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COMPARATIVE ANATOMY OF THE THORAX OF LARVAL ODONATA, PROTHORAX

By

R. S. SAINI AND DINESH SINGH,*

College of Science, Rewa (M. P.).

INTRODUCTION

Both adult and larval thorax in Odonata have been studied by several morphologists. Asahina (1954) and Chao (1953) have taken up the thorax of adult Azygopterous forms. Cowley (1941) gave descriptive terms to the pterothorax, Hakim (1963) has described the thorax of twelve species of adult Odonata and Trottier (1969) has made attempts at the morphology of certain *Sympeterum* larvae. But none of the workers have, however, paid attention to the thorax of the larvae of Zygopterous forms. In the present paper, detailed morphology of the prothorax of six species of zygopterous larvae namely *Pseudagrion decorum*, *Copera marginipes*, *Ischnura delicata*, *Ischnura senegalensis* of the Coenagriidae family, *Ceriagrion coromandelianum* of Platycnemidae and *Libellago lineata* belonging to the Chlorocyphidae family have been taken up in order to elucidate this aspect. The methods employed are the same as described by Hakim (1963).

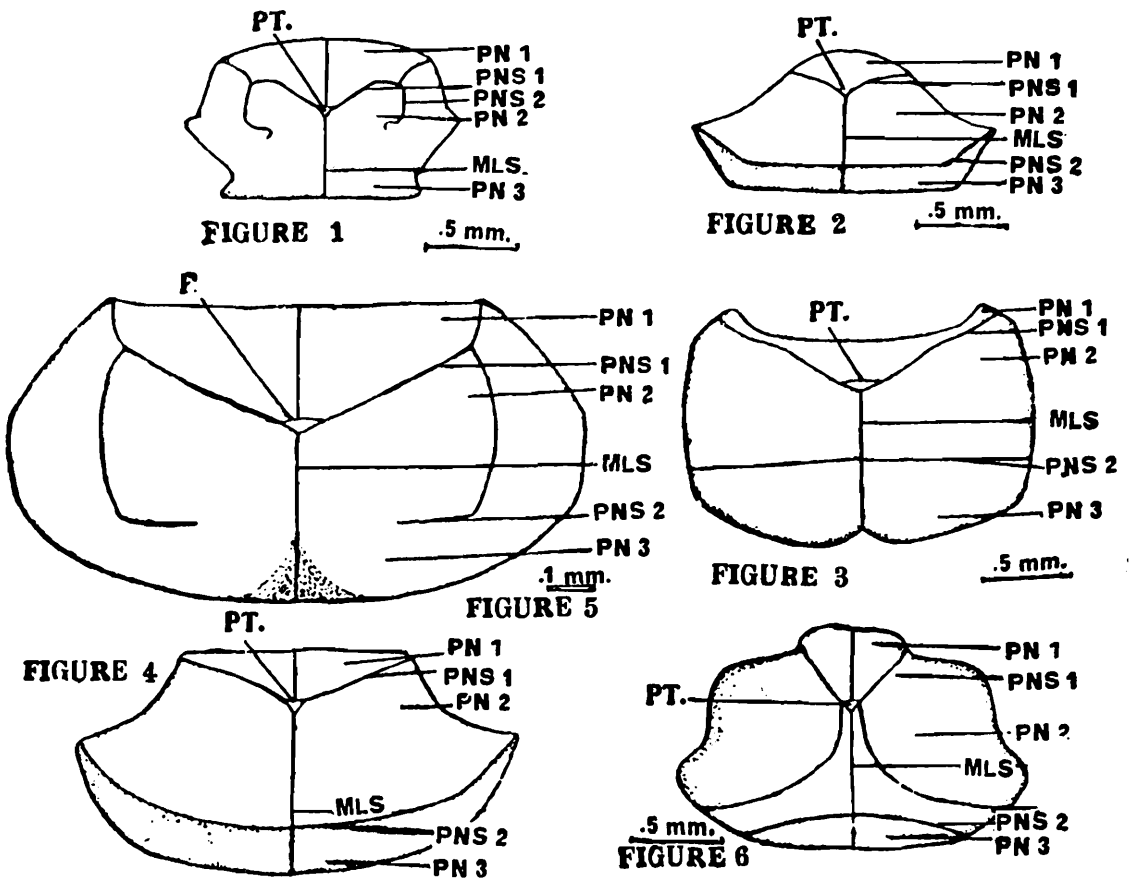
THE PROTHORAX

It is the shortest of the three thoracic segments and is separated from the mesothorax by a membrane.

