METAPLEURAL TRANSFORMATIONS WITH RESPECT TO PROPODEUM AND METAPOSTNOTUM IN HYMENOPTERA

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Abstract

In Symphyta the metapleural suture is prominent and the epimeron is continuous with the metapostnotum through an epimeropostnotal bridge. However, in Xiphydridae and Siricidae the bridge and the metapostnotum are considerably reduced. In Hymenoptera Parasitica the pleural suture has become marginal thus obliterating the epimeron and narrowing the bridge. In aculeatans (Chrysididae, Scoliidae and Sphecidae) this bridge and the metapostnotum are untraceable and the episternum becomes subdivided into 2 portions. Similar conditions occur in Vespidae, Eumenidae, Apoidea and winged forms of Formicidae except that the posterior half of the pleural suture has lost its identity. In Pompilidae secondary modifications of the metapostnotum are prominent and the bridge is conspicuous. In non-winged forms of Formicidae and female Mutillidae the bridge, metapostnotum, and the pleural suture are absent. These changes can be helpful in establishing the relationships among the various hymenopteran families.

The present work specifically deals with the positional variations in the path of the metapleural suture and the gradual disappearance of the line of demarcation between the metapleuron and the propodeum. The extent and magnitude of these changes varies in a systematic pattern which is evolutionarily significant and establishes phylogenetic relationships among different families of the order Hymenoptera. No literature is available of the work which might have been conducted on similar lines and which elaborate the succession of changes affected by the thoracic topography in this insect order. Snodgrass (1910) recorded some observations pertaining to changes in the thoracic topography of the Hymenoptera but his observations were based on the study of types from 8 families only.

References concerning the studies of hymenopteran morphology include Snodgrass (1910, 1935), Bird (1926), Reeks (1937), Ross (1937), Alam (1951), Arora (1953, 1956), Rivard (1955), Matsuda (1960a, 1960b, 1970), Bracken (1961), Tait (1962), Wong (1963), Dhillon (1966) and Brothers (1976). But these authors mainly worked on an ontological basis rather than on the comparative basis, which is the main objective of the present work. This work is based on the study of 22 different families belonging to this insect order.

Material and Methods

Most specimens of Apocrita were collected from the Punjab and Himachal Pradesh during September and October 1975 and preserved in 80% alcohol.

Except for Megalodontidae and Orussidae, Symphyta were supplied by the Biosystematic Research Institute, Canada, and the Zoological Survey of India. Since these specimens were dry, they were softened in 2% KOH for 6 days. Diagrams were drawn with the help of a binocular microscope fitted with an ocular grid.

OBSERVATIONS AND DISCUSSION

A distinct metapleural suture and the presence of a conspicuous epimeropostnotal bridge are the common features of almost all the symphytans, but both structures gradually disappear in the Apocrita. The gradual disappearance of these 2 entities indicates a morphological trend having an evolutionary significance which is almost akin to the one prevailing in the case of the mesopleuron, but its effects on the neighboring sclerites i.e. metapostnotum and the propodeum are somewhat different. The coherent account of the entire morphological trend is summarized for 22 families of order Hymenoptera.

