding in débris beneath shelving. The BMNH records are from London between 1936 and 1987 from shops, factories, flats and offices. It was recorded, in one instance, to have been breeding on the floor of a printing works in London and feeding on dried condensed milk, biscuits and crumbs. It has also been imported into Britain in various commodities e.g. flour, wheat, oil cakes, bones, beans etc.

This species is a pest in domestic and commercial premises abroad, damaging various commodities including animal products e.g. wool, fur, and skins, and cereal products. It is established in Europe but is not as important a pest as in the USA. In the USSR it has been recorded damaging books (Hickin, 1985). It attacks dried insect collections and other museum specimens and in Japan is a pest of silk worm pupae and cocoons and is a cause of concern to the silk industry. In the U.S.A. it is found in the nests of birds associated with man, particularly sparrow, swallow and house martin and in rodents' and social Hymenoptera nests. Beal (1970) records the species in granaries in the USA, on and under floor boards. He has reared it on dried dog food and oatmeal. The adults feed on nectar and pollen, but successive generations can be produced without access to an outdoor environment. It has been shown to be of use in cleaning tiny delicate skeletons in museums, although it is much slower than *Dermestes maculatus* (Meeuse, 1965).

Adults reared in the laboratory mate and lay fertile eggs without flying or having access to food or water, although access to both increases the number of eggs laid by about 6 times (Howe, 1952a). At 25°C., 70% R.H. the eggs hatch in about 12 days; the larva, if fed on wheat feed, completes its development in about 218 days and the pupa in 13 days. The adult lives about 3 or 4 weeks. The number of eggs laid with no access to food or water is about 24 (Howe, 1952a).

Attagenus brunneus Faldermann (resembles *A. unicolor* in external appearance (fig. 67)). Distribution:- Palaearctic and Nearctic (introduced): Mediterranean Region, USSR, Afghanistan, Britain (recent introduction), Pakistan, USA.

This species has only recently been found breeding in this country, in London, in a carpet in a department store, vi. 1985 and in felt under floorboards in 1986 (a 12 month old infestation).

It has often been confused with *A. unicolor* so past information about its biology is unreliable. Recent records show that it is a minor pest in the U.S.A, the larvae having been found on woollens, in houses and in commercial food stores associated with dried buttermilk, dried milk and peanuts. In the USA the adults have been collected from flowers, on celery and beets and occasionally at light.

It is treated in detail by Beal (1970) under the name *elongatulus* Casey (synonymized by Halstead, 1981).

Genus **Trogoderma** Dejean

Trogoderma glabrum (Herbst) (fig. 123). The distribution of this species is:- Europe, Caucasus, W. Kazakhstan, S. Siberia, USA, Mexico, Britain (imported).

It is only found in Britain on imports. The first authenticated records for Britain were in cargoes from Texas (Bezant, 1956a). Since then it has been occasionally imported on products such as rice, rice bran, flour and cottonseed meal.

It is not such an important pest as *granarium*. In a 12 year survey of grain pests in California it was the least abundant species. However, it is able to produce severe infestations. Although dead insects may form part of its larval diet, it is able to breed and feed on cereal food alone. It can develop on grain and has been collected from stored wheat and shelled corn.

In the United States this species has been found in granaries and sparrows' nests and the larva feeds on dead insects in the wild. In Finland *T. glabrum* is rather rare and has most often been found near human habitations, but it also occurs in the wild. Adult beetles are often found on the outsides of buildings but rarely inside. They fly from June to early August and have been found on flowers and taken in light traps. Larvae are reported to live in the nests of aculeate wasps in wood and in bees' nests (Hämäläinen & Mannerkoski, 1984). *T. glabrum* is regarded as a forest species

throughout the Palaearctic Region, where, apart from living in nests of Hymenoptera, larvae have been found under bark and the adults have been observed feeding on the bleeding sap of deciduous trees (Mroczkowski, 1962). Zhantiev (1976) says that the adult beetles do not feed and that there is one generation per year in the USSR.

Life cycle details are given in Beck (1971a,b, 1972); under favourable laboratory conditions the life-cycle from egg to adult may take 75–85 days at 25°C., 45–60% R.H. At 30°C., 65–70% R.H. about 60–80 eggs are laid, these hatch in about 6 days, total larval period is about 36 days for females, 30 for males, pupal period is about 6 days. The adults live about 4–10 days.

Trogoderma inclusum LeConte (the Large Cabinet Beetle, the Mottled Dermestid [Canada]) (fig. 124). This species is found in N. America, S. and C. Europe, the Mediterranean Region, India, Egypt, USSR (rarely) and Britain (imported).

In Britain it is occasionally found in manufacturing premises and on imports. It is able to feed on animal as well as vegetable material but is generally only considered a minor pest here as it rarely attains sufficient numbers to do serious damage. It has been imported to Britain in flour, rice, rice bran, soya bean meal, cottonseed, carobs, dried fruit, nuts etc.

Hadaway (1956) studied its biology (under the name *versicolor*) and found that it is more restricted in its temperature and humidity range than *granarium* so is unable to breed successfully in the more extreme environments that its relative does. It can develop within the range 20°–40°C. but breeds less successfully at the upper and lower limits. According to Howe (1952a) the larva is very resistant to starvation, being able to survive without food for up to 511 days at 50% R.H. It can also withstand high temperatures, both adults and larvae surviving for at least 6 days at 45°–50°C., R.H. 20–30%. The adult female lives for about 16–30 days (Howe, 1952a). At optimum temperatures (30°C.) the entire life-cycle (egg to adult) may take only 2 months, but there are only 2 generations a year (Grünberg, 1931, cited in Hinton, 1945). Abroad, the species may feed on dead insects in beetle burrows and bees' nests and in the USA it has been found infesting a bee-hive (Beal, 1956).

Trogoderma granarium Everts (the Khapra Beetle) (fig. 88). This species is a native of India, Sri Lanka and Malaya, but has been spread throughout the world through commerce. It has been listed as cosmopolitan, but is now said to have been eradicated from the USA, Mexico, S. Africa and mainland Tanzania and to be absent from Australia, the USSR, E. Malaysia, Ethiopia, Micronesia and New Guinea (Banks, 1977). In Britain it is an import only.

It is mainly imported to Britain from the Oriental and Ethiopian Regions (Aitken, 1975) and will only breed here in heated conditions. Although previously a serious pest in maltings and sometimes recorded from granaries in England, it rarely occurs now and is perhaps no longer established in Britain. The few records gathered from England are:- Berkshire: Slough, ii. 1951 and ii. 1952 (Massee). Kent: Chatham, 1895 (Everts); Rainham, viii. 1990, damaging private insect collection (Armes); Strood, 1917, in granary (Walker). Wiltshire: Salisbury, 1921, in malt brewery. Yorkshire: Leeds, in barley. Ireland: Dublin, 1st record, 1943, larvae in tea chest from India, more adults and larvae since; Limerick; Belfast; Derry, mostly in grain; Cork, in malt bins, 1950 (Mahoney).

In hot dry climates it is one of the most serious storage pests and thrives on vegetable material alone, although it has been known to develop on substances of animal origin. It is unusual among the Dermestidae in being an important pest of stored grain and can also attack a wide range of cereals, oilseeds and their derivatives. The species lives in ships' holds, where there may be long-established infestations, and in grain stores. It is able to live in very hot, dry conditions, unfavourable to many insects, which contributes to its importance as a pest. It is able to breed in the core of infested sacks where it can multiply unseen and unsuspected (Howe 1958b).

Hadaway (1956) found that breeding was possible between 21° and 40°C. and that the species could breed in a relative humidity as low as 2%. Burges (1957) found that at 30°C., 70% R.H., and a diet of wheatfeed, the average life cycle was 39 to 45 days. Below 30°C. the life cycle may be greatly prolonged as the larva enters diapause, in which state it can survive for long periods (8 years has been known), in adverse conditions. The larvae frequently leave their food and hide in crevices in the walls of food stores so that they can later infest new produce (Burges, 1957).

Trogoderma variabile Ballion (Warehouse Beetle [Canada]) (fig. 125) is probably indigenous to Central Asia (Thompson, 1978) but is now virtually Holarctic, being found in the USA, Canada, Mexico, southern Europe, Finland, C., S. and W. Asia, Saudi Arabia, N.W. China, Mongolia, USSR and Britain (introduced).

It was first recorded in Britain in a grain processing factory in Greater Manchester and seemed to have been imported from the USA (Thompson, 1978). It was subsequently found with *T. inclusum* infesting the premises of a British milk powder manufacturer and, more recently, was discovered infesting a bird skin and an ungulate skull of N. American origin in the Royal Museum of Scotland, Edinburgh (Shaw, pers. comm., 1986). On the latter it was feeding on dried tissues. It is possible that this species has been overlooked previously or misidentified owing to its similarity to *T. inclusum* and *granarium*.

T. variabile is a polyphagous pest, particularly of grain, seeds, cereals, legumes, nuts and a very wide range of other high-protein products. It is able to subsist on cereal products alone (Beal, 1956) and although mainly a vegetable feeder it has been found on dried milk, fish meal, beef cubes etc. Larvae have been known to damage zoological collections and herbaria abroad.

In the wild, in the USSR, the adult beetles fly from April to June and the larvae develop in bees' nests where they feed on dried honey and dead bees. They often break down and destroy the walls of the nests in their search for food. There is usually one generation per year (possibly more in favourable conditions). The larvae always hibernate and pupation occurs in the spring. The adults do not feed. In the USA the species is widespread in regions with a dry climate.

The life cycle has been studied by Loschiavo (1960, 1967) and Burges (1961) in the U.K. At optimum temperatures (30°C.) the female lays 100–200 eggs, egg-laying lasts 2–6 days, incubation period 5–6 days, larval stage 20 days, pupal stage 3–4 days, therefore the entire life cycle could take 30 days. Its temperature range is 17°–37°C. (Thompson, 1978).

Genus **Reesa** Beal

Reesa vespulae (Milliron) (Museum Nuisance [Finland]) (fig. 89). This is a synanthropic Nearctic species which has become widespread in northern Europe during the last 25 years and is established elsewhere. The first European record was probably from Germany (1957–1958) (Bahr & Nussbaum, 1974) and since then it has been recorded from USSR, Afghanistan, Norway, Finland, Sweden, Denmark, Iceland, England, The Netherlands and France (Martinez & Cocquempot, 1985). It has also been recorded in New Zealand (Waller & Watt, 1979; Waller, 1982).

In Britain there are few records, but as it is parthenogenetic the chances of its becoming widespread here seem high. It was first recorded in Britain in 1977 (Adams, 1978) in Essex, infesting seeds of Cock's foot (*Dactylis glomerata* L.) and Timothy-grass (*Phleum pratense* L.), in which it had been established for about 2 years. It was found in the Entomology Department in the British Museum (Natural History) [now known as The Natural History Museum], London between 1979 and 1986, although its spread has been arrested there; it had been breeding in the fluff under furniture

and had damaged a small number of dried insects before it was noticed. Although adults have been collected in the grounds of the Museum, it is not known whether it is breeding out-of-doors. Other infestations:- Lancashire: Manchester University, damaging insect collections (C. Johnson, pers. comm.); Northumberland: Newcastle University, Agricultural Field Laboratory, in dried cereal inflorescences and seeds (Luff, 1982), the only damage being to the seeds of spikes of rye (*Secale cereale* L.). The beetle was probably brought in with seed from Sweden in 1975 but was not noticed until 1981. York: Biology Laboratories, University of York (1983), in entomological collection and boring in polystyrene boxes (Booth, pers. comm.); in 1984 several more adults and larvae were found in different laboratories. Scotland: Dunfermline, Fifeshire, May 1981, Edwards (1982), adults and larvae in débris on the floor of a chemist's shop, source of infestation not found.

Its habits are described by Hämäläinen & Mannerkoski (1984), who say that in Finland its main importance is as a pest in insect collections, but it also damages plant material and is now a widespread pest in households and food stores. It has damaged vascular plant collections and dried fungus specimens in botanical museums. In Iceland (Olafsson, 1979) it was found in a bird-skin collection and damaging fungi and in Germany (Bahr & Nussbaum, 1974) the larvae were found feeding on the seeds of tomatoes and peppers and ate through paper and cloth to attack new batches. In Sweden (Andersson, 1973) it skeletonized four freeze-dried lizards and in Finland (Makisalo, 1970) it has been found living on incompletely cleaned vertebrate skulls. In houses the larvae feed mainly on bread crumbs and food residues e.g. apple pips, but have been found in flour, dried milk, dried mushrooms etc.

The reproduction of this species is parthenogenetic so only one adult (or one egg) is necessary to start an infestation. In synanthropic situations larvae of *R. vespulae* are found all the year round but mainly from October to May. The life cycle duration varies from a few months to 2–3 years. Adults fly readily and are usually found at windows from April to October with a peak of records in July; they live for one to two weeks. In America the species has been found feeding on dead insects in wasps' nests and the adult is known to take honey and pollen (Mehl, 1975).

Genus **Globicornis** Latreille

Globicornis nigripes (Fabricius) (fig. 90) is a very rare British species which is now considered to be endangered. It is not found in stored products. The larvae live under loose bark and in old decayed wood where they feed on the dry larval and pupal skins of other insects. The beetles are sometimes found in the summer on flowers, grass and foliage.

