

SPECIAL ARTICLE

Pictorial keys for the identification of domestic mites

M. J. COLLOFF* and F. Th. M. SPIEKSMAT†

*Department of Zoology, University of Glasgow, Scotland and †Department of Pulmonology, University Hospital Leiden, The Netherlands

Introduction

The importance of pyroglyphid house dust mites in allergic respiratory diseases in many parts of the world is now established [1-3], but the role of other anthropophilic mites inhabiting the domestic environment is less well-understood. For example, the question of the nature and extent of crossreactivity between allergens of pyroglyphid house dust mites and acarid and glycyphagid storage mites is a matter of much current study and debate [3-7]. The number of mite species that have been studied in relation to their allergenic significance is increasing steadily, and with this comes the prospect of confusion over their correct scientific and common names, their taxonomic identity and relationships.

During the Second International Workshop on Dust Mite Allergens and Asthma [7] it was proposed that the term 'Domestic Mites' be used for the various free-living mites that inhabit human dwellings, including such taxa as house dust mites (family Pyroglyphidae), storage mites (families Acaridae, Glycyphagidae and Chortoglyphidae) and their predator mites (family Cheyletidae). Clearly, correct taxonomic identification of allergenic mites is essential: not only does it underpin research on their biology and ecology, but is vital in the study of their allergenicity. For example, the sibling species, *Dermatophagoides farinae* and *D. microceras* are morphologically very similar and can be difficult to distinguish. Consequently, *D. microceras* has been widely misidentified as *D. farinae*. Yet several immunochemical studies have revealed important differences between the allergen repertoires of the two species [8-11]. Unfortunately, it is commonplace for allergen extracts to be prepared from cultures of mites without the identity of the species contained therein having first been checked. The need for the consistent application of this elementary precaution was a major reason for the First International Workshop on Dust Mite Allergens and Asthma [2] to recognize the need for simple but accurate keys for use by non-acarologists. The present work is the product of this demand.

Correspondence: Dr M. J. Colloff, Department of Zoology, University of Glasgow, Glasgow G12 8QQ, Scotland, U.K.

Principle of the keys

Most identification keys that are contained in formal taxonomic monographs are constructed from combinations of numerous morphological characters. This level of detail in the key is needed in order that all the members of the taxon (e.g. family, genus) be accommodated and discriminated. The optimal usage of this kind of key requires experience in mite taxonomy and morphology, and sometimes specialized optical systems and methods of specimen preparation. In order to be of practical value, a key to species in a particular habitat, such as house dust, does not require the same exhaustive treatment for the simple reason that the vast numerical majority of mites in a given habitat will be represented by relatively few species.

Most identification keys consist of verbal descriptions of the characters, usually in the form of couplets, and almost always in a telegraphic, technical style. Such verbal keys to the two subfamilies of pyroglyphid house dust mites have been published by Wharton [12] and, more recently, by Fain *et al.* [13,14]. Verbal keys to the genera and species of the storage mite families can be found in the handbook by Hughes [15]. In order to avoid the requirement of a knowledge of acarological morphology, a pictorial formulation was chosen for the keys presented here. Pictorial keys for the identification of mites from house dust have been presented before by van Bronswijk and Sinha [16] exclusively for pyroglyphid house dust mites, and by Ottoboni and Piu [17] for 'allergenic mites.'

The identification scheme presented here has a dendrogram format, and consists of five pictorial keys: to the different life-cycle stages, to the most common families of domestic mites, to the common genera of glycyphagid domestic mites, to those of the pyroglyphid house dust mites and to the species of the genus *Dermatophagoides*.

Short annotations to the keys

The pictorial keys have been designed to be self-explanatory, but a few short supplementary notes to each key are given below.

In key no. 1 the stages of the life-cycle of domestic mites are dealt with, identifying the egg, pre-larva, larva,

protonymph, motile and inert hypopus (deutonymph), tritonymph and the adult male and female. This key applies to the majority of domestic mite species belonging to the order Astigmata; the mites lacking specialized respiratory organs. It is noteworthy that the hypopial stage is absent from the life-cycle of members of some domestic mite families, e.g. the family Pyroglyphidae. More data on life-cycle biology of the various domestic mite families can be found in the work by Hughes [15]. The key is not applicable to the rarer orders of domestic mites, the Prostigmata, Mesostigmata or Oribatida.

