Odonatologica 8 (1): 47-54 *March 1, 1979*

SOME DRAGONFLY KARYOTYPES FROM THE VOLTAIC REPUBLIC (HAUTE VOLTA), WEST AFRICA

B. KIAUTA and G.A. BOON VON OCHSSÉE
Department of Animal Cytogenetics and Cytotaxonomy,
University of Utrecht, Padualaan 8, Utrecht, The Netherlands

Received November 29, 1978

From Bobo-Dioulasso and the broader surroundings the male germ cell complements were examined of the following 9 spp.: Coenagrionidae: *Pseudagrion whellani* Pinhey; Libellulidae: *Orthetrum b. brachiale* (P. de Beauv.), *O. chrysostigma* (Burm.), *O. guineense* Ris, *O. monardi* Schmidt, *Palpopleura lucia portia* (Dru.), *Trithemis atra* Pinhey, *T. imitata* Pinhey and *T. kirbyi ardens* Gerst. All of them possess 13 elements in the haploid set; an *m*-bivalent is present in all libellulids. The *P. whellani* complement apparently originates from an n = 14 set, but it is not clear whether or not the original X participates in the fusion, hence the identity of the small element and the mode of sex determination are uncertain. *O. brachiale* is the only sp. earlier studied cytologically. While the karyotype of a Kenyan specimen is clearly of a secondary origin (n ♂ = 11, no *m*, increased chiasma frequency; cf. KIAUTA, 1969, Arnoldia, Rhodesia 4 [15]: 1-8), those of the 2 spec. from Upper Volta are of the usual *Orthetrum* type.

INTRODUCTION

The present report deals with the chromosomes of nine odonate species, collected by the second author in the broader surroundings of Bobo-Dioulasso, Upper Volta (January-March, 1978), in the framework of a tsetse project, carried out by the Department of Toxicology of the Agricultural University, Wageningen, the Netherlands, in cooperation with the World Health Organization (WHO). *Orthetrum brachiale* (P. de Beauv.) is the only species previously examined cytologically; the karyotype of the Voltaic population is essentially different from that described in a specimen from Kenya (cf. KIAUTA, 1969c). The other taxa dealt with here are: Coenagrionidae: *Pseudagrion whellani* Pinhey; Libellulidae: *Orthetrum*

chrysostigma (Burm.), *O. guineense* Ris., *O. monardi* Schmidt, *Palpopleura lucia portia* (Drury), *Trithemis atra* Pinhey, *T. imitata* Pinhey and *T. kirbyi ardens* Gerst.

This is the fourth note on the chromosomes of African dragonflies, bringing the number of hitherto cytologically studied African (incl. Malgasian) species up to 25 (cf. KIAUTA, 1968, 1969c; VAN BRINK & KIAUTA, 1977). From the cytological point of view, after Australia, the African fauna is so far the least known dragonfly fauna of all.

The specimens were collected either in the Bobo-Dioulasso city area (Marigot and Koro rivers), or, mostly, at the Guenako River (the Volta Noire source), at a distance of some 40 km in the savanna.

The aceto-carmine slides were made on the spot under field conditions, then airmailed to the Netherlands and Feulgen processed. The specimens, slides and films are in the collection of the Department of Animal Cytogenetics and Cytotaxonomy, University of Utrecht.

DESCRIPTIONS AND DISCUSSIONS OF THE COMPLEMENTS

PSEUDAGRION WHELLANI PINHEY, 1956
Figures 1-2

Material. — 3 ♂, Guenako River (Volta Noire source), 29-I/11-III-1978. — [10 complements photographed].

n = 13. The primary spermatocyte karyotype is characterized by the presence of a large element, the symmetrical cross-like shape of which suggests its bivalent, not trivalent, structure. The other elements are medium-sized and slightly graded, save for a small element of uncertain structure. In figures considered to represent telophase II, there are 12 elements, including the small one.

