illustrated key to West-Palearctic Genera of Pteromalidae

Zdenek Bouček
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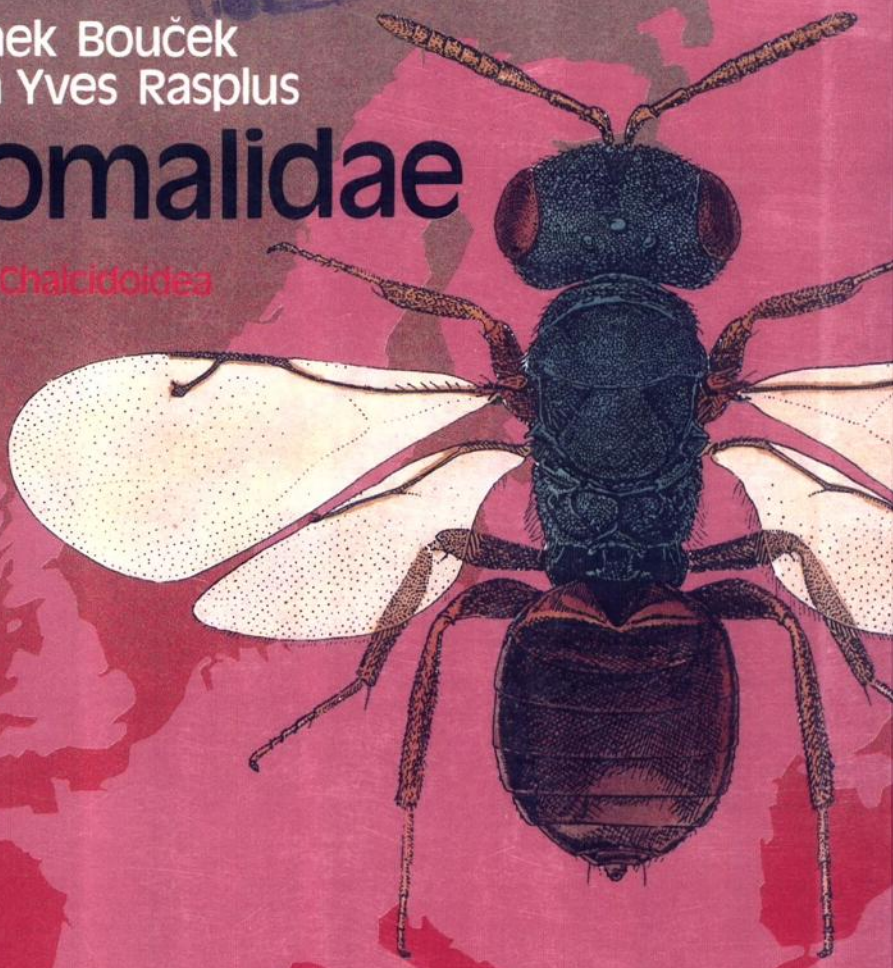
Hymenoptera-Chalcidoidea



TECHNIQUES ET PRATIQUES

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ILLUSTRATED KEY TO WEST-PALEARCTIC GENERA OF PTEROMALIDAE
(HYMENOPTERA: CHALCIDOIDEA)

ILLUSTRATED KEY TO WEST-PALEARCTIC GENERA OF PTEROMALIDAE

(HYMENOPTERA: CHALCIDOIDEA)

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CONTENTS

SYNOPSIS

This is a new key to the genera of Pteromalidae (Hymenoptera Parasitica) of the western part of the Palearctic region. It contains characteristics of 221 genera and 10 subgenera. Each of these taxa is accompanied by records of synonymy and key works published after Graham's work (1969), and by a summary of known biological data including hosts and geographical distribution, and the number of species of each genus. The key is illustrated by 491 elaborate drawings and 110 electroscan photographs. Two new genera and five new species are described and the newly discovered necessary changes of names are presented.

