

COMMENTS UPON DIAKONOFF'S SUGGESTIONS ON THE
TERMINOLOGY OF THE GENITALIA IN LEPIDOPTERA*by ATUHIRO SIBATANI, MASAMI OGATA, HIROMU OKAGAKI,
and YOSHIO OKADA

Quite recently, half a year after the publication of the first paper of our studies on the morphology and nomenclature of male genitalia of the Lepidoptera (Sibatani *et al.*, 1954), DIAKONOFF (1954) published a very stimulating and informative article entitled "Considerations on the terminology of the genitalia in Lepidoptera". He intended in this paper to establish a standard system of terminology of the genitalia in Lepidoptera and to remove the notorious confusion prevailing in this field of study. Although the main points of his proposal are closely paralleled by ours, there are several disagreements in the terminological systems suggested by the two groups of workers. Since DIAKONOFF and we both aimed to contribute to a "sanitation" of the terminology of genitalia in Lepidoptera, we considered it urgently necessary to reach a conclusion which could be agreed by both sides. The purpose of the present paper is to discuss briefly the main disagreements of the two systems. We do not wish to insist on our terminological system and are very willing to adopt the DIAKONOFF one whenever it is reasonably shown that the use of a term in DIAKONOFF'S system is preferable to ours for minimizing later confusion and giving sound morphology and easy usage.

There is no discrepancy in the views of the two schools concerning the first and second points of the DIAKONOFF proposal: (1) the use of the classical terms to denote the important parts of the genitalia and (2) relinquishment of the rule of priority in terminology of genitalia. The treatment of the term "uncus" was quite the same in both studies (cf. Ogata *et al.*, 1957). We have not emphasized his point (3): the preference of PIERCE'S terminology for general use, but actually we have followed it tacitly in most cases.

The last point (4): to neglect the classical terms which have been proposed to denote minor details of the structure and to avoid presenting new terms in Latin or Greek, were followed in part by us quite explicitly, but nevertheless we continued to give new terms in Latin or Greek for some minor structures and also we preserved some of the existing terms denoting minor structures (Sibatani *et al.*, 1954; Okagaki *et al.*, 1955). But this was made only when a prudent examination of such structures across a variety of taxonomic groups revealed that the intended recognition of these structural details is crucial for understanding the morphological integrity of higher structures involving them. Such a thorough understanding of the morphology of the genitalia may seem to be unnecessary to taxonomists. This may be true if taxonomists employ the genitalia only to distinguish different

*Editor's note: The manuscript for this paper was received in 1955, but publication was delayed until now. The authors have, however, agreed to let it be published without major additions other than this footnote. C. L. R.

species, but undoubtedly not so if the genitalia are to be studied in systematics dealing with higher categories of classification such as genus, tribe, family, etc., in which the interrelation of different groups should be considered. Thus, our intention to denominate certain minor structural details, some of which may even seem to be rather obscure and difficult to study, has its explicit objective to attract the untrained (if we may say so) taxonomists' eye to the key part of the structure and to enhance the morphological usage.

From our view the DIAKONOFF system is definitely objectionable in several points because in some instances he failed to evaluate the morphological integrity of various parts of male genitalia in different forms. In such cases a drastic synonymization of terms as suggested by DIAKONOFF simply results in obscuring a definition of individual morphologic entities and degrading many terms into omnibus concepts. An example is his treatment of the term *harpe*. He suggested that the entire complex of marginal and mesal modifications of the *valva* be denoted with the compound term *harpe*. How such a decision is irrelevant from the morphological point of view is fully discussed previously (Sibatani *et al.*, 1954) and are not recapitulated here.