A tentative analysis of this evidence is extremely difficult, since neither diakinetic nor any anaphase figures are available in our material.

This is the ninth *Pseudagrion* species so far examined cytologically; in the remaining eight there are 14 elements in the primary spermatocyte set (cf. DASGUPTA, 1957; VAN BRINK & KIAUTA, 1977), while the complement of the allied Hawaiian *Megalagrion oahuense* (Blackburn) is also essentially similar (KIAUTA, 1969b). It seems that the reduction of the chromosome number in *P. whellani* is due to a fusion of two elements of the primary, n = 14, karyotype, the evidence of which is the occurrence of the extra large bivalent. The fusion appears irreversible; no other complements were found in our (limited) material.

The identity of the elements involved in fusion cannot be ascertained with certainty, and it is not clear whether the small element represents the original

m-bivalent or the secondary neo-Y. In view of the evidence of the anaphase II figures, containing only 12 elements, including the small one, the latter proposition seems more likely (cf. KIAUTA, 1969a).

P. whellani is referable to group B of PINHEY (1964). The only other cytologically examined member of this group is *P. acaciae* Foerst., possessing a perfectly "normal" *Pseudagrion* karyotype (VAN BRINK & KIAUTA, 1977).

ORTHETRUM BRACHIALE BRACHIALE (P. DE BEAUVOIS, 1805)
Figure 3

Material. — 2 ♂, Guenako River (Volta Noire source), 19-II-1978. — [28 complements photographed].

n = 13. This is a "normal" *Orthetrum* karyotype. The metaphase I elements are gradually decreasing in magnitude, save for a small X and a minute *m*-bivalent. No bivalent can be easily discerned by its larger size, and none has more than a single chiasma.

A very different complement has been described in a specimen from Mombasa, Kenya, pertaining to the "form" *kalai* Longfield, and consisting of 11 elements, including an unpaired X, but lacking the *m*-bivalent. Due to an exceptionally high chiasma frequency, the recombination index in the Kenyan specimen is considerably higher than that in the Upper Volta population (cf. fig. 5 in KIAUTA, 1969c).

The form *kalai* occurs amongst the typical *b. brachiale* in most parts of its range, hence PINHEY (1970a) suggested that it much more likely represents a melanotic condition rather than an infraspecific form. It would be extremely interesting, therefore, to examine systematically the karyotypes of all the various forms of *brachiale*, of which only the Seychellean *wrighti* (Sel.) seems to be a true subspecies. On the other hand, it is certainly possible that the secondary karyotype of the Kenyan specimen is incidental; several similar cases are known in the order (cf. KIAUTA, 1972).

ORTHETRUM CHRYSOSTIGMA (BURMEISTER, 1839)
Figures 4-5

Material. — 1 ♂, Guenako River (Volta Noire source), 19-II-1978. — [8 complements photographed].

2 n = 25, n = 13. The spermatogonial elements are gradually graded, save for a well recognizable *m*-pair. At metaphase I, the X is the second smallest of the set, only slightly superior in volume to the *m*-bivalent. The same chromosome number has been reported from Swasiland (VAN BRINK &

