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A CONTRIBUTION TO THE PHYLOGENY OF THE MYCETOPHILIDAE1

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The interest of the author was drawn to the study of thoracic sclerites as possible aids in the determination of the relationships of insects. In 1925, Dr. Crampton presented data to indicate the interrelationship of the non-tipuloid Nematocera based on a study of thoracic selerites. From time to time, the author had made random observations on the shape of pleural sclerites in the Mycetophilidae, but until the present time, no attempt has been made to classify this family by the use of these sclerites.

It is recognized that the number of forms studied is far from complete. However, certain tendencies appear to be observable. It is hoped that the study will serve to stimulate interest in this group and that someone will develop this work to cover all of the genera.

In most cases the studies were made on males which were preserved in 80% alcohol. In a few instances only dried specimens were available. These were boiled in KOH, soaked in water, and then preserved in alcohol. The setae are omitted intentionally in order to present clearly the shape of the sclerites. Credit is given to Elmcr Smith for the preparation of all the figures. Without his able assistance, the present work could not have been completed.

Before trying to develop a phylogenetic grouping for the genera of the Mycetophilidae, it will be best to discuss briefly some of the concepts concerning the evolution of the entire family. It is felt that this is essential in order to form an opinion of what a primitive or generalized Mycetophilid may be.

Enderlein, 1911, presented views concerning the interrelationships of the family. He derived the Mycetophilidae, the Bibionidae, the Scatopsidae, and the Cecidomyiidae from a common ancestry Within the Mycetophilidae he appears to have regarded the Ceroplatinae as most primitive. The Macrocerinae were apparently derived from an ancestral stock similar to that of the Ceroplatinae. This view seems

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to be substantiated by some later workers who have indicated that the Macrocerinae should be included in the Ceroplatinae. The author does not agree with that grouping.

According to Enderlein the Bolitophilinae, the Pachyneurinae, the Mycetobinae and the Diadocidinae all were developed from one common stock. Of these, the Bolitophilinae were considered the most primitive.

The Sciophilinae and the Mycetophilinae were considered to have evolved from a distinct stock more closely related to the Simuliidae, the Cecidomyidae, the Scatopsidae and the Bibionidae and the Sciarinae than are the other Mycetophilid genera. It is probable that this is based on the opinion that the Sciarinae may have evolved through the Sciophilinae. I do not agree with this concept since I feel that the resemblance of certain Sciophiline genera to the Sciarinae is a case of parallel development.

Enderlein considered that the Sciarinae were more closely related to the Lestremiinae of the Cecidomyiidae than to the Mycetophilids. This is based on the presence of a dorsal eye bridge in both groups. Considerable controversy has existed concerning this grouping. Edwards has considered that the larvae of Mycetophila and Sciara show evidence of having been derived from a common stock on the basis of specialized labial structures and similar tracheal systems. On the basis of the present studies the Sciarinae show relationships with *Hesperinus* (Bibionide); *Catocha* and *Rhabdophaga* of the Cecidomyiidae. This is evidenced by the presence of a midpleural pit in all four genera, by the general shape of the katepisternum, and the presence of a precoxal bridge. The present study would support the belief that the Sciarinae, while of Mycetophilid stock, have characters sufficiently distinct to justify their being a separate family.

Crampton, 1925, considered that the Mycetophiliodea. i. e., Mycetobiidae, Mycetophilidae, and the Sciaridae, arose from the Anisopodidae themselves or from forms extremely like the Anisopodidae. Crampton felt that it would be extremely difficult to determine whether to group the annectant form, the Mycetobiidae, with the Anisopodidae or the Mycetophilidae. The same author considered that the Sciaridae are rather primitive Mycetophiloids and indicated that they should be given family rank. He did not feel that the Bolitophilinae, while primitive, are deserving of family rank, nor does he agree with Malloch that the Platyurinae should be raised to the same level.

Edwards, 1925, does not agree that *Mycetobia* represents an annectant form between the Mycetophilidae and the Anisopodidae. This view is based on the fact that the tracheal system of Mycetophila is more primitive than that of *Mycetobia*. I feel that Crampton's views concerning the relationship of *Mycetobia*, the Anisopodidae and the Mycetophilidae are more logical than those of Edwards.

Crampton, 1925, considered that the Cecidomyiidae are closely related to the Mycetophilidae and should be included in the supertamily Mycetophiloidea. This is based on the narrowing of the mesothoracic epimeron and the reduction of the meron, both of which characters occur in the Mycetophilidae. Crampton considered that the Bibionidae were derived from the same ancestral stock as the Mycetophiloidea and in a sense were intermediate between this group and the Chironomoidea. Edwards stated that about the beginning of the Jurassic period, if not earlier, the Diptera were divided into three main groups. The first included the Mycetophilidae, Bibionidae, Scatopsidae, and Cecidomyiidae; the second, the Ptychopteridae, Culicidae. Psychodidae, and Chironomidae; the third, the Trichoceridae and the Tipulidae.

