The Somatic Karyotype of
Meriones unguiculatus
A morphologic and autoradiographic study

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IMPROVED cytogenetic techniques have stimulated much recent interest in the taxonomic classification of Rodentia. The genus Meriones (Gerbillinae) comprises 14 widely distributed species, and taxonomic relationships among members of this group have been extensively reviewed by Nadler and Lay. The karyotypic findings of ten of these species have been described by other authors. This communication presents the somatic karyotype of the Mongolian gerbil, Meriones unguiculatus, as well as autoradiographic studies which, for the first time, definitively identify the sex chromosomes of this species.

Materials and Methods

The animals studied were obtained from a local pet dealer and formed a small breeding group. The 4 adult and 5 newborn specimens were studied and positive species identification as M. unguiculatus was made by Dr. R. G. Van Gelder of the American Museum of Natural History (AMNH #215249). Of the 9 animals studied, 6 were males and 3 were females. Fibroblast cultures were established from biopsies of skin, lung, and spleen in Ham's F10 medium containing 20 percent fetal calf serum, penicillin and streptomycin. Chromosomal preparations were made from early subcultures initiated from these tissues as well as lymphocytes from peripheral blood and bone marrow by slight modification of the method of Moorhead et al. Leukocyte preparations were obtained from two to three drops of whole blood from the orbital sinus, cultured for 72-98 hours at 37° C using commercially available microculture kits (Chromosome medium 1A, Grand Island Biological Company, Grand Island, New York). Colcemid (0.05 μg/ml) was added for the final five and three hours, respectively, to fibroblast and leukocyte cultures.

Autoradiographic studies were performed on four males and two females to investigate the DNA replication pattern of the sex chromosomes. Tritiated thymidine (1.9 C/mM) was added for the last six hours of culture at a final concentration of (1 μC/ml) and colcemid for the last three hours. The slides were coated with Kodak nuclear track emulsion (Type NTB3), dried and incubated at 4° C for a period of 10 days. Development of the slides and staining of the cells were achieved by the method of Schmid. After photographing informatively labeled cells, the silver grains were removed by use of 10 percent potassium ferricyanide (40 minutes) in 25 percent sodium thiosulfate (one minute) and the cells were then photographed without grains for karyotypic comparison.

Results

From a total of 420 cell counts and 90 photographic karyotypes, the diploid number of the species was established at 2n = 44. This modal number was constant within the tissues of a given animal and among the various animals examined. The frequency of tetraploid cells was 1.9 percent (8/420).

The autosomal karyotype (Figure 1) has been divided into three morphological groups of elements: metacentric, submetacentric, and acrocentric. The

![FIGURE 1—Karyotypes of Meriones unguiculatus (2n=44).](source)
The metacentric group consists of a graduated series of 16 chromosomes. No pairs in this group can be individually identified on morphological grounds. There are 14 submetacentric elements of which one pair is extremely large and easily separated from the others. The remainder of the submetacentric chromosomes form a graded indistinguishable series. Twelve acrocentric chromosomes complete the autosomal complement. Among the acrocentrics, however, one pair possesses a prominent short arm and can be separated from the others. Satellites were seen on some of the acrocentric elements and satellite associations among acrocentrics were observed.

The sex chromosomes in this species are XX in the female and XY in the male. The identity of these chromosomes was suggested by “cutting and pasting”, but absolute identification was achieved by autoradiography. On the basis of DNA replication patterns, one chromosome in each sex is late replicating. Of 40 informatively labeled cells in the female specimens, 27 (67.5 percent) showed a consistently late replicating submetacentric chromosome (Figure 2A). This element is the second largest in the group. Since this chromosome is morphologically unpaired in the male and is late replicating in the female, it can be assumed to be the X chromosome. Similarly of 118 informatively labeled cells in the male, 92 (79.0 percent) showed a late replicating small submetacentric element (Figure 2B). This chromosome is a medium size submetacentric and possesses a secondary constriction, approximately in the middle of the long arm (Figure 1). Since such a chromosome does not appear in the female and yet is late replicating in the male, it presumably represents the Y. Figure 2C illustrates a tetraploid male cell with two late replicating Y chromosomes.

**Discussion**

Considerable knowledge has been amassed concerning the taxonomy of the genus *Meriones*, and in some instances, the karyotypic findings have helped to elucidate some difficulties in the classification of subgroups within this genus. Although the previous reports of *M. unguiculatus* are in general agreement, minor differences do exist in the presented karyotypes. Awa et al. suggests that the Y chromosome in the male is “the smallest element having probably a terminal centromere”. The study of Nadler and Lay as well as the present investigation indicate both morphologically (Figure 1) and autoradiographically (Figure 2B) that the Y chromosome is a medium size submetacentric element. The Y chromosome in many cells of this study exhibited a secondary constriction midway in the long arm. A previously published karyotype also shows this constriction although the authors make no comment concerning its presence. Similarly, in agreement with Nadler and Lay, the autoradiographic analysis in females indicates that the X chromosome is the second largest of the metacentric chromosomes. Although wide variation in the diploid number (2n = 42–72) exists in the genus *Meriones* a rather narrow range in the fundamental number of chromosome arms exist (NF = 72–78). According to the classification of the *M. unguiculatus* karyotype, as presented by Nadler and Lay, the NF = 78. The NF in the present investigation agrees with the previous estimate if the acrocentric chromosome with the prominent short arm is counted as having two arms. If however, it is considered as a true acrocentric (single armed), then the NF would be 76. Several other minor differences exist in the distribution of the various types of chromosomes between the published karyotype and this study. Nadler
and Lay\textsuperscript{7} state that the karyotype consists of 22 metacentric, 10 submetacentric and 10 acrocentric chromosomes while the present study classifies the autosomes as 16 metacentric, 14 submetacentric, and 12 acrocentric elements. The two reports agree on the identification of the sex chromosomes. Since this genus is relatively small and only four species remain to be investigated cytogenetically, the application of chromosomal data to the evolutionary development of Meriones may possibly help in elucidating the taxonomic relationships within this group.

Addendum: Since this manuscript was submitted for publication, Weiss et al. (Cytologia 35:102–106. 1970) have reported an autoradiographic study of M. unguiculatus in which the diploid number of 2\(n\) = 44, and the identification of the X chromosome agree with our findings. However, these authors have identified a small metacentric element as the Y chromosome.

Summary
The somatic karyotype of the gerbil, Meriones unguiculatus, is described; and the autosomal complement consists of 16 metacentric, 14 submetacentric, and 12 acrocentric chromosomes. The sex chromosomes, identified by both morphologic and autoradiographic means, consist of a large submetacentric X chromosome and a medium size submetacentric Y chromosome.

Literature Cited

Announcements
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(University of Texas), Arno Motulsky (University of Washington), Francisco Ayala (Rockefeller University), and R. W. Allard (University of California, Davis), who also will chair the session.

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The American Genetic Association will sponsor a one-day symposium, “Advances in human genetics and their impact on society”, at the 1970 AAAS meetings in Chicago, Illinois, December 26–31. The speakers and discussants will include Dr. Digamber S. Borgaonkar, Johns Hopkins; Dr. Kurt Hirschhorn, Mount Sinai School of Medicine; Dr. Neil Macintyre, Case Western Reserve University; Dr. Saleem Shah, National Institute of Mental Health; Professor Nathan Hershey, University of Pittsburgh; and Professor Elyce Zenoff Ferster, George Washington University.