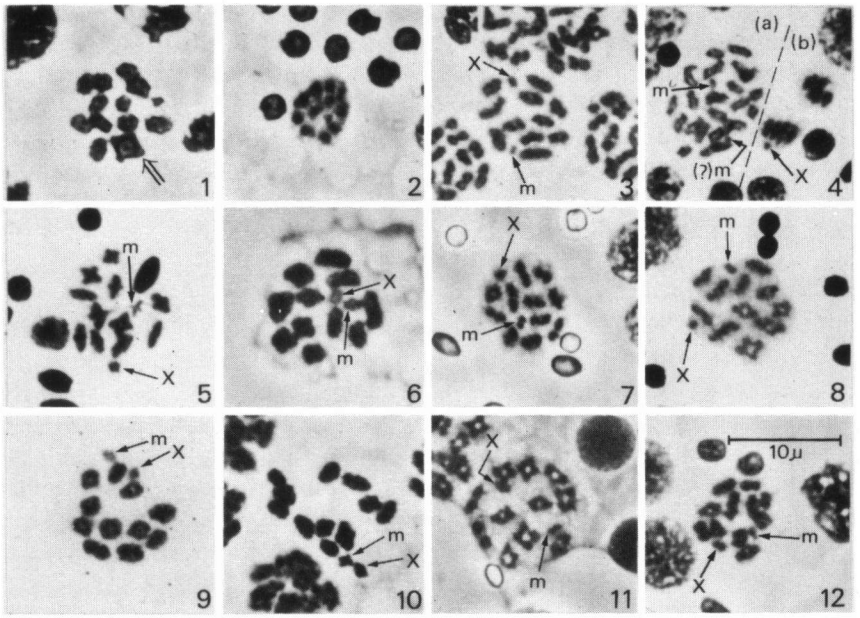
KIAUTA, 1977).

ORTHETRUM GUINEENSE RIS, 1909
Figure 6

Material. — 1♂, Guenako River (Volta Noire source), 10-III-1978, — [20 complements photographed].

n= 13. The species is new to cytology. Its metaphase I complement consists of 11 bivalents gradually decreasing in magnitude, whereas the *m* and X are of approximately similar size.

ORTHETRUM MONARDI SCHMIDT, 1949
Figure 7



Figs. 1-12. Male germ cell chromosomes of some dragonflies from Upper Volta (Feulgen squash, 1500 X): (1-2) *Pseudagrion whellani* Pinhey, metaphase I (Fig. 1, note the large bivalent-like element, indicated by the arrow) and metaphase II (Fig. 2); — (3) *Orthetrum b. brachiale* (P. de Beauv.), metaphase I; — (4-5) *O. chrysostigma* (Burm.), spermatogonial metaphase (Fig. 4a), metaphase I (Fig. 5), anaphase-telophase II, lateral view (Fig. 4b); — (6) *O. guineense* Ris, metaphase I; — (7) *O. monardi* Schmidt metaphase I; — (8-9) *Palpopleura lucia portia* (Drury), metaphase I; — (10) *Trithemis atra* Pinhey, metaphase I; — (11) *T. imitata* Pinhey, early metaphase I; — (12) *T. kirbyi ardens* Gerst., metaphase I.

Material. — 1♂, Marigot River, Bobo-Dioulasso, 8-I-1978. — [33 complements photographed].

n = 13. The species is new to cytology. Its metaphase I complement is similar to that of the preceding species, including the X: *m* ratio at this stage.

O. chrysostigma and *O. monardi* are referable to the Chrysostigma-group of PINHEY (1970a). Their karyotypes appear similar; however, they differ from that of *O. taeniolatum* (Schneid.), another member of the group, and which has been studied from Greek material (KIAUTA, 1972b). In the latter species one bivalent is recognizably larger than the others, while the *m*-pair (bivalent) is minute. The volume of the *m*-bivalent, as compared to X, is decreasing in the direction *monardi* (approximately equal) — *chrysostigma* (slightly smaller) — *taeniolatum* (extremely minute).

It should be stressed that this observation has no phylogenetic significance, the less so since Pinhey's grouping has been set up for convenience rather than for any phylogenetic purpose. Alternative classifications are certainly possible; two such systems have been provided by LONGFIELD (1955) and PINHEY (1970a). In the former, *chrysostigma* and *monardi* are grouped together and separated from *taeniolatum*, while in the latter system *taeniolatum* figures as an annectent member of the Chrysostigma-Monardi group.

PALPOPLEURA LUCIA PORTIA (DRURY, 1773)
Figures 8-9

Material. — 2♂, Guenako River (Volta Noire source), 19-II/10-III-1978. — [52 complements photographed].

n = 13. At metaphase I there is hardly any size gradation in the 11 "normal" bivalents. The *m*-bivalent and X are nearly uniform in size, though the latter is slightly smaller than the former.