PREFACE

Nowadays most of us increasingly realize that our children's future depends on preservation of nature, especially on the ecological conditions surrounding our lives. Much attention is being given to the problems of environmental degradation but in many cases our knowledge of the biotic factors involved is gravely deficient. We older naturalists can call to mind (supplemented by the records of films and photographs) how much greater was the variety in nature even as little as twenty or thirty years ago, the decrease in wild flowers for instance is a phenomenon that will be familiar to many people.

The detrimental changes affect not only larger plants and animals, but to an alarming extent the whole microcosm of nature of which the insects form a substantial part. Many species that are pests of the monocultures of crops and trees are relatively well known. But less is known about the thousands of species that are not of direct economic interest, and almost nothing is known about their ecological role. Then too the beneficial honeybee is relatively well known but in Europe alone there are many hundreds of other species of bees that are known only to the specialists on the group but that are important in pollinating many flowering plants so keeping them in existence. There are also thousands of species of other beneficial insects, such as parasites (parasitoids) of various insect species among them pests of our cultivated plants. They maintain a sort of balance in nature, preventing mass breeding of their particular hosts, or at least reducing their epidemic outbreaks. But when we ask how much even scientists know about these parasitic insects, the answer often is: very little.

Systematic research on insects has often been neglected and the greatest amount of knowledge is owed, in particular in Europe, to dedicated amateur entomologists. However, because many of them studied insects only because they liked it, they paid attention mainly to larger and colourful insects. Hence in the past insects of smaller size, and that includes most of the parasitic Hymenoptera, attracted only few students. Even among professional entomologists, because there was practically no helpful literature and the optical equipment was not good enough, little work was done on the group.

The Hymenoptera is probably the largest order of insects in Europe, represented by thousands of species in every country (a recent check-list enumerates almost 7500 species from Czechoslovakia (Šedivý 1989). They include bees, wasps, sawflies and ants, but about two-thirds of species belong to the Hymenoptera Parasitica, often collectively called 'parasitic wasps'. These wasps include over two dozen families, the three largest being Ichneumonidae and Braconidae (both Ichneumonoidea), and Pteromalidae (Chalcidoidea).

The pteromalids, treated in this booklet, are alone represented in Europe by certainly over 1000 species. About 98% of them develop as parasites (parasitoids) of various stages of other insects or, rarely, of spiders; only few species are known to be exclusively or partially phytophagous. Therefore they play an enormous (though often hidden) role in agriculture, forestry and in nature in general.

However, knowledge of the group is rather poor, despite a relatively recent monograph published by Graham (1969). Many species, especially those of the largest subfamily, the Pteromalinae, look rather alike and differ only in tiny characters that are often difficult to describe. Students of pteromalids are usually soon discouraged by these difficulties and the frequently uncertain discrimination of species resulting from them, even though the species studied are apparently different from others in their biology. By presenting a new and richly illustrated key to their genera it is hoped to facilitate increased study of these wasps so allowing the better assessment of their ecological values and enabling their great potential to be exploited in the fight against pests of our crops and trees.

ACKNOWLEDGEMENTS

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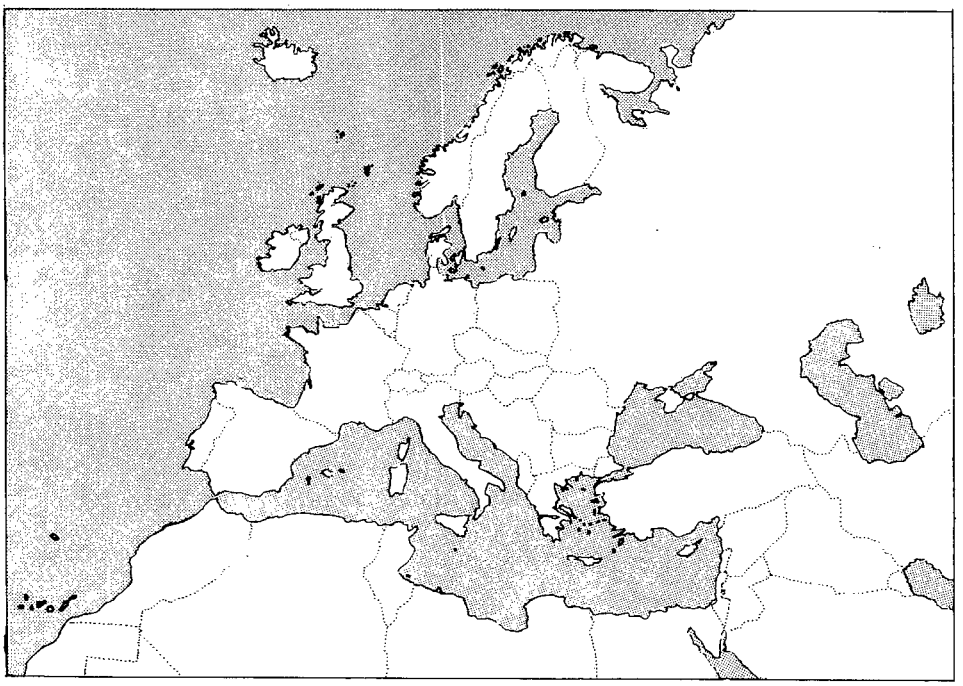
Drs M. de V. Graham, G. Delvare and E.E. Grissell (US National Museum in Washington) kindly read the manuscript and Mr. T. Huddleston (BMNH in London) corrected a part of it.