In the symphytans, as observed in *Acantholyda maculiventris* (Norton) (Fig. 1) (Pamphiliidae), *Xyela bakeri* Konow (Fig. 2) (Xyelidae), *Arge clavicornis* (F.) (Fig. 3) (Argidae), *Cimbex americana americana* Leach (Fig. 6) (Cimbicidae), *Pristiphora cincta* Newman (Fig. 5) (Tenthredinidae), *Neodiprion abietis* (Harris) (Fig. 4) (Diprionidae), *Cephus (Cephus) cinctus* Norton (Fig. 7) (Cephidae), *Xiphydria mellipes* Harris (Fig. 8) (Xiphydridae) and *Sirex cyaneus* F. (Fig. 9) (Siricidae), a well developed metapleural suture is present which divides the metapleuron into its usual 2 regions, the episternum and the epimeron. In almost all of these it traverses diagonally across the pleural plate after starting from the pleural wing process, and terminates at the pleural articular knob which provides pleural articulation to the coxa. A similar condition has also been reported in various other symphytans by Snodgrass (1910, 1935), Bird (1926), Reeks (1937), Ross (1937), Arora (1953, 1956), Rivard (1955), Matsuda (1960a, 1960b, 1970), Bracken (1961), Tait (1962), Wong (1965) and Dhillon (1966). However, in *Sirex cyaneus* (Fig. 9) it starts slightly behind the pleural wing process while in *Xiphydria mellipes* (Fig. 8) after starting from the pleural wing process it takes a semicircular path to become submarginal to the posterior margin of the pleural plate, thus reducing the area of epimeron considerably. In all the symphytans, except Xiphydridae and Siricidae, which have a well developed metapostnotum the anterodorsal angle of the epimeron forms an epimeropostnotal bridge with the metapostnotum. However, in Xiphydridae and Siricidae the metapostnotum is considerably reduced so consequently the bridge is also quite narrow.

In the members of Hymenoptera Parasitica, as in the case of *Sycoscapter stabilis* (Walker) (Fig. 10) (Torymidae-Chalcidoidea) the metapleural suture is very faint, but with a well marked internal ridge, and also in course it has shifted to a submarginal position along the posterodorsal margin of the pleuron. The internal pleural ridge terminates posteriorly at pleural articulation of the hind coxa, while on its way it receives the lateral end of the furcal arm. Because of these modifications the epimeral area, if not totally obliterated, is a thin streak along the posterodorsal margin of the pleuron, and is not visible until the plate is dissected out. A similar condition also has been observed in many other chalcids like *Walkerella temeraria*

