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A MOSQUITO WITH EIGHT CHROMOSOMES: *CHAGASIA BATHANA* DYAR

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ABSTRACT. The brain cell and testes chromosomes of *Chagasia bathana* are described. The species has eight chromosomes, 2N=8. The males are heterogametic and have one long X chromosome and one short Y chromosome, both of which are telocentric, and the females have two long X chromosomes. The three autosomal pairs are metacentric or submetacentric. Relationships between Culicinae and Anophelinae are discussed.

INTRODUCTION

Karyotype studies of mitotic and/or meiotic chromosomes have been made of many species in Culicidae, and in each case the chromosome number is six, 2N=6 (Breland 1961, Rai 1963, Kitzmiller et al. 1967, Coluzzi and Kitzmiller 1975, Kitzmiller et al. 1976).

Rai (1963) described the brain cell chromosomes of *Corethra* sp., a genus in Chaoboridae. The chromosome number is eight, 2N=8. The males are heterogametic with one metacentric X chromosome and 1 telocentric Y chromosome; females have two X chromosomes.

Karyotype studies of species in Anophelinae have been limited to the subgenera *Anopheles, Nyssorhynchus, Cellia,* and *Stethomyia* (Coluzzi and Kitzmiller 1976, Kitzmiller, et al. 1976). No karyotype data are available from species in the other 2 genera of Anophelinae *Chagasia* and *Bironella*. The results of a cytological study of *Chagasia bathana* Dyar from Panama are reported here.

MATERIALS AND METHODS

Field collected larvae from Mojinga swamp in the Canal Zone, Panama, which is the type-locality for *C. bathana* (Dyar 1928) were reared to fourth instar in the laboratory. These larvae have the anterior flap of the spiracular apparatus modified into a long process which ends in an equally long seta. Prothoracic hairs 5, 6 and 7 are large with the inner pair inserted much beyond the median pair and with 12 to 14 branches. Abdominal hair one (palmate tuft) of segments I-II has narrow leaflets, all, or almost all of them with smooth margins. Certain of these larvae were allowed to pupate and emerge as adults. The adults have a trilobed scutellum, wings peppered with white scales on all veins, and hind tarsi II-III have 2 dark rings, the basal one very small. All these characters identify the larvae collected as the species, *C. bathana*.

Chromosome preparations were made following the standard techniques of French et al. 1962.

RESULTS

The diploid chromosome number of *C. bathana* is eight, 2N=8. The karyotype of females consists of 4 pairs of chromosomes each pair homomorphic, Figure 1. In the male one of the pairs is heteromorphic and consists of 1 long (X) and 1 short (Y) chromosome, Figures 2–4. Therefore, *C. bathana* is heterogametic, the X and Y or sex chromosomes are telocentric, and about one half of the free end of the X is missing in the Y chromosome, Table 1.

Rai (1963) reported that it is usually possible to identify the brain cell metaphase chromosomes of mosquito species by size alone. The shortest chromosome pair of the complement is designated one. This pair is heteromorphic in studied species in the genus *Anopheles*. Chromosome pair one is homomorphic in studied Culicinae species. In *Anopheles* a short Y chromosome is found with a longer X chromosome in the males, and the