Electronscan photographs were prepared by the junior author, with help of Mr. P. Barry and Mr. J.L. Dommanget (INRA in Versailles); the latter assisted us also in various other ways.

INTRODUCTION

GEOGRAPHICAL LIMITS

The area covered by the key is outlined on the adjoint map. Biogeographically it is the western part of the Palearctic region, i.e. that west of the Ural Mountains, including the whole Europe, parts of the Middle East, Africa north of the Sahara and the Islands in the Atlantic ocean: Iceland, Madeira and the Canary Islands. In other terms it covers, in the genera and comments on the species included, the European part of the Northern temperate zone with the Mediterranean subregion.



Map of the West-Palearctic region as treated here.

STATE OF RESEARCH IN THE AREA

The pteromalids, as parasitic wasps of small to moderate size (most of them 1.5-3 mm in body length), had been little studied before the middle of this century.

Apart from purely descriptive works of Walker, Westwood, Nees ab Esenbeck, Förster, Ratzeburg and a few less important authors of the 19th century, there was one outstandingly useful work - Thomson's monograph (1876, 1878) of the Scandinavian species. In spite of many smaller and often useful papers published by a number of European authors up to about 1950, including keys by Schmiedeknecht (1930), every serious student of Pteromalidae had to turn back to Thomson's descriptions and groupings of genera and species (published in Latin, with introductory remarks in Swedish). Nikolskaya (1952) published generic keys that were unfortunately based largely on unreliable descriptions of previous authors, only partly on actual material. Bouček's keys to genera were found more useful, especially because of his illustrations (1957 in Czech, 1964 in English under Peck, Bouček and Hoffer). In 1969 Graham published his monumental monograph of the Pteromalidae of North-Western Europe. This will certainly long remain unsurpassed - an excellent treatment of the whole group to species level. That is the first modern rigourous and comprehensible treatment of the group, revealing also its richness of forms (over 800 species in 196 genera).

In the following twenty years the family has been studied in several more countries. Several dozens of species and genera have been described as new, a number of other taxa have had their names corrected or otherwise changed. Besides, however excellent Graham's monograph is, students often feel that the great care by which all known exceptions were included in the keys made them very complicated and led to uncertainty in identifications. It was felt in particular that still more illustrations would make the keys easier to use.

Graham (1969) keyed out 196 genera of which 11 had been since synonymized or reduced to subgenera. Chrysolampinae, with 3 genera in Graham, have been transferred to Perilampidae. Since his publication 42 genera have been described as new, but only 26 of these are now recognized as valid. Now 14 more genera are added, mostly from Mediterranean countries, so that the present paper offers illustrated keys to 221 genera and 10 subgenera. In the treated area these genera presently include almost 1000 described and recognizable species.