The *pronotum* (Fig. 1 to 6). It is a strongly sclerotised plate and is divisible into three sub-regions, an anterior, a middle and a posterior. The anterior pronotal sclerite (PN 1) occupies about one fourth of the entire pronotal region. It is demarcated from the middle sclerite by the first pronotal sulcus (PNs 1). In the middle of this sulcus is a pit (PT) which leads into a long pronotal apophysis. The middle pronotal sclerite (PN 2) lies in between the first and the third divisions of pronotum ; it is usually the largest of the three sub-divisions and constitutes about half of the pronotum. The hind limit of this sclerite is marked by the second pronotal sulcus (PNS 2). The middle sclerite is traversed by a short mid longitudinal sulcus (MLS) which joins the

*Research Scholar College, Satna (M. P.).

first pronotal sulcus in the front and the second pronotal sulcus behind. The posterior pronotal sclerite (PN 3) is almost as large as the anterior sclerite.



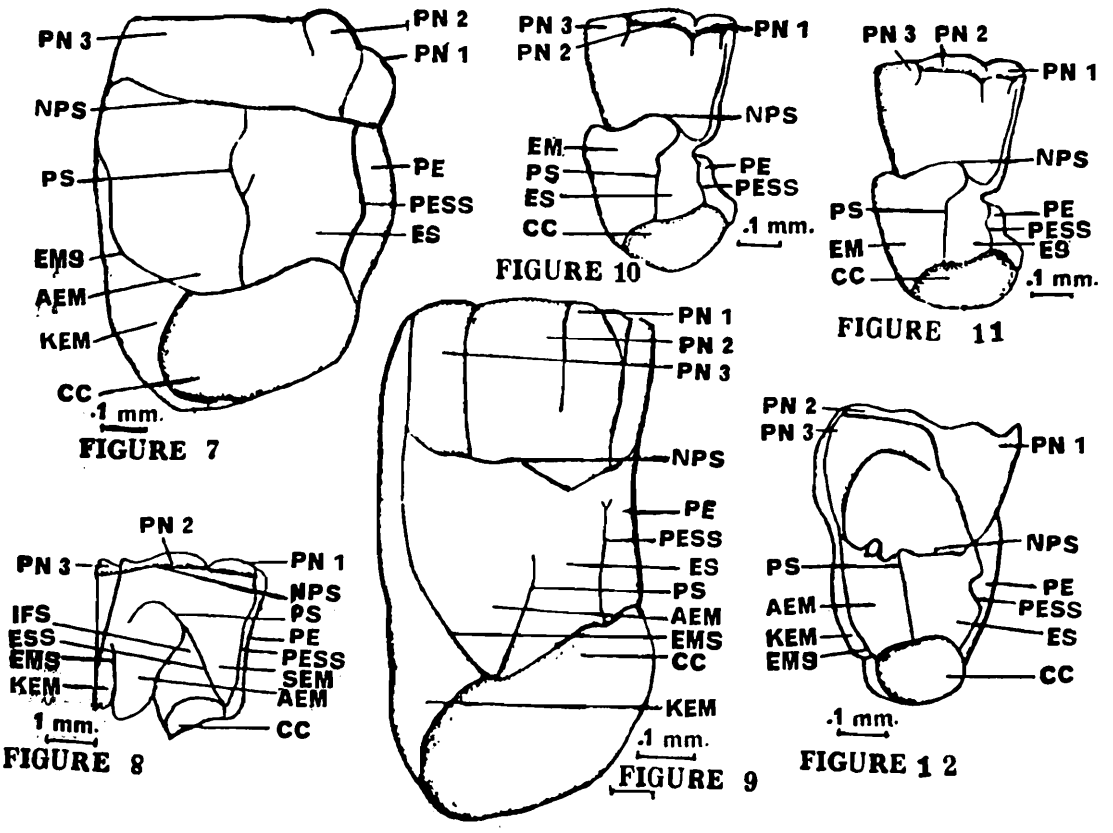
Figs. 1-6. Dorsal view of the Prothorax of Larval forms.