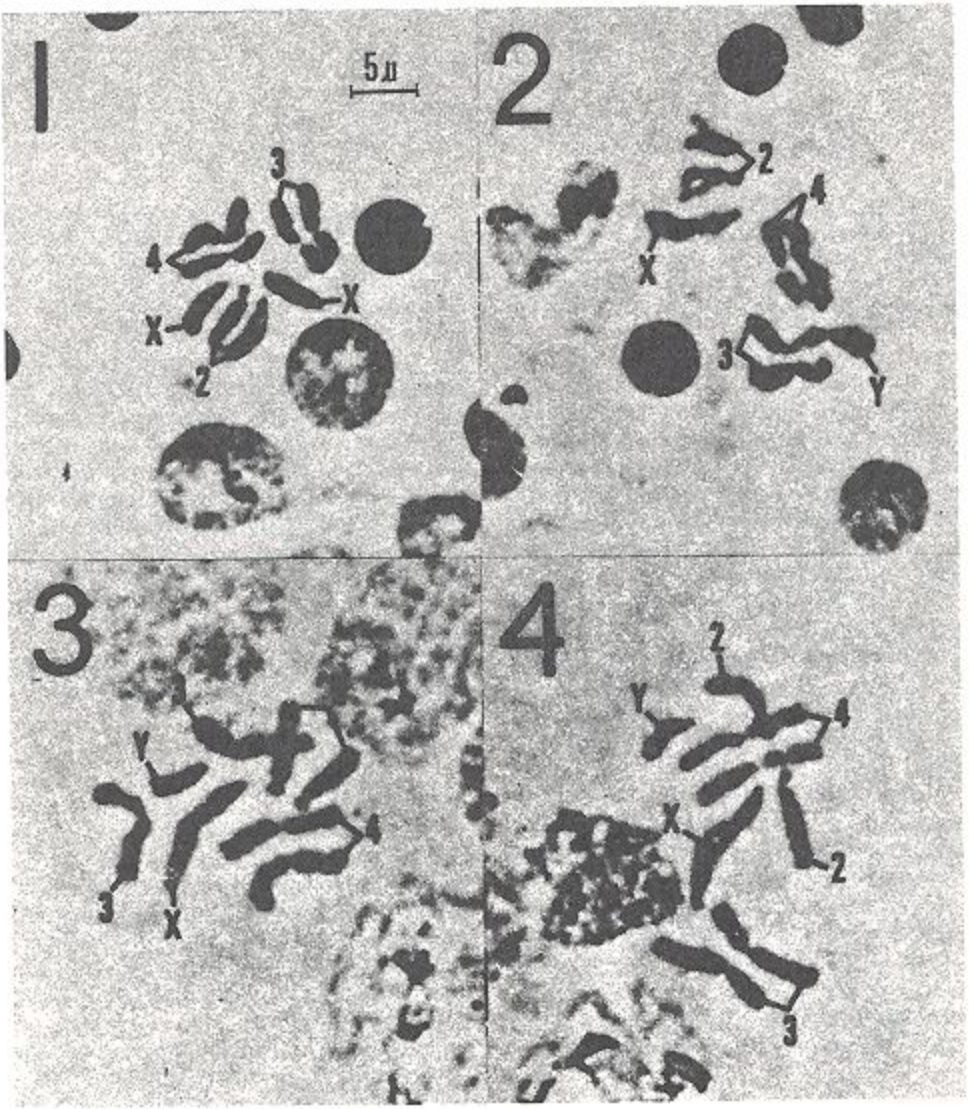

Figure 1. Chromosomes from brain cells of a female larva.

Figure 2. Chromosomes from brain cells of male larva.

Figure 3. Chromosomes from the testes of the larva in Figure 2.

Figure 4. Chromosomes from larval testes.

Table 1. Brain cell chromosome lengths in *Chagasia bathana*.

Chromosomes	Chromosome Description	Length in Microns		Ratio to Length of X Chromosome
		Right Arm	Left Arm	
I X	Telocentric	5.4	—	1.0
Y	Telocentric	2.7	—	.5
II	Subtelocentric	4.1	0.7	.9
III	Submetacentric	3.1	2.4	1.0
IV	Metacentric	3.1	3.1	1.2

females have two X chromosomes (Kitzmiller et al. 1967). Chromosome pair two is the next longest, while the longest chromosome pair is designated three.