In 1942, Crampton advanced the belief that three main stocks arose from an Anisopodid-like ancestor. One branch gave rise to Mycetophilidae, Sciaridae and Cecidomyiidae, a second branch to Mycetobiidae, Anisopodidae and Trichoceridae, and a third to the Hesperinidae, Bibionidae, and the Scatopsidae.

The author feels that the Sciaridae possess characters indicating close relationship with the Mycetophilidae, the Bibionidae, and the Scatopsidae on the basis of the structure of the pleura.

With this as an introduction, I would like now to consider interrelationships among the Mycetophilidae. Meunier, 1904, advanced the belief that the Sciarinae were the most primitive with other members of the family being derived from this group.

Apparently Meunier considered the Bolitophilinae to be the most primitive of the Mycetophilidae excluding the Sciarinae. The Ceroplatinae, Macrocerinae, Mycetobiinae, and the Diadocidinae were represented as having been derived from the Bolitophilinae along similar lines. He derived the higher forms through the Sciophilinae which were a direct offshoot from the Bolitophilinae. The Bolitophilinae, while admittedly primitive, do possess some specializations which are not found in forms supposedly derived from the group. Some venational characters appear in *Bolitophila* which are not as primitive as those found in *Palaeoplatyura*.

Fisher, in correspondence, presented a scheme to show the interrelationship of the various groups. Her concepts are based on the study of the male genitalia as well as other characters. From her diagram, Fisher derived the subfamilies from a common ancestor with 5 main divisions. According to her beliefs, the subfamily Ditomylinae is the most primitive of the Mycetophilidae. The Bolitophilinae are the second most primitive group, followed by the Diadocidinae. The Macrocerinae and Ceroplatinae were believed to have originated from a common stock a little higher in development than the Diadocidinae. She considered that the Mycomylini arose next and gave rise to the Exechini and Mycetophilini. The Sciophilini, Gnoristini and Leiini were from the same stock. She considers that the Sciarinae arose from the Leiini.

With the exception of the development of the Sciarinae, my findings agree in the main with those of Fisher. I do consider that the Ditomyiinae are more highly evolved than certain of the Ceroplatinae.

With this as a review of what earlier writers have proposed I would like to begin a discussion of the findings of my study. Before doing this, I would like to indicate the features that seem to be primitive.

1. In all of the more primitive forms—*Sciara*, *Bolitophila*, *Palaeoplatyura*, *Symmerus*, *Apemon*—the mesothoracic episternum is unequally divided, resulting in the katepisternum being much larger than the anepisternum. 2. In the same forms, the anepisternum is divided by a cleft into an anterior and posterior portion.

3. In the more primitive forms, the pronotum is divided into two distinct portions. This is not the case in the higher forms.

4. In the more primitive forms, the mesothoracic epimeron, while narrower ventrally, does reach to the base of the mesothoracic coxa. In the more specialized forms the pleurotergite seems to develop anteriorly, thus narrowing the epimeron and in some cases cutting it off.

5. In the more primitive forms there is an indication of a suture separating the prescutum of the mesonotum from the scutum. This is lacking in the higher forms.

6. The presence of a meron is probably a primitive one. It is found in *Bolitophila*, *Apemon*, and there are indications of it in *Platyura* and some other forms. However, it is apparently reduced in *Palaeoplatyura* which, on the basis of venation, is more primitive than *Bolitophila*.

7. The more nearly perpendicular the mesopleural suture, the more primitive is the genus.

Having considered the characters which I consider to be primitive, I now wish to consider the various genera on the Lusis of these characters.

Sciara, figure 1, has a relatively large katepisternum, a wide epimeron, a distinct division of the pronotum into two portions. However, the mesosternal suture is destinctly angulate and the katepisternum is similar to that of *Herperinus*, *Catocha*, and *Rhabdophaga*. Sciara possesses a mid pleural pit as is shown in all of the three genera mentioned. The meron appears to be lacking. The sclerite indicated at the base of the mesothoracic coxa is probably the trochanter. It differs in these respects from other Mycetophilids and I feel that this evidence supports the concept that the Sciarinae represents a distinct family and I so propose to treat it.

Bolitophila, figure 2, possesses all of the thoracic characters I consider primitive with the exception that the indication of a suture distinguishing the prescutum and scutum of the mesonotum is not as distinct as it is in *Palaeoplatyura*. It is certainly near the base of the ancestral stock.