British records are as follows:- Berkshire: Windsor (Curtis, 1837); Cranbourne Park, vi. 1971, off an old oak (Allen); Windsor Forest, 19.v.1944 and 11.vi.1944, sweeping grass under oaks, 22.v., 11.vii.1946, sweeping umbels of hogweed, *Heracleum sphondylium*, near oak (Allen), vii.1986 (Owen): Windsor Park, v. 1948, sweeping Umbelliferae (Allen), 1949 (Donisthorpe), 1950 (Massee); Slough, vi.1970, 13 examples on flowers of garden shrubs, mainly *Spiraea* in grounds of ADAS Central Science Laboratory, Slough (Woodroffe); Gloucestershire: near Tewkesbury, beating and sweeping at side of wood (Blatch) (Fowler & Donisthorpe, 1913).

Woodroffe kept some adult beetles (see above) in a tube for a week and although no eggs were seen, by November 10 fully grown larvae were present. The tube contained fish meal, yeast and cholesterol and a piece of cotton flock. The larvae took 5 months to become fully grown.

Genus **Megatoma** Herbst

Megatoma undata (Linnaeus) (fig. 91). Distribution:- Europe (including Britain) and Siberia.

In Britain *M. undata* is fairly widespread. BMNH records are mainly from southern England, with some from the midlands, the north, Wales and Scotland. It is not regarded as a pest species. Fowler (1889) recorded it on skins and furs, and the author found a larva on a sheepskin numnah (horse's saddle 'cloth') in a garden shed in Middlesex: Stanwell Moor, 1985, but no other records have been found which associate this species with stored products and no damage has been recorded. It has been recorded as a scavenger in the nests or burrows of other insects, in spiders' webs, feeding on remnants of insects, spider exuviae etc., in bee-hives and bee burrows, where its larvae feed on cast skins, pupae etc. (Hinton, 1945). Adults are occasionally found in houses in Britain and on walls of barns, under bark and on tree trunks; as they have been found on flowers they are believed to be pollen feeders although they have been observed feeding on cast aphid skins and dead cat fleas (S. L. Shute, pers. comm.).

The larvae may develop in insect galleries (e.g. those of *Tetropium gabrieli* Weise and *Anaglyptus mysticus* (L.) (Cerambycidae)), also under bark and in wood of dead trees e.g. elm, larch, oak, crab apple, sycamore, willow, maple, ash, beech. Larvae and adults are often found under bark together. The beetles are mainly taken out-of-doors from April to June although they can be collected throughout the year under bark.

According to Hämäläinen & Mannerkoski (1984), in Finland the adults emerge in the autumn but do not leave the breeding place until spring, and they have been known to develop in birds' nests. Adult beetles have also been found there indoors as early as February; no damage to goods has been recorded.

This species is easily distinguished from other British species by its distinctive appearance (fig. 91), which may provide camouflage against lichen-covered bark. It seems to resemble the common jumping or zebra spider, *Salticus scenicus* Clk. with which it is often found.

Genus **Anthrenocerus** Arrow

Anthrenocerus australis (Hope) (the Australian Carpet Beetle) (fig. 92). Distribution:- Australian Region, Europe (introduced) (Britain and the Netherlands).

In Australia and New Zealand *A. australis* is common in houses, where it seriously damages woollen materials. In Belgium it has been recorded feeding on dried insects.

It has been imported into Britain in barley, rye, flour and bran residues (Aitken, 1975). An infestation was found in Britain in 1933, but it was not recorded from households here until 1945 (Hinton, 1958) and has not become of any importance as a domestic pest.

The following British records have been gathered (only one outdoor record was found):- Durham, damaging brushes, iii. 1954; Gloucestershire: Westbury on Trym, Bristol, infestations in 3 private houses, v. 1956 and 1957; Kent: Tunbridge Wells, in house, larvae feeding on dust and woollen fluff beneath floorboards, vi (adult), xii (larvae), 1956; Lancashire: Manchester, adult on *Lyctus*-infested case of Australian jam, xii. 1946 (J. D. Norris), Salford, adult on case of dried fruit from Australia, x. 1947 (M. J. Stevens); London, in printing office, 1933 (S. Wakely), living between floorboards on dried condensed milk, cake crumbs and biscuits, 1936; London wharf, in hides, vii. 1933 (R. Howe); London: Penge, infestation in fabrics department of shop, in cracks in counters and shelving in accumulations of woollen fibres, vi. 1956 (Bezant); London, vii. 1984, on sticky trap in grounds of BMNH (Rogers);

Middlesex: Harrow, adults and larvae in house, vi. 1945 and 1946; Worcestershire, in haircloth manufacturing premises, causing extensive damage, also sparrows' nests in roof had been colonised, xii. 1953. Scotland: Leith, larva on bag of oats from Sydney on ship, iv. 1948 (R. M. Dobson); Roxburghshire, in knitting factories, xii. 1950.

Other household records are given by Bezant (1956b; 1957) and Woodroffe & Parkin (1957). Occasional infestations have been found in commercial premises in Britain since 1933 but have been of little consequence.

The larvae can withstand British winter temperatures (Solomon & Adamson, 1955) but the summer temperatures may not be high enough for rapid breeding. Lamb (1952) records that the larvae are able to live for long periods without food. Wakely (1936) proved that they are able to live in captivity as he kept a thriving culture in a glass jar for over 20 years.

Genus **Orphinus** Motschulsky

Orphinus fulvipes Guérin-Méneville is the only species of the genus which is occasionally imported into Britain, as it is partly synanthropic. It is widely distributed along the sea coasts throughout the tropics and has been introduced into Germany and France. Its distribution covers Australia, the Pacific Is. Java and Madagascar. It has been introduced into S. and C. America, Florida, France and Germany.

It has been found feeding on dried insects and attacking book bindings and tobacco seeds; also on green cheese, dried shrimps and in termite cavities in wood. It has been imported into Britain in various commodities including nuts, cocoa beans, butter beans, ginger, cinnamon bark, sago flour, nutmegs, illipenuts and rice (Aitken, 1975).

Genus **Ctesias** Stephens

Ctesias serra (Fabricius) (fig. 93). This species is widely distributed throughout most counties in England as far north as Cumberland, although it is scarce in the west and records have not been found further than Somerset, except for one old record from Devon (1867). Wales: Carmarthen, Denbigh, Merioneth and Radnor (Alexander, pers. comm.). Scotland: Midlothian: Dalkieth; Lanarkshire: Hamilton (Crowson).

The larva of the species occurs all the year round under loose webby bark, or in rotting trees or stumps of mainly deciduous, over-mature trees, particularly oaks and elms, but also plane, poplar, sycamore, hawthorn, fir, beech, horse and sweet chestnut, maple, redwood, wild cherry and willow. It is less frequently found under conifer bark. The species of tree is not critical, only the condition. It is found in insect galleries, in old fungus, around webs of tube- and sheet-web building spiders where it apparently feeds on dead insects and woodlice which accumulate near the webs and possibly also the web material. It has also been recorded attacking the immature stages of various moths including the egg masses.

This species seems to have become more common in recent years. In the London area major outbreaks of Sycamore Sooty Bark Disease provided the opportunity for the species to increase its population (Hammond, pers. comm.) and in Suffolk it became more common as a result of Dutch Elm Disease, although most elms are now past the stage when they are suitable (Mendel, pers. comm.). It is listed as a Grade 3 Old Forest Indicator by Harding (1986), but it seems to occur anywhere where there are mature trees e.g. old parks, ancient woodlands, pasture woodland, hedgerow trees etc.

The adult beetles are rarely seen, usually being found either under bark with the larvae or singly by sweeping vegetation under old trees, from May to August. They

have also been collected at the fermenting sap of an oak tree infested with *Cossus cossus* (L.) (the Goat Moth).

About 40 eggs are laid under bark and they take from 15–21 days to hatch. The larvae often occur in groups. They may be easily reared in captivity on dead flies etc. and will eat paper and dry crusts. They moult 5 times at irregular intervals. The larva protects itself from attack by erecting its abdominal brushes of setae and vibrating its long tail hairs for about 10–15 seconds at 30-second intervals (Donisthorpe, 1920). This is thought to protect it from spiders. This movement is made possible by a well-developed supra-anal organ on the last abdominal segment (first noticed in some species of *Anthrenus* (Ma *et al.*, 1978).) Pupation occurs inside the last larval skin, the pupal stage lasting about 2 weeks, the adult emerging after a short resting period inside the larval skin. Donisthorpe (1920) records the British references to the species up to 1920.

In Finland the larvae have been found in the bark of a live pine tree in the galleries of the cerambycid, *Nothorhina punctata* F. and aculeate wasps (Hämäläinen & Mannerkoski, 1984). The larval development has been known to take one year (Palm, 1951). In Scotland, observations in captivity suggest that the life cycle takes at least 2 years (Crowson, 1962).

Genus **Anthrenus** Müller
(carpet beetles, larvae= woolly bears)

There are three native long-established British species of the genus *Anthrenus*, two of which, *A. fuscus* and *A. museorum*, live almost completely in the wild, rarely infesting households. The other species, *A. verbasci* is a common domestic pest in the southern part of England and also occurs in stored food products. Another species, *A. sarnicus*, has become established as a domestic and museum pest in the south-eastern counties during the last 25 years. Three pest species, *A. flavipes*, *A. pimpinellae* and *A. scrophulariae*, may be found on imports, as, less frequently, is *A. coloratus*. *A. olgae* is a recently introduced species which has been found breeding in one location in domestic premises in London.

Most *Anthrenus* larvae will damage wool, fur, skins and other material of animal origin and have also been known to damage vegetable and synthetic fibres if they are impregnated with animal matter, e.g. blood etc. They also feed on dried insects.

The adult beetles may feed on the nectar and pollen of flowers from the end of May until early August, but it is not necessary for the females to feed before laying viable eggs and it is possible for successive generations to be produced within an enclosed environment without access to an outdoor habitat. Indoors the adults may be found on windows from March to September. In their natural habitat the larvae of some species live in the nests of birds, insects and mammals and some may migrate into domestic premises either as larvae or adults.

Some of the species in this genus have a seasonal rhythm to their life cycles which is continued even under laboratory conditions (Blake, 1958; Armes, 1985).

Anthrenus verbasci (Linnaeus) (the Varied Carpet Beetle, the Varied Cabinet Beetle, the Small Cabinet Beetle) (fig. 139). Distribution cosmopolitan (Mroczkowski, 1968). Europe, N. America, Egypt, Japan and Australia (Hinton, 1945).

Occasionally imported into Britain, mainly on dried fruit and nuts, but is mostly known as a household pest in S. E. England (records go back over 100 years). A survey of its occurrence in Britain (Woodroffe & Southgate, 1954) found that it was abundant only in S. E. England. Typically it occurred within households of the residential suburbs around big towns, particularly London, where it fed on woollens etc. By 1971 it had spread to 28 counties (Cornwell, 1971), but most records were from the 8

counties around London. A few records were gathered from Devon, Dorset and Somerset. Only 10% were north of a line from Bedford to Gloucester, including Lancashire and Cheshire, 2 in Yorkshire: Hull and 3 in Scotland: Lanarkshire and Ayrshire. The BMNH records from 1983–1987 were mainly from the London area, but a few were from western, midland and northern counties and from N. and S. Wales: Flint and Glamorgan. Ireland: Dublin, 1984 (in house).

This species is the commonest synanthropic species of the genus in Britain and has now surpassed the clothes moth in the amount of damage caused to property (Cornwell, 1971). It is a destructive household pest as well as a pest of dried insect and mammal collections (and silkworm cocoons). In houses it is best known as a pest of woollen goods – carpets, bedding, clothes etc. – and it has been known to eat the glue of book bindings. It is the only British species of the genus which is found in stored food products as well as its preferred food. Sometimes in stored products it may be living on the remains of dead insects but there is definite proof that it feeds on certain stored products e.g. savoury biscuits, dried baby food (author's observation), flour, middlings, peanuts, cakes, seeds, wheat, maize (Aitken, 1975). It has also been found on grains, cereals, oats, rice, drugs, cayenne pepper, cacao, spice, dried cheese, health food tablets, rusks etc. It can also live in the wild in Britain in birds' nests (wet or dry), particularly sparrow, martin, swallow and wagtail. It has been found in bat roosts and it often occurs in or around habitations. Household infestations are often found to have originated from nests or dead birds or rodents in or near the roof space or in disused, boarded-up chimneys. When the food supply runs out the larvae migrate into the upper rooms of the house. There is probably no large scale damage to commercial stocks of woollen materials by *A. verbasci* although a few retailers have been affected. An unusual case of damage by this species occurred when electrical faults in a telephone exchange were found to be caused by the larvae eating the cotton/wool insulating material.

The larval development is usually in one or more cycles in which there is a period of active growth followed by a diapause (resting period). The latter may be extended in outdoor conditions to synchronize with the seasons, so that adults are present when the environment is favourable for their activity i.e. during May and June when sunshine favours flight and the preferred flowers are in bloom. The rhythm is present even under laboratory or indoor conditions although the length and number of cycles may vary according to temperature. Successful larval development takes place between 15° and 25°C. The life cycle under outdoor fluctuating conditions is two or more years. Active development of all stages takes place during the summer months, but growth ceases (diapause) during the winter which is spent as a resting larva. Larval development is spread over 2 summer seasons, so that the first winter is spent as a young larva and the second as a full grown larva. Pupation takes place in the spring. Indoors, development is sometimes completed within a year (Blake, 1958). Under laboratory conditions at 20°C. the shortest time for larval development is 8 months, while at 30°C. few pupate. Adults live between 13 and 44 days.