Key no. 2 separates the adult stages of the various orders of domestic mites: the Prostigmata, Astigmata, Mesostigmata and Oribatida and identifies prostigmatid families such as the Cheyletidae and Tarsonemidae, and the astigmatid families such as the Acaridae, Chortoglyphidae, Glycyphagidae and Pyroglyphidae. The Chortoglyphidae are represented among the domestic mites by one species: *Chortoglyphus arcuatus*. With this key two genera of the Acaridae can be identified: *Acarus* and *Tyrophagus*. Although these two genera are found in house dust fairly frequently, they are not permanent residents, having usually invaded from infested stored foodstuffs in the kitchen. They are rarely present in house dust in large numbers and keys for identification to species-level can be found in Hughes [15] and Ottoboni and Piu [17].

In key no. 3 the most frequently encountered genera and species of the family Glycyphagidae in house dust are dealt with, discriminating the genus *Austroglycyphagus*, and the species *Glycyphagus privatus*, *G. domesticus*, *Lepidoglyphus destructor*, *Blomia tropicalis*, *B. tjiobodas* and *B. kulagini*. Members of this family represent an important component of the domestic mite fauna, particularly in damp homes and those in rural and agricultural communities in temperate regions. In the tropics and subtropics they may often be numerically dominant to pyroglyphid mites in house dust in both rural and urban areas.

The house dust mites of the family Pyroglyphidae are identified by keys no. 4 and 5. In key no. 4 the three domestic species of the subfamily Pyroglyphinae are presented: *Gymnoglyphus longior*, *Euroglyphus maynei* and *Hughesiella africana*, as well as the four least-common domestic species of the subfamily Dermatophagoidinae: *Sturnophagoides brasiliensis*, *Hirstia domicola*, *Malayoglyphus intermedius* and *M. carmelitus*. These species are found predominantly in the tropics and subtropics [13, 14].

In key no. 5 the six domestic species of the genus *Dermatophagoides* are presented: *D. pteronyssinus*, *D. farinae*, *D. evansi*, *D. microceras*, *D. neotropicalis*, and *D.*

siboney. The latter two species have been recorded from South America and the Caribbean, respectively [13, 14].

The keys are based on a combination of the authors' own observations on morphology of the taxa concerned and the original taxonomic descriptions, or redescrptions of species, which should be consulted for additional information [8, 12–14, 18–30].

Discussion

The keys presented here should aid the correct identification of the more common domestic mites encountered in samples of house dust in various parts of the world. Should, in the future, other species be found to occur regularly in house dust, then the keys will require revision and extension. The keys can be used to identify species in laboratory cultures that are kept for investigations of species-biology and for allergen production. However, it should be noted that where there is any doubt over the identity of species in cultures, or whether or not the culture is monospecific, samples should be referred to an acarologist.

When only one specimen of a particular species has been isolated from a sample of house dust, the applicability of certain parts of the key may be limited, because for some decisions it is preferable to have both a male and female specimen available for study. It is also desirable, though not always essential, to have complete, intact specimens, because damaged ones will be missing some characters, especially on the legs (usually the first structures to be lost from dead specimens).