Symmerus, figure 3, while primitive as regards venation, is apparently somewhat specialized in other ways. The latepisternum is large and the anepisternum is divided as in *Bolitophila*. It is possible that what

LIST OF ABBREVIATIONS

| AES—Anepisternum of mesothorax. APN—Anterior pronotum — pronotal | M—Meron. MP—Midple |
|---|-----------------------|
| scutum. | MT-Medio |
| CX ₁ Prothoracic coxa. | PLT-Pleure |
| CX ₂ Mesothoracic coxa. | PN—Post. |
| CX3Metathoracic coxa. | PPN—Poste |
| CXS—Coxal spur. | scu |
| EM ₁ -Prothoracic epimeron. | PSC—Prescu |
| EM2-Mesothoracic epimeron. | SC-Scutum |
| EM ₃ -Metathoracic epimeron. | SCT-Scutel |
| ES1-Prothoracic episternum. | SP-Spiracle |
| ES ₃ Metathoracic epistemum. | TR-Pleurot |
| KES-Kateristernum of mesothorax | |

MP—Midpleural pit. MT—Mediotergite. PLT—Pleurotergite. PN—Post. PPN—Posterior pronotum—pronotal scutellum. PSC—Prescutum of mesonotum. SCT—Scutum of mesonotum. SCT—Scutellum of mesonotum. SP—Spiracle. TR—Pleurotrochanter.











appears to be a dorsal lobe of the katepisternum may in reality be the posterior lobe of the anepisternum. However, the pleurotergite has developed an anterior process which apparently divides the mesothoracic epimeron into two distinct portions. I suspect that what seems to be a larger metapleuron may be actually a fusion of the meron and the pleura. 言葉

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Palaeoplatyura, figure 4, from the standpoint of venation, is more primitive than *Bolitophila*. However, a true meron is not visible. The meso-epimeron is also narrower ventrally. The indication of a prescutellar suture is more distinct in *Palaeoplatyura* than in *Bolitophila*.

Diadocidia, figure 5, on the basis of thoracic sclerites, is more highly evolved than *Bolitophila*. The anepisternal cleft is not as deep, the mesoepimeron is narrowed ventrally and what I judge to be the remnant of the meron is apparently fused with the metapleura. The evidence of a prescutellar suture is very faint.

Apemon, figure 6, possesses several features indicating its primitiveness. The epimeron is relatively broad ventrally, the anepisternal cleft is deep, there is a small meron which is still attached to the eucoxa. However, as evidence of specialization, the thorax is depressed dorsoventrally. The venation, while primitive, is not as primitive as in *Palaeoplatyura*. The bro_der epimeron and the remnant of a meron would indicate that the genus is more primitive than *Palaeoplatyura*. In this case we have conflicting evidence as between the venational characters and thoracic sclerites.

Platyura, figure 7, is clearly related to both Palaeoplatyura and Apemon. That it is more specialized than either is shown by the pronounced narrowing of the mes-epimeron. The anepisternal cleft is not as deep in this genus as it is in either Palaeoplatyura or Apemon. On the basis of venation, Platyura is more closely related to Ap.mon than to Palaeoplatyura. In Platyura there may be the culmination of a tendency of the meron to fuse back with the coxa. This tendency is indicated in Palaeoplatyura.

Macrocera, figure 8, in some ways appears intermediate in thoracic structure between Palaeoplatyura and Platyura. However, on the basis of thoracic sclerites, it does not seem to be close to Apemon. Indications of specialization are the sinuous mesopleural suture, the ventrally narrowed epimeron, the absence of the cleft in the anepisternum. The primitiveness is indicated by the lack of dorso-ventral depression.

Fenderomyia, figure 9, on the basis of venation, is more primitive than Macrocera. The base of media is indicated as continuing from the wing base to the base of what has normally been considered to be the M-Cu crossvein. This form would seem to support the contention that media may possess three distinct branches in this group. Evidence of specialization is shown by the dorso-ventral depression of the thorax. Even more important is the reduction of the mesoepimeron. Whether the small triangular area above the base of the mesothoracic coxa is the remnant of the epimeron or a meron is open to question. I am inclined to the former view.



Polyepta, figure 10, shows characters similar to those of *Platyura*. It is more specialized than *Platyura*, as is shown by the narrowed epimeron and the smaller post pronotum. A small area in connection with the coxa would seem to be similar to the structure considered to be the meron.

Mycomyia, figure 11, on the basis of venation, would be considered fairly close to Polylepta. From the study of thoracic structures it is evident that a significant change has occurred. The katepisternum is reduced in size. This condition is universal in the more specialized forms. On the basis of male hypopygial characters, Fisher considered that Mycomyia would be an annectant form between the Sciophilini and the Mycetophilini. This is borne out by the study of the pleura.