Graham's keys were translated, with very few additions or alterations, into Russian (Dzhanokmen 1978) and that was later translated back into English (see Tryapitsyn 1987), these two translations are supposed to be keys to pteromalids of the European USSR. In general, however, this group has been studied to some extent in central and western Europe (but hardly e.g. in Germany), to a lesser degree in southern Europe, but very little in parts of the European USSR, and still less in North Africa and the Middle East. Many undescribed taxa may be discovered especially in the last two areas, including some afrotropical elements widely distributed further south.

COMMENTS ON SYSTEMATICS, NAMES AND THE KEY

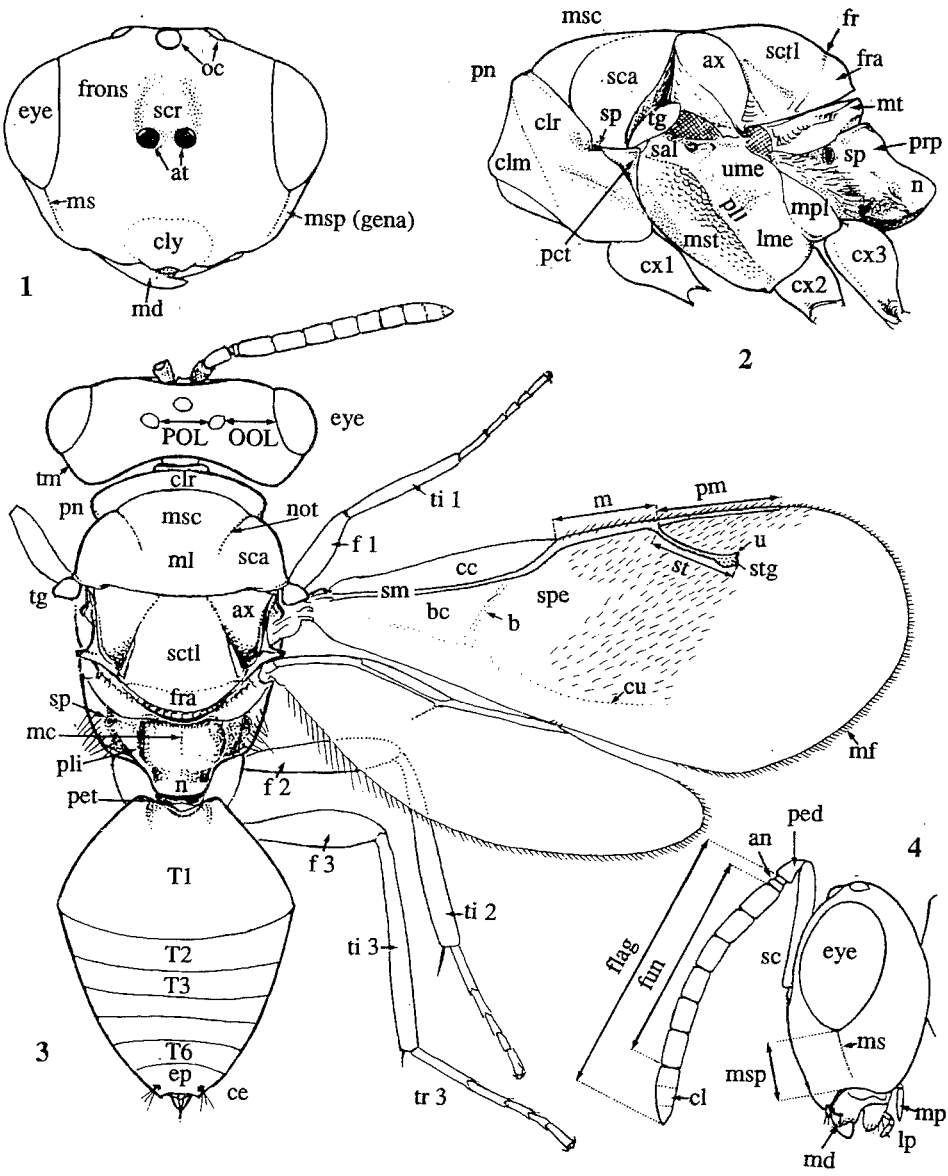
From the simplified history mentioned above it is clear that a thorough evaluation of the suprageneric taxa, e.g. by cladistics methods, might well enhance the stability of the systematics of the group. It should also clarify relationships of taxa,

including the limits of the subfamilies and other suprageneric categories. As our key is supposed to be mainly a practical tool for identification of the genera, we make little mention of the subfamily and tribal classification.