PLATE -1

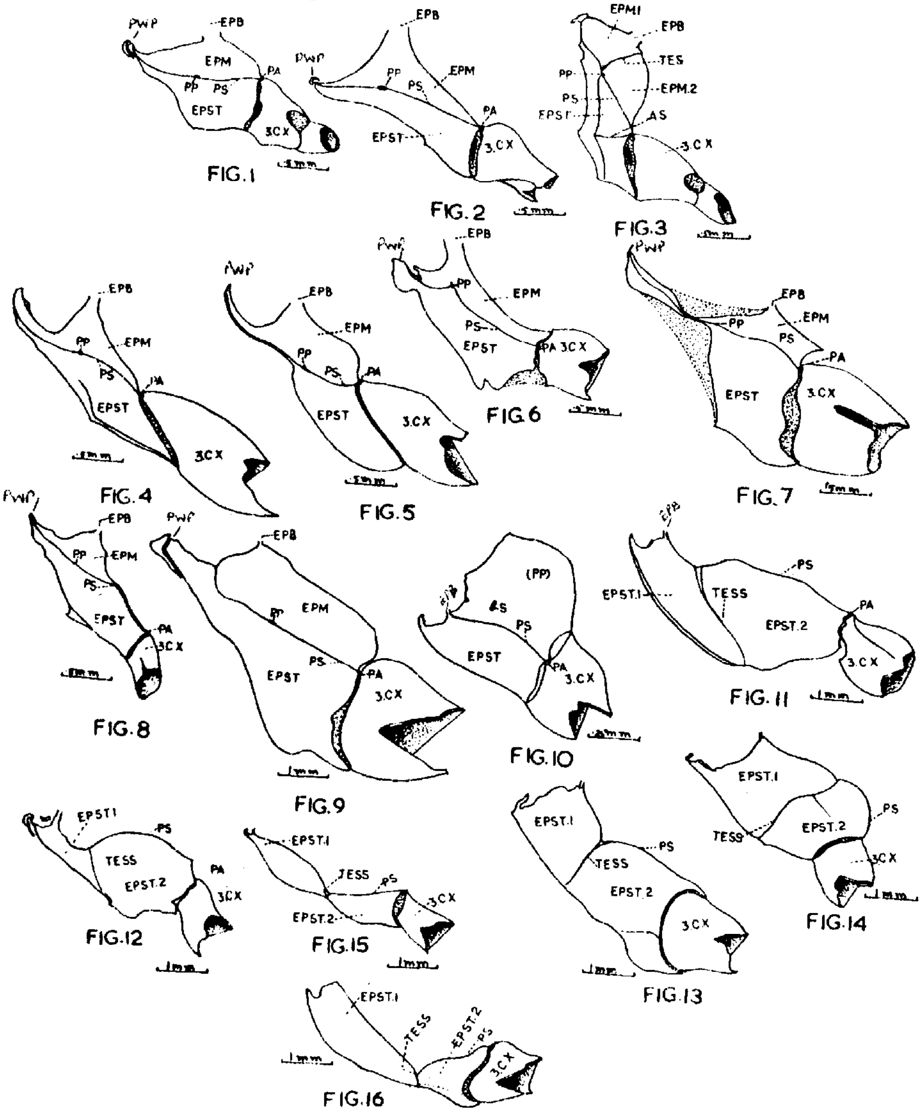

Fig. 1-16. Side view of the metapleural plate of: 1. *Acantholyda maculiventris;* 2. *Xyela bakeri;* 3. *Arge clavicornis;* 4. *Neodiprion abietis;* 5. *Pristiphora cincta;* 6. *Cimbex americana americana;* 7. *Cephus* (*Cephus*) *cinctus;* 8. *Xiphydria mellipes;* 9. *Sirex cyaneus;* 10. *Sycoscapter stabilis;* 11. *Netelia kashmirensis;* 12. *Trachysphyrus* sp.; 13. *Scolia quadripustulata;* 14. *Chrysis indogotea;* 15. *Scelephron intrudens;* 16. *Stizus vespiformis.* Abbreviations: 3. CX—Metacoxa; EPB—Epimeropostnotal bridge; EPM—Epimeron; EPST—Episternum; PA—Pleural articulation; PP—Pleural pit; (PP)—Propodeum; PS—Pleural suture; PWP—Pleural wing process; S—Spiracle; TES—Transepimeral suture; TESS—Transepisternal suture.

Westwood (Torymidae), *Sycophila decatomoides* Walker (Eurytomidae), *Micranisa pteromaloides* (Walker) (Torymidae) and *Blastophaga masoni* (Saunders) (Agaonidae). However, Snodgrass (1910) has shown the absence of the pleural suture in various chalcids but he is silent about the narrowing down or obliteration of the epimeron. In this case the metapostnotum is extremely reduced and its presence cannot be determined until it is dissected out.

In the members of the Superfamily Ichneumonoidea as in *Netelia kashmirensis* Cameron (Fig. 11) and *Trachysphyrus* sp. (Fig. 12), the overall condition is quite similar to that of chalcids i.e. they possess a submarginal pleural suture and a reduced epimeropostnotal bridge. However, in them the metapleuron is secondarily divided into 2 areas due to the presence of a transverse suture. These 2 areas have been named by Snodgrass (1910) as the dorsal wing bearing segment and a ventral leg bearing segment. Internally this transverse suture is represented by a prominent ridge. Similar conditions also have been reported by Snodgrass (1910) in the ichneumons like *Erymotylus macrurus, Metopius pollinctorius* and *Megarhyssa lunator* and by Jonathan and Gupta (1973) in almost all the ichneumons belonging to the genus *Goryphus*. Alam (1951) has reported the presence of a pleural suture in *Steenobracon deesae* which is incomplete and loses its identity in the posterior half. In the same insect he has also reported the complete absence of the metapostnotum.

In Hymenoptera Aculeata, as is observed in *Chrysis indogotea* Duf. et. Pesr (Chrysididae) (Fig. 14), *Scolia quadripustulata* F. (Scoliidae) (Fig. 13), *Scelephron intrudens* Smith (Fig. 15) and *Stizus vespiformis* F. (Sphecidae) (Fig. 16), the condition is almost similar to that of ichneumons. The metapleural plate is clearly divisible into wing bearing and leg bearing segments by the presence of a transverse suture. There is not trace of the pleural suture except that a marginal internal ridge running along the posterodorsal margin of the metapleural plate is taken as an indication of its fate; it terminates posteriorly at the pleural metacoxal knob which provides pleural articulation to the metacoxa. The metapostnotum as such is untraceable and consequently the epimeropostnotal bridge has lost its independent identity.