As previously indicated, Fisher considered that the Sciophilini, the Gnoristini, and the Leiini, while derived from a similar stock, were not evolved from one another. This view is supported by the present study in that, while on the basis of venation *Polylepta* is more primitive than the following genus, on the basis of certain thoracic characters the following genus is more primitive.

Leia, figure 12, possesses a broader meso-epimeron than Polylepta. Also, the post pronotum is more distinct in this genus. Another primitive character is the more distinct indication of a suture between the prescutum and the scutum of the mesonotum.

Coelosia, figure 13, is very similar to Leia on the basis of thoracic structure. The narrowed epimeron indicates that this genus is more specialized than Leia.

Boletina, figure 14, is closely related to both *Coelosia* and *Leia* or the basis of pleural characters. I consider it the most specialized of these genera on the basis of the reduction of the epimeron and postpronotum.

Of the Mycetophilini studied, *Phronia*, figure 15, seems to be the most primitive. The thorax is not markedly compressed dorso-ventrally, the epimeron is comparatively long, and is not as markedly oblique as in the other forms studied. In connection with this genus, the hexagonal shape of the anepisternum may be important as a distinguishing character. Another character which appears in Phronia and is developed more strongly in *Mycetophila*, *Opistholoba*, and *Sceptonia* is the groove in the lateral margin of the mesonotum caused by the pronotum pushing dorsally.

Allodia, figure 16, and Exechia, figure 17, are closely related I consider that Allodia is more primitive. I do not consider that Allodia and Exechia were derived through Phronia, but arose from a separate stock.

Mycetophila, figure 18. as already indicated, is related to *Phronia*. It is certainly closely related to *Opistholoba*, figure 19. In an earlier paper, I considered that *Opistholoba* should be united with Mycetophila. However, the greater dorso-ventral thoracic depression and the more oblique epimeron lead me to consider that *Opistholoba* is distinct from Mycetophila.

The position of *Epicypta*, figure 20, is somewhat problematical. As regards dorso-ventral depression it is intermediate between *Opistho*-



loba and Sceptonia, figure 21. However, there are two characteristics that distinguish it from these two genera. The ventral surface of the meso-epimeron is Epicypta is flaired at the tip. This is not true in either Opistholoba or Sceptonia. Neither is it true in the species of Mycetophila studied. A further distinguishing characteristic is that the prothoracic epimeron in Mycetophila, Opistholoba, and Sceptonia is relatively large and lobe-like. In Epicypta this structure is only moderately developed. The present indications are that while Epicypta is more highly developed than Mycetophila, its ancestry must have been from a stock lower than the Mycetophila complex. While I formerly united this genus with Mycetophila, my present study indicates that Epicypta is distinct.

The final genus to be considered is *Sceptonia*, figure 21. This is clearly the most highly specialized of all of the genera studied. In it the dorso-ventral depression of the thorax is most marked. A character apparently of generic value is the dorsal development of the prothorax so that the lateral margin of the mesonotum is interrupted.

From this study it is evident that the shapes of the thoracic sclerites afford characters that are of value in both taxonomic and phylogenic studies. They can be used to some extent as generic characters.

Based on the data presented in this paper it would seem possible to divide the family into two major groups based on the relative sizes of the anepisternum and the katepisternum. *Mycomyia* is considered to be the annectant form between the two major groups. In such a grouping, the Bolitophilinae, Ditomyiinae; Ceroplatinae, Diadocidinae, Macrocerinae and Sciophilinae including the Gnoristini and the Leiini form one group and the Exechini and Mycetophilini another. It would seem that this would support Edwards' placing certain of the Mycetophilinae with the Sciophilinae.

Other characters of value in the taxonomy of this group include the cleft anepisternum as found in the more primitive groups, the narrowed epimeron and the dorso-ventral depression of the thorax. This last phenomenon causes a shifting of the epimeron, and the pleurotergum from a horizontal to a transverse position.

SUMMARY

The pleural sclerites of twenty-one genera of the Mycetophilidae are illustrated and comparisons made between the different forms.

On the basis of the study, it would appear that the group could be divided into two major divisions based on the relative sizes of the mesothoracic anepisternum and katepisternum.

The pleural sclerites of *Sciara* support the belief that members of this subfamily are sufficiently distinct as to be in a group by themselves. This is in agreement with various European workers. In the past, 1935, I have considered the Sciarinae to be a subfamily. I now recognize the group as a distinct family—the Sciaridae.

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CONCLUSIONS

While it is admitted that insufficient genera have been studied, it is evident that the pleural sclerites are of value in classifying the Mycetophilidae. It is hoped that this study will provoke sufficient interest to make a complete survey of the problem.

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