The present somewhat vague limits of certain suprageneric taxa, in particular those concerning the Pteromalinae and Miscogasterinae (with their constituent elements), are reflect on the instability of the classification, some taxonomists even questioning the family limits. We consider the classification presented here to be the best solution possible on the evidence at present available. The placement of the Chrysolampinae, however, now regarded as a part of Perilampidae (Bouček 1988), still poses problems because of their similarity to some Pteromalidae. *Odontofroggatia* Ishii, found in Greece and Israel and sometimes classified as a pteromalid genus (e.g. Compton 1989), belongs to the Agaonidae, Epichrysomallinae (Bouček 1988).

In some cases we use subgenera as a taxonomically helpfull category, mainly in cases where further research (when more species are described and their relationships analysed within the relevant group) may either reduce these subgenera to species groups, or upgrade them to genera. In any case in the applied literature (including textbooks) subgenera should be disregarded and only *Genus species* Author used as scientific names. The Author name is placed in brackets if the species name was originally proposed (described) under a genus name different from the present one. It is a useful abbreviation of reference to the original description of the species. According to the generally recomended practice the Author name should be at least once used unshortened in every publication of scientific literature (but L. for Linnaeus and F. for Fabricius are generally used). The year after the Author's name is used only in taxonomic literature, especially in groups in which very few comprehensive works are available and the identity of taxa is not yet well established.

The key is dichotomous, hopefully easy to follow, with back reference to the previous couplet. Preference was given to practical characters. Therefore the key is in many respects artificial, and so some large and diverse genera (*Pteromalus*, *Mesopolobus*, etc.) are keyed out more than once. The key is based mainly on the females, because their distinguishing generic characters are generally more conspicuous than in the males. The males often have unusual specific features but, being on average of smaller size, sometimes even subnormal (dwarfs), their generic characters are less easy to detect. Some difficulties in identification are enhanced by the extensive intraspecific variation which to some extent may affect also the generic identification. In general the males of many species have the petiole longer than the females. The wing spots or infumation may be weak in teneral specimens (killed too soon after emerging from the pupa) or even absent in males. The variation in the size of the body is anusually great in many parasites of wood-boring beetles and bark beetles. Another aspect of variation affects the size of the wings; some species exhibit gradual brachyptery, i. e. shortened wings of varying length (e.g. in *Trichomalopsis*), or always reduced to the same length (*Meraporus*, males of *Nasonia* etc.).



1-4. *Pteromalus puparum* (L.). --- *an*: anelli, *ax*: axilla, *at*: antennal toruli (sockets), *b*: basal hairline, *bc*: basal cell, *cc*: costal cell, *ce*: cercus, *cl*: clava, *clm*: collum, *clr*: collar, *cly*: clypeus, *cu*: cubital vein, *cx 1-3*: fore, mid and hind coxa, *ep*: epipygium, *f 1-3*: fore, mid and hind femur, *flag*: flagellum, *fr*: frenal line, *fra*: frenal area, *fun*: funiculus, *lme*: lower epimeron, *lp*: labial palpus, *m*: marginal vein, *mc*: median carina, *md*: mandible, *mf*: marginal fringe, *ml*: mid lobe, *mp*: maxillary palpus, *mpl*: metapleuron, *ms*: malar sulcus, *msc*: mesoscutum, *msp*: malar space, *mst*: mesepisternum, *mt*: metanotum, *n*: nucha (neck), *not*: notaulus, *oc*: ocelli, *OOL*: ocell-ocular distance, *pct*: prepectus, *ped*: pedicellus, *pet*: petiolus, *pli*: plica, *pll*: pleural line, *pm*: postmarginal vein, *pn*: pronotum, *POL*: post-ocellar distance, *prp*: propodeum, *sal*: subalar area, *sc*: scapus, *sca*: scapula (lateral lobe), *scr*: scrobes, *sctl*: scutellum, *sm*: submarginal vein, *sp*: spiracle, *spe*: speculum, *st*: stigmal vein, *stg*: stigma (knob), *T1-T6* : gastral tergites, *tg*: tegula, *ti 1-3*: fore, mid and hind tibia, *tm*: temple, *tr3*: hind tarsus, *u*: uncus, *ume*: upper mesepimeron.