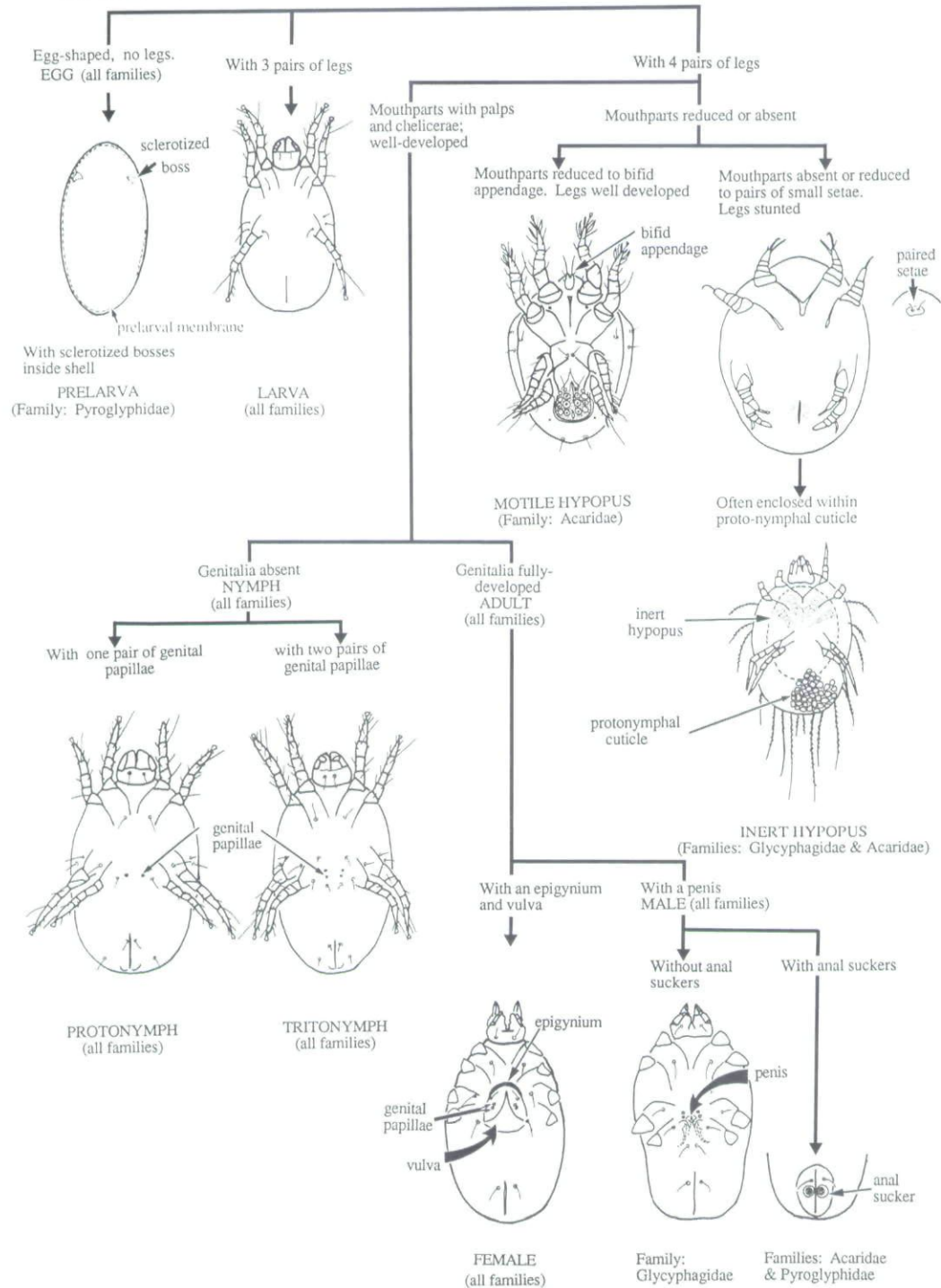
Some species of the house dust mite family Pyroglyphidae have abnormally-built, so-called heteromorphic males: that is males with some elements, particularly the legs, much bigger, stouter or otherwise more strongly developed than 'normal' (homomorphic) males. This phenomenon has been described for *Dermatophagoides neotropicalis* [23], for *D. farinae*, and *Sturnophagoides brasiliensis* [13, 14]. Abnormal morphological features in a female of *D. pteronyssinus* have been described once [31].

In order to be of value, any identification key needs to be tested in day-to-day use by many people, and information on difficulties and ambiguities conveyed back to the authors so that the key can be modified and improved. We would welcome criticisms from future users.