Anthrenus flavipes LeConte (the Furniture Carpet Beetle [USA]) (figs 143, 144). This species was originally an Oriental species but is now widely distributed throughout the warmer regions of the world. Its geographic range is limited by the susceptibility of the pupal stage to low temperatures. Although it is not normally able to establish itself in temperate climates, a severe infestation has been recorded in Canada in a centrally heated house (MacNay, 1954), which shows that it would not be impossible for it to become established in this country, under artificial conditions.

It is not established in Britain. So far it has only been found here in imported goods – e.g. bones, mohair, wheatgerm, hooves, horns, cottonseed cake, rice, apricot kernels. The larva feeds on any animal substances e.g. wool, hair, fur, feathers, bristles, horn, tortoise-shell, skins and dried insects. It needs keratin in its diet and

will not pupate if fed on pure wool unless it is impregnated with some other animal substance (Hinton, 1945). It has been known to eat the glue in book bindings and to gnaw holes in cardboard and paper and to skeletonize dead mice (Back & Cotton, 1936). Vegetable and synthetic fibres may be attacked if they are impregnated with animal matter. Ireland: Dublin, in trunk from USA, 1949 (O'Mahoney). In tropical and subtropical regions this species is a destructive household pest.

The larvae are able to survive for long periods at sub-zero temperatures and can complete their development within the range 20°–35°C. The life cycle takes over 100 days even under optimum conditions (30°–35°C.), and may take up to two years. The adult beetle may live from 2 weeks to several months. After pupation the pupa lies motionless for 2–30 days in the last larval skin. The adult then emerges and, after mating, the female will lay 30–100 eggs. The eggs hatch in 10–15 days in warm conditions. In cold weather the eggs will not hatch and females do not lay. The pupal stage lasts from 9–13 days (Back & Cotton, 1936). Detailed morphology of the different stages is described by Patel (1958). The adult beetles feed on the nectar and pollen of flowers.

Anthrenus pimpinellae Fabricius (fig. 145). Distribution:- Palaearctic and Oriental Regions, recently also the Nearctic Region. Owing to erroneous synonymies it has been thought to be almost cosmopolitan (Mroczkowski, 1968), but it has only very recently been recognized in the Western Hemisphere (Hoebeke *et al.*, 1985).

This species only occurs on imports. The sole British record found is:- London: Blackheath, 1895, emerged from dead maple branch with many other insect species including *Megatoma undata*, *Ctesias serra* and wood-boring beetles (Beaumont, 1895).

On the continent and in the USA it is occasionally found attacking dried insect collections and has been found damaging dried fish, woollens, horsehair and stored products, but it is not considered a major pest. In the wild the species develops mainly in birds' nests where the larvae feed on feathers, hair, dead nestlings or insect remains. The adults feed on pollen and nectar.

There is usually one generation per year, but occasionally the life cycle takes 2 years. The females lay up to 50 eggs in spring or early summer; hatching occurs in 8 days at 26°C. and in 15 days at 20°–22°C. Larval development takes 3–4 months. The pupal stage lasts 8–10 days with pupation taking place in the autumn within the last larval skin. It normally overwinters in the adult stage, then becomes active in May and is attracted to flowers (Hoebeke *et al.*, 1985).

Anthrenus scrophulariae (Linnaeus) (the Common Carpet Beetle, the Old-fashioned Carpet Beetle, the Buffalo Moth [USA], the Buffalo Carpet Beetle [Canada]) (fig. 146). Its distribution is nearly cosmopolitan (Mroczkowski, 1968). It is indigenous to Eurasia and occurs in Finland, N. America, Australia and Tasmania.

This is a pest species but so far has only been found in Britain on imports. It has not been recorded with certainty in the wild here. Records gathered are:- London: Blackheath (Douglas) (Allen, pers. comm.). Wales: Merioneth: Dauddyfryn, viii. 1964 'not quite certain' (Gilmour, Merioneth List). Scotland: Forth, Edinburgh (Stephens) (introduced).

In many countries, it is a serious pest of clothing and textiles. It is known to feed on a wide variety of animal products e.g. hair, bristles, horn, feathers, silk, woollens and furs, and has been found infesting insect collections. It has also been recorded on dried plants, rye flour and wheat. In some countries (e.g. Finland) it has only been found in the wild, living in insect galleries in trees, birds' and bees' nests, and on dead animals and birds. The adults are found on flowers where they feed on pollen and nectar.

The life cycle usually takes 1 year, but sometimes 2. Up to 40 eggs are laid (stuck tightly to the food substance) and the incubation period is 13–20 days. Most eggs laid in May or June give rise to adults by autumn. The adults then overwinter in the last

larval skin and become active the following spring. About 25% hibernate as larvae and begin to feed again the following spring. These then pupate in the summer or may pass their second winter as quiescent adults. The adults may live actively from 4–31 days. They have been bred at temperatures from 18°–27°C. (Greenwald, 1941 and Kunike, 1939; cited in Hinton, 1945.)

Anthrenus fuscus Olivier (fig. 141). Distribution:- Europe, Asia, Japan, N. America (Holarctic).

Britain – ranges from S. England to Lancashire and Yorkshire, but is commonest in the south and extends westwards to Cornwall in undiminished numbers. Wales: Swansea district, Llandaff, Castell Coch. Although it does occur in towns, it is principally a rural species.

This is one of the commonest British species of the genus; it is not normally a birds' nest dweller and has not become a household pest (see below). The larvae usually maintain themselves on dead insects in outbuildings, sheds, barns, houses, stone and brick walls etc., around spiders' webs (particularly the sheet webs of *Tegenaria domestica* L.), in the nests of aculeate Hymenoptera and under tree bark. It is often found in the company of *A. museorum* and like that species it appears to lack the behavioural reactions necessary to enable it to locate and colonise birds' nests (Woodroffe, 1961). If, on rare occasions, it is found in a nest, then there is usually a spider's web nearby and it is probably in a barn rather than a house. It has also been found in bat roosts. It is seldom as plentiful as *A. verbasci* in suburban areas except in the vicinity of sheds and outbuildings. The adults are found on flowers, particularly those of Umbelliferae, from May to August where they feed on pollen and nectar.

A. fuscus is not regarded as a pest in Britain. It is rarely recorded in houses and seldom causes damage although it has been found in stored blankets and in carpets in a disused wing of a country house (Woodroffe & Southgate, 1954) and in houses in Suffolk, 1978 and Herefordshire, 1981 (Mendel pers. comm.). It is able to develop normally on wool alone (Hinton, 1943a) and it has occasionally been recorded damaging insect collections. In the USSR in 1953, Kozulina found it damaging books (Hickin, 1985).

The eggs are laid on dead insects. Out-of-doors in Britain, larvae which hatch in spring or early summer do not pupate until April or May of the following year. Mating usually occurs on flowers. At 24.5–25.5°C. the pupal stage takes 5–6 days, then after emerging from the pupal skin the adult remains quiescent in the last larval skin for 4–5 days (Hinton, 1943a).

Anthrenus museorum (Linnaeus) (the Museum Beetle) (fig. 142). Distribution:- Holarctic Region (Mroczkowski, 1968), Java, Australia, New Zealand (Hinton, 1945).

Britain – occurs in the wild in England, rarely as a pest. It is sometimes imported. Records are mainly from S. E. England, but some are from as far west as Devon, some from the midlands and some are as far north as Cumberland and Durham. Wales: Newport.

A. museorum is a native of Britain but is far less common than *A. verbasci* and *A. fuscus*. Like *A. fuscus* this species is not normally a nest dweller in Britain and has not become a household pest (Woodroffe, 1961), although according to Mendel (pers. comm.) it is now common as a domestic pest in Suffolk: Ipswich. In Britain it has a rural distribution, usually living in accumulations of dead insects near the sheet webs of spiders such as *Tegenaria domestica* L. The larvae are also found in the egg sacs of these spiders, feeding on the empty egg shells, eggs that have failed to hatch and young spiders that died before leaving the egg sac. Larvae are frequently found crawling on the webs, without being attacked by the spider. Pupation occurs among the remains of insects, in old egg sacs and occasionally even on the under surface of the webs. Larvae are sometimes found feeding on moth pupae in cocoons and in the

nests of wood bees and honey bees. They are often found in outbuildings or under tree bark, usually in small numbers, often in company with larvae of *A. fuscus*. It has also been found on carrion on one occasion. At one time *A. museorum* was a pest in insect collections but is no longer common and seems to have been superseded by other species of the genus. It has sometimes been found in grain or grain products but in these cases it may be feeding on the remains of other insects (Hinton, 1945).

In Finland, it is said to be synanthropic, lives indoors and in birds' nests (Hämäläinen & Mannerkoski, 1984) and has also caused severe damage to furs and clothing. On the continent it has been found feeding on woollens, carpets, silk, furs, feathers and skins. In New Zealand it has been found on furs and feeding on mummified corpses and the remains of insects that had fed on the corpses (various references, cited in Hinton, 1945).

The adults feed on the nectar and pollen of flowers (particularly privet, parsley, cow parsley and daisy). They are most frequently seen from June to August.

There is usually one generation per year, with the winter spent in the larval stage, pupation usually occurring from May to July. At 20–22°C. the pupal stage takes 9–10 days, the quiescent adult period about 4–7 days and the active adult life between 10–18 days. Mating often occurs on flowers in sunlight, then the female beetles become negatively phototactic and seek a suitable place for egg-laying (Hinton, 1943, 1945 and Kunike, 1939, cited in Hinton, 1945).

Anthrenus olgae Kalik (fig. 147). Distribution:- Czechoslovakia, Poland, Yugoslavia, W. Ukraine SSR, Sweden, Finland, Hungary, Austria, Germany, Britain (introduced).

This species has only been comparatively recently introduced into Britain. A light infestation (mainly single specimens) was recorded in England: W. London: Maida Vale, in flat, vi. 1984, iii., vi. 1985, vi. 1986, vii. 1987 (Adams, 1988); also a single specimen was found in the Entomology Department of the BMNH, on a windowsill, vii. 1984 (author's observation).

It is a minor household pest abroad and a pest of entomological and ornithological collections (Kalik, 1946; Hämäläinen & Mannerkoski, 1984; Mroczkowski, 1975). Detailed morphological descriptions are given in Kalik (1946) and Adams (1988). As far as is known its biology has not been studied.

Anthrenus coloratus Reitter (fig. 148). Distribution:- S. E. Europe, USSR, Greece, N. Africa, Afghanistan, Sudan, India, USA.

Britain – first recorded in 1944 (Hinton, 1945) and occasionally imported. As far as is known this species is not established in Britain. Two captures have been made in London: BMNH (Entomology Department), live adult on windowsill (2nd floor) (1983) and larva feeding on a dried cockroach (4th floor) (1984). There is a specimen in the BMNH collection which has been bred from caraway seeds.

In Turkmenia, the adults are found on flowers and the larvae have been found in the crevices of rocks where they feed on dried insects in the nests of spiders and wasps.

One generation is produced per year and the larvae hibernate (Zhantiev, 1976).

Anthrenus sarnicus Mroczkowski (the Guernsey Carpet Beetle) (fig. 140). Distribution:- Guernsey, Britain: England (introduced).

A. sarnicus was described in 1963 from specimens bred from larvae collected in a house in Guernsey in 1961. It was first found in London in 1963 and is now common in S. W. London and has also been recorded in other parts of west and central London. It has been found mainly in private houses and shops, although a clothing factory has been infested. Other records are from:- Kent: Langley, vii. 1967; Lancashire: Liverpool, in museum, feeding on mounted birds and insect collection, 1970–1985 (suspected of being introduced in 1970 in a collection of mounted birds from Essex);

Middlesex: Ruislip, in BMNH store, 1986; Wiltshire: Salisbury, in dead pigeon, vi. 1966. Scotland: W. Lothian, in house in large numbers, vii. 1988.

Since 1967 it has become firmly established as a pest in and around the South Kensington area of London and has been frequently sent into the museum for identification from flats, private houses and commercial premises. It was discovered in the Victoria and Albert Museum and the insect collection in the BMNH in 1973, the stuffed animal collection in 1981 and the V. and A. store (W. 14) in 1989. It has also been collected out-of-doors on Umbelliferae and larvae have been found in dry birds' nests (house sparrow) and pigeons' nests in the BMNH tower, where they feed on droppings, feathers, dead birds and insects. In this area of London (S. W.) this species seems to have taken the place of the previously common *A. verbasci* and the chances of it eventually spreading throughout southern England seem high.

The larvae feed on almost any dried animal products such as fur, feathers, wool, skins, and dried insects, but rarely, if at all, damage plant materials. They thrive on fluff, dust and food débris accumulating between cracks in floorboards, under furniture, in carpets and in disused fireplaces etc. The adults feed on pollen and nectar if they manage to gain access to an outdoor environment. However, as with other species of the genus, this is not necessary for the species to breed successfully.