The illustrations are placed always on the right-hand page and, where possible, next to the relevant text on the two adjoining pages. The drawings of features of males are always accompanied with a male symbol, those of females only occasionally. The drawings are mostly original, but many are partly redrawn from previous publications, mainly those of the senior author, but a few of Graham's, Delucchi's, etc.

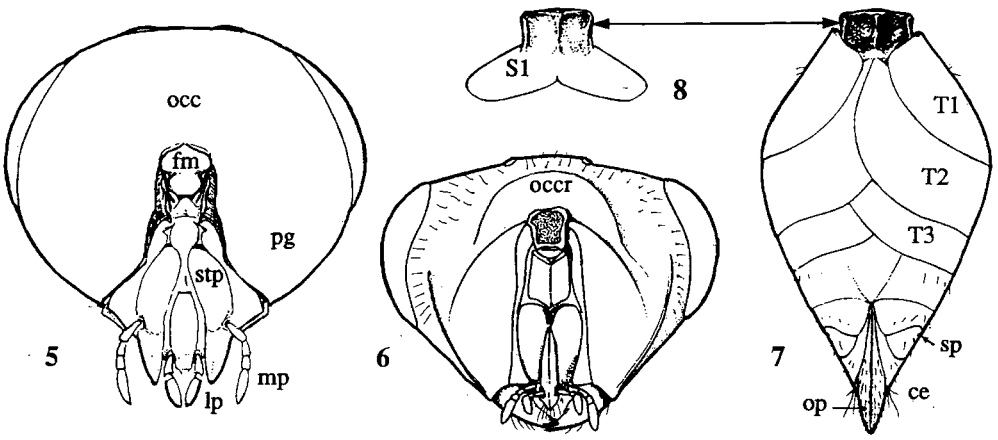
The comments under each genus include all synonyms established after Graham's monograph (1969), those mentioned by him are not repeated. Further statements include number of species of the genus in the treated region and a summary of the known biology. References are given to key works published after Graham's work.

Four new genera were described, with taxonomic notes on some other genera and species, just before the completion of this manuscript (Bouček 1991), two more are described here (pp. 129-131) together with several species mentioned in the text, and with some additional notes concerning mainly the synonymy.

Only the more recent publications are cited (References, pp. 133-138), especially those including descriptions of new genera or new generic synonymy. Those given by Graham are not repeated.

MORPHOLOGICAL TERMS

The terminology follows Bouček (1988). The term 'thorax' as used here includes the propodeum and thus is an equivalent to the 'mesosoma' of the mainly American literature. The petiole plus the gaster together compose what is called 'metasoma' in that literature. The antennal formula denotes the scape, the pedicellus, the number of anelli, of funicular segments and of claval segments, e.g. 11263 for



5. *Pteromalus puparum* (L.). --- 6. *Asaphes vulgaris* Walker. --- 7, 8. *Trichomalopsis* sp. --- *ce*: cercus, *fm*: foramen magnum, *lp*: labial palpus, *mp*: maxillary palpus, *occ*: occiput, *occr*: occipital carina, *op*: ovipositor sheaths, *pg*: postgena, *S1*: first gastral sternite, *sp*: spiracle, *stp*: stipes, *T1-T3*: gastral tergites,

Pteromalus puparum (fig. 3). Almost all terms are illustrated in figs 1-8. POL is the distance between posterior ocelli, OOL the ocell-ocular distance (between posterior ocellus and the eye).

The surface of the pteromalid body exhibits various types of sculpture. Some sculpture is occasionally indicated in the drawings but to help the user of the key more a number of electroscan photographs are reproduced on pp. 115-128.