1. *Copera marginipes*, 2. *Pseudogrion decorum*, 3. *Ceriagion coromandelianum*, 4. *Ischnura delicata*, 5. *Ischnura senegalensis*, 6. *Libellago lineata*.

In *Copera marginipes*, *Ischnura delicata*, *Ischnura senegalensis* and *Libellago lineata* the anterior pronotal sclerite is sub-divided into two lateral parts by a median longitudinal sulcus (MLS) it remains undivided in *Pseudagrion decorum* and *Ceriagrion coromandelianum*. The sclerite is triangular in all the species. The middle pronotal sclerite remains clearly differentiated from the posterior pronotal sclerite by a complete second pronotal sulcus (PNS 2) in *Pseudagrion decorum*, *Ceriagrion coromandelianum*, *Ischnura delicata* and *Libellago lineata*. Second pronotal sulcus is incomplete in *Copera marginipes* and *Ischnura senegalensis*.

The *propleuron* (Fig. 7 to 12). It is also a large sclerotised plate and is united with the notum above, the junction being marked by a sulcus the notopleural sulcus (NPS). Ventrally the pleuron is united with the sternum in its front and in the hind part it forms the dorsal margin of the coxal cavity (CC). The propleuron is differentiated into three parts, the pre-episternum, episternum and epimeron which are situated one behind the other.

The *pre-episternum* (PES) is the anterior most of the pleuron and is slightly overlapped by the second lateral cervical sclerite. Its shape, relative size and position varies in different forms. The pre-episternum extends from notopleural to the sternopleural junction. It is a narrow, biconvex sclerite. This sclerite remains marked posteriorly by the pre-episternal sulcus (PESS).



Figs. 7-12. Lateral view of the Prothorax of Larval forms.