Further in *Vespa orientalis* Linn. (Vespidae) (Fig. 17) and *Eumenes dimidiatepennis* Sauss (Eumenidae) (Fig. 18) conditions are somewhat similar to those noted in the above group of aculeatans, but with the difference that the posterior half of the marginal pleural suture as well as the pleural ridge are missing; this may be because of a greater magnitude of solidarity between the matapleuron and the propodeum. Another peculiarity occurs in the members of these families because the size of the wing bearing segment is larger than the leg bearing segment, a condition almost reverse to what is present in ichneumons. However, Brothers (1976) has reported an invaginated metapostnotum in the members of the Vespidae.

In certain Pompilidae, e.g. *Calicurgus* sp. (Fig. 19), all conditions of the metapleuron remain the same as discussed above, except the secondary development of the metapostnotum and consequently the bridge in discussion. Similar conditions pertaining to the metapostnotum also have been reported by Brothers (1976) in the Pompilidae.

In Apoidea and winged forms of Formicidae, e.g. *Xylocopa lemuiscapa* Westwood (Fig. 20), winged *Camponotus camelinus* Smith (Fig. 22) and male *Dorylus labiatus* Shick (Fig. 21) conditions seem to be very similar to that of Vespidae and Eumenidae except for the complete absence of a metapostnotum and consequently the epimeropostnotal bridge. In male

PLATE-2

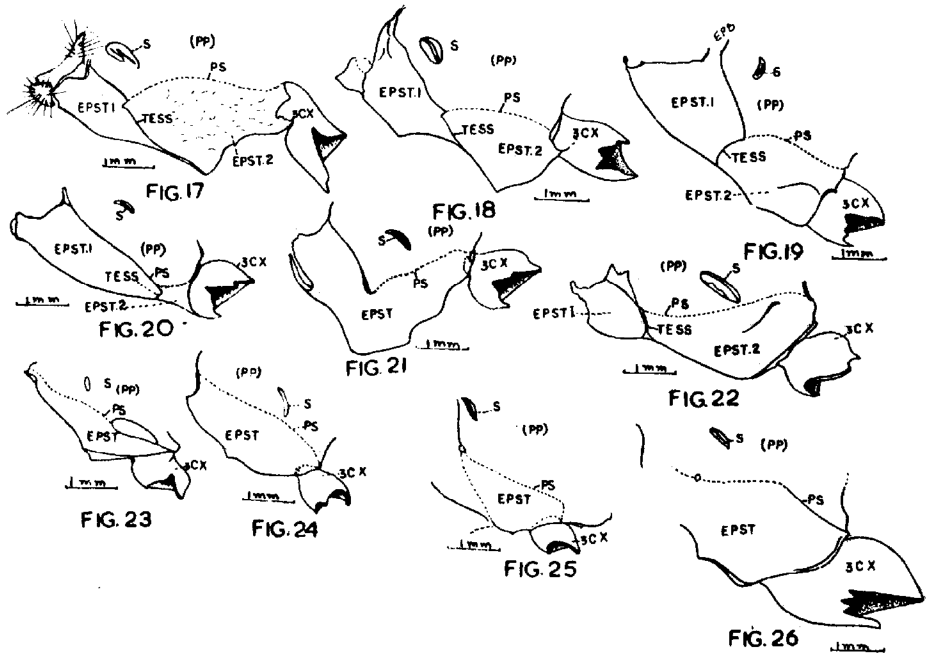

Fig. 17-26. Side view of the metapleural plate of: 17. *Vespa orientalis;* 18. *Eumenes dimidiatepennis;* 19. *Calicurgus* sp.; 20. *Xylocopa lemuiscapa;* 21. Male *Dorylus labiatus;* 22. Winged *Camponotus camelinus;* 23. *Sima rufonigra;* 24. *Camponotus camelinus;* 25. *Mutilla* sp.; 26. *Dorylus labiatus.* Abbreviations: 3. CX—Metacoxa; EPB—Epimeropostnotal bridge; EPM—Epimeron; EPST—Episternum; PA—Pleural articulation; PP—Pleural pit; (PP)—Propodeum; PS—Pleural suture; PWP—Pleural wing process; S—Spiracle; TES—Transepimeral suture; TESS—Transepisternal suture.