Acknowledgments

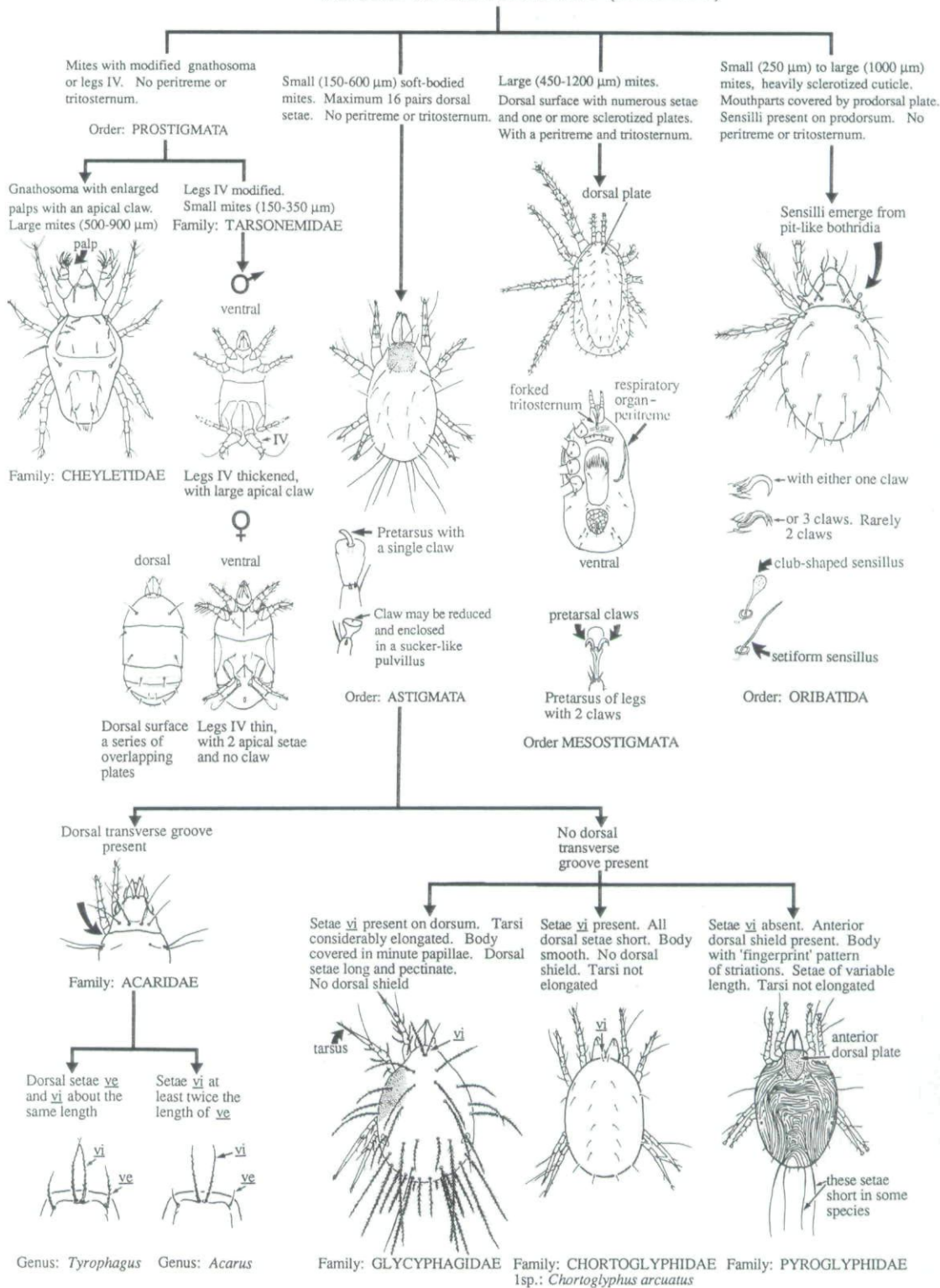
We wish to thank Mrs E. Denton (Department of Zoology, University of Glasgow) for preparing the captions to the keys. Part of this work was conducted during the tenure of a grant to M.J.C. from the Wellcome Trust.