DIKONOFF'S treatment of various terms indicating different structures around the *ædæagus* (including *transtilla*, *anellus*, and *juxta*) is, though convenient and useful in general, quite irrelevant in some points. Concepts of some terms of primary morphologic significance such as *juxta* and *transtilla* (in their strict sense) are affected, in the DIAKONOFF system, by the extraneous admixture of minor morphological modifications of, say, *labides* (of Pierce, 1914). It is not intended here that the term *labides* should be retained; it is so peculiarly an organ of some forms of Larentiinae that it may be unnecessary to denote it in Latin or Greek. But this structure is obviously independent from *transtilla* or *juxta*, as will be detailed in later communication (a conclusion mainly derived from the study of musculature).

That the part of PIERCE'S *furca* (Pierce, 1914), which we called in our previous paper by this same name (Okagaki *et al.*, 1955), is a part of the *valva*, as we have demonstrated therein, not pertaining to the *juxta*. We will not, of course, insist on retaining the term *furca* if DIAKONOFF wishes to denote it with barbarous terms. DIAKONOFF made one exception in his discussion about the *juxta* to retain the term *caulis* Obratzov (1949) in Tortricoidae. However, this is not the connection of the "anellus" and *juxta*, but a special form of sclerotized outer proximal sheath of the *ædæagus* which was called *annullus* by Oiticica (1946) in his very excellent paper on the morphology of the *penis* in Lepidoptera and may be homologous to similar structures found widely but irregularly in different forms of Lepidoptera and Trichoptera, e. g., Pieridæ (*Colias*), Lasiocampidæ, Riodinidæ (here the structure was called *fibula* by Stichel in 1911).

If the simplification of terminology proposed by DIAKONOFF would not be an expression of his ignorance of the morphology, but would imply the restriction of classic terms to those structures whose morphological significance is well established, leaving morphologically obscure parts unnamed, we would completely agree with his proposal. Unfortunately, however, it

does not seem that the system proposed by DIAKONOFF has emerged from a sound and complete study on the morphology of the male genitalia.

There is an important question as to which term we should use for the *uncus-socii* complex. As has recently been shown in a separate paper (Ogata *et al.*, 1957), this complex is a morphological unit, and the *uncus* and the *socii* may be secondary modifications thereof. We are proposing to call this complex the *scaphium* because GOSSE's (1882) *scaphium* seems to denote this structure in Papilionidæ and not *tegumen* as suggested by DIAKONOFF. The term *scaphium* caused a notorious confusion in later studies, and it is now used according to PIERCE (1909) to denote the dorsal sclerotization of anal tube in Noctuidæ. But this latter structure is peculiar to Noctuidæ and obviously of minor morphological importance. Unfortunately there is no other Latin name to designate the *uncus-socii* complex as a whole, so we are compelled to choose one of the following possibilities: (1) to retain *scaphium* to denote the *uncus-socii* complex; (2) to introduce a new term; or (3) to expand the concept of *uncus* to include *socii* and use it as the name of the entire complex. In case (1) the noctuid *scaphium* may be called *ligula* according to BERIO (1936), but then the expression *subscaphium* as used by PIERCE (1914) becomes inadequate to denote the ventral sclerotization of the anal tube. This term may be replaced by a new term *subligula* or completely abandoned, because it is a structure of secondary nature and the special term for it is undoubtedly superfluous. In case (2) some entirely new expression must be devised. And also in case (3) a new term is required to denote the *uncus* proper or the median dorsal process of the 10th somite, because the lateral processes (*socii*) and the median one (*uncus*) are quite equivalent in the extent of independence and morphologic as well as taxonomic importance. Thus, in either (2) or (3), a new term is required. We thought it is not advisable here to attempt presenting a new term and decided to apply *scaphium* to the structure in question. The confusion would not be so great because the occurrence of dorsal anal sclerotization is very limited and evidently of no general interest in morphology and taxonomy of Lepidoptera.

We would be pleased if Dr. DIAKONOFF or any other authorities would publish their view upon the above and to settle the matter as soon as possible.