Females lay some 50–80 eggs which hatch in about two and a half weeks at room temperature (Armes, 1985). Larvae emerging from eggs laid in the spring and summer develop rapidly at room temperature, usually enter a diapause stage during the winter from November to January-March, then continue moulting and pupate from late February onwards. The pupal period is from 1.5 to 2.5 weeks. The adults emerge but remain quiescent within the last larval skin for about 5 days after which they become active and are ready to mate. Under constant conditions at 20°C. the larval development takes 40–50 weeks; at 25°C. some larvae pupate after 10–18 weeks (Armes, 1985). The adult beetles live between 3 and 14 weeks. At low temperatures (15°C.) some take 2 years to develop (Coombs & Woodroffe, 1983).

Genus **Trinodes** Dejean

Trinodes hirtus (Fabricius) (fig. 6). Distribution:- Europe (including Britain), Algeria, Caucasus and Turkmen SSR.

This species is not known to be synanthropic here. Records are as follows:- England: Berkshire: Windsor Forest, 1923, 1924, 1926 (Donisthorpe); 1927 (Tottenham); 1934 (Allen); Windsor Park, 1984 (Mendel). Cheshire: Dunham Park, before 1900 (Hardy). Derbyshire, 1905 (Tomlin). Devonshire: nr Exeter (Spence). Hampshire: New Forest, 1911 (Sharp). London, 1864. Oxfordshire: Thame Park, 1916 (Britten). Suffolk: Coddenham (Fox); Shrubland Park, 1980 (Nash). Surrey: Richmond Park, 1860 (Power); 1899 (Bennett); 1910, 1913 (Dollman); 1912 (Donisthorpe & Dollman); 1913–1915 (Wallis Kew); 1910, 1921, 1926 (Donisthorpe); 1983, 1987 (Hammond). Yorkshire/Lincolnshire: Thorne Moors – subfossil record.

Trinodes hirtus (Fabricius) is a rare species which lives out-of-doors in Britain. It is listed as a Grade 1 Old Forest Indicator species by Harding (1986) and is featured as a rare species in the Red Data Book (Shirt, 1987). It is found in or near webs of tube- and sheet-web building spiders which accumulate dead insects, under loose bark and in old decayed wood or stumps or hollow trees, where the larvae feed on dead insects and dead spiders and on dry larval and pupal skins. It is mainly found in oak, but also elm and poplar, sometimes in company with *Ctesias serra*. It feeds on animal matter or materials containing animal protein. The adult beetles have been seen between May and August on flowers and foliage.

Family Derodontidae

Characters for distinguishing between the British Derodontidae and Dermestidae can be found on page 9.

The superfamily Derodontoidea has recently been restored for the family Derodontidae (Hammond & Barham, 1982). Crowson (1944) originally erected the superfamily but in a later work (1955) included the family in the Dermestoidea (see *Introduction*). Later authors adopted his arrangement. Lawrence & Hlavac's (1979) review of the family includes an account of the phylogenetic relationships within the Derodontidae, and between it and other beetle families. Lawrence & Britton (1991) retain its separate status.

The Derodontidae contains 22 species in 4 genera and is restricted to the temperate parts of the northern and southern hemispheres. One genus, *Nothoderodontus,* is known from New Zealand, Australia and Chile and the other three, *Peltastica, Derodontus* and *Laricobius,* occur in the Holarctic Region. They all feed on fungal material except for *Laricobius*:- *Notheroderodontus* is known to feed on moulds on trunks of *Nothofagus*, *Peltastica* inhabits fermenting areas under bark and *Derodontus* feeds on the fruiting bodies of various macrofungi (Lawrence, 1982). *Laricobius* is exceptional among the Derodontidae in being a predator of adelgid Homoptera; one species has recently become established in Britain.

Genus **Laricobius** Rosenhauer

Of the 6 species in this genus, three are indigenous to N. America, one to the Caucasus, one to Siberia and one to Europe.

— One British species, adult of distinctive appearance (fig. 294). Length 1.5–2.5 mm. (Larva, figs 299, 300) ..... **erichsonii** Rosenhauer
Franz (1958a,b) gives a very detailed, well-illustrated morphological account of both adult and larva. On conifers. England, Scotland. Scarce but spreading.

Distribution and biology

Laricobius erichsonii (figs 293–300) has recently been discovered in Britain (Hammond & Barham, 1982). This species originated in continental Europe in the Alps and Carpathian Mountains, but has recently spread northwards to Belgium, Holland, N. Germany, Denmark and Sweden. This is probably partly due to the extensive planting of conifers which has taken place during the last 100 years in parts of N. Europe where these trees are not native. In 1962 it was introduced into N. America for biological control and became established there.

In Britain *Laricobius erichsonii* was first discovered in 1971 in Boyton, E. Suffolk (Hammond & Barham, 1982) on fir trees. Further examples have since been collected from Suffolk: Coddenham, on Douglas Fir, larch and spruce, 1980–1982 (Nash), Ipswich and Rendlesham Forest, 1981 (Mendel), so it seems likely to become widespread in Suffolk. Overwintered adults appeared as early as April in small numbers, became very common in May (Nash, 1983) and were still seen as late as July. In 1972 the species was introduced into Kent, from Germany, as a biological control of an acute woolly aphid infestation on firs, but the species has not since been collected at this site and there is no evidence that it has become established as a result of this introduction. It is thought that the established colonies probably arrived by natural dispersal across the sea from continental Europe. Further examples of the species have been collected in Scotland: Stirling: Bridge of Allan, on stone, 2.iv.1982 and on Scots Pine, 15.iv. 1985; West Inverness: Waltersmuir Reservoir, swept from

grass beneath larch, 9.vi.1984 (Lyszkowski); West Lothian: Dalmeny Park, beaten from miscellaneous trees, including conifers, 16.vii.1985 (Crowson).

The preferred host of *L. erichsonii* is the woolly aphid, *Adelges piceae* (Ratzeburg), but other hosts are known (Hammond & Barham, 1982). Adults of *L. erichsonii* feed primarily on adult adelgids, but may also take eggs, and frequently fungal hyphae and spores are found in the gut. Early instar larvae prefer eggs, while later instars take adults as well. The mechanics of feeding involve a piercing-sucking action with the aid of a pharyngeal pump.

Glossary

la = larva, ad = adult. Most adult parts are labelled in figs 1–3 and larval parts in fig. 172. Mouthparts of the adult are figured in Halstead (1986) and those of the larva in Marshall et al (1991). The occasional insert in brackets, immediately after the word to be defined, is the plural ending.

abdomen – hind part of body, derived from 10 segments, concealed from above by elytra in adult.
accessory appendage – a small conical process (la) (fig. 272).
acrotergite – the part of tergite anterior to transverse ridge or antecostal suture (la) (fig. 192).
antecostal suture – a transverse line at anterior margin of tergite; external groove of antecosta (la) (fig. 192).
antennal cavities – excavations of the hypomera which receive antennae, when retracted (ad).
anterior transverse ridge – a transverse ridge on anterior margin of tergite, in same position as the antecostal suture (la).
apical – at or near apex.
basal – at base; end nearest point of attachment to body; part of elytra and pronotum nearest scutellum.
basal strut – basal part of head of hastiseta (la) (fig. 199).
BMNH – British Museum (Natural History), the statutory name of the Natural History Museum in London.
cardo – basal piece of 1st maxilla.
carina – fine ridge.
caudal – pertaining to posterior end of body.
caudal tuft – tuft of setae near posterior end of body (la) (fig. 185).
clubbed – apical segments larger than others (antennae) (ad): broadening towards apex (setae) (la) (fig. 182).
compound eye – eye present on either side of head, usually with many facets (ad).
contiguous – very close together (coxae) (ad).
copulatory sac – bursa copulatrix; vagina (female) (ad).
cosmopolitan – worldwide.
coxa (e) – basal segment of leg.
coxal cavities open behind (fore coxal cavities) – not bordered posteriorly by the hypomeron (usually), which in closed cavities may extend medially to meet prosternal process (ad). It may be necessary to separate the prosternum from the mesosternum to see this character.
coxal plate – (hind coxae) (ad) a thin flat lamina partly covering femur when retracted (fig. 3).
cuticle – a fairly hard exoskeleton, which provides protective armour and waterproof cover (ad).
deflexed – (head) abruptly bent downward.
disc – central upper surface.
dorsal – upper.
dorsal line – longitudinal line down middle of back (la).
eccentrically – not centrally.
elytra – 'wing cases'; hardened, but usually movable, fore-wings which meet in a longitudinal straight line (suture) down the back of the beetle and form a protective covering for the hind-wings (ad).
emarginate – notched or with an obtuse, curved or quadrate section cut from a margin.

epicranial suture – a Y-shaped suture on dorsal surface of head, with the arms diverging anteriorly (la) (fig. 245).
epipharynx – an organ, probably of taste, attached to the inner surface of the labrum.
epipleuron (a) – sharply defined inflexed margin of elytra, seen from ventral side of body (ad).
erect – standing upright.
femur (ora) – thigh, stoutest segment of leg, articulated to body through the trochanter and coxa and bearing the tibia.
feral – wild.
filiform – thread-like; slender and of equal diameter.
frons – part of head lying between arms of epicranial suture.
frontal – pertaining to frons.
frontal suture – clypeal or epicranial suture.
galea – outer lobe of maxilla, usually 2-segmented, often hood-like.
glabrous – without setae.
gula – throat sclerite, forming the central part of underneath of head.
hastisetae – the unique multi-segmented spear-headed setae found on the Anthreninae and the Megatominae (la).
hind wings – functional membranous, veined wings, which are borne on the posterior part of the thorax (meta). These are usually much larger than the elytra under which they are folded when not in use (ad).
hypognathous – having head vertical and mouth directed downwards.
hypomeron (a) – inflexed margin of pronotum (seen from beneath) (ad).
indigenous – native (of), not immigrant.
instar – stage between moults (shedding a skin) (la).
khapra – destroyer.
labial palps – paired 1 to 4-segmented sensory appendages of the labium, borne on the palpiger, shorter than maxillary palps.
labium – lower lip.
labrum – upper lip, covers base of mandible and forms roof of mouth.
lacinia – a blade, inner lobe of 1st maxilla, articulated to the stipes, bearing brushes of setae or spines.
lamina – a thin flat chitinous plate (ad).
lanceolate (seta) – lance or spear-shaped; oblong and tapering to end (la).
laterad – towards side; away from midline.
lateral impressed lines – grooves at sides of abdomen in *Dermestes* spp. (ad) (figs 29–42, 49).
laterally – at the side.
ligula – central sclerite of labium.
linear (seta) – straight-sided (la).
lobed – with processes (ad).
mandibles – 1st pair of jaws.
maxillae – 2nd pair of jaws.
maxillary palp – sensory organ on outer end of stipes, 1 to 7-segmented.
median – in or at the middle.
membranous – thin, semi-transparent, pliable.
mesonotum – upper surface of mesothorax.
mesothorax – middle thoracic segment, bearing middle legs.
metanotum – upper surface of metathorax.
metasternum – underside of metathorax.
metathorax – posterior thoracic segment, bearing hind legs.
metepimeron – sclerite near hind coxae (fig. 3).
metepisternum – sclerite next to metasternum nearer side of body (ad) (fig. 3).
morphology – study of form and structure.
nomenclature – system of naming: terminology.
normal setae – not modified (la).
nudisetae – smooth setae.
ocellus (i) – simple eye.
open behind – see coxal cavities.
palpiger – sclerite bearing a palp.
papilla (e) – soft projection (la).

papular urticaria – a chronic or recurrent eruption of irritable papules, usually grouped in irregular clusters and frequently seasonal in incidence.
phototactic – moving towards the light.
pretarsal setae – paired setae near base of claw, on underside (la).
pronotum – the upper surface of prothorax.
prosternal process – part of prosternum between fore coxae which projects posteriorly towards mesosternum (ad) (fig. 2).
prosternum – the fore breast, the sclerite between the fore legs.
prostheca – articulating mandibular sclerite set with setae; fleshy or membranous process on interior face of mandible.
prothorax – 1st thoracic segment (nearest head), bearing the fore legs.
pubescence – covering of setae.
pupa – resting, inactive instar between larva and adult.
pygopod – appendage of 10th abdominal segment, used for locomotion (la).
quiescent – dormant.
ramous – (setae) branched (la).
recumbent – lying down.
retrorse – (tubercles) backwardly directed (la).
ribs (on elytra) – weak longitudinal ridges (ad).
sclerite – any piece of the insect body wall bounded by sutures.
sclerotized – hardened.
scutellum – triangular piece between elytra (ad).
seta (e) – hair.
shagreen – with microsculpture or granules, appearing dull (ad.).
simple – (seta) unmodified (la).
sinuate – wavy.
spermatheca – sac in female that receives sperm during coition (ad).
spinulate setae – 'rat-tailed' setae; slender setae covered with sharply pointed imbricate scales or spines (la) (fig. 172).
spiracle – breathing pore.
spiracular sclerite – sclerite ajoining spiracle (la) (figs 181, 263–264).
sternite – ventral body sclerite.
stria (e) – longitudinal row of punctures (ad).
supra-anal organ – an elliptical cuticular plate situated at the upper middle portion of the last larval segment above the anus (in some species of *Anthrenus*). It bears long spicisetae which are capable of rapid vibration.
suture – a seam or impressed line indicating the division of the distinct parts of the body wall; also see 'elytra'.
synanthropic – associated/living with man.
synonym – a different name given to a species or genus previously named and described.
tarsal formula – the number of segments on each tarsus, quoted in the order, fore, middle and hind – e.g. 5,5,5 (ad).
tarsus (i) – foot (fused with claw in dermestid larvae).
teneral – condition of adult beetle shortly after emergence, when it is not entirely hardened or of the mature colour.
tergite – sclerite on dorsal side of body.
thoracic – pertaining to thorax.
thorax – middle section of body between head and abdomen, bearing the legs (and wings in adults).
tibia – 4th segment of leg, articulated to the femur and bearing the tarsus (claw + tarsus in larva).
transverse – broader than long; running across.
trochantin – a small sclerite associated with the fore and middle coxae, usually concealed (ad) (fig. 75).
tubercle – small raised outgrowth or prominence in the cuticle (la).
unicolorous – of one colour throughout.
urogomphi – paired dorsal spines or processes, on 9th abdominal segment (la).
ventral – under.