The only other cytologically examined member of the genus is *P. sexmaculata* (Fabr.) from Nepal. According to figure 37 of KIAUTA (1975), in metaphase I of this species one bivalent is distinctly larger than the others, and so is the unpaired X compared to the *m*-bivalent.

More information is available on the cytology of the allied American genus *Perithemis*, of which eight members have been examined (cf. CUMMING, 1964; KIAUTA & VAN BRINK, 1978; FERREIRA, KIAUTA & ZAHA, 1979). The genus shows a considerable variation in such karyotypic features as the relative length of some autosomal elements (bivalents), X: *m* ratio and the TCL. As evidenced by the occurrence of a low-n species, the overall recombination index in the genus is also not stabilized. This could point to a relatively young phylogenetic derivation of *Perithemis* from the ancient Old

World "Palpopleura" stock, but the sample of the *Palpopleura* taxa examined is too small to allow a more conclusive speculation on this problem.

TRITHEMIS ATRA PINHEY, 1961
Figure 10

Material. — 2♂, Guenako River (Volta Noire source), 10-III-1978. — [18 complements photographed].

n = 13. The metaphase I complements of the two specimens studied are not identic. In one specimen there are 12 elements gradually decreasing in size, while the smallest element has but half the size of the second smallest. It is likely, though not certain, that the latter is the X. In the other specimen, there are two small elements of approximately the same size; the smallest of these is the *m*-bivalent. The species is known for its infraspeciation and/or variation, but our two specimens definitely pertain to the nominate form (cf. PINHEY, 1970b). This species has not been examined from other localities.

TRITHEMIS IMITATA PINHEY, 1961
Figure 11

Material. — 1♂, Koro River, Bobo-Dioulasso, 30-XII-1977; — 1♂, Guenako River (Volta Noire source), 19-II-1978. — [15 complements photographed].

n = 13. X is about half the size of the *m*-bivalent. The other metaphase I elements are slightly decreasing in size. The species is new to cytology and the overall karyotypic morphology of the two specimens is identic.

TRITHEMIS KIRBYI ARDENS GERSTAECKER, 1891
Figure 12

Material. — 1♂, Marigot River, Bobo-Dioulasso, 2-I-1978. — [4 complements photographed].

n = 13. The metaphase I karyotype is similar to that of the preceding species, including the X:*m* ratio. It has not been examined previously.

The five cytologically examined African members of the genus are referable to the groups I (*annulata, arteriosa, imitata*), II (*kirbyi ardens*) and VI (*atra*) of PINHEY (1970b). To these should be added the Oriental taxa, *T. aurora* (Burm.) (OGUMA & ASANA, 1932; KIAUTA, 1975), *T. festiva* (Ramb.) (KIAUTA, 1975), and *T. pallidinervis* (Kirby) (ASANA & MAKINO, 1935; DASGUPTA, 1957). Generally, there are very minor variations in the chromosome morphology of the species examined, and no

grouping is apparent on the basis of cytotaxonomic evidence. Nevertheless, Pinhey's group I, to which *T. aurora* also pertains, is the only one in which certain anomalies are found, viz. the occasional occurrence of an additional minute element in *T. arteriosa* (VAN BRINK & KIAUTA, 1977) and the (variable) low-n complement of *T. aurora* (KIAUTA, 1975).

ACKNOWLEDGEMENTS

The second author is grateful to Professor Dr. J.H. KOEMAN (Department of Toxicology, Agricultural University, Wageningen, the Netherlands) for giving him the opportunity to work in Upper Volta. For the identification of specimens thanks are due to Professor Dr. M.J. PARR (Department of Biology, University of Salford, United Kingdom).

REFERENCES

ASANA, J.J. & S. MAKINO, 1935. A comparative study of the chromosomes in the Indian dragonflies. *J. Fac. Sci. Hokkaido Univ.* (VI) 4 (2): 67-86.

