STUDIES ON RODENT CHROMOSOMES

Part IV. Chromosomes of a Metad, *Millardia meltada* (GRAY), and an Account of an Aberrant Karyotype in a Male

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CHROMOSOMAL patterns in animal populations are indicators of cytogenetic variations which might provide a basis for understanding the evolutionary mechanisms. In this report we describe the chromosomes of a metad, *Millardia meltada* (Muridæ) from somatic and germinal tissues. Description of a male with an aberrant karyotype is also reported and its possible significance discussed.

Metads are soft-furred field rats with large round ears. They live in burrows, chiefly near cultivated fields, and are known to damage paddy and other crops. Animals were collected from the environs of Kolar, South India, during the month of June, 1967. Chromosome preparations from bone marrow, cornea and testis were made and karyotypes prepared according to the methods described earlier.[4]

OBSERVATIONS

Somatic chromosome number and morphology.—Out of 110 well-spread metaphases, 86% showed that there are 26 chromosomes in both sexes (Table I). The chromosomes are all rod-shaped and can be arranged into three groups, large, medium and small. In female there are six pairs in the first group, five pairs in the second and two pairs in the third group (Figs. 1 and 2). Although the identification of the X chromosome is difficult, a comparison of male and female karyotypes has led us to designate one of the large chromosomes of Group I as the X chromosome. The Y chromosome, on the other hand, is the smallest in the complement (Fig. 2).

TABLE I
The chromosome counts in M. meltada

Sex	Chromosome counts				Total cells counted
	<25	25	26	27	
Female	..	1	43	6	50
Male	2	5	52	1	60
Aberrant Male	6	44	..	..	50

Male meiotic chromosomes.—The spermatogonial cells also show 26 chromosomes (Fig. 3), all being rod-shaped. However, in certain prometaphase figures, it is possible to see a short telomeric segment clearly in some chromosomes which indicates that they are acrocentric. The X chromosomes cannot be identified with certainty but the Y chromosome is marked at the spermatogonial anaphase as it is positively heteropycnotic (Fig. 4).