References

ADAMS, R.G. 1978. The first British infestation of *Reesa vespulae* (Milliron) (Coleoptera: Dermestidae). *Entomologist's Gazette* **29:** 73–75.

ADAMS, R.G. 1980. *Dermestes leechi* Kalik in stored products and new diagnostic characters for *Dermestes* spp. (Coleoptera: Dermestidae). *Journal of Stored Products Research* **16:** 119–122.

ADAMS, R.G. 1988. *Anthrenus olgae* Kalik, new to Britain (Coleoptera: Dermestidae) with notes on its separation from *A. caucasicus* Reitter. *Entomologist's Gazette* **39:** 207–210.

AHMED, A.R., MOY, R., BARR, A.R., & PRICE, Z. 1981. Carpet beetle dermatitis. *Journal of the American Academy of Dermatology* **5**(4): 428–432.

AITKEN, A.D. 1975. Insect Travellers 1 Coleoptera. *Technical Bulletin. Ministry of Agriculture, Fisheries and Food* **31:** i–xvi, 1–191.

ALLEN, A.A. 1935. Some recent captures of Coleoptera. *Entomologist's Monthly Magazine* **71:** 64–67.

ALLEN, A.A. 1945. *Globicornis nigripes* F. (Col. Dermestidae) rediscovered in Windsor Forest and reinstated as British. *Entomologist's Monthly Magazine* **63:** 84–85.

ALLEN, A.A. 1947. *Globicornis nigripes* F. (Col., Dermestidae) in Britain: corrections and additions. *Entomologist's Monthly Magazine* **83:** 171.

ALLEN, A.A. 1958. An observation on the beetle *Megatoma undata* Er. (Dermestidae) in association with the spider *Salticus scenicus* Clk. (Attidae). *Entomologist's Monthly Magazine* **94:** 256.

ALLEN, A.A. 1960. Is *Dermestes peruvianus* Lap. (Col., Dermestidae) becoming naturalised in Britain? *Entomologist's Monthly Magazine* **96:** 34.

ALLEN, A.A. 1963. *Dermestes peruvianus* Lap. (Col. Dermestidae): a correction. *Entomologist's Monthly Magazine* **99:** 229.

AMOS, T.G. 1968. Some laboratory observations on the rates of development, mortality and oviposition of *Dermestes frischii* (Kug.) (Col., Dermestidae). *Journal of Stored Products Research* **4**(2): 103–117.

ANDERSON, W.H. 1949. Larval description and transfer of *Thaumaphrastus karanisensis* from Colydiidae to a new subfamily of Dermestidae (Coleoptera). *Bulletin of the Brooklyn Entomological Society* **44:** 121–127.

ANDERSSON, G. 1973. A new pest in Sweden – *Reesa vespulae* (Mill.) *Fauna och Flora* **68:** 69–73.

ARMES, N.J. 1983. *The biology of* Anthrenus sarnicus *Mroczk. and preliminary observations on the biology of* Reesa vespulae *Mill.* 58 pp. Unpublished 1st year report of research at Imperial College Field Station.

ARMES, N.J. 1985. *Biology and control of* Anthrenus sarnicus *Mroczk. (Coleoptera, Dermestidae).* 273 pp. Unpublished PhD Thesis, Imperial College, University of London.

ARMES, N.J. 1988. The seasonal activity of *Anthrenus sarnicus* Mroczkowski (Coleoptera Dermestidae) and some other beetle pests in the museum environment. *Journal of Stored Products Research* **24**(1): 29–37.

ARMITAGE, D.M. 1986. Population changes of four species of insects (Col. & Dipt.) in three deep pit poultry houses. *Entomologist's Monthly Magazine* **122:** 75–77.

AYAPPA, P.K., CHEEMA, P.S. & PERTI, S.L. 1957. A life history study of *Anthrenus flavipes* Lec. (Col., Dermestidae). *Bulletin of Entomological Research* **48:** 185–198.

AZAB, A.K., 1972. Factors affecting development and adult longevity of *Dermestes maculatus* Degeer (Coleoptera: Dermestidae). *Bulletin. Société Entomologique d'Egypte* **56:** 21–32.

AZAB, A.K., TAWFIK, M.F.S. & ABOUZEID, N.A. 1972a. The biology of *Dermestes maculatus* Degeer (Coleoptera: Dermestidae). *Bulletin. Société Entomologique d'Egypte* **56:** 1–14.

AZAB, A.K., TAWFIK, M.F.S. & ABOUZEID, N.A. 1972b. Factors affecting the rate of oviposition in *Dermestes maculatus* Degeer. *Bulletin. Société Entomologique d'Egypte* **56:** 49–59.

BACK, E.A. & COTTON, R.T. 1936. The furniture carpet beetle (*Anthrenus vorax* Waterhouse), a pest of increasing importance in the United States. *Proceedings of the Entomological Society of Washington* **38**(9): 189–198.

BAHR, I. & NUSSBAUM, P. 1974. *Reesa vespulae* (Milliron) (Coleoptera: Dermestidae), ein neuer Schädling an Sämereien in der Deutschen Demokratischen Republik. *Nachrichtenblatt für den Deutschen Pflanzenschutzdienst* **28:** 229–231. [English summary.]

BANKS, H.J. 1977. Distribution and establishment of *Trogoderma granarium* Everts (Coleoptera: Dermestidae): climatic and other influences. *Journal of Stored Products Research* **13:** 183–202.

BARBER, H.S. 1947. On the odd, or tissue paper beetle supposed to be *Thylodrias contractus*. *Annals of the Entomological Society of America* **40**(2): 344–349.

BARBER, H.S. 1951. Another name for the furniture carpet beetle. *Coleopterists' Bulletin* **5**(3): 44–45.

BARTINDALE, G.C. & BARTINDALE, G.W.R. 1948. Coleoptera of the Macclesfield District. *Entomologist's Monthly Magazine* **84:** 130–138.

BATES, F. 1896. The Coleoptera of Bradgate Park. *Transactions of the Leicester Literary and Philosophical Society* **4:** 170–176.

BEAL, R.S. Jr 1954. Biology and taxonomy of the Nearctic species of *Trogoderma* (Coleoptera: Dermestidae). *University of California Publications in Entomology* **10**(1): 35–101.

BEAL, R.S. Jr 1956. Synopsis of the economic species of *Trogoderma* occurring in the U.S. with description of a new species (Col.: Dermestidae). *Annals of the Entomological Society of America* **49:** 559–566.

BEAL, R.S. Jr 1959. A key to the Nearctic genera of Dermestidae. *Coleopterists' Bulletin* **13:** 99–101.

BEAL, R.S. Jr 1960. Descriptions, biology and notes on the identification of some *Trogoderma* larvae (Coleoptera, Dermestidae). *Technical Bulletin. U.S. Department of Agriculture* **1228:** 1–26.

BEAL, R.S. Jr 1961. Coleoptera, Dermestidae. I. *Insects of Micronesia* **16**(3): 109–131.

BEAL, R.S. Jr 1967. A revisionary study of the N. American dermestid beetles formerly included in the genus *Perimegatoma* (Col.). *Miscellaneous Publications of the Entomological Society of America* **5:** 281–312.

BEAL, R.S. Jr 1970. A taxonomic and biological study of species of Attagenini (Coleoptera: Dermestidae) in the United States and Canada. *Entomologica Americana*. **45:** 141–235.

BEAUMONT, A. 1895. Insects bred from a dead branch of maple at Blackheath. *Entomologist's Monthly Magazine* **31:** 281.

BECK, S.D. 1971a. Growth and retrogression in larvae of *Trogoderma glabrum* (Coleoptera: Dermestidae). 1. Characteristics under feeding and starvation conditions. *Annals of the Entomological Society of America* **64**(1): 149–155.

BECK, S.D. 1971b. Growth and retrogression in larvae of *Trogoderma glabrum* (Coleoptera: Dermestidae). 2. Factors influencing pupation. *Annals of the Entomological Society of America* **64**(4): 946–949.

BECK, S.D. 1972. Growth and retrogression in larvae of *Trogoderma glabrum* (Coleoptera: Dermestidae). 3. Ecdysis and form determination. *Annals of the Entomological of America* **65**(6): 1319–1324.

BELLAMARE, E.R. & BRUNELLE, L. 1950. Larval and pupal development of *Dermestes maculatus* Degeer under controlled conditions of temperature and relative humidity. *Canadian Entomologist* **82**(1): 22–24.

BELLAS, T.E. 1982. Insects as a cause of inhalant allergies. A Bibliography. Second Edition. *Commonwealth Scientific and Industrial Research Organization, Division of Entomology Report* **25:** 1–60.

BELLAS, T.E. 1984. Addendum to the Second Edition. [Source not traced.]

BEZANT, E.T. 1956a. First records of *Trogoderma boron* Beal (Col., Dermestidae) in Britain. *Entomologist's Monthly Magazine* **92:** 308.

BEZANT, E.T. 1956b. Further records of the Australian Carpet Beetle, *Anthrenocerus australis* (Hope) (Col., Dermestidae) in Britain. *Entomologist's Monthly Magazine* **92:** 401.

BEZANT, E.T. 1957. The Australian carpet beetle, *Anthrenocerus australis* (Hope) (Col., Dermestidae) in Britain. *Entomologist's Monthly Magazine* **93:** 207.

BEZANT, E.T. 1963. The occurrence of *Dermestes peruvianus* La Porte and *Dermestes haemorrhoidalis* in Britain. *Entomologist's Monthly Magazine* **99:** 30–31.

BEZANT, E.T. 1965. Food handling premises in Britain as an ecological niche for *Dermestes* (Coleoptera, Dermestidae). *International Congress of Entomology* **12:** 647–648.

BILLINGS, C.J. 1984. The use of a domestic freezer for killing insects in dry foodstuffs. 6 pp. Unpublished report, ADAS Central Science Laboratory, Slough. *Storage Pests Department Report* **2.**

BLAIR, K.G. 1931. The beetles of the Scilly Islands. *Proceedings of the Zoological Society of London* **4:** 1211–1258.

BLAIR, K.G. 1936. An Australian Dermestid beetle, *Anthrenocerus australis* Hope, in London. *Entomologist's Monthly Magazine* **72:** 175–177.
BLAKE, G.M. 1958. Diapause and the regulation of development in *Anthrenus verbasci* (L.) (Col. Dermestidae). *Bulletin of Entomological Research* **49**(4): 751–775.
BLAKE, G.M. 1961. Length of life, fecundity and oviposition cycle in *Anthrenus verbasci* (L.) (Col., Dermestidae) as affected by adult diet. *Bulletin of Entomological Research* **52**(3): 459–472.
BLAKE, G.M., HAMBLIN, G., PARIS, I. & RICHARDSON, W. 1968. Life history and physical limits of the fur beetle. Untitled note in Report of the Director, 1968. *Pest Infestation Research* **1968:** 5–6.
BOLD, T.J. 1871. A catalogue of the insects of Northumberland and Durham. *Natural History Transactions of Northumberland and Durham* **4:** 1–117.
BOUSQUET, Y. 1990. *Beetles associated with stored products in Canada: an identification guide.* iv + 220 pp. Ottawa: Canadian Government Publishing Centre. (Canadian Department of Agriculture Publication 1837).
BÖVING, A.G. & CRAIGHEAD, F.C. 1930. An illustrated synopsis of the principal larval forms of the Order Coleoptera. *Entomologica Americana* **11**(1–4). 351 pp.
BUCK, F.D. 1955. A provisional list of the Coleoptera of Epping Forest. *Entomologist's Monthly Magazine* **91:** 174–192.
BURGES, H.D. 1957. Studies on the dermestid beetle *Trogoderma granarium* Everts. 1. Identification and duration of the developmental stages. *Entomologist's Monthly Magazine* **93:** 105–110.
BURGES, H.D. 1960. Studies on the Dermestid beetle *Trogoderma granarium* Everts. IV. Feeding, growth and respiration with particular reference to diapause larvae. *Journal of Insect Physiology* **5:** 317–334.
BURGES, H.D. 1961. The effect of temperature, humidity and quantity of food on the development and diapause of *Trogoderma parabile* Beal. *Bulletin of Entomological Research* **51:** 685–696.
CAMPBELL, J.M., SARAZIN, M.J. & LYONS, D.B. 1989. *Canadian beetles (Coleoptera) injurious to crops, ornamentals, stored products, and buildings.* iv + 491 pp. Ottawa: Canadian Department of Agriculture Publication 1826.
CARR, J.W. 1916. *The invertebrate fauna of Nottinghamshire.* 618 pp. Nottingham: Nottingham Naturalists' Society.
CARR, J.W. 1935. *The invertebrate fauna of Nottinghamshire. Supplement.* 287 pp. Nottingham: Nottingham Naturalists' Society.
CHATTERJI, S. & SARUP, P. 1959. Biology of *Thorictodes heydeni* Reitt. (Thorictidae: Coleoptera) a pest of stored cereals and their products in India. *Indian Journal of Entomology* **21**(4): 282–283.
CHU, H.F. 1949. *How to know the immature insects.* 234 pp. Dubuque, Iowa: Wm. C. Brown Company.
COOMBS, C.W. 1979. The effect of temperature and humidity upon the development and fecundity of *Dermestes haemorrhoidalis* Küster and *Dermestes peruvianus* Laporte de Castelnau (Coleoptera: Dermestidae). *Journal of Stored Products Research* **15:** 43–52.
COOMBS, C.W. & WOODROFFE, G.E. 1963. An experimental demonstration of ecological succession in an insect population breeding in stored wheat. *Journal of Animal Ecology* **32:** 271–279.
COOMBS, C.W. & WOODROFFE, G.E. 1983. The effect of temperature upon the longevity, fecundity and circannual development of *Anthrenus sarnicus* Mroczkowski (Coleoptera: Dermestidae). *Journal of Stored Products Research* **19**(3): 111–115.
CORMIA, F.E. & LEWIS, G.M. 1948. Contact dermatitis from beetles, with a report of a case due to the carpet beetle (*Anthrenus scrophulariae*). *New York State Journal of Medicine* **48:** 2037–2039.
CORNWELL, P.B. 1971. Rising cost of damage by insect pests of fabrics in Britain. *International Pest Control* **13**(5): 22–27.
CRISAFULLI, S. 1980. Herbarium insect control with a freezer (Note p. 224). *Brittonia* **32**(2): 109–280.
CROWSON, R.A. 1944. Further studies on the metendosternite in Coleoptera. *Transactions of the Royal Entomological Society of London* **94**(2): 273–310 + 10 plates.
CROWSON, R.A. 1951. The classification of the families of British Coleoptera. *Entomologist's Monthly Magazine* **87:** 147–156.