APPENDIX

Just after completing the comments presented above, the 'notes' of FORBES and the "reply" of DIAKONOFF appeared in this journal. It would be pertinent here to extend our comments to what was discussed in these articles. The points raised by FORBES are rather close to our view, as he emphasized the importance of homologies in establishing the terminology of the male genitalia. Nevertheless, there are serious discrepancies between the conclusion finally reached by FORBES and by us. This shows that morphologists may fail to reach a reasonable agreement among themselves. Taxonomists may be discouraged to rely upon the opinion of any single morphologist, while they find it confusing and cumbersome to trace the discussions of morphologists.

Such a situation would certainly affect persuasibility of our argument against DIAKONOFF. However, as we believe that the final establishment of

the genitalic terminology must be firmly based on morphological studies, we would like to present some of our views as an argument against FORBES' opinion. A detailed discussion is being published elsewhere.

FORBES assumes, mainly based on his study of noctuid genitalia, that the *valva* is the coxite (=coxopodite) and his "clasper", or our "*harpe*", may be the second segment, or the *stylus*, on the ground of a prominent muscle which arises at the base of the *valva* and inserts into the basis of the clasper. The occurrence of this type of sclerite and musculature in the *valva* is, however, not general in the whole order Lepidoptera, but rather peculiar to more specialized forms such as Noctuidæ, Geometridæ, or Rhopalocera. A completely different type may be represented by the Eucosmidæ, as illustrated by SNODGRASS in his textbook. Here a muscle runs from the base of the *valva* to the *anellus* of the *adæagus* (in many other Lepidoptera, this muscle arises from the *tegumen*, the *vinculum*, or the outer base of the *valva*). And further there is no other muscle within the *valva*, nor can we find any sclerite recognizable as our "*harpe*." A somewhat similar type of male genitalia may be found in the Adelidæ and Incurvariidæ. Also the *valva* of the Hepialidæ is without *harpe* and intrinsic muscle. These evidences clearly indicate that the *harpe* and its muscle in more specialized forms are of secondary origin, having nothing to do with the *stylus*, or the second segment of the gonopod.

In our opinion, the first segment of the gonopod in Lepidoptera would be represented by the *juxta* and the *stylus* by the *valva* itself, as suggested in 1926 by EYER, if the lepidopterous *valva* be homologous to any part of the gonopod and not to the paramere as postulated by SNODGRASS (1941). The evidences supporting this view come from the following findings:

(1) There are some transitions from typical basal segments of the "gonopods" to the *juxta* in many forms of Trichoptera, being fused medially with each other and articulating by its central protrusion with the "*anellus*" of the *phallus* (see the main part of this paper).

(2) The articulation of the *juxta* with the base of the *valva* is quite a fixed character and observable throughout different forms of Lepidoptera.

(3) The muscle connecting the *juxta* and *vinculum* and another muscle connecting the *juxta* and *valva* are seen generally in various families. Usually either one of the two muscles is present, but sometimes both occur together (in Lycænidæ, Satyridæ, etc. among Rhopalocera and Adelidæ and Incurvariidæ among primitive Lepidoptera), indicating the distinction of the two muscles and suggesting a primary importance.

Now again as regards the term for various modifications on the inner side of the *valva*. If DIAKONOFF feels it to be convenient to apply a collective name to such formations, as their homology with the "*harpe*" (in our sense) in higher forms may frequently be questionable in more primitive groups, then it may be advisable to designate it with barbarous terms, as suggested by DIAKONOFF himself, and to retain the classic term *harpe* to designate the morphologically definable formation with its characteristic musculature. How such an attitude is helpful in the systematics of the Lepidoptera may be typically illustrated by a group of Ennomiæ (Geometridæ) having the "*furca*"

of PIERCE, in part (Okagaki *et al.*, 1955). Here a taxonomist will certainly fail to find a *harpe* in DIAKONOFF'S sense, because there is usually no strong sclerotized modification on the inner side of the *valva*. But still, there is a definite *harpe* with its characteristic muscle arising from, or rather inserting into (because the direction of the movement of sclerite is reversed in this particular instance) the base of the *furca*, or a modified form of *sacculus*. The *harpe*, in reality, is a quite weakly sclerotized "streak" at the base of the *valva* in such forms. Then such a modification of the basic plan of the *valva* can readily be compared with less rudimentary forms in other genera of Ennominae. Its recognition may very much help a taxonomist to trace the relationship of different genera of Ennominae. An effort in this direction is being made by Mr. HIROSHI INOUE, who proved our theory reasonable and illustrative in his extensive generic studies of Ennominae.

