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Subscriptions: Year 2019 (Volume 59): 450 €
http://www1.montpellier.inra.fr/CBGP/acarologia/subscribe.php
Previous volumes (2010-2017): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France
ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d’avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

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THE TAXONOMICAL IMPORTANCE
OF THE RESPIRATORY SYSTEM IN TROMBIDIFORMES *

BY

Z. FEIDER †

ABSTRACT

The respiratory system in Trombidiformes, and particularly in Trombidia, has a complex structure which varies following the evolutive stadium of the taxa from superior and inferior rank. Besides the other criteria given by other systems it can participate in creating a phylogenetical systematics.

RESUMÉ

Le système respiratoire des Trombidiformes et spécialement des Trombidia a une structure qui varie chez les taxons d’après l’état d’évolution. À côté des autres systèmes il peut servir pour l’établissement d’une systématique phylogénétique.

In the taxonomy of the mites in general and in that of the Trombidiformes many organs have been used as criteria for establishing a rational and even a philogenetic taxonomy. For the accomplishment of this goal it is necessary to use as many criteria as possible and to emphasize those which reflect better the relations existing between certain taxonomic groups. The importance of the criteria is in relationship with the systematic rank. In the superior ranks the stress may lay on some criteria while in the lower ranks other important criteria may appear. Generally in the taxonomic direction the tagmose, the presence of the actinochitine, the ontogenetic development, the structure of the respiratory system, the structure of the appendices, the presence of the sensorial organs, the chetotaxy and the coxal organs have a great importance. There is an objective hierarchy regarding the necessity of giving advance to some as other criteria. Undoubted that the subjective element has a great importance in the utilisation of the criteria.

In this paper we intend to pond out the importance of the respiratory system in establishing a philogenetic taxonomy of the Trombidiformes, especially regarding the superior taxonomic ranks hoping that those data will serve at least partially to other authors interested in this subject.

It is known that parts from the surface of the body of the respiratory system have been used for a long time in establishing the taxonomy of the mites in general and of Trombidiformes Reuter, 1909 (= Actinedida Van der Hammen, 1968). We will give only examples regarding the classi-

* Communiquée au Ve Congrès International d’Acarologie.


All the above mentioned classifications took into consideration the presence, the number, and position of the stigmas. Van der Hammem has justly criticized the utilisation of certain denominations ended in "stigmata". Thus the species of Tetrastigmata have six stigmas instead of four, certain species of Prostigmata have no stigmas at all, but they have genital tracheae, the Cryptostigmata have no stigmas at all and some Astigmata are endowed with genital stigmas. Besides the criticism which is referring to the stigmas it must be mentioned that the above denominations are not referring to the whole structure of the respiration system, that is the tracheae and their peculiarities and the structure of the stigmas.

In this article we will take into consideration only the respiratory system called the alogenital respiratory system which is constantly widespread and which has no connection with the opening of the genital orifice. This system has a structure which permits comparisons between the mites from Trombidiiformes group and also deductions regarding the relationship and eventually the derivation of the subgroups.

Although we have preserved the denomination of Trombidiiformes, we consider that the Tarsonemini Canestrini et Fanzago, 1877 form an independent group due to the general structure of their body the topography of the stigmas from the anterior part of the idiosome through the structure of the palps, the extremity of the legs and other features. As Van der Hammem (1970-1972) has shown they form an independent group, and Vercammen-Grandjean (1973) classifies the Tarsonemini in a separate subgroup. Considering that the Tarsonemini form a sister-group either with the Trombidiiformes if we emphasize the phlogenetical value of the stigmas topography, or with the Acaridida, as Van der Hammem has shown, taking into consideration the structure of the ambulacras and of other organs.

Because Prostigmata has a respiratory system constantly endowed with tracheae and not always stigmas we consider that the denomination Cladotracheata n. sub. is more proper. The others belonging to the Trombidiiformes, which have no respiratory system Endeostigmata Grandjean, 1937 (= Alycinae Van der Hammem, 1972) are considered to be a sister-group. If we emphasize the respiratory system the subgroup can be called Acladotracheata n. sub.

The Cladotracheata is characterized by the presence of a single pair of tracheae at the supercohorte Tetraclad Feider, 1950. This respiratory system corresponds in Van der Hammem’s classification to the respiratory system derived from the porous areas from the axial series (Grandjean, 1966) with stigmas on the paraxial side of the chelicerae basis.

In our study we will put the stress on this respiratory system (the chelicerae respiratory system) avoiding the vicariante respiratory systems as the genital respiratory system and the respiratory system with stigmas at the level of the epimeras, as it is observed at the Leuvenwensekiidae larvae.

We consider that through its constancy and diversity the chelicerae respiratory system is suited to comparisons and applications in the field of comparative anatomy and this is valuable from the supercohorte taxonomy of Diclada and Tetraclad to the species rank.

In the supercohorte Diclada, the simple pair of tracheae may be in connection with the exterior through an orifice having the form of a stigma (fig. 1, 2) or through a peritreme (fig. 3) by the sub-
Fig. 1. — *Paratetranychus simplex* André (1933).
Fig. 2. — *Cryptognathus lagena* Feider (1954).
Fig. 3. — *Caeculus echinipes* André (1936).
Fig. 4. — *Tydeus subalpinus* Thor (1932).
Fig. 5. — *Zetzeilia alni* Oudemans (1931).
cohortе Eleuterengona Oudemans, 1909 (Anystina Van der Hammen, 1972) or communicates with the pharings at the subcohortе Stomastigmita Oudemans, 1906. In the Eupodostigmata Cunliffe, 1955 (Bidellina Van der Hammen, 1972) the connection of the tracheae through the stigmas has stopped as a result of a secondary process (fig. 4, 5). The Eleuterengona and the Stomastigmita with tracheae, which communicate through the stigmas, may be grouped in a group called Oigodichlada (οιγοδίκλα = open) in contrast with the Eupodostigmata which have closed tracheae and which formed the Cleiodichlada (κλειδίκλα = closed) group.

