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AMONG mammalian genera *Rattus* Fischer is the largest. It is noteworthy, however, that the literature on the chromosomes of wild rats is very scanty. Recently, the chromosomes of several wild species of *Rattus* have been described[3, 8-12], and these have shown the existence of chromosomal polymorphism and variability in the diploid number. This prompted our attention to a detailed karyological survey of Indian *Rattus*. We report here the chromosomes of *Rattus blanfordi* (Thomas) of the subgenus *Rattus*, which has a unique karyotype in that it possesses uniformly telocentric chromosomes, except the Y which is submetacentric, and prominent centric constitutive heterochromatin.

Material and Methods

Four animals of each sex of *Rattus blanfordi* were collected from the Bhimaneri and Balagodu forests near Sagar, Mysore State (South Western India). This rat (Figure 1) is a medium-sized animal, with a long tail (longer than 120 percent of head-body

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FIGURE 1—Male rat, *Rattus blanfordi* showing the white underparts, feet, and terminal part of tail.

length); the fur is soft and lightish brown to grey dorsally, while the belly and underparts are white. The feet are most often white and the tail is wholly dark basally but wholly whitish terminally and well haired. Bone marrow chromosome preparations were made according to the standard techniques and stained with carbol-fuchsin. Air-dry preparations of interphase nuclei from liver were obtained without hypotonic pretreatment for the study of heterochromatin.

Observations

The diploid number of 36 was determined by counting 50 metaphase plates from each animal. All the chromosomes in the karyotype form a graded series of telocentrics, except the Y, which is submetacentric (Figure 2). The X chromosome has been placed as the second pair in the series, since in the male it is not homomorphically paired. On the basis of length measurements, the X appears to be a 'duplicate' type, comprising about 12.4 percent of haploid autosomal length; the Y comprises about 9.5 percent (Table I). The Y chromosome can be easily identified, as it is the only submetacentric chromosome and serves as a marker.

Another interesting feature concerns the heterochromatic segments on the chromosomes. In well extended chromosomes, prominent pericentric heterochromatic regions are strongly evident on all the chromosomes of the complement (Figure 3), but in

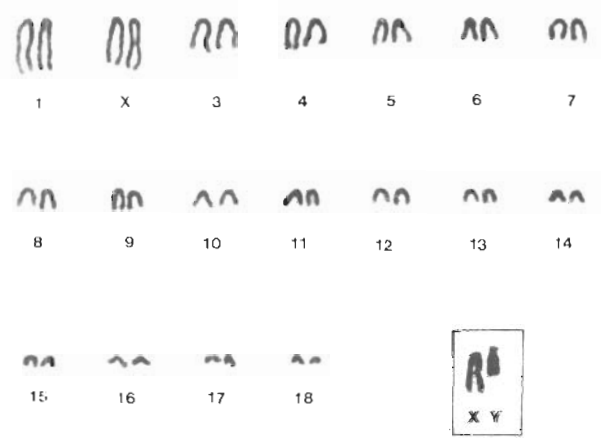


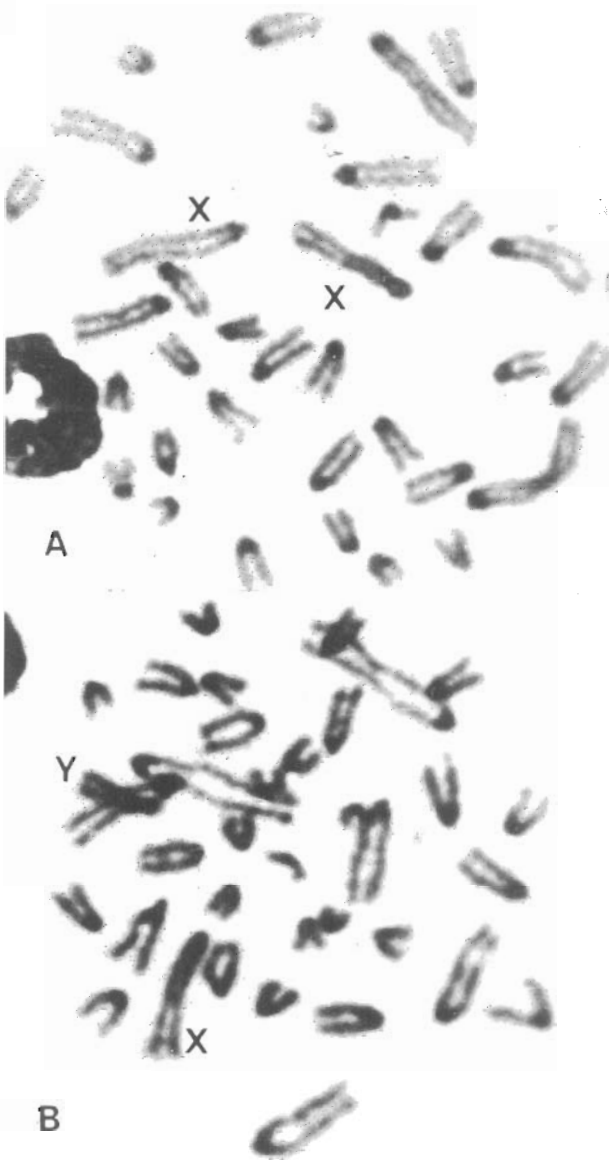
FIGURE 2—Karyotype of female *Rattus blanfordi*. The insert shows the X and Y chromosomes of the male. (ca. 1800×.)