CROWSON, R.A. 1955. *The natural classification of the families of Coleoptera.* London: Nathaniel Lloyd. 187 pp. (Reprint 1967 with addenda and corrigenda from *Entomologist's Monthly Magazine*, 1967, **103:** 209–214. E.W. Classey, London.)
CROWSON, R.A. 1956. Coleoptera. Introduction and keys to families. *Handbooks for the Identification of British Insects* **4**(1): 1–59.
CROWSON, R.A. 1962. Observations on Coleoptera in Scottish oak woods. *Glasgow Naturalist* **18**(4): 177–195.
CROWSON, R.A. 1964 (1965). Some Coleoptera associated with old trees in Grimsthorpe Park, Lincs. *Entomologist's Monthly Magazine* **100:** 198–200.
CROWSON, R.A. 1981. *The Biology of the Coleoptera.* xi. + 802 pp. London: Academic Press.
CROWSON, R.A. 1987. Some records of Coleoptera from Dalmeny Park, West Lothian, Scotland. *Entomologist's Monthly Magazine* **123:** 14.
CURTIS, J. 1837. *A guide to an arrangement of British insects.* 294 pp. London. Published privately by the author.
CURTIS, J. 1838. *British Entomology*, plates 674–721, with legends. London. Privately published by the author.
DAY, F.H. 1923. The Coleoptera of Cumberland. *Transactions of the Carlisle Natural History Society* **3:** 70–107.
DILLWYN, L.W. 1829. *Memoranda relating to coleopterous insects found in the neighbourhood of Swansea.* 76 pp. Swansea: Murray & Rees.
DONISTHORPE, H. 1920. *Tiresias serra* F. and its larva. *Entomologist's Monthly Magazine* **56:** 206–209.
DONISTHORPE, H. 1930. The larva of *Trinodes hirtus* F. (Dermestidae, Col.). *Entomologist's Record and Journal of Variation* **42**(10): 129–130.
DONISTHORPE, H. 1931. An annotated list of the additions to the British coleopterous fauna, made since the publication of the supplementary volume (VI) of Fowler's 'Coleoptera of the British Islands'. *Entomologist's Monthly Magazine* **67:** 164–175.
DONISTHORPE, H. 1939. *A preliminary list of the Coleoptera of Windsor Forest.* 126 pp. London: Lloyd.
DUFFY, E.A.J. 1945. The Coleopterous fauna of the Hants-Surrey border. *Entomologist's Monthly Magazine* **81:** 169–179.
DUNKEL, F.V. & BOUSCH, G.M. 1970. Light and electron microscopy of the meconium of the Black Carpet Beetle. *Journal of Invertebrate Pathology* **15:** 431–439.
EDWARDS, R. 1969. *Anthrenus sarnicus* Mroczk. (Col., Dermestidae); the present status of this insect in the British Isles. *Entomologist's Monthly Magazine* **105:** 119–121.
EDWARDS, R. 1976. *Dermestes peruvianus* (Cast.) and *D. haemorrhoidalis* (Küst.) (Col., Dermestidae): their distribution in Britain. *Entomologist's Monthly Magazine* (1975) **111:** 65–67.
EDWARDS, R. 1982. Notes and observations: *Reesa vespulae* (Milliron) (Coleoptera Dermestidae) in Britain. *Entomologist's Gazette* **33**(1): 34.
EDWARDS, S.R., BELL, B.M. & KING, M.E. (Editors and Compilers) *et al.* 1981. *Pest control in museums: a status report (1980).* Pp. 1–34, A1–G9. Lawrence, Kansas: Association of Systematics Collections, University of Kansas.
ELLIS, J.W. 1885. Coleoptera of the Liverpool District. Part V. Clavicornia and Lamellicornia. *Naturalist, Hull*: **10:** 237–246.
EMDEN, F.I., VAN 1942. Larvae of British beetles. B. Keys to the families. *Entomologist's Monthly Magazine* **78:** 206–226, 253–272.
EMDEN, F.I., VAN 1951. On the genus *Thaumaphrastus* Blaisdell (Coleoptera: Thorictidae). *Bulletin of the Brooklyn Entomological Society* **46:** 39–41.
EVANS, W. 1900. Some records of Scottish Coleoptera and Hemiptera. *Annals of Scottish Natural History* **1900:** 91–103.
FAUSTINI, D.L. & HALSTEAD, D.G.H. 1982. Setiferous structures of male Coleoptera. *Journal of Morphology* **173:** 43–72.
FRANCISCOLO, M.E. 1975. Sulla pozizione sistematica di *Thylodrias contractus* Motschulsky 1939. *Bollettino della Società Entomologica Italiana* **107**(6–8): 142–146.
FRANZ, J.M. 1958a. Studies on *Laricobius erichsonii* Rosenh. (Coleoptera: Derodontidae) a predator on chermesids. Part 1. Distribution, life-history and ecology. *Entomophaga* **3:** 109–164.
FRANZ, J.M. 1958b. Studies on *Laricobius erichsonii* Rosenh. (Coleoptera: Derodontidae) a predator on chermesids. Part 2. External anatomy. *Entomophaga* **3:** 165–196.

FREUDE, H., HARDE, K.W. & LOHSE, G.A. (Eds) 1979. Diversicornia. *Die Käfer Mitteleuropas*. **6:** 1–367. Krefeld: Goecke & Evers. (Derodontidae, pp 98–99, and Dermestidae, pp 304–327, by Lohse.)

GARLAND, S.P. 1983. Beetles as primary woodland indicators. *Sorby Record* **21:** 3–38.

GIRLING, M.A. 1984. Eighteenth Century records of human lice (Pthiraptera, Anoplura) and fleas (Siphonaptera, Pulicidae) in the City of London. *Entomologist's Monthly Magazine* **120:** 207–210.

GOODMAN, L.J. 1970. The structure and function of the insect dorsal ocellus. *Advances in Insect Physiology* **7:** 97–195.

GREEN, M. 1979. The identification of *Trogoderma variabile* Ballion, *T. inclusum* LeConte and *T. granarium* Everts (Coleoptera: Dermestidae) using characters provided by their genitalia. *Entomologist's Gazette* **30:** 199–204.

GURNEY, A.B. 1956. On the rendering of Charles De Geer's surname. *Bulletin of the Brooklyn Entomological Society* **51:** 127–136.

HADAWAY, A.B. 1956. The biology of the Dermestid beetles *Trogoderma granarium* Everts and *Trogoderma versicolor* (Creuts.). *Bulletin of Entomological Research* **46:** 781–796.

HAINES, C.P. & REES, D.P. 1989. A field guide to the types of insects and mites infesting cured fish. *Fisheries Technical Papers. Food and Agriculture Organization of the United Nations.* **303:** 33 pp. Rome.

HALL, E.R. & RUSSELL, W.C. 1933. Dermestid beetles as an aid in cleaning bones. *Journal of Mammalogy* **14**(4): 372–374.

HALSTEAD, D.G.H. 1981. Taxonomic notes on some *Attagenus* spp. associated with stored products, including a new black species from Africa (Coleoptera; Dermestidae). *Journal of Stored Products Research* **17:** 91–99.

HALSTEAD, D.G.H. 1986. Keys for the identification of beetles associated with stored products. 1. Introduction and key to families. *Journal of Stored Products Research* **22**(4): 163–203.

HALSTEAD, D.G.H. & GREEN, M. 1979. *Attagenus woodroffei* sp.n., previously confused with *Attagenus fasciatus* (Thunberg) (Coleoptera, Dermestidae). *Notulae Entomologicae* **59:** 97–104.

HÄMÄLÄINEN, M. 1980. *Attagenus smirnovi* Zhantiev (Dermestidae) uusi asuntotuholainen Suomessa. *Notulae Entomologicae* **60:** 230.

HÄMÄLÄINEN, M. & MANNERKOSKI, I. 1984. Occurrence and distribution of dermestids (Coleoptera, Dermestidae) in Finland. *Notulae Entomologicae* **64:** 167–184.

HAMMOND, P.M. & BARHAM, C.S. 1982. *Laricobius erichsoni* Rosenhauer (Coleoptera: Derodontidae), a species and superfamily new to Britain. *Entomologist's Gazette* **33:** 35–40.

HAMMOND, P.M., SMITH, K.G.V., ELSE, G.R. & ALLEN, G.W. 1989. Some recent additions to the British insect fauna. *Entomologist's Monthly Magazine* **125:** 95–102.

HARDING, P.T. 1986. *Pasture woodlands in lowland Britain. A review of their importance for wildlife conservation.* 89 pp. Huntingdon: Institute of Terrestrial Ecology.

HARDY, J. & BOLD, T.J. 1848. *A catalogue of the insects of Northumberland and Durham.* 135 pp. Newcastle Upon Tyne: Hodgson.

HICKIN, N. 1985. *Bookworms. The insect pests of books.* 176 pp. London: Sheppard Press Ltd.

HINCKS, W.D. 1950. The odd beetle, *Thylodrias contractus* Motschulsky (Col., Dermestidae) in Britain. *Entomologist's Monthly Magazine* **86:** 148.

HINTON, H.E. 1943a. Notes on two species of *Attagenus* (Col., Dermestidae) recently introduced into Britain. *Entomologist's Monthly Magazine* **79:** 224–227.

HINTON, H.E. 1943b. Natural reservoirs of some beetles of the family Dermestidae known to infest stored products, with notes on those found in spiders webs. *Proceedings of the Royal Entomological Society of London* (A) **18:** 33–42.

HINTON, H.E. 1945. *A monograph of the beetles associated with stored products* **1**. 443 pp. London: British Museum (Natural History) (Reprinted, Johnson Reprint Corporation, 1963.)

HINTON, H.E. 1946. The "gin-traps" of some beetle pupae; a protective device which appears to be unknown. *Transactions of the Royal Entomological Society of London* **97**(19): 473–496.

HINTON, H.E. 1958. The first household infestation of the Australian carpet beetle, *Anthrenocerus australis* (Hope), in Britain. *Entomologist's Monthly Magazine* **94:** 192.

HOCKIN, D.C. 1980. The invertebrate fauna of birds' nests with special reference to Microlepidoptera and stored-products' Coleoptera. *Entomologist's Monthly Magazine* (1979) **115:** 139–144.