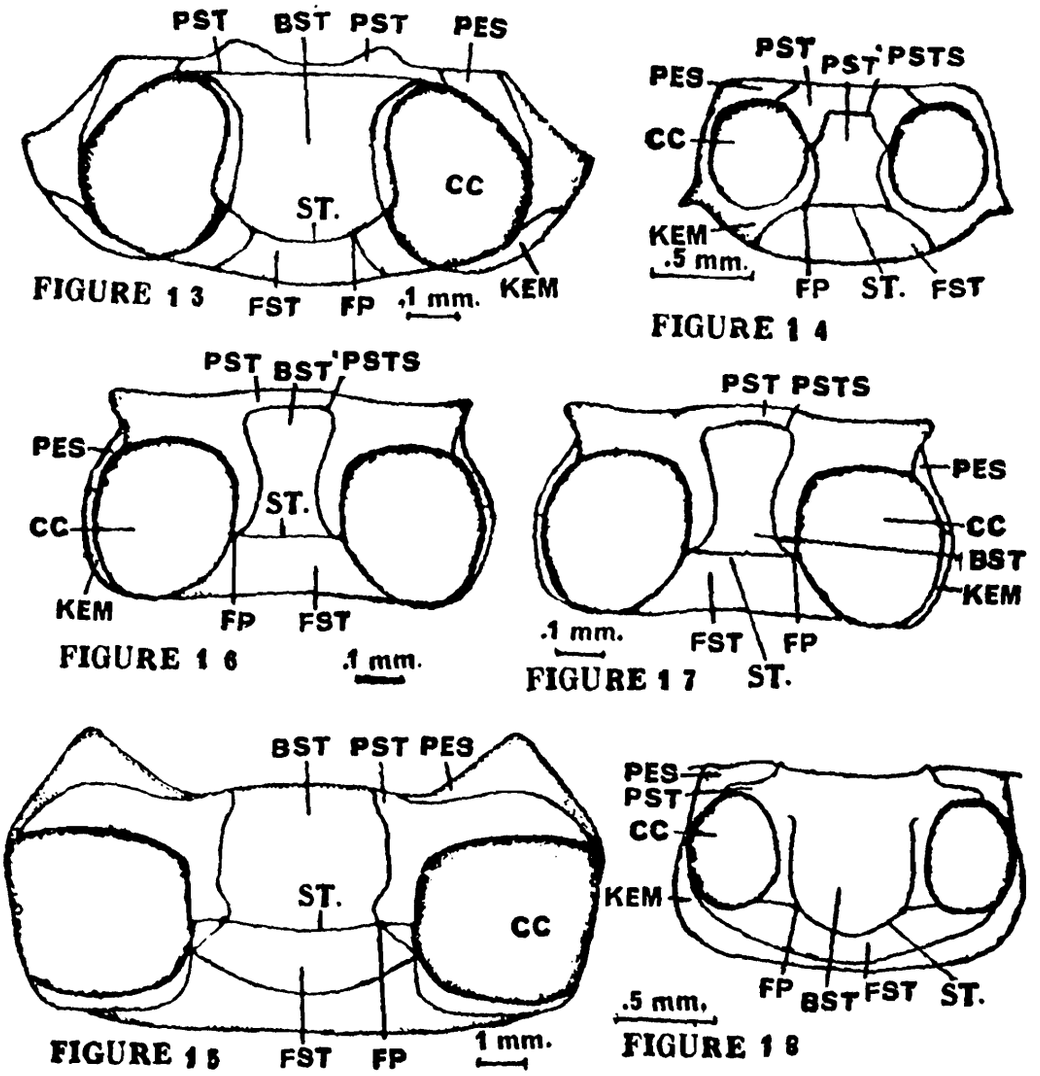
7. *Copera marginipea*, 8. *Pseudogrion decorum*, 9. *Ceriagrion coromandelianum*, 10. *Ischnura delicata*, 11. *Ischnura senegalensis*, 12. *Libellago lineata*.

The *episternum* (ES) is some what traingular, the base of which is formed by its ventral margin and its apex is dorsal. It occupies about half of the pleuron, the episternum is demarcated from epimeron behind by a pleural sulcus (PS). The front part of the base of the episternum is limited by the sternopleural sulcus and the hind part by the coxal cavity (CC). The entire ventral margin of the episternum forms the upper boundary of the coxal cavity.

In *Copera marginipes*, *Ischnura delicata*, *Ischnura senegalensis* and *Libellago lineata* the pleural sulcus is complete and reaches the noto pleural sulcus (NPS). It is incomplete in *Pseudagrion decorum* and *Ceriagrion coromandelianum*.

The *epimeron* (EM) is also some what triangular and occupies almost half of the pleural region. Its dorsal and anterior limits are marked by notopleural (NPS) and pleural sulcus (PS) respectively.

The posterior margin is slightly wavy in *Copera marginipes* rounded in *Pseudagrion decorum, Ischnura delicata, Libellago lineata* and straight in *Ceriagrion coromandelianum* and *Ischnura senegalensis*. In *Copera marginipes, Pseudagrion decorum, Ceriagrion coromandelianum, Libellago* lineata the epimeron is differenciated into an anterior large *anepimeron* (AEM) and a posterior, narrow, *katepimeron* (KEM) by an epimeral sulcus (EMS) which extends from the ventral ends of the pleural sulcus, dorsal upto the notopleural junction.



Figs. 13-18. Ventral view of the Prothorax of Larval forms.

13. *Copera marginipes*, 14. *Pseudogrion decorum*, 15. *Ceriagrion coromandelianum*, 16. *Ischnura delicata*, 17. *Ischnura senegalensis*, 18. *Libellago lineata*.

The *prosternum* (Fig. 13 to 18). It is a well sclerotised mid ventral area of the segment which is broader than long. Laterally the sternum is united with the pleuron. The sternum consists of presternum, basisternum and the furcasternum, situated one behind the other.