Table I. Relative length of chromosomes from six nuclei of each sex in *Rattus blanfordi*. (All chromosomes are telocentric with the exception of the Y, which is submetacentric with an arm ratio of 2.4)

Chromosome no.	Relative length*
1	13.7
2 (X)	12.4
3	9.9
4	8.3
5	7.4
6	6.6
7	6.3
8	5.9
9	5.6
10	5.1
11	4.8
12	4.4
13	4.2
14	3.9
15	3.8
16	3.5
17	3.0
18	2.8
Y	9.5

* Percent of haploid autosomal length

FIGURE 3—Extended metaphase chromosomes of female (*A*) and male (*B*) *R. blanfordi*. Note the pericentric heterochromatin on all the chromosomes and the heteropycnotic Y and centric half of X.



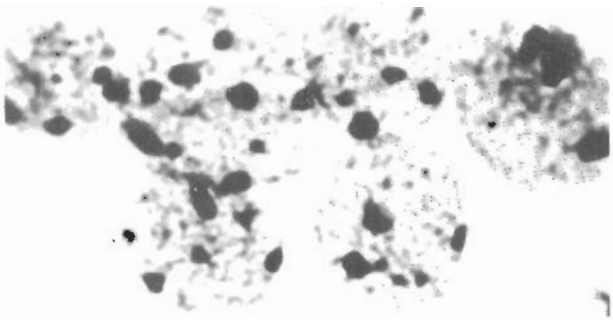


FIGURE 4—A group of interphase nuclei from liver of female *R. blanfordi* showing heterochromatin blocks.

condensed metaphases these segments are not so prominent (Figure 2). In certain nuclei, the entire Y and centric half of the X chromosome appear to be heteropycnotic and the chromatids in them are often in close apposition (Figure 3). In the interphase nuclei of liver cells the heterochromatin is even more pronounced (Figure 4). The metaphase pericentric heterochromatin in these cells is represented by 3 to 4 large blocks of condensed chromatin and these obscure identification of the sex chromatin in female nuclei. The size of these bodies varies and at times large masses result from their fusion.

Discussion

The karyotype of *Rattus blanfordi* presents several interesting features. The basic diploid chromosome number in the genus *Rattus* appears to be 42 as suggested by Yosida and Tsuchiya[11], and the deviations usually are presumed to be due to Robertsonian mechanisms of centric fusion or fission. However, it is obvious that the *R. blanfordi* karyotype cannot be derived by this mechanism alone. All the chromosomes in this species are telocentric, a situation unique, as far as the authors are aware, in the genus *Rattus*. This, combined with the low diploid number of 36, makes *R. blanfordi* outstanding among *Rattus* species.

Ellermann[2], in his systematic account of Indian rodents, groups *R. blanfordi* in the subgenus *Rattus* on the basis of its unusually large bullae. Otherwise, he comments that "this is an aberrant species" and "it stands rather well apart from typical *Rattus*". This view is probably substantiated by the present observations on its unusual karyotype; thus, *R. blanfordi* may not deserve to be included in the subgenus *Rattus*. Ellermann[2] regards this species to be allied with the subgenus *Cremnomys*, another "Western Indian *Rattus* offshoot". However, karyological studies on the *Rattus* species of the subgenus *Cremnomys* are needed to arrive at any conclusion regarding the systematics of *R. blanfordi*.

The presence of an easily identifiable duplicate type X (12.4 percent of haploid autosomal complement) and a large Y (9.5 percent) in the karyotype of *R. blanfordi* is interesting. In the genus *Rattus*, perhaps the only other species reported to have a large X and Y is *Rattus* (*Mastomys*) *natalensis*, from South Africa, described by Huang and Strong[4]. Coincidentally, *R. natalensis* also has $2n = 36$, although the karyotype otherwise is very different, consisting of meta-, submetacentrics, and telocentrics. As is very often the case in mammals with a large X, the Y in *R. blanfordi* is comparatively large.

The presence of large pericentric heterochromatin blocks, observed without any special pretreatment, on all the chromosomes of *R. blanfordi* is indeed fascinating. It also may be noted here that in the oocytes of *R. norvegicus* similar, although less prominent, differentially staining regions near the centromere may be seen in Figure 4 of Ohno *et al.*[6]. Recently, in the mouse, *Mus musculus*, and several other mammals, similar pericentric constitutive heterochromatin has been shown by special staining[1, 7] (J.J. Yunis *et al.*, personal communication) and *in situ* cytological hybridization techniques[1, 5, 7] to be composed of satellite DNA with highly repetitive sequences. It is tempting to speculate that the pericentric heterochromatin observed in *R. blanfordi* may represent high amounts of satellite DNA, but further work along these lines is needed before conclusions should be drawn.

Summary

The karyotype of a wild rat, *Rattus* (*Rattus*) *blanfordi* (Thomas) from forests near Sagar, Mysore State (South Western India) is described. Bone marrow preparations revealed the diploid chromosome number to be 36. All the 18 chromosome pairs form a graded series of telocentrics. The Y chromosome is submetacentric; the X is identified as the second largest in the series. The X and Y chromosomes are large, comprising 12.5 percent and 9.4 percent of the haploid autosomal complement, respectively. Extended metaphase chromosomes exhibit very prominent pericentric constitutive heterochromatin on all the chromosomes. Interphase nuclei from liver cells show several large heterochromatic bodies. Some aspects of the systematics of the species are discussed.

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