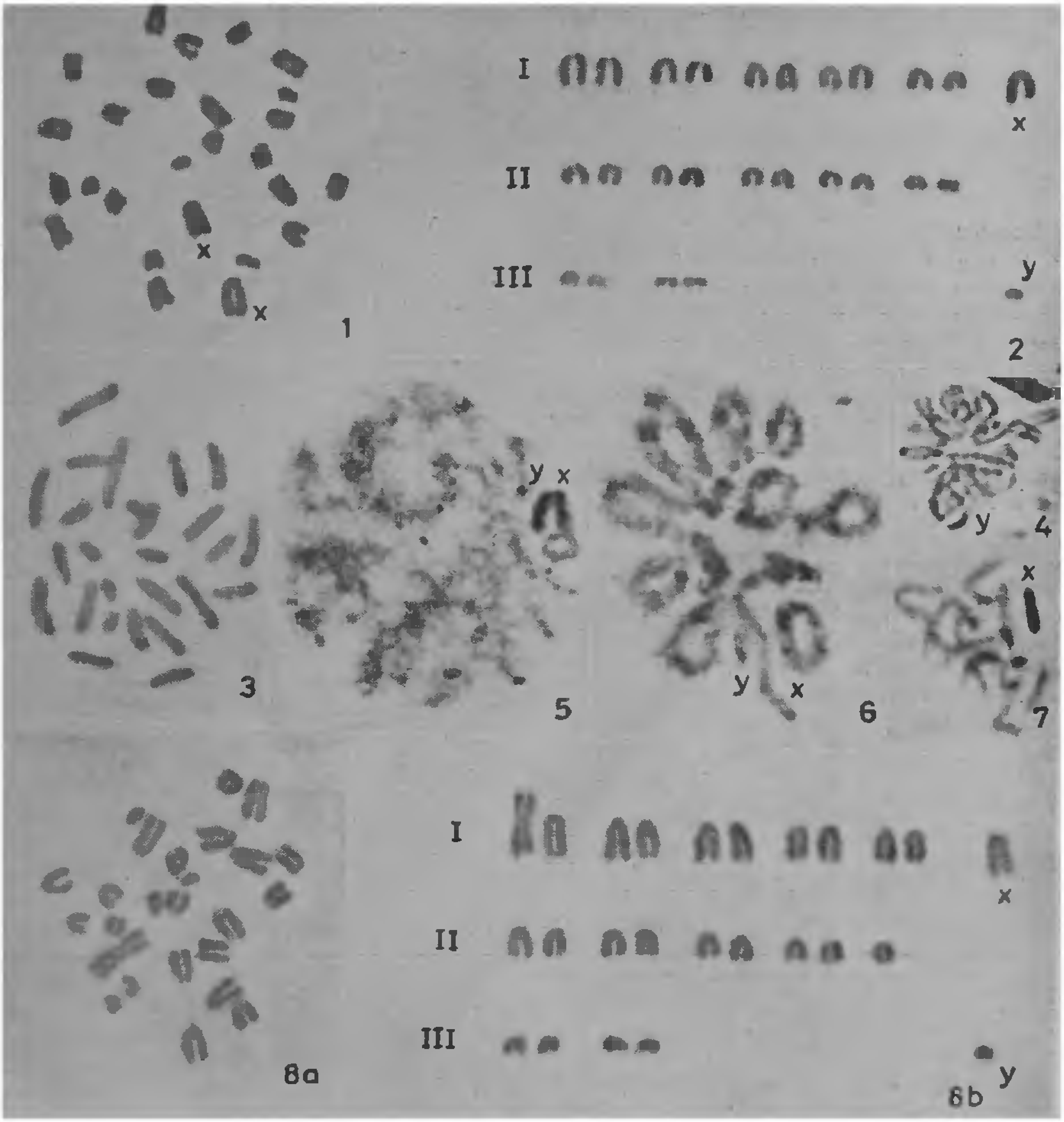
During early meiotic divisions the sex chromosome complex stands out clearly in the sex vesicle amidst autosomes. It is possible to make out two regions in the long X chromosome, a darkly staining region (heteropycnotic) which is approximately 1/3 the length of the chromosome and the rest which is lightly stained. The Y chromosome is heteropycnotic throughout its length (Fig. 5). Sometimes a close association of the heteropycnotic portion of the X and the Y chromosome gives an impression of crossing over between them. However, a typical chiasma between them has not been observed. They show a characteristic end-to-end association at later stages (Fig. 6).

Aberrant karyotype.—One male individual apparently with normal phenotype showed an aberrant karyotype. There are 25 chromosomes, one less than the usual number (Table I). An examination of the karyotype reveals that there is a large submetacentric chromosome and an unpaired one in the second group. Fusion of two chromosomes might account for this (Figs. 8 *a* and *b*). It is difficult to say if the fusion is between two autosomes or between an autosome and a sex chromosome.

DISCUSSION

The present study shows an evidence of departure from normal chromosomal pattern in individuals from natural populations without involving any noticeable phenotypic change. Similar deviations have often been reported in several groups of animals[3,6] and in man.[1] In *Millardia*, the fusion of two chromosomes has resulted in the formation of a large submetacentric chromosome and reduction of the chromosome number from 26 to 25.

Of the possible mechanisms for the formation of metacentric chromosomes, Ruddle[5] has suggested a terminal union of two acrocentrics, while Hsu *et al.*[2] feel it could be due to centric breakage, followed by sister chromatid fusion.



FIGS. 1–8. Fig. 1. Metaphase plate of female, × 1,900. Fig. 2 Male karyotype, × 1,900. Fig. 3. Spermatogonial metaphase, × 1,900. Fig. 4 Polar view of spermatogonial anaphase showing heteropycnotic Y chromosome, × 1,200. Fig. 5. Meiotic prophase showing sex vesicle enclosing the sex chromosomes. Note that the entire Y and part of X heteropycnotic, × 1,900. Fig 6. Early metaphase I showing end-to-end association of X and Y, × 1,900. Fig. 7. Secondary spermatocyte showing the positively heteropycnotic X chromosome, × 1,200. Fig. 8. Metaphase (*a*) and karyotype of the aberrant male (*b*). Note the submetacentric chromosome, × 1,900.

According to the former, fusion can result in a submetacentric or metacentric chromosome. In the latter, only a metacentric is produced. In *Millardia meltada* the submetacentric chromosome is probably due to the fusion of two unequal acrocentric chromosomes indicating the operation of the former mechanism.

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