Consistent with other species in subfamily Anophelinae the sex chromosomes of *C. bathana* are designated pair one. The next longest elements but the shortest autosomes are the subtelocentric chromosomes, pair two. The right arm of this chromosome is about 6 times as long as the left. Submetacentric pair three is slightly longer than pair two. The right arm of this element is about 10% longer than the left. The longest autosomal pair, four, is metacentric, Figure 1–4 and Table 1. These proportional arm length designations have been assigned after study of many complements from brain or testis tissue of over 100 specimens. Although actual lengths of the elements of the complement (Table 1) may differ from tissue to tissue and from complement to complement within the same tissue, the proportional designations are consistent and the same in all complements studied. The lengths in Table 1 are typical of most brain cell complements.

DISCUSSION

The complement of *C. bathana* consists of 8 chromosomes 2N=8. Considering the high degree of cytogenetic uniformity in Culicidae this is a radical difference from the norm for the family.

Certain other species of Nematocera have 8 chromosomes. Of particular interest is the genus *Corethra* of the family Chaoboridae, a group which is morphologically similar to the Culicidae. The lengths of autosomes of complements from brain tissue of *Corethra* sp. and *C. bathana* are similar. In fact in both species the longest chromosome (four) is metacentric with each arm measuring 3.1 μm. The sex chromosomes in each heterogametic species are different in length and type. In *Corethra* sp. the X is metacentric; each arm is 1.1 μm and the Y is telocentric and 1.1 μm; whereas in *C. bathana* both chromosomes are telocentric with the X 5.4 μm and the Y 2.7 μm in length.

A hypothetical derivation of the *Anopheles* chromosomes from those of *Corethra* sp. has been reported by Frowlowa (1929) and Frizzi (1947). They propose that the heterosomes of *Corethra* sp. were translocated to 1 of the pairs of autosomes. This would result in 3 pairs of chromosomes, one pair heteromorphic and subtelocentric and 2 pairs of homosomes either metacentric of submetacentric.

Chagasia has morphological similarities with both anophelines and culicines, Table 2. It might represent the remnants of a base type from which the 2 groups, Anophelinae and Culicinae, were derived. It is possible to hypothesize the synthesis of known Anophelinae and Culicinae karyotypes of 6 chromosomes from a *C. bathana* type complement. The sex chromosomes minus the centromere could have been translocated to the long arms of chromosomes 2 which would produce a new pair of longer subtelocentric heterosomes and would reduce the chromosome number to 6. The resulting karyotype resembles the brain cell complement of *An. punctipennis* (Baker and Kitzmiller 1964) and certain other *An.* species. That is, 1 pair of metacentric, 1

pair submetacentric, and 1 pair of subtelocentric chromosomes. The subtelocentric chromosomes are heterosomatic in the males, Figure 5. A translocation of the same sections of the sex chromosomes to the short arms of chromosome two with later modification in the male either a gain or loss of some genetic material, would result in a Culicinae karyotype with 3 pairs of metacentric or submetacentric chromosomes each pair homosomatic Figure 5.