The simple piliferous puncturation, i.e. punctures (dots) bearing hairs, is relatively rare. It is found e.g. in *Spalangia* (photo 35 and fig. 431) in which case the interspaces are often smooth or they may be finely reticulate to rugulose. In some Cleonyminae, as in *Cleonymus* and *Amotura*, the thorax sculpture consists only of dense piliferous puncturation. In most forms, however, the piliferous punctures are reduced in number and the surface of the thorax is characteristically reticulate (and often bearing metallic gloss, a combination so typical of most Pteromalinae). Deep isolated punctures are found on the head of *Systasis* (photo 37), very deep irregularly scattered ones on the lower face of *Roptrocerus* (photo 26).

The reticulation may be of mainly two types: a less common engraved reticulation and the more widespread raised reticulation.

The engraved reticulation (photo 1-6) is a network of engraved meshes. The engraved lines of the reticulation may be very shallow and fine, so that the surface looks almost smooth, as in *Macroglenes* (photo 1). The meshes may be sometimes quite wide as in *Psychophagus* (photo 2), *Nasonia* (photo 3) or *Perniphora* (photo 6). Deep engraved reticulation is found on the anterior part of mesoscutum of *Perniphora* (photo 6). Associated with piliferous punctures engraved reticulation gives a characteristic aspect to the mesoscutum of *Semiotellus* (photo 4).

The raised reticulation is very common in pteromalids and exhibits a wide range of variation. The normal type, almost without piliferous punctures, is shown on the mesoscutum of *Pteromalus* (photo 9), with smaller dense meshes e.g. in *Roptrocerus* (photo 14), and dense deep meshes encountered on head and thorax of many species associated with conifers, in particular with *Pinus* and *Juniperus*. On the other hand raised reticulation may be wide-meshed and shallow, as on the mesoscutum of *Dibrachys* (photo 13). The meshes can be polygonal or lengthened in transverse, diagonal or longitudinal direction, often one merging with another (e.g. *Holcaeus*, photo 11). The intermixed piliferous punctures may be conspicuous, as in *Meraporus* (photo 12) or indicated only by the arising hairs which may be fairly dense as in *Gugolzia* (photo 10).

Another type of sculpture is rugosity (wrinkles) or strigosity which may appear as striation if regular. Radiating striation on the lower face of many species provides sometimes good characters (photos 17, fig. 331). The mesoscutum of *Oxyglypta* is characteristically transversely striate (photo 7), whilst on its frenal area the rugosity merges with raised reticulation (photo 8).

The pronotum often has antero-dorsally an edge separating the dorsal collar from the sloping neck (collum). The form of the separating edge is used as key character of some genera. This part of pronotum can be rounded (photo 97), or

margined by a blunt edge, a rectangular edge in which the meshes of reticulation are present right on the edge (e.g. most *Pteromalus*, *Mesopolobus*; photos 98, 101), or not quite sharp but raised edge (photo 96) or the edge is sharp, carinate (photos 93, 95, 100).

STUDY OF THE PTEROMALID MATERIAL

The best way to begin a study of Pteromalidae is with fresh material, especially if it is still soft or relaxed. Methods of collecting and mounting are described by Noyes (1982). We want to stress that at least for those who have no extensive assistance in mounting, the best method proved to be to glue the specimen on a white quadrangular card, with the body placed on its right-hand side. The specimen, when being mounted, should preferably be soft or relaxed, so that at least the antennae and wings can be lifted with a fine brush. The glue should be water-soluble, non-poisonous, preferably clear (e.g. "Lepage's". If water-soluble glue is used on a card and some of its parts cannot be seen, it is easy to remount it by putting a drop of water on the specimen or its parts, e.g. the head. As seen from the Key below actually all body parts should be accessible for examination, especially including the lower face (below antennae, with the mouth region) and the propodeum, and of course the antennae, wings, dorsal and lateral parts of the body, apex of the mid and hind tibia (spurs) etc. Mounting on triangular points, customary in America, provides even better visibility of all body parts and is relatively quick. It is often preferred, if the specimen cannot be relaxed after being kept in alcohol, from collecting into traps of various types. However, the specimens mounted this way are very vulnerable and after several handlings the appendages sticking out unprotected are liable to get broken. Apart from this, fine detail e.g. the anelli, and hairs on the wing, are more distinguishable against the white surface of the quadrangular card which also provides much better protection for the appendages. The specimens collected e.g. by sweeping or rearing from hosts, galls, etc., are picked up with an aspirator and killed by vapours of ethyl acetate. For several hours (depending on the dryness of the air) after killing the specimens remain relaxed and their body parts can be moved as needed. Specimens killed this way can be left to dry (and 'layered', i.e. placed between layers of fine soft paper) and relaxed any time later, e.g. by several drops of glacial acetic acid placed nearby. Even the mandibles can be opened in such relaxed specimens, without dissection. Of course all specimens must be properly labelled.