The supercohortе Tetraclada has a respiratory system which derives from the dicond respiratory system, as may be frequently observed in certain larvae of the group (fig. 6) which have a dicond system, or exceptionally at some adults of the species Tanaupodidae (fig. 7), which manifests an incomplete genetic disjunction. At the Tetraclada, a simple trunk begins from the respiratory orifice which is called, as for as the place of forking, anterior trachea. It is divided into a lateral trachea and a median tracheal trunk. The two trunks have the same development at the cohortе Isotetraclada (superfamily Calyptostomatoidea) (fig. 8). In the other Tetraclada the development of the tracheal trunks is modified. At the Prototetraclada (superfamily Erythraeoida) the anterior tracheal trunk is very much developed, as it results from the name given to the group. The median tracheal trunk is developed too, while the lateral trunk remains thin (fig. 9, 10). The Prototetraclada larvae which have four trunks have the same features as the adults (fig. 11). Both the Isotetraclada and the Prototetraclada have a common feature, a prolonged chelicera with all its articles from the trochanter to the apotel joined in a single piece. At the Tetraclada from Endotetraclada cohortе the proximal article of the chelicera has an inductive action and is transformed in a chitinous sheath, which surround the median tracheal trunk. In the first subcohortе Eucladina with developed median and lateral tracheal trunk, the phalanx Trombidia is involved. In the subcohortе Inconcladina, where Hydcarina are classified, the lateral tracheal trunk is reduced to a bladder (fig. 12). Among the inferior families of Trombidia as it may be observed at the Rhinothrombidiidae the median tracheal trunk has no chitinous sheath (fig. 13), but the chelicera is much more prolonged than the other Trombidia. With some Trombidia, larvae which have four tracheal trunks, the chitinous sheath lacks as a sign of primitivity (fig. 14). Regarding the species of this group there can be observed some alteration of the opening of the tracheae. In the subphalanx Stigmotrombidia the species have stigmas, while in the subphalanx Peritremotrombidia the species have a peritreme. In each subphalanx, the primitive forms have the tracheal trunk ramifications in an arborescent way (fig. 14, 15), while the developed forms with peritreme have the ramifications of the tracheal trunk under the forms of bushes of thin tracheae (fig. 16). The median tracheal trunk with a chitinous sheath was observed by many authors, but the lateral tracheal trunk was described for the first time by M. André (1930) (fig. 17). Many authors merge it into the so called podocephalic canal. In the Trombidia together with the development of the median tracheal trunk, the lateral tracheal trunk diminishes its area until it penetrates exclusively in the first pair of legs (this is an extreme case) (fig. 18). This last case can be observed at the specialized families Teresothrombidiidae and Allothrombidiidae. The evolution of the areas of the median and lateral trunks goes hand in hand with the evolution of other organs.

The structure of the tracheal trunks, the distribution areas as well as the form of the stigmas and peritrems give the classification criteria for the suborder, supercohortе, cohortе, subcohortе, phalanx, for the family and sometimes for the genus and species too. These criteria are in agreement with the structure of other organs, as the metopic crista, the chetotaxie, the uropore structure, the eyes and so on. In addition to the features of the respiratory system one may be linked on the basis of the relations of the comparative anatomy as much at the superior rank taxonomy as within each taxon.
Abreviations: S = stigme; P = peritreme; A = anterior trunk; M = médian trunk; L = lateral trunk.
Fig. 8. — *Calyptostoma beegei* Feider (1950).

Fig. 10. — *Smaris squamata* Feider (1950).

Fig. 11. — *Charletonia krendovshi* Feider (1954).

Abbreviations: S = Stigme; P = peritreme; A = anterior trunk; M = median trunk; L = lateral trunk.
Fig. 12. — Hydriphantes ruberprolongatus Feider (1950).
Fig. 13. — Rhinothrombium nemoricola Feider (1950).
Fig. 14. — Hanemmania dunni Wharton (1950).
Abbreviations: S = stigme; P = peritreme; A = anterior trunk; M = median trunk; L = lateral trunk.
FIG. 15. — Neothrombium neglectum (adult) Feider (1950).

FIG. 16. — Podothrombium ponticum Feider (1950).

Abbreviations: S = stigme; P = peritreme; A = anterior trunk; M = median trunk; L = lateral trunk.
Fig. 17. — *Teresothrombium carpaticum* Feider (1950).
Fig. 18. — *Neotrombicula autumnalis* André (1930).
The classification based on the respiratory system has a phyllogenetic character, as regarding the apparition and a relative chronology of the appearance of the taxons. The diclad character appears before the tetraclad character. The median tracheal trunk appears first through the terminal ramifications and then through its undivided side. The chitinous sheath appears before the joint of the chelicera trochanter. The ramifications of the median tracheal trunk appear first under arborescent form and then under the form of tracheal bushes. The lateral tracheal trunk by Tetractiada is reduced at the most developed groups. The peritreme results through the complication of the stigma. In the Protetraclada the anterior trunk is prolonged first and then it is voidnet. Owing to the structural character, but not only of this, one may ascertain the age and the degree of evolution both of the organs and of the respective taxons.

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