References

- Berio, E., 1936. Osservazioni sulla morfologia e nomenclatura dell'apparato copulatore dei Lepidotteri. Che cosa siano realmente l'uncus e lo scaphium. *Festschr. f. E. Strand* 2: 205-211.
- Diakonoff, A., 1954. Considerations on the terminology of the genitalia in Lepidoptera. *Lepid. News* 8: 64-74, 2 figs.
-, 1955. Reply to the Forbes "Notes." *Lepid. News* 8: 169.
- Eyer, J. R., 1926. The morphological significance of the juxta in the male genitalia of Lepidoptera. *Bull. Brooklyn Ent. Soc.* 21: 32-37, 1 pl.
- Forbes, W. T. M., 1939. The muscles of the Lepidopterous male genitalia. *Ann. Ent. Soc. Amer.* 32: 1-10, 5 figs.
-, 1955. Notes on the terminology of the lepidopterous male genitalia. *Lepid. News* 8: 167-168.
- Gosse, P. H., 1882. On the clasping organ ancillary to generation in certain groups of the Lepidoptera. *Trans. Linn. Soc. London* 2: 265-345, pls. 26-35.
- Ogata, M., Y. Okada, H. Okagaki, & A. Sibatani, 1957. Male Genitalia of Lepidoptera: Morphology and Nomenclature. III. Appendages Pertaining to the tenth Somite. *Ann. Ent. Soc. Amer.* 50: 237-244, 3 figs.
- Oiticica, J. Fo. 1946. Sobre a morfologia do penis em Lepidoptera. *Bol. Museu Nacional, Zoologia* 50: 1-36, 49 figs.
- Okagaki, H., A. Sibatani, M. Ogata, & Y. Okada, 1955. Male Genitalia of Lepidoptera: Morphology and Nomenclature. II. Morphological Significance of Sacculus and Furca. *Ann. Ent. Soc. Amer.* 48: 438-442, 2 pls.
- Pierce, F. N., 1909. *The genitalia of the group Noctuidæ of the Lepidoptera of the British Islands*. Liverpool.
-, 1914. *The genitalia of the group Geometridæ of the Lepidoptera of the British Islands*. Liverpool.
- Sibatani, A., M. Ogata, Y. Okada, & H. Okagaki, 1954. Male genitalia of Lepidoptera: Morphology and Nomenclature. I. Divisions of the valva in Rhopalocera, Phalaenidæ (=Noctuidæ) and Geometridæ. *Ann. Ent. Soc. Amer.* 47: 93-103, 2 pls.
- Snodgrass, R. E., 1935. *Principles of insect morphology*. New York and London.
-, 1941. The male genitalia of Hymenoptera. *Smiths. Misc. Coll.* 99 (14): 1-86, pls. 1-33.
- Stichel, H., 1911. Lepidoptera Rhopalocera. Riodinidæ. *Genera Ins.* 112.

(Sibatani) Cytochemistry Lab., Yamaguti Medical School, Ube, Yamaguti-ken, JAPAN
 (Ogata) Ogata Hospital, No. 18, 3-Chome, Imbashi, Higashi-ku, Osaka, JAPAN
 (Okada) Tuberculosis Research Institute, University of Kyoto, Kyoto, JAPAN
 (Okagaki) Uradome Town's Hospital, Uradome, Tottori-ken, JAPAN