KEY TO THE STAGES IN THE LIFE-CYCLE OF VARIOUS FAMILIES OF THE ORDER ASTIGMATA FOUND IN HOUSE DUST



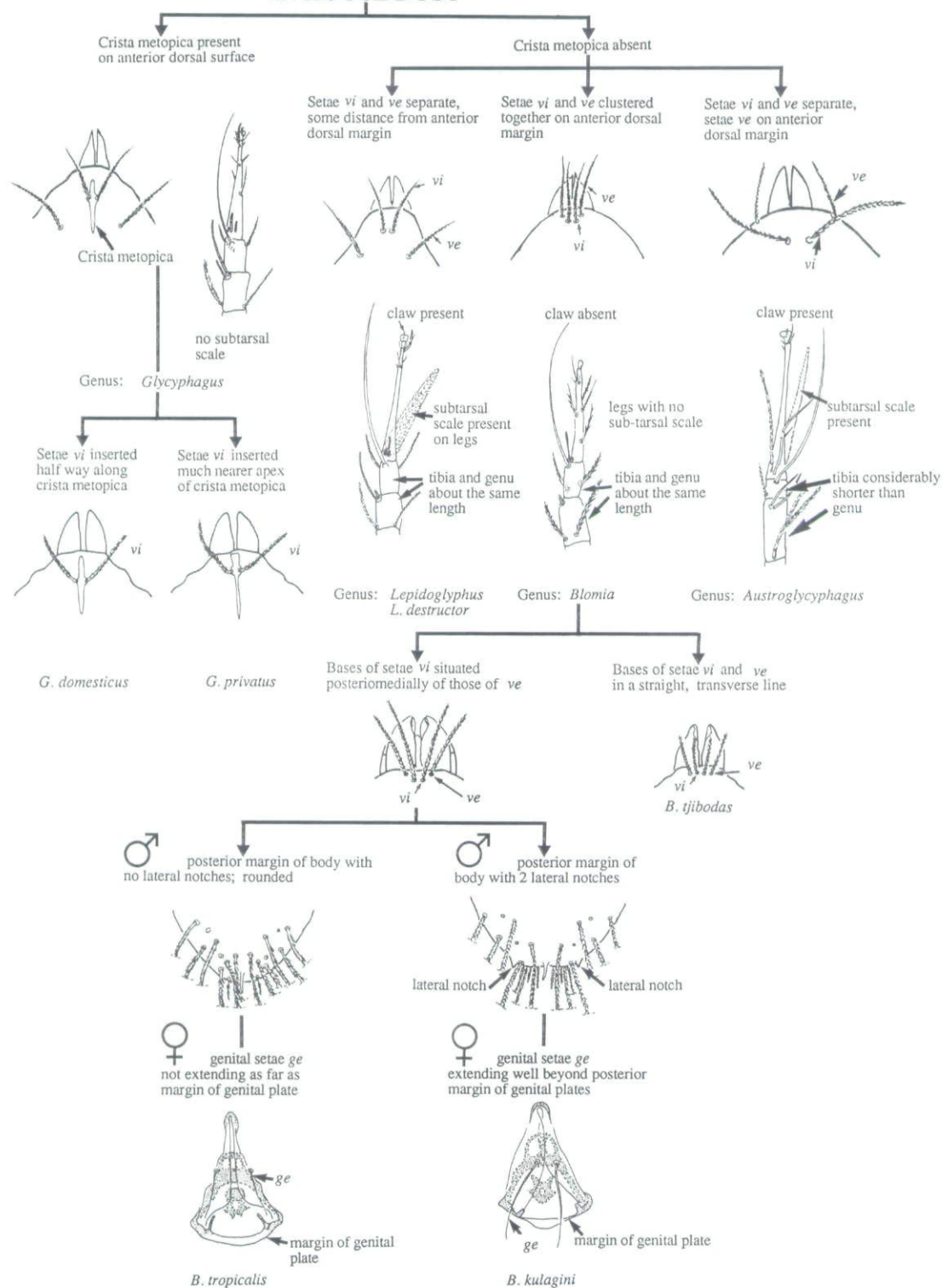
Key 1.