Dorylus labiatus (Fig. 21) the transepisternal suture is absent. Brothers (1976) has reported that in Apoidea and Sphecoidea the metapostnotum has expanded backward and includes the so called *propodeal triangle* present in the posterior region of the propodeum. Present authors are of the opinion that during the course of evolution this sclerite has become completely obliterated rather than expanded backward. If even this expansion is to be taken into account then the posterior limits of this expanded metapostnotum cannot go beyond the propodeal spiracle which is actually the first abdominal spiracle. When the latter is stationary there is no question of the expansion of the metapostnotum. During expansion the metapostnotum must also have pushed the spiracle backward.

Further advancement over this condition can be noted in the apterous and the female representatives of the Formicidae and Mutillidae. In case of female *Camponotus camelinus* (Fig. 24), *Sima rufonigra* Jerdon (Fig. 23), female *Dorylus labiatus* (Formicidae) (Fig. 26) and female *Mutilla* sp. (Mutillidae) (Fig. 25) there is no outward sign of any suture. The pleural ridge along the posterodorsal margin of the pleuron is not traceable in them. The fusion of the metapleuron with the propodeum is so intimate that even the limits of the external boundaries of the 2 are not traceable. The metathorax anteriorily also has become unobtrusively fused with the mesothorax with the consequent result that 2 segments form a single compact unit and no separate entity of the metanotum or postnotum can be made out. This compactness has also effected the furca endosterna of these segments which have become quite weak. Similar conditions have also been reported by Snodgrass (1910) in *Pogonomyrmex transversum* (Formicidae).

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DISPERSAL OF VEGETABLE LEAFMINER[1] ONTO A TRANSPLANT PRODUCTION RANGE[2]

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ABSTRACT

Experiments were conducted on a commercial vegetable and ornamental transplant range in Sun City, FL during the 1977 fall and winter to determine attraction of various trap colors and to monitor leafminer dispersal into the range.

Significantly more adult flies were captured on yellow traps than on yellow-green, orange, green and blue. Use of a protective transparent plastic bag on the yellow poster board traps had no significant affect on the number of adult flies trapped. Significantly more flies were trapped on cards located on the periphery of the range nearest the prevailing wind and within 100 ft of commercial tomato farms. Fly movement onto the transplant production range and infestation within production houses reflected both proximity of source and prevailing wind direction.

The vegetable leafminer, *Liriomyza sativae* Blanchard, is a serious pest of Florida vegetables (Musgrave et al. 1975). The leafminer female directly damages its host by repeated insertions of the ovipositor into the upper leaf surface, leaving punctures (stipples) ca. 0.35 mm in diameter. The oviposition insertions permit: 1) feeding from the exudate or 2) the deposition of an egg (Elmore 1954). The oviposited egg hatches in 2-4 days into a maggot which feeds through the leaf mesophyll creating the characteristic serpentine mine. After 3-6 days the maggot emerges from the mine, and pupates in a 2-3 mm golden brown puparium. The adult emerges 9-14 days later, completing the cycle (Musgrave et al. 1975).

Research in Florida agriculture currently emphasizes integrated controls in an effort to effectively manage the leafminer in celery and tomatoes. A primary thrust in this research is to find alternative or complementary tactics to the use of chemical insecticides. Leafminer population levels remain low longer when healthy transplants free of leafminers are used. Many Florida commercial tomato and celery fields (70% and 5%, respectively) begin with transplants (Fla. Agr. Statistics 1977-78) that must be pest-free (Tauber 1977). This zero insect threshold precludes the use of biological

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[1] *Liriomyza sativae* Blanchard.

[2] Agriculture Experiment Station Journal Series No. 1973.