The *presternum* (PST) shows remarkable differences in its position, shape and size in different forms. In *Copera marginipes, Pseudagrion decorum, Ischnura delicata* and *Ischnura senegalensis*, it is characterized

by broad lateral areas and a narrow middle region which forms a bridge uniting the two lateral areas. The latter are situated one on either side of basisternum and the middle area lies in front of the basisternum. The uniting bridge is much reduced in *Ceriagrion coromandelianum* and *Libellago lineata*. The pre-episternum is demarcated from the basisternum by a presternal sulcus (PSTS).

The *basisternum* (BST) is broad, plate like structure. It lies behind presternal sulcus, the sternal suture (ST) separates the basisternum and the furcasternum (FST). A pair of furcal pits lie between the two coxal cavities. The position of furcal pits differs from species to species. The furcal pits in *Ischnura delicata* and *Ischnura senegalensis* are situated some what nearer to the coxal cavities, in *Copera marginipes*, *Pseudagrion decorum*, *Ceriagrion coromandelianum* and *Libellago lineata* they are situated at a farer distance from it.

Discussion

In larval forms the *pronotum* is divisible into three regions, an anterior (PN 1), a middle (PN 2) and a posterior (PN 3) as in adult Odonata (Hakim 1963). The anterior pronotal sclerite is demarcated from the middle sclerite by first pronotal sulcus (PNS 1) bearing pronotal apophysis. This has been regarded as phragma of the pronotum by Garman (1917), Clark (1940) and Asahina (1954), Hakim (1963) interpretes this as an apophysis. We agree to Hakim's interpretation. In *Copera marginipes*, *Ischnura delicata*, and *Libellage lineata* the anterior pronotal sclerite is traversed by a mid longitudinal sulcus while in *Pseudagrion decorum* and *ceriagrion coromandelianum*, the mid longitudinal sulcus is absent as in adult forms (Hakim, 1963). The hind limit of first pronotal sclerite is marked by second pronotal sulcus (PNS 2) which is incomplete in *Copera marginipes*, and *Ischnura senegalensis* as in *Hemimax* and complete in *Ceriagrion coromandelianum*, *Ischnura delicata*, and *Libellago lineata* as in *Ictinogomphus* and *Crocothemis* (Hakim, 1963). The middle pronotal sclerite is also traversed by a mid longitudinal sulcus which joins the first pronotal sulcus in front and second pronotal sulcus behind as in adult Odonata (Hakim, 1963). The mid longitudinal sulcus extends on the posterior pronotal sclerite through out it's mid length and not for a short distance as in *Hemianax* (Hakim, 1963).

In all the larval forms the *propleuron* is united with the notum above, the junction is marked by a complete notopleural sulcus (NPS) as in *Lestis* (Hakim, 1963). Ventrally the pleuron is united with the sternum in its front part and in the hind part it forms the margin of

the coxal cavity (CC) as in adult forms (Hakim, 1963). The propleuron is differentiated into pre-episternum, episternum and epimeron. The *pre-episternum* (PES) is the anterior most region of pleuron. In *Copera marginipes*, *Pseudagrion decorum*, *Ceriagrion coromandelianum* and *Libellago lineata*, it extends from notopleural to sterno pleural junction as in *Lestes*, it is narrow and by convex sclerite in *Ischnura delicata*, and *Ischnura senegalensis* as in *Ictinogomphus* (Hakim, 1963). This sclerite is marked posteriorly by the pre-episternal sulcus (PESS) in all the larval forms while it is absent in adult Libulids (Hakim, 1963). The *episternum* (ES) occupies about half of the pleuron in all the larval forms as in adult Zogoptera, it occupies only one third of it in Azygopterous adult forms (Hakim, 1963). The episternum remains demarcated from the epimeron by a pleural sulcus (PS). The pleural sulcus is complete in *Copera marginipes*, *Ischnura delicata*, *Ischnura senegalensis* and *Libellago lineata* as in adult *Lestes*, *Hemianax*, *Ictinogomphus* and *Crocothemis*, it is incomplete in *Pseudagrion decorum* and *Ceriagrion coromandelianum*, as in adult *Pseudogrion* (Hakim, 1963). The episternum is undivided and is not differentiated into supra and infra episternum as in adult *Hemianax* (Hakim, 1963). *Epimeron* (EM) occupies half of the pleural region and is differentiated into an anterior large anepimeron (AEM) and a posterior narrow *Katepimeran* (KEM) by a epimeral sulcus (EMS) as in adult forms (Hakim, 1963). These observations are at variance with those of previous workers (Snodgrass, 1909 ; Tillyard, 1917 ; Garman, 1917 and Chao, 1953) who regarded the epimeron as an undifferentiated sclerite and consider the kat-epimeron as the ventral extention of the posterior notal sclerite.