DASGUPTA, J., 1957. Cytological studies on the Indian dragonflies. II. A study of the chromosomes during meiosis in thirty species of Indian Odonata (Insecta). *Proc. zool. Soc. Calcutta* 10 (1): 1-66.

FERREIRA, A., B. KIAUTA & A. ZAHA, 1979. Male germ cell chromosomes of thirty-two Brazilian dragonflies. *Odonatologica* 8 (1): 5-22.

KIAUTA, B., 1968. The chromosome numbers of eight Old World dragonflies (Odonata). *Chrom. Inf. Serv., Tokyo* 9: 3-4.

KIAUTA, B., 1969a. Sex chromosomes and sex determining mechanisms in Odonata, with a review of the cytological conditions in the family Gomphidae and references to the karyotypic evolution of the order. *Genetica* 40 (2): 127-157.

KIAUTA, B., 1969b. The chromosomes of the Hawaiian endemic dragonflies, Megalagrion oahuense (Blackburn) (Coenagrionidae: Pseudagrioninae) and Nesogonia blackburni (McLachlan) (Libellulidae: Sympetrinae), with a note on the cytotaxonomic affinities between the genera Nesogonia Kirby and Sympetrum Newman (order Odonata). *Proc. Hawaii. ent. Soc.* 20 (2): 429-433.

KIAUTA, B., 1969c. The chromosomes of eight dragonfly species from Continental Africa and Madagascar (Odonata). *Arnoldia (Rhod.)* 4 (15): 1-8.

KIAUTA, B., 1972a. Synopsis of the main cytotaxonomic data in the order Odonata. *Odonatologica* 1 (2): 73-102.

KIAUTA, B., 1972b. Notes on new or little known dragonfly karyotypes. II. Male germ cell chromosomes of four east mediterranean species, Lestes barbarus (Fabricius), Calopteryx splendens amasina (Bartenev) (Zygoptera: Lestidae, Calopterygidae), Caliaeschna microstigma (Schneider) and Orthetrum taeniolatum (Schneider) (Anisoptera: Aeshnidae, Libellulidae). *Genen Phaenen* 15 (2/3): 95-98.

KIAUTA, B., 1975. *Cytotaxonomy of dragonflies, with special reference to the Nepalese fauna*. Nepal Research Center, Kathmandu.

LONGFIELD, C., 1955. The Odonata of N. Angola. Part I. *Publçoes cult. Co. Diam. Angola* 27: 11-64.

OGUMA, K. & J.J. ASANA, 1932. Additional data to our knowledge on the dragonfly chromosome, with a note on the occurrence of X-Y chromosome in the ant-lion (Neuroptera). *J. Fac. Sci. Hokkaido Univ.* (VI) 1 (4): 133-142.

PINHEY, E., 1964. A revision of the African members of the genus "Pseudagrion" Selys (Odo-

nata). *Revta Ent. Moçamb.* 7 (1): 5-196.

PINHEY, E., 1970a. A new approach to African Orthetrum (Odonata). *Occ. Pap. natn. Mus. Rhod.* (B) 30: 261-321.

PINHEY, E., 1970b. Monographic study of the genus Trithemis Brauer (Odonata: Libellulidae). *Mem. ent. Soc. sth. Afr.* 11: 1-159.

VAN BRINK, J.M. & B. KIAUTA, 1977. Annotations on the chromosome complements of some dragonflies from southern Africa. *Abstr. Pap. 4th int. Symp. Odonatol., Gainesville*, pp. 18-19.

NOTE ADDED IN PROOF (February 20, 1979):

In a paper published recently (J. GREEN, 1979, The fauna of Lake Sonfon, Sierra Leone. *J. Zool., Lond.* 187: 113-133) it is argued that *Orthetrum kalai* Longf. is a good species, not merely a melanistic form of *O. brachiale* (P. de Beauv.). In the light of this statement the cytological evidence on the two taxa seems of particular interest.