KEY TO ORDERS AND FAMILIES OF MITES
FOUND IN HOUSE DUST (ADULTS)



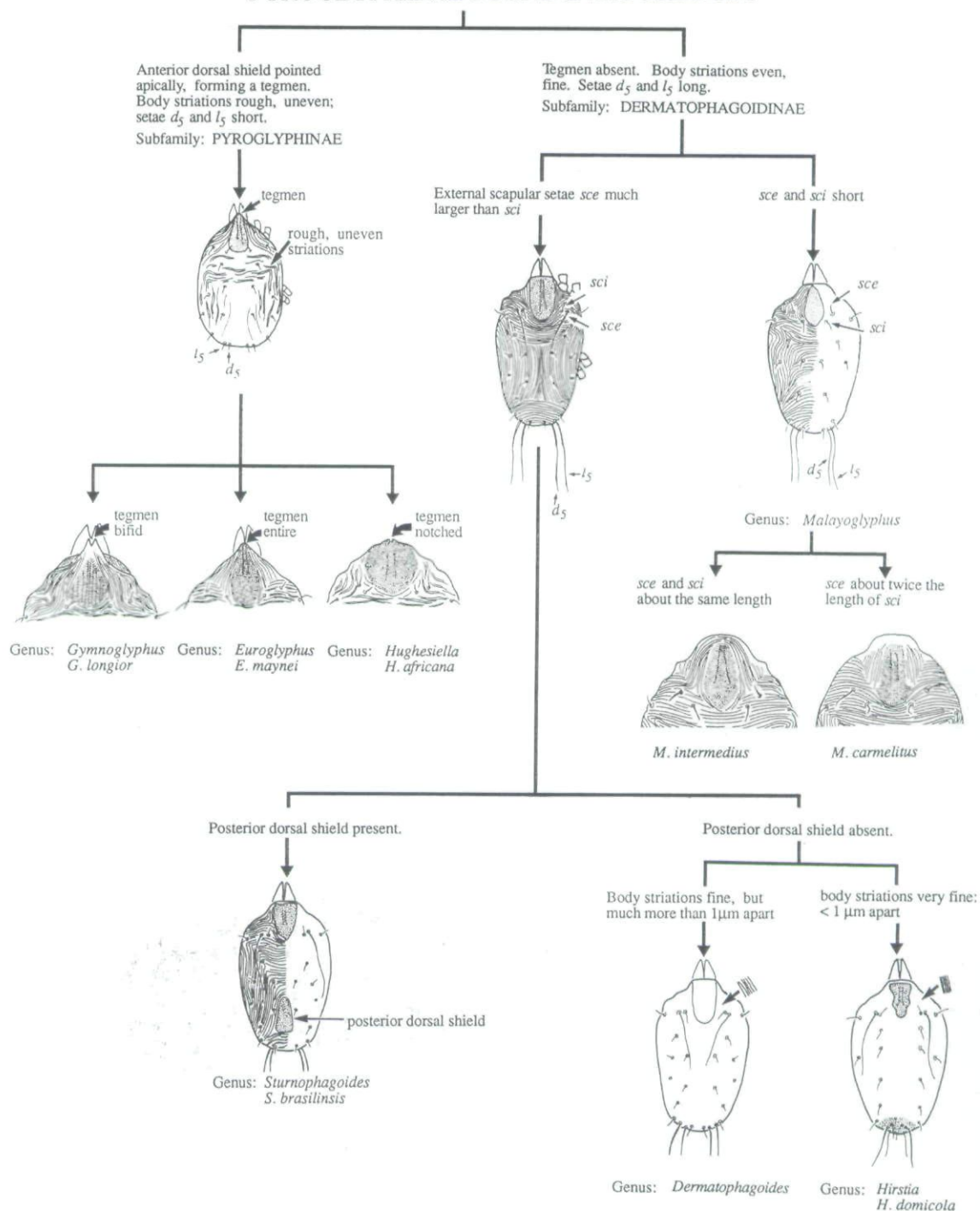
Key 2.