A good stereo-microscope is needed for a thorough examination of all pteromalids and for their identification. The resolution power of the optical equipement can be greatly enhanced by good light. A strong light is often needed, but it must be diffused. Either a luminescent (neon) lamp is used or the light can be diffused by inserting a piece of mat translucent sheet between the light and the object, nearer to the latter. The part examined must be placed in proper position, or the direction of light must be kept changing till the examined part can be seen clearly. That applies especially to the examination of the pronotal edge which can be seen best if the

incident light is directed from the posterior part of the body. Other features that require careful lighting are the meshes of the sculpture, sensilla (singular: sensillum) of the antenna and the micropilosity areas on the claval segments.

BIOLOGY

The morphological diversity of pteromalids seems to reflect the wide variety of their biological attributes. Ecological preferences are apparent even in species the hosts of which are still unknown. Many pteromalids are found in open ground areas. Some of these seem to be associated with sandy or light soil, others with grassy vegetation of certain kinds, others with marshes, reeds, or even with water vegetation (e.g. *Gyrinophagus* attacking cocoons of gyrinid beetles or of neuropterous Sisyridae). There are species that inhabit deciduous or coniferous forests, or are attracted by old trees. The temperature requirements may be the decisive factor in limiting the spread of a species. Then we can group them as Mediterranean elements, alpine elements, and so on. Other climatic factors may also be important such as the extent of precipitation, the severity of winters and whether summers are hot and dry or not.

The trophic conditions seem to be most important. Very few species (e.g. some *Systasis*, but probably also some other Ormocerinae of which many are known to be gallmakers e.g. in Australia) seem to develop partly or exclusively on a vegetarian diet. They consume the seeds of certain grasses, or the soft parts of plant galls caused by Cecidomyiidae (Diptera) or by Cynipidae (Hymenoptera). They seem to be inquilines rather than parasites, but in the past all species of parasitic groups reared from the galls were recorded as parasites of the gallmakers. This role has been questioned only recently, and more detailed studies are greatly needed.

We are using here the term parasite, but some hymenopterists prefer the term parasitoid for 'protelean parasites', i.e. species which are parasitic in habit only in their larval stage. Our reason for this is that some terms (e.g. to parasitize) cannot be derived from 'parasitoid' and in any case the term parasite does not cause any confusion anyway (Bouček 1988: 19).

Almost all pteromalids of the region are either known to be or are assumed to be entomophagous parasites. However, some of them act as predators, e.g. the Eunotinae, that (as far as known) oviposit into the egg-mass under the body of a dying female coccid and their larvae are predatory, feeding on the eggs of the coccid. A *Panstenon* larva feeds in a similar way on eggs and young larvae of cicadellids in stems of Gramineae. Some pteromalids oviposit into the egg of the host, others into a larval stage, or into the prepupa or pupa. A very few species develop in adult beetles. *Tomicobia* species oviposit into weevils (*Otiorhynchus*) or into bark beetles. *T. seitneri* (Ruschka) develops in the abdomen of adult *Ips typographus* (L.), but may itself be attacked by another pteromalid, *Mesopolobus typographi* (Ruschka). Another such hyperparasitic species is *Pteromalus conopidarum* (Bouček) which parasitizes conopid (dipterous) larvae within the body of a bumble-bee (*Bombus*).