HODGE, P.J. 1979. *Aulonium trisulcum* (Fourc.) (Col. Colydiidae) and *Ctesias serra* (F.) (Col. Dermestidae) in East Sussex. *Entomologist's Monthly Magazine* (1977) **113:** 246.
HOEBEKE, E.R., WHEELER, A.G., Jr & BEAL, R.S., Jr 1985. *Anthrenus pimpinellae* F., a palearctic dermestid established in eastern North America (Coleoptera: Dermestidae). *Journal of the New York Entomological Society* **93**(4): 1216–1222.
HOPE, F.W. 1841. On insects and their larvae occasionally found in the human body. *Entomologist* **1:** 54.
HOWE, R. 1939. Note on *Anthrenocerus australis* Hope (Col., Dermestidae). *Entomologist's Monthly Magazine* **75:** 187.
HOWE, R.W. 1952a. A note on the egg output of *Attagenus megatoma* (F.) (=*piceus* (Ol.) (Col., Dermestidae). *Entomologist's Monthly Magazine* **88:** 40–41.
HOWE, R.W. 1952b. Notes of the biology of *Trogoderma versicolor* Creutz. (Col., Dermestidae). *Entomologist's Monthly Magazine* **88:** 182–184.
HUNTER, F.A. 1959. *Megatoma undata* (L.) (Col., Dermestidae) associated with Cerambycids. *Entomologist's Monthly Magazine* **95:** 43.
HURLOCK, E.T. 1961. Persistence of khapra beetle in ships' holds. *Pest Technology* **3:** 144–146.
JACOB, T.A. & FLEMING, D.A. 1981. The effect of temperature and relative humidity on the oviposition pattern and longevity of *Dermestes lardarius* L. (Col. Dermestidae). *Entomologist's Monthly Magazine* (1980) **116:** 222–224.
JACOB, T.A. & FLEMING, D.A. 1982. Observations on the influence of free water on the fecundity and longevity of *Dermestes lardarius* L. (Col., Dermestidae). *Entomologist's Monthly Magazine* **118:** 127–131.
JACOB, T.A. & FLEMING, D.A. 1984. The effect of temperature and humidity on the egg period, larval instars and oviposition of *Dermestes haemorrhoidalis* Küster (Col., Dermestidae). *Entomologist's Monthly Magazine* **120:** 131–137.
JACOB, T.A. & FLEMING, D.A. 1986. The influence of temperature and relative humidity upon the number and duration of larval instars in *Dermestes lardarius* L. (Col., Dermestidae). *Entomologist's Monthly Magazine* **122:** 43–50.
JEFFERIES, M.G. 1979. The occurrence of *Dermestes* species (Coleoptera: Dermestidae) in "deep pit" poultry houses in Britain. *Entomologist's Gazette.* **30**(3): 207–212.
JOHN, H. 1961. Zwei neue Spezies der Gattung *Thorictodes* Rtt. (Col. Dermestidae). *Revue de Zoologie et de Botanique Africaines* **64**(1–2): 41–44.
JOHN, H. 1963. Revision der Gattung *Thorictus* Germar (Thorictidae, Clavicornia, Coleoptera). Ein Bestandsaufnahme, Kritik und Neubeschreibung. I. Teil. *Entomologische Abhandlungen und Berichte aus dem Staatlichen Museum für Tierkunde in Dresden* **28:** 177–255.
JOHN, H. 1965. *Ibid.* II Teil. *Ibid.* **31:** 319–395.
JOHN, H. & ANDREAE, H. 1967. Revision der Gattung *Thorictus* Germar (Coleoptera, Thorictidae). III. Teil. *Entomologische Abhandlungen und Berichte aus dem Staatlichen Museum für Tierkunde in Dresden* **34:** 145–199.
JOHNSON, W.F. & HALBERT, J.N. 1902. A list of the beetles of Ireland. *Proceedings of the Royal Irish Academy.* (3rd Ser.) **6**(4): 535–827.
KALIK, V. 1946. Dermestidae nouveaux de la faune paléarctique. *Entomologické Listy* **9:** 133–138.
KALIK, V. 1952a. New and interesting species of Dermestidae (Coleoptera). *Pan-Pacific Entomologist* **28:** 43–49.
KALIK, V. 1952b. Neue Dermestiden aus der paläarktischen Fauna (Col.) (5. Beitrag). *Annales Historico-Naturales Musei Nationalis Hungarici* (series nova), **2:** 75–76.
KALIK, V. 1986. Dermestidae der Kapverden (Insecta: Coleoptera). *Senckenbergiana Biologica* **67**(1–3): 77–83.
KALIK, V. & OHBAYASHI, N. 1982. A new dermestid beetle from Asia (Coleoptera). *Entomological Review of Japan* **37**(1)S: 65–67.
KINGSOLVER, J.M. 1969. *Anthrenus coloratus* Reitter, a Dermestid new to North America (Coleoptera). *Cooperative Economic Insect Report* **19**(5): 61–62.
KIRITANI, K. & KAWAHARA, S. 1963. Effect of adult diet on the longevity, fecundity, oviposition period and phototaxis in the black carpet beetle, *Attagenus megatoma* (F.). *Japanese Journal of Ecology* **13**(1): 21–28.
KLAUSNITZER, B. 1978. Ordnung Coleoptera (Larven). (Dermestidae: pp. 166–169). *Bestimmungsbücher zur Bodenfauna Europas* **10:** 1–378.
KORSCHEFSKY, R. 1944. Bestimmungstabelle der bekanntesten deutschen Dermestidenlarven. *Arbeiten über Physiologische und Angewandte Entomologie* **11**(2–4): 140–152 + 2 plates.

LAMB, K.P. 1950. The Australian carpet beetle, *Anthrenocerus australis* (Hope) (Col., Dermestidae), in New Zealand. *Entomologist's Monthly Magazine* **86:** 228–230.

LAMB, K.P. 1952. Note on the survival without food of Australian carpet beetle larvae (*Anthrenocerus australis* (Hope)) (Coleoptera: Dermestidae). *New Zealand Journal of Science and Technology* (B) **34**(1): 67–68.

LAWRENCE, J.F. 1982. Coleoptera. Pp 482–553. *In*: Parker, S.F. (Editor), *Synopsis and classification of living organisms,* Volume **2**. New York: McGraw-Hill.

LAWRENCE, J.F. & BRITTON, E.B. 1991. Coleoptera (beetles). Pp 543–683. *In*: C.S.I.R.O. *The insects of Australia*. Second edition **2**. Pp i–vi. 543–1137. Melbourne: Melbourne University Press.

LAWRENCE, J.F. & HLAVAK, T.F. 1979. Review of the Derodontidae (Coleoptera: Polyphaga) with new species from North America and Chile. *Coleopterists' Bulletin* **33:** 369–414.

LAWRENCE, J.F. & NEWTON, A.F. 1982. Evolution and classification of beetles. *Annual Review of Ecology and Systematics* **13:** 261–290.

LAWSON, A.K. (Ed.) 1930. *A check list of the fauna of Lancashire and Cheshire*. **1**. Pp. i–xii, 1–115. Hale, Cheshire: Lancashire and Cheshire Fauna Committee.

LINNIE, M.J. 1987. Pest control, a survey of Natural History Museums in Great Britain and Ireland. *International Journal of Museum Management and Curatorship* **6:** 277–290.

LLOYD, R.W. 1940. Coleoptera at Skenfrith, Monmouthshire. *Entomologist's Monthly Magazine* **76:** 177.

LOIR, A. & LEGANGNEUX, H. 1922. Accidents de travail occasionnés par des coléoptères. *Bulletin de l'Académie de Médecine* **88**(29): 68–72.

LOSCHIAVO, S.R. 1960. Life-history and behaviour of *Trogoderma parabile* Beal (Coleoptera: Dermestidae). *Canadian Entomologist* **92:** 611–618.

LOSCHIAVO, S.R. 1967. Adult longevity and oviposition of *Trogoderma parabile* Beal (Coleoptera, Dermestidae) at different temperatures. *Journal of Stored Products Research* **3:** 273–282.

LUFF, M.L. 1982. Notes and observations: *Reesa vespulae* (Milliron) (Coleoptera: Dermestidae) infesting stored rye inflorescences near Newcastle. *Entomologist's Gazette* **33**(1): 40.

LYSZKOWSKI, R.M. 1987. Seven species of Coleoptera apparently unrecorded from Scotland. *Entomologist's Monthly Magazine* **123:** 250.

MA, M., BURKHOLDER, W.E. & CARLSON, S.D. 1978. Supra-anal organ: a defensive mechanism of the furniture carpet beetle, *Anthrenus flavipes* (Coleoptera: Dermestidae). *Annals of the Entomological Society of America* **71**(5): 718–723.

MACKECHNIE JARVIS, C. 1945. Additions to the Bedfordshire list of Coleoptera. *Entomologist's Monthly Magazine* **81:** 126–127.

MACNAY, C.G. 1954. New records of insects in Canada in 1952: a review. *Canadian Entomologist* **86**(2): 55–60.

MADEL, W. 1941. Zur Kenntnis der Biologie einiger *Dermestes* – Arten. Vergleichende Beschreibung von *Dermestes peruvianus* Cast. und dem wieder neu einzuführenden *Dermestes haemorrhoidalis* Küster. *Entomologische Blätter für Biologie und Systematik der Käfer* **37:** 107–111.

MÄKISALO, I. 1970. A new pest of museums in Finland – *Reesa vespulae* (Mill.) (Col. Dermestidae). *Annales Entomologici Fennici* **36**(1): 192–195.

MARSHALL, J.E., JESSOP, L. & HAMMOND, P.M. (in press). Beetle larvae – a guide to families. *Handbooks for the Identification of British Insects* **5**(18).

MARTINEZ, M. & COCQUEMPOT, C. 1985. Sur la présence en France de *Reesa vespulae*, espèce indésirable (Coleoptera Dermestidae). *Entomologiste* **41**(1): 21–25.

MATHLEIN, R. 1971. Investigations in the biology of *Attagenus gloriosae* Fab. (Col., Dermestidae). *Meddelanden från Statens Växtskyddsanstalt* **15:** 159–186.

MEEUSE, A.D. J. 1965. The cleaning of skeletons by means of larvae of dermestid beetles. *Bijdragen tot de Dierkunde* **35:** 135–139.

MEHL, R. 1975. The American wasps'-nest dermestid, a pest in museums. *Fauna, Oslo* **28:** 198–204.

MERTINS, J.W. 1982. Occurrence of *Anthrenus fuscus* Olivier (Coleoptera: Dermestidae) in Iowa. *Entomological News* **93**(5): 139–142.

MILLIRON, H.E. 1939. A parthenogenetic new species of the genus *Perimegatoma* Horn (Coleoptera: Dermestidae). *Annals of the Entomological Society of America* **32:** 570–574.

MOORE, B.P. 1955. Notes on carrion Coleoptera in the Oxford District. *Entomologist's Monthly Magazine* **91:** 292–295.
MOREY, F. 1908. *A guide to the natural history of the Isle of Wight*. 560 pp. Newport: Country Press.
MORISON, G.D. 1925. The khapra beetle (*Trogoderma granarium* Everts). *Proceedings of the Royal Physical Society of Edinburgh* **21**(1): 10–13.
MORLEY, C. 1899. *The Coleoptera of Suffolk*. Pp. iii–xiv, 1–113. Plymouth: Keys.
MORLEY, C. 1915. *The Coleoptera of Suffolk. First Supplement*. Pp. 1–12. Plymouth: Keys.
MORLEY, C. 1935. A beech-tree's insects and their parasites. *Entomologist's Monthly Magazine* **71:** 90–91.
MOUND, L.A. (Ed.) 1989. *Common insect pests of stored food products: a guide to their identification*. 7th Edition. 68 pp. London: British Museum (Natural History).
MOURIER, H. & WINDING, O. 1975 (1977, English edition, translated and adapted by G. Vevers). *Collins guide to wild life in house and home*. 224 pp. London: Collins.
MROCZKOWSKI, M. 1951. *Anthrenus* (*Helocerus*) *polonicus* sp. n. from Central Eastern Europe with a description of a new subgenus of *Anthrenus* Geoffr. *Annales Musei Zoologici Polonici* **14**(17): 253–260 + plate 35.
MROCZKOWSKI, M. 1954. Klucze do Oznaczania Owadow Polski. Coleoptera: Dermestidae. *Polski Zwiazek Entomologiczny* **19**(52): 3–47. [in Polish].
MROCZKOWSKI, M. 1962. Dermestidae (Coleoptera) from the Kazakh SSR. *Annales Zoologici. Instytut Zoologiczny, Polska Akademia Nauk* **20**(14): 229–259.
MROCZKOWSKI, M. 1963. *Anthrenus sarnicus* sp. n. (Coleoptera, Dermestidae) from the Island of Guernsey. *Annals and Magazine of Natural History* (1962) (ser. 13) **5:** 697–700.
MROCZKOWSKI, M. 1968. Distribution of the Dermestidae (Coleoptera) of the world with a catalogue of all known species. *Annales Zoologici. Instytut Zoologiczny, Polska Akademia Nauk* **26**(3): 16–191.
MROCZKOWSKI, M. 1975. Dermestidae Skormikowate (Insecta: Coleoptera) [Dermestidae. Hide Beetles]. *Fauna Polski* **4:** 1–163. [in Polish].
NASH, D.R. 1983. Spring emergence of *Laricobius erichsoni* Rosenhauer (Col.: Derodontidae). *Entomologist's Record and Journal of Variation* **95:** 207.
NASH, D.R. 1990. *Trinodes hirtus* (F.) (Col.: Dermestidae) rediscovered in Suffolk. *Entomologist's Record and Journal of Variation* **102:** 186.
NEWBERY, E.A. & SHARP, D. 1915. *An exchange list of British Coleoptera*. viii + 56 pp. Plymouth: Keys.
O'CONNOR, J.P. 1978. An Irish record of the Hide Beetle *Dermestes carnivorus* F. (Col., Dermestidae). *Entomologist's Monthly Magazine* (1977) **113:** 150.
O'CONNOR, J.P. & NASH, R. 1986. Insects imported into Ireland. 8. Records of Hemiptera, Coleoptera, Diptera and Lepidoptera. *Irish Naturalists' Journal* **22**(3): 104–106.
OKUMURA, G.T. 1967. A report of canthariasis and allergy caused by *Trogoderma* (Coleoptera: Dermestidae). *California Vector Views* **14:** 19–22.
OLAFSSON, E. 1979. Hambjalla, *Reesa vespulae* (Mill.) (Coleoptera, Dermestidae), nýtt meindýr á Islandi. [English summary]. *Náttúrufræðingurinn* **49**(2–3): 155–162.
O'MAHONY, E. 1950. Irish records of introduced Coleoptera. *Entomologist's Monthly Magazine* **86:** 72–73.
OMER-COOPER, J. & TOTTENHAM, C.E. 1932. The Coleoptera of Wicken Fen. III. Hydradephaga; IV. Palpicornia; V. Staphylinidae-Ipidae. Pp 489–538. *In*: Gardiner, J.S. (Editor) *The Natural History of Wicken Fen*, part 6. Pp 489–652. Cambridge: Bowes & Bowes.
OTTESEN, P.S. 1985. *Attagenus smirnovi* Zhantiev (Col., Dermestidae) new to Norway – a coming insect pest. *Fauna Norvegica* B **32**(1): 108–109.
PARFITT, E. 1867. *A catalogue of the fauna of Devon, with notes and observations. Coleoptera*. 104 pp. Exeter: Clifford.
PARKIN, E.A. & WOODROFFE, G.E. 1965. The habits and control of the fur beetle. *Public Health Inspector*. **73**(7): 301–304.
PATEL, G.M. & CHARI, M.S. 1977. Bionomics of tobacco seed beetle *Attagenus fasciatus* Thunb. (Coleoptera: Dermestidae). *Gujarat Agric. Univ. Res. J.* **2:** 69–75 (Not seen; abstract in *Review of Applied Entomology* (A), 1977, **65:** 6922.)
PATEL, H.K. 1958. The furniture carpet beetle (*Anthrenus vorax* Waterhouse). *Memoirs of the Entomological Society of India* **6:** 1–47.