KEY TO GENERA AND SPECIES OF THE FAMILY GLYCYPHAGIDAE FOUND IN HOUSE DUST



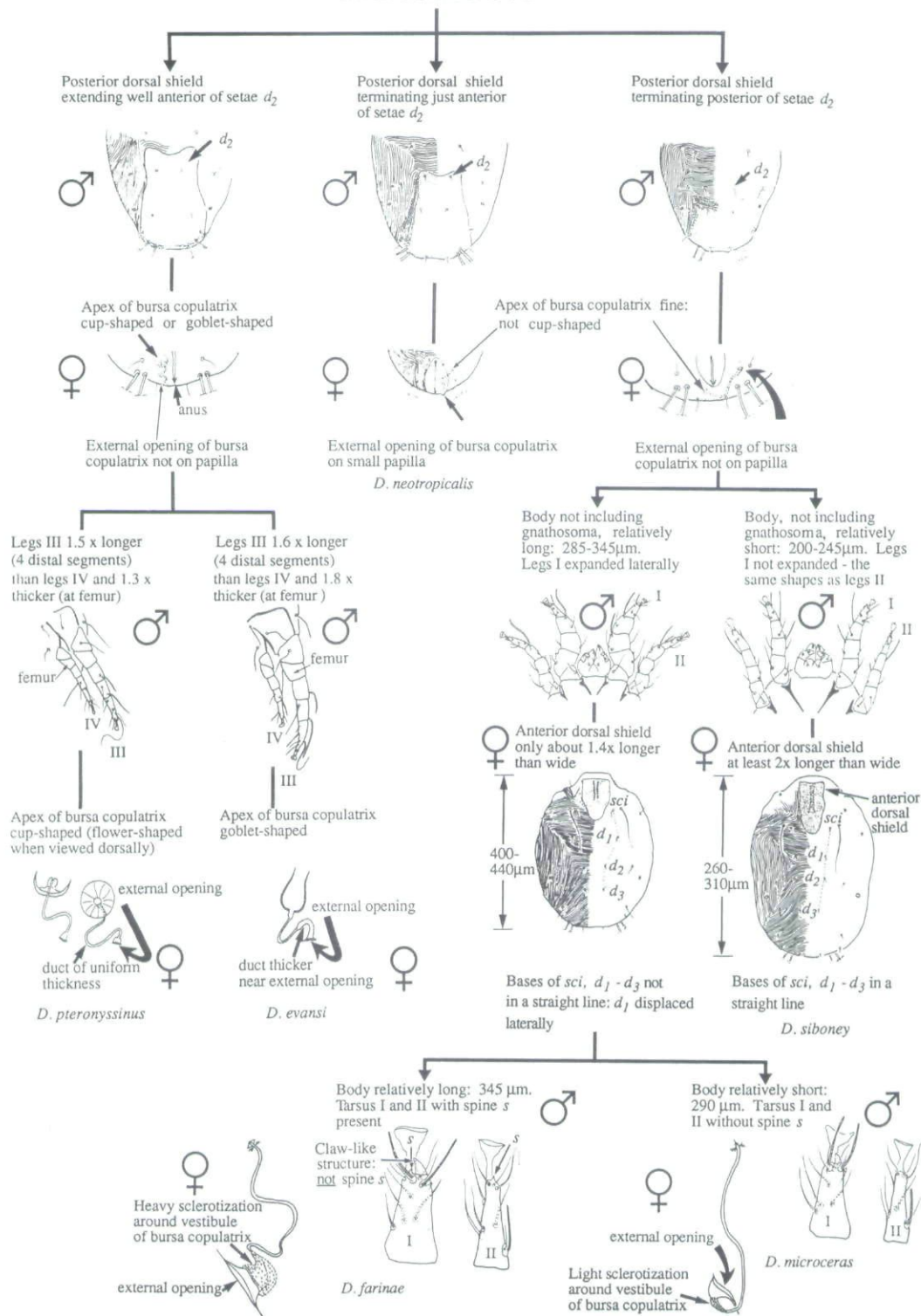
Key 3.

KEY TO SUBFAMILIES, GENERA AND SPECIES OF MITES OF THE FAMILY PYROGLYPHIDAE FOUND IN HOUSE DUST



Key 4.

KEY TO SPECIES OF *DERMATOPHAGOIDES* FOUND IN HOUSE DUST



Key 5.

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