A NEW KARYOTYPE FOR CYLLEX TRITAENIORHYNCHUS

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Linkage group—chromosome correlations have been made in the mosquito, Culex tritaeniorhynchus, by the use of genetic and cytologic observations of radiation-induced inversions and translocations (Baker, Sakai, Mian 1971a and 1971b, and Sakai, Baker and Mian 1971). Linkage groups were assigned to the following chromosomes (Fig. 1A): linkage group I to the smallest chromosome, linkage group II to the submetacentric chromosome and linkage group III to the metacentric chromosome. Sixteen heterozygous pericentric inversions were produced that completely or nearly completely suppressed crossing over in the males between golden (go) and sex (M) which represent the currently known extreme ends of linkage group I (25–27 map units). Evidence was also found suggesting that the centromere is between the two markers, go and M. The pericentric inversions were fairly easy to detect since the chromosome affected had changed from the normal metacentric

Fig. 1.—Metaphase chromosomes from testes. Arrows point to pericentric inversion chromosomes. A—Normal "wild type" complement. B—Heterozygous pericentric inversion on M-bearing chromosome. C—Heterozygous pericentric inversion on M-bearing chromosome. D—Homzygous pericentric inversion complement.
chromosome to a clearly submetacentric chromosome (Fig. 1B and C).

The pericentric inversion showing the highest percentage of crossing over between go and sex was $I(1)55$. When the inversion was on the M-bearing chromosome, the recombination found between these two markers was 1.7 percent. The 37 percent sterility observed in the eggs is probably due to the lethality resulting from the duplications and deficiencies produced by crossing over within the inversion loop. This same inversion when present on the $m$-bearing chromosome is quite interesting: females heterozygous for this chromosome are completely fertile. This is expected as complete linkage has been found in females for this linkage group (Baker and Rabbani, 1970). However, the $F_1$ heterozygous sons of these females which carry the pericentric inversion on the $m$-bearing chromosome showed sterility of 31 percent, and crossing over between go and $m$ of 5.4 percent. This is somewhat higher than that observed in the original inversion males, but considerably lower than the crossing over value of 25-27 percent between these two markers in untreated chromosomes.

Since we now had stocks with this inversion on both the $m$-bearing and M-bearing chromosomes, crosses were set up to produce a line in which this pericentric inversion could be made homozygous. This paper reports the results of these crosses.

**Methods and Materials.** Two types of crosses were made to produce a stock homozygous for the inversion. We recovered females and males respectively which were homozygous for the inversions from the following two crosses, (1) $I(1)55 w M + m \varnothing \times I(1)55 w M + m \delta$ and (2) $I(1)55 w M + m \varnothing \times I(1)55 w M + M \delta$. It may be mentioned here that the recessive marker, white eye ($w$), was present within the inverted segment; thus, we were able to detect homozygosity for the inversion not only cytologically but also genetically. The chromosomal techniques were the same as reported earlier (Baker, Sakai, Mian 1971b).

**Results.** The cytogenetic aspects of these crosses can be seen in Fig. 1. Fig. 1A represents the wild type karyotype with the two identical metacentric chromosomes. Fig. 1B and 1C represent the heterozygous inversion on the $m$-bearing and M-bearing chromosomes respectively. Fig. 1D shows the homozygous pericentric inversion. Here both chromosomes are equally submetacentric.

The genetic results of the crosses involving the inversion homozygotes are interesting. When homozygous females were crossed with homozygous males, all the resulting eggs failed to hatch. Outcrossing of the homozygous females to wild type males also resulted in eggs which did not hatch. Dissection of these females reveal that a few had been inseminated as evidenced by the presence of sperm in the spermathecae. Most females, however, had not been inseminated. The homozygous males on the other hand produced fully fertile egg rafts when crossed to either wild type or inversion heterozygous females. The results of these crosses suggest that the sterility observed in the homozygous females is due to the females and not to the males. Since the homozygous females have not as yet produced fertile eggs, the stock is maintained by continually backcrossing the homozygous $\varnothing$ to the homozygous $\delta$, $I(1)55 w M + m \varnothing \times I(1)55 w M + M \delta$. All the inversion homozygous offspring, males and females, have white eyes and the inversion heterozygotes, normal eyes.

**Discussion.** Since pericentric inversions include the centromere, they may produce morphologically new chromosomes if the breaks occur unequally from the centromere on the chromosome arms. One of the interesting evolutionary aspects of pericentric inversions is their possible influential role in producing new karyotypes. Strong evidence of this having occurred has been found in *Drosophila* and in members of the Orthoptera where apparent centromeric shifts have been detected (Swanson, 1957). If the pericentric in-
version is viable as a homozygote but
semisterile as a heterozygote, a separate
group may be evolved which is fully fer-
tile, cytologically identifiable, and does not
breed well with the parental population.

Except for the anophelines and possibly
the subgenus *Lutzia* of the genus *Culex*,
the karyotypes of all mosquitoes studied
are surprisingly uniform (Baker and As-
lamkhan 1969). This may possibly sug-
gest that pericentric inversions have not
played an important role in the evolution
of these mosquitoes with uniform karyo-
types. At least, no culicine mosquito kary-
otype has been reported which is similar to
the new karyotype described above for
*Culex tritaeniorhynchus*. Although prob-
ably by coincidence, the I(1)55 homo-
zygous inversion karyotype bears striking
resemblance to that of some of the anophe-
line karyotypes (Kittmiller 1967; Aslam-
khan and Baker 1969), particularly the
*quadrimaculatus* female type. Here the
X chromosomes are shorter than the auto-
somes, and they are definitely submeta-
centric (one long arm and one short arm).
In this respect it is interesting to note that
Kittmiller (1953) has suggested the possi-
bility that the chromosome with approxi-
mately equal length (a median centro-
mere) as found in *Culex, Culiseta* and
*Aedes* may have been derived from or may
have given rise to the subtelocentric (sub-
metacentric) type found in *Anopheles* by
a pericentric inversion.

**SUMMARY.** A new karyotype has been
established in *Culex tritaeniorhynchus* by
selection for homozygosity for a pericentric
inversion (I(1)55) on chromosome I. Al-
though no fertile egg rafts have yet been
recovered from the homozygous inversion
females, the homozygous inversion males
are fully fertile.

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