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Cytological Contributions to the Phylogeny and Classification of the Rodent Genus *Gerbillus*

THE Gerbillinae are highly differentiated rodents exhibiting many instances of parallel specializations in external and anatomical features evolved in independent lines. Consequently, the present state of the taxonomy of this group is unsatisfactory. Three years ago we started an extensive study of the chromosome complements in the species occurring in Israel. The comprehensive cytological studies of Matthey[1,2] enabled us to compare the idiograms of our species with those of others from different parts of the family range.

Table 1, which summarizes some of the karyological characters of the species currently considered to belong to the genus *Gerbillus*, reveals a great diversity in numbers and forms of chromosomes. Nevertheless, the forms studied may be arranged in four groups on the basis of chromosome morphology and evolution.

Table 1

	Origin	2*n* (male)	Sex chromosomes	No. of metacentric chromosomes	No. of chromosome arms
Group *a*					
*Gerbillus gerbillus gerbillus**	Israel (Negev)	43	XY_1Y_2	38–40	81–83
Group *b*					
Gerbillus allenbyi Thomas	Israel (coastal plain)	40	XY	40	80
Gerbillus pyramidium	Algeria	40	XY	38	78
Gerbillus pyramidum	Israel (coastal plain)	52	XY	22–24	74–76
Gerbillus pyramidum	Israel (Negev)	66	XY	8–12	74–78
Group *c*					
Gerbillus (Dipodillus) nanus	Israel (Negev)	52	XY	10–14	62–66
Gerbillus (Dipodillus) dasyurus Wagner	Israel (various localities)	60	XY	6–8	66–68
Group *d*					
Gerbillus calurus Thomas	Israel (Negev)	38	XY	32–36	70–74

* Authors' names are omitted when the populations referred to cannot reasonably be supposed to correspond with the types on which the original description was based.

Group *a* includes so far only *G. gerbillus gerbillus*. Multiple sex-chromosomes, very probably of the XY_1Y_2 type, are readily recognizable as a trivalent in metaphase I (Fig. 2). The male diploid chromosome number is 43 (Fig. 1), whereas a single female examined was found to have almost certainly 42 chromosomes. The large and easily distinguishable *X*-chromosome is present twice in the female. Although this species has almost the same number of chromosomes and chromosome arms as *G. allenbyi* and *G. pyramidum* (Algeria), its metacentric chromosomes present a striking contrast to those of all other forms studied in being much shorter than the *V*-shaped elements of the other karyotypes. This unique character, which was observed in all plates, demonstrates clearly the caution required in evaluating the significance of the number of chromosome arms. It appears to us that both the detailed morphology and the gross differences in the size of the elements deserve consideration in comparative studies.

Since within groups *b* and *c* there is approximate correspondence in the size of the chromosomes and in the number of their arms, the wide variation in the mitotic numbers must be attributed to Robertsonian changes. Group *b* comprises four forms. The first is endemic to Israel and currently considered as the subspecies *allenbyi* of *G. gerbillus* Olivier[3]. There is no doubt that *G. allenbyi* shares the main karyological characteristics of the three other members of this group while presenting none of the cytological features described above for *G. gerbillus*. It must be concluded, therefore, that it can no longer be regarded as conspecific with *G. gerbillus*. We propose to restore the original author's name *G. allenbyi* Thomas 1918. The other three forms of this group, each of different geographical origin, have been provisionally designated as *G. pyramidum*, since for the present they can only be distinguished by their cytological characteristics. Dr. T. C. S. Morrison-Scott (personal communication), who kindly examined a few specimens from the three populations, came to the conclusion that those differences that "exist between the six specimens submitted are not such as would justify nomenclatural differentiation according to the normal criteria used in taxonomy. I should not have called them different races". It should be noted that *G. pyramidum* is sympatric with *G. allenbyi* in the coastal plain. We believe, therefore, the latter to be specifically different from the *pyramidum* complex in Israel. *G. pyramidum* from the Negev, the southern semi-desert of Israel, is of particular interest since it exhibits a chromosomal polymorphism the study of which is now in progress. Apart from the

individuals possessing 33 bivalents, other specimens from the same locality were found to have only 31 autosomal elements in the first meiotic metaphase, one of them rather asymmetrical. This would seem to be the first record of an intrapopulational chromosomal polymorphism in mammals. Matthey's observation[1,4] of a multiple sex mechanism in *G. pyramidum* from Algeria could not be confirmed in the three Algerian specimens examined by us.

Group *c* includes *G. nanus* and *G. dasyurus*, which are very similar externally. Earlier taxonomists referred these species to the genus *Dipodillus*. Modern authorities considered the characters used for this separation to be of secondary value and therefore assigned only subgeneric rank to the *Dipodillus* group[5]. The cytological evidence favours the separate status of these species, since they are different from the other groups in chromosome size and number of arms. Like group *b*, they show a Robertsonian relationship among themselves. *G. campestris*, $2n = 56$, studied by Matthey[1], cannot be fully compared with the above species because no mitotic plates are figured. But the similarity in the aspect of the first metaphase plates would seem to confirm the affinity of this form to the *Dipodillus* group[3,5]. *G. nanus* ($2n = 52$) has a distinct sex bivalent, whereas the sex chromosomes could not be identified in *G. garamantis* ($2n = 54$)[2], considered to be another race of the same species[3].

G. calurus (group *d*) has been assigned to the genus *Meriones*, although originally described as *Gerbillus calurus*[3]. Recently, it was referred once again to the subgenus *Dipodillus* by Wassif[6] on morphological

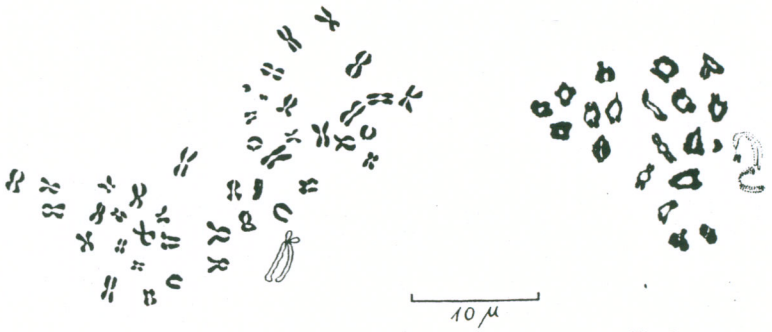

Fig. 1 Fig. 2

Gerbillus gerbillus gerbillus. Acetic–orcein squashes after hypotonic pretreatment. Camera lucida drawings. × 1,650. Fig. 1. Spermatogonial metaphase; chromosome *X* in outline. Fig. 2. Metaphase I; sex trivalent stippled

evidence. The cytological picture does not warrant the inclusion of this species in the *Dipodillus* group. The mitotic plate somewhat resembles that of group *b*. However, cytological characteristics alone do not seem to suffice at the present stage to justify the establishment of a novel taxonomic grouping.

On the other hand, the findings reported here—which will be presented in full elsewhere—suggest that by applying comparative cytological methods it is possible to split artificial assemblages of forms. Moreover, in view of the cytological heterogeneity already recorded, we hope that a wide-scale study of the numerous gerbils known will contribute materially to the natural classification of this family.

The technique of pre-fixation treatment with diluted Tyrode solution was mentioned in an earlier note[7]. Excellent results are also obtained by the use of 0·3–0·5 per cent sodium chloride solutions. Three to seven males of each species were analysed.

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