PAUL, C.F., SHUKLA, G.N., DAS, S.R. & PERTI, S.L. 1963. A life-history study of the hide beetle *Dermestes vulpinus* Fab. (Coleoptera: Dermestidae). *Indian Journal of Entomology* **24**(3): 167–179.

PEACOCK, E.R. 1976. *Dermestes peruvianus* Cast., *D. haemorrhoidalis* Küst. and other *Dermestes* spp. (Col., Dermestidae). *Entomologist's Monthly Magazine* (1975) **111:** 1–14.

PEACOCK, E.R. 1978. *Trichelodes* (= *Hexanodes*), type of Trichelodini new tribe, and its affinities with the Trinodini (Coleoptera: Dermestidae). *New Zealand Journal of Zoology* **5:** 341–349.

PEACOCK, E.R. 1979. *Attagenus smirnovi* Zhantiev (Coleoptera: Dermestidae) a species new to Britain, with keys to the adults and larvae of British *Attagenus*. *Entomologist's Gazette* **30:** 131–136.

PEARCE, E.J. 1926. *A list of the Coleoptera of Dorset*. 78 pp. Dorchester: Dorset Natural History and Antiquarian Field Club.

PEARCE, E.J. 1930. *A list of the Coleoptera of Dorset (2nd Supplement)*. 19 pp. Dorchester: Dorset Natural History and Archeological Society.

PETERSON, A. 1960. *Larvae of insects, an introduction to Nearctic species. Coleoptera, Diptera, Neuroptera, Siphonaptera, Mecoptera, Trichoptera*. Part 2. 416 pp. Columbus, Ohio: Ohio State University.

PINNIGER, D.B. 1989. *Insect pests in museums*. 45 pp. London: Institute of Archaeology Publications.

POPE, R.D. 1977. Coleoptera *In* Kloet, G.S. & Hincks, W.D., A check list of British insects. (Second edition). *Handbooks for the Identification of British Insects*, **11**(3): xiv + 105pp.

REES, B.E. 1943. Classification of the Dermestidae (larder, hide and carpet beetles) based on larval characters, with a key to the North American genera. *United States Department of Agriculture. Miscellaneous Publication* **511**: 1–18.

REES, B.E. 1947. Taxonomy of the larvae of some North American species of the genus *Dermestes* (Coleoptera: Dermestidae). *Proceedings of the Entomological Society of Washington* **49**(1):1–14.

RITCHIE, J.M. 1978. The discovery of *Oecobius annulipes* Lucas in Britain. *Bulletin. British Arachnological Society* **4**(5): 210–212.

ROTH, L.M. & WILLIS, E.R. 1950. The oviposition of *Dermestes ater* Degeer, with notes on bionomics, under laboratory conditions. *American Midland Naturalist* **44**(2): 427–447.

RUSTIN, M.H.A. & MUNRO, D.D. 1984. Papular urticaria caused by *Dermestes maculatus* Degeer. *Clinical and Experimental Dermatology* **9:** 317–321.

RYAN, J.G., O'CONNOR, J.P., BEIRNE, B.P. 1984. *A bibliography of Irish Entomology*. 367 pp. Glenageary: The Fly Leaf Press.

RYLE, G.B. & TOTTENHAM, C.E. 1920. Coleoptera in Sussex: a supplement to the "Victoria County History" list. *Entomologist's Monthly Magazine* **56:** 228–229.

SAGE, B.L. 1977. The Coleoptera of Skomer Island, Pembrokeshire, and their ecology. *Nature in Wales* **15**(4): 184–208.

SHARP, D. & FOWLER, W.W. 1893. *Catalogue of British Coleoptera*. London. 46 pp. London: Reeve.

SHARP, W.E. 1908. *The Coleoptera of Lancashire and Cheshire*. 75 pp. Lancashire and Cheshire Entomological Society.

SHELDON, J.M. & JOHNSTON, J.H. 1941. Hypersensitivity to beetles (Coleoptera). Report of a case. *Journal of Allergy* **12:** 493–494.

SHIRT, D.B. (Editor) 1987. Insects. *British red data books* **2**. 402 pp. Peterborough: Nature Conservancy Council.

SKIDMORE, P. & JOHNSON, C. 1969. A preliminary list of the Coleoptera of Merioneth, N. Wales. *Entomologist's Gazette* **20**(3): 137–225.

SKIDMORE, P., LIMBERT, M. & EVERSHAM, B.C. 1987. The insects of Thorne Moors. *Sorby Record* (1985) **23** (Supplement): 90–153.

SMITH, K.G.V. 1986. *A manual of forensic Entomology*. 205 pp. London: British Museum (Natural History).

SMITH, K.G.V. & SMITH, V. 1983. *A bibliography of the Entomology of the smaller British offshore islands*. 115 pp. Oxford: E.W. Classey Ltd.

SOKOLOV, E.A. 1973. Biology of five species of hide beetle (Coleoptera, Dermestidae), which are injurious to grain products in Central and South Kazakhstan. *Trudy Kazakhskogo Nauchno-Issledovatel'skogo Instituta Zashchity Rastenii* **12:** 57–64. [in Russian]

SOLOMON, M.E. & ADAMSON, B.E. 1955. The powers of survival of storage and domestic pests under winter conditions in Britain. *Bulletin of Entomological Research* **46:** 311–355.
STANSFIELD, G. 1989. Physical methods of pest control. *Journal of Biological Curation* **1**(1): 1–4.
STEELE, R.C. & WELCH, R.C. (Eds) 1973. *Monks Wood: a nature reserve record.* xiv + 338 pp, 3 pls. Monks Wood: Nature Conservancy.
STEPHENS, J.F. 1839. *Manual of British Coleoptera, or Beetles.* 443 pp. London: Longman, Orme.
STRONG, L. 1981. Dermestids – an embalmer's dilemma. *Antenna* **5:** 136–139.
SÜSS, L. & FOGATO, W. 1977–78. Considerazioni sulla sistematica e sulla diffusione di *Thylodrias contractus* Motsch. (Coleoptera Dermestoidea). *Bollettino di Zoologia Agraria e Bachicoltura* Ser.II, **14:** 95–112.
THOMPSON, J. 1978. First record of *Trogoderma variabile* Ballion (Col. Dermestidae) in Britain. *Entomologist's Monthly Magazine* **113**(1977): 29.
TIVINN, C.R. 1932. The occurrence of the odd beetle and a brief note on other Dermestid species in Canada. *Canadian Entomologist* **64**(7): 163–165.
TOMLIN, J.R. le B. 1913. The Coleoptera of Glamorgan. *Transactions of the Cardiff Natural History Society* **46:** 1–31.
VERDCOURT, B. 1949. Miscellaneous records of Arachnida and Insecta from N.W. Hertfordshire. *Entomologist's Monthly Magazine* **85:** 249–253.
VERDCOURT, B. 1982. Attack of a book by *Dermestes lardarius* L. (Col., Dermestidae). *Entomologist's Monthly Magazine* **118:** 254.
WAKELY, S. 1936. Occurrence of an Australian beetle, *Anthrenocerus australis* Hope, together with *Attagenus piceus* Ol. var. *megatoma* F. at Finsbury. *Entomologist's Monthly Magazine* **72:** 174–175.
WALKER, J.J. 1899. A list of the Coleoptera of the Rochester District (continued). *Rochester Naturalist* **2:** 542–548.
WALKER, J.J. 1931. Dermestid beetles attacking wood: an Elizabethan record? *Entomologist's Monthly Magazine* **67:** 114–115.
WALKER, J.J. 1932. An annotated list of the Coleoptera of the Isle of Sheppey. *Transactions of the Entomological Society of the South of England* (1931) **7**(2): 81–140.
WALLER, J.B. 1982. A further record of *Reesa vespulae* (Coleoptera: Dermestidae) in New Zealand. *New Zealand Entomologist.* **7**(3): 318–319.
WALLER, J.B. & WATT, J.C. 1979. A record of *Reesa vespulae* (Coleoptera: Dermestidae) in New Zealand. *New Zealand Entomologist* **7**(1): 51.
WATT, J.C. 1975. Notes on priority of family-group names in Coleoptera. *Coleopterists' Bulletin* **29**(1): 31–34.
WELCH, R.C. 1972. New records of Coleoptera from Huntingdonshire. *Report of the Huntingdonshire Fauna and Flora Society* (1971) **24:** 27–30.
WELCH, R.C. & HARDING, P.T. 1974. A preliminary list of the fauna of Staverton Park, Suffolk. Part 2. Insecta: Coleoptera. *Suffolk Natural History* **16**(5): 287–304.
WILSON, H.F. 1940. Lures and traps to control clothes moths and carpet beetles. *Journal of Economic Entomology* **33**(4): 651–653.
WILSON, W.A. 1958. Coleoptera of Somerset. *Proceedings of the Somersetshire Archeological and Natural History Society* **101,102** (Supplement): 1–167.
WOODROFFE, G.E. 1956. Some insects and mites associated with bat-roosts, with a discussion of the feeding habits of the Cheyletids (Acarina). *Entomologist's Monthly Magazine* **92:** 138–141.
WOODROFFE, G.E. 1961. Natural sources of domestic insects: a fundamental approach for the stored products entomologist. *Sanitarian,* Lond. **69:** 281–284.
WOODROFFE, G.E. 1965. The sterol requirements of several species of *Dermestes* (Col. Dermestidae). *International Congress of Entomology* **12:** 625.
WOODROFFE, G.E. 1966. Short communication. The significance of the ninth abdominal segment of the male in the systematics of *Dermestes* L. (Coleoptera, Dermestidae). *Journal of Stored Products Research* **1:** 377–379.
WOODROFFE, G.E. 1967. *Anthrenus sarnicus* Mroczkowski (Col., Dermestidae) in Britain. *Journal of Stored Products Research* **3:** 263–265.
WOODROFFE, G.E. 1971. *Globicornis nigripes* F. (Col. Dermestidae) in Buckinghamshire. *Entomologist's Monthly Magazine* (*1970*) **106:** 148.

WOODROFFE, G.E. 1975. Attagenus species. *Pest Infestation Control Laboratory Report* **1971–73:** 9.

WOODROFFE, G.E. & AYRE, M. 1968. Life-history studies of various beetles. *Pest Infestation Research* **1967:** 6.

WOODROFFE, G.E. & BURN, M. 1965. *Attagenus* sp. nr *cyphonoides*. *Pest Infestation Research* **1964:** 11–12.

WOODROFFE, G.E. & PARKIN, E.A. 1957. The first household infestation of the Australian carpet beetle *Anthrenocerus australis* (Hope)(Col., Dermestidae) in Britain. *Entomologist's Monthly Magazine* **93:** 144.

WOODROFFE, G.E. & SOUTHGATE, B.J. 1954. An investigation of the distribution and field habits of the varied carpet beetle, *Anthrenus verbasci* (L.) (Col., Dermestidae) in Britain, with comparative notes on *A. fuscus* Ol. and *A. museorum* (L.). *Bulletin of Entomological Research* **45**(3): 575–583.

ZHANTIEV, R.D. 1973. New and little known dermestids (Col.) in the fauna of the U.S.S.R. [in Russian]. *Zoologicheskii Zhurnal* **52:** 282–284.

ZHANTIEV, R.D. 1976. *Dermestids (fam. Dermestidae) of the fauna of U.S.S.R.* 182 pp. Moscow University. [in Russian].