C. bathana has excellent salivary gland chromosomes and a map of these

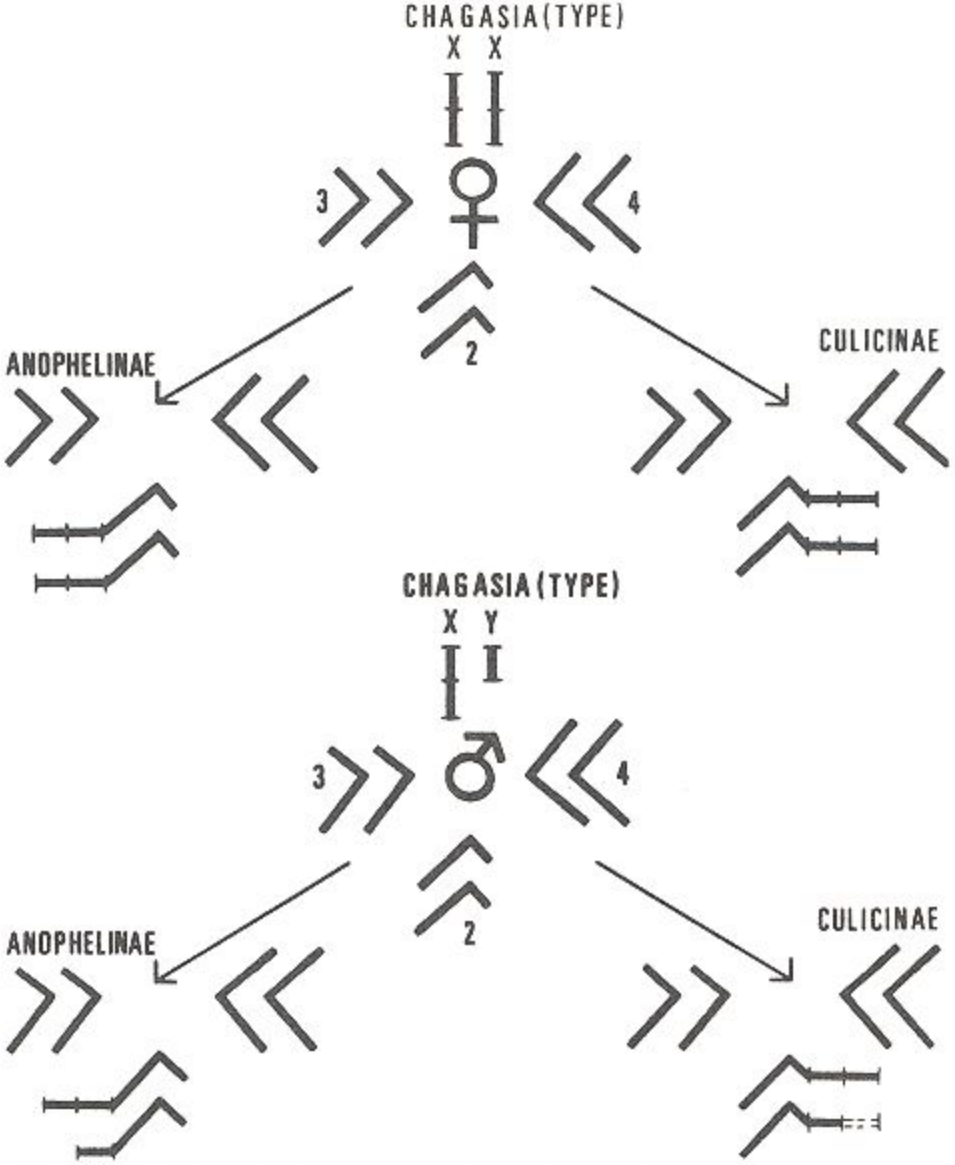

Figure 5. Possible derivation of Anophelinae or Culicinae mitotic chromosomes from *Chagasia* (type) chromosomes.

Table 2. Summary of certain morphological similarities among Culicinae, *Anopheles* and *Chagasia* (Lane 1953).

Characteristic	Culicinae	*Anopheles*	*Chagasia*
First abdominal tergite	At least a tuft of scales	No scales	No scales
Hind coxae	Distinctly larger than width of mesepimeron	Slightly shorter	Slightly shorter
Scutellum	Trilobed	Rounded	Trilobed
Palpus of female	Shorter than proboscis	About the same length	About the same length
Posterior pronotal setae	Present	Absent	Present
Adult resting stance	Parallel to surface	Almost perpendicular to surface	Parallel to surface
Larvae at water surface	Hang below surface	Remain at surface	Remain at surface
Suitability of polytene chromosomes for study	Very poor	Very good	Very good

chromosomes will soon be available. Preliminary studies indicate little banding similarity between *C. bathana* and any anopheline pattern.

Further cytogenetic studies on the other species in *Chagasia* or species in *Bironella* may provide additional information on the chromosomal relationships among the Culicidae.

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