The *prosternum* consists of pre-sternum (PST) ; basisternum (BST) and furca sternum (FST). In *Copera marginipes*, *Pseudagrion decorum*, *Ischnura deticata* and *Ischnura senegalensis* the presternum (PST) is characterised by broad lateral and a narrow middle region which form a bridge uniting the two lateral areas as in *Ictinogomphus* and *Hemianax* (Hakim, 1963). The uniting bridge is much reduced in *Ceriagrion coromandelianum*. In *Copera marginipes*, *Ceriagrion coromandelianum* and *Libellago lineata* the pre-sternal sulcus is transverse as in *Ictinogomphus* and *Hemianax*, it is inverted V shaped in *Pseudagrion decorum*, *Ischnura delicata*, and *Ischnura senegalensis* as in adult pseudagrion (Hakim, 1963). The *basisternum* is plate like the sternal suture separates the basisternum (BST) and the furca sternum (FST). In *Ischnura delicatn*, *Ischnura senegalensis* furcal pits (FP) are situated nearer to the coxal cavities. In *Copera marginipes*, *Pseudagrion decorum*, *Ceriagrion coromandelianum* and *Libellago lineata* these lie at a distance

from the coxal cavities. The *furcasternum* is quite large and forms half of the sternal region as in adult zygepterous forms (Hakim, 1963).

SUMMARY

The prothorasic pronotum is divisible into anterior, middle and posterior pronotal sclerites. The first pronotal sulcus demarcates the anterior sclerite. The second pronotal sulcus seperates middle and the posterior sclerites. Middle and posterior pronotal sclerites are traversed by a mid longitudinal sulcus.

The propleuron is demarcated from notum by, notopleural and from sternum by sterno plural sulcus. The pro pleuron is differentiated into three parts the pre episternum episternum and epimeron. The pre-episternum extends from noto pleural to the sterno-pleural junction. The episternum is a triangular plate like structure and remains demarcated from epimeron behind by a pleural sulcus. The epimeron is differentiated into an anterior epimeron and a posterior katepimeron by an epimeral sulcus.

The prosternum is longer than its breadh. It forms the ventral boundary of the coxal cavities. It consists of presternum, basisternum and the furcasternum situated one behind the other. The presternum is demarcated from the basisternum by presternal sulcus. The sternal suture seperates the basi sternum and the furca sternum. The position of furcal pits differs in various species.

Extent of various sclerites of prothorax and demarcations of sulci have been described and their interspecific variations discussed.

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ABBREVIATIONS

AEM—Anepimeron, BST—Basisternum, CC—Coxal cavity, EM—Epimeron, EMS—Epimeral sulcus, ES—Episternum, ESS—Episternal sulcus, FP—Furcal pit, EST-Furca sternum, IFS—Infra episternum, KEM—Kat epimeron, MLS—Mid longitudinal sulcus, NPS—Notopleural sulcus, PES—Pre episternum, PESS—Pre episternal sulcus, PN1—Anterior pronotal sclerite, PN2—Middle pronotal sclerite, PN3—Posterior pronotal sclerite, PNS—1—First pronotal sulcus, PNS2—Second pronotal sulcus, PS—Pleural sulcus. PST—Pre-sternum, PSTS—Pre-sternal sulcus, PT—Pit, ST—Sternal suture.

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