New observations on the karyotype of the Djungarian hamster, Phodopus sungorus

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Summary. In this paper, the C-banding pattern of the karyotype of Phodopus sungorus is presented and polymorphism is taken into consideration.

During the last 2 decades, the karyotype of Phodopus sungorus has repeatedly been investigated. Matthey[1,2], Pogosianz and Bruyako[3], Voronzov et al.[4], Pogosianz et al.[5], and Soldatović et al.[6] gave information about number and morphology of chromosomes in this species. Further details are known since G-banding techniques have been employed[7–9]. Even location of nucleolar organizing regions has been described[10], but as C-banding pattern of the complement has not been published so far, important information is missing. Distribution of heterochromatin in the sex chromosomes of Phodopus sungorus has recently been reported by us[11], and here, we intend to report upon further observations on the C-banded karyotype of the Djungarian hamster.

Material and methods. Studies were carried out on several male and female individuals of Phodopus sungorus sungorus, bred in our laboratory. Our hamsters are descended from 4 individuals captured in Western Siberia; offspring of these 4 hamsters were kindly provided to us by Dr K. Hoffmann, Max Planck Institut für Verhaltensforschung, Seewiesen (Germany). Chromosome preparations were derived from fibroblast cultures of different tissues according to the technique described earlier[12]. $Ba(OH)_2$-treatment[13] (modified) was employed for C-banding.

Results. The karyotype of Phodopus sungorus consists of 28 mainly meta- and submetacentric chromosomes (2n = 28). Figure 1 shows the complement of 1 of our female individuals after application of C-banding technique. While each pair of chromosomes can easily be identified by its G-banding pattern, the distribution of C-bands is not as characteristic. Pairs No. 2, 3, 4 and 10 are remarkable because of their lack of distinct centromeric heterochromatin. The same is true for chromosome No. 6, though this may be doubtful at first glance. Exact analysis reveals that there is an additional heterochromatic band which is located on the short arm of the chromosome, close to the centromeric region. This band appears rather weak. Its staining intensity is similar to that of the centromeric heterochromatin of chromosome No. 5. Further additional bands of heterochromatin can be found on the long arm of chromosome No. 1, on the short arm of chromosome No. 2, and on the long arm of chromosome No. 9. The last-mentioned band is very strong and does not always show the same appearance. In some cases, the additional heterochromatic material cannot be divided from the centromeric one, and in other cases, centromeric and additional heterochromatin appear as 2 adjoining bands of similar dimensions. We do not think that these differences are the expression of a polymorphic structure of chromosome No. 9. True polymorphism, however, can be observed in chromosome No. 1. We found one type with a distinct in-

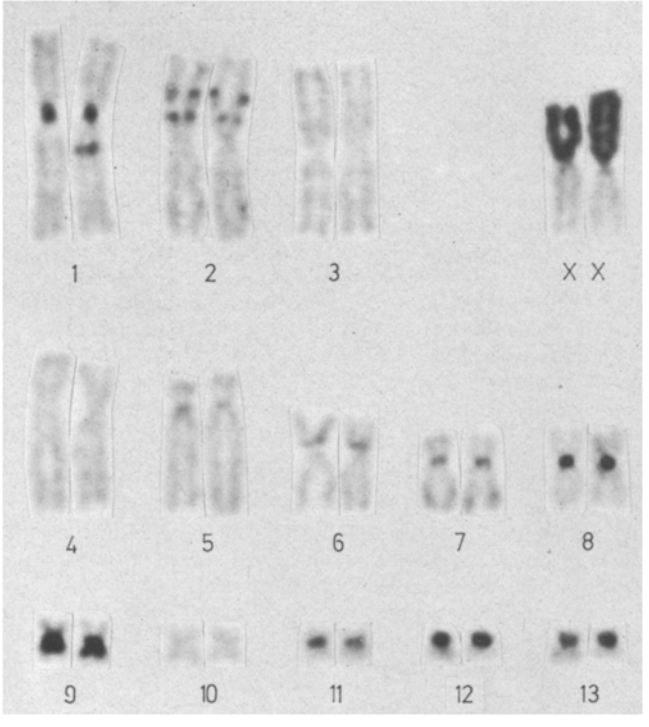

Fig. 1. C-banded karyotype of a female individual of Phodopus sungorus sungorus.

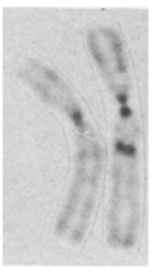

Fig. 2. Polymorphic pair of chromosomes No. 1 from a different individual; note the low amount of heterochromatin in the left chromosome.

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5 H. E. Pogosianz, O. I. Sokova and L. I. Yanovich, Tsitologiya *12*, 1297 (1970).
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8 R. Thust, Exp. Path. *9*, 153 (1974).
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10 T. R. L. Bigger and J. R. K. Savage, Cytogenet. Cell Genet. *16*, 495 (1976).
11 G. Vistorin, R. Gamperl and W. Rosenkranz, Cytogenet. Cell Genet. *18*, 24 (1977).
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terstitial heterochromatic band on the long arm, and others where this band is very weak or even absent. Further polymorphism became obvious in the amount of centromeric heterochromatin of chromosome No. 1 (figure 2).

In addition to our description of the sex chromosomes of Phodopus sungorus[11], we want to mention that we found it difficult to decide whether in the hamsters examined by us, a polymorphism of the X-chromosomes is present or not. We observed great variations in arm ratio. Apart from exactly metacentric X-chromosomes, we found submetacentric ones with a longer euchromatic arm, as well as others with a longer heterochromatic arm. But as the appearance of the X-chromosomes of each individual varied from one mitosis to the next, we came to the conclusion that the variations in arm ratio have their origin in different degrees of condensation and not in polymorphism.

Discussion. Our studies on the C-banded karyotype of Phodopus sungorus have revealed a distribution of heterochromatin which, to some extent, reminds us of that found in Cricetulus griseus[14–16]. The similarities, however, are not far-reaching and, apart from this, a difference can be seen in the amount of heterochromatin which is significantly lower in Phodopus sungorus than in Cricetulus griseus. Additional comparative remarks on the karyotypes of several hamster species will be given in a further publication which we have in preparation.

While our cytogenetic analysis was concerned with the subspecies Ph. s. sungorus, the majority of previous investigations[3, 5, 7, 8] have been carried out on Ph. s. campbelli. In a few publications, the name of the subspecies has not been mentioned[1, 6, 10]. Chromosome structure and G-banding patterns make us believe that there is no significant difference in the karyotypes of the 2 subspecies, but sufficient certainty will only be obtained, when a greater number of individuals of both subspecies has been examined. Special attention should be paid to polymorphism which could easily be confused with true differences. Here, comparison of C-banding patterns may give important information, because in most cases it is heterochromatic material which is involved in polymorphic structures.

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Karyological difference between Sagittarius and Cariama (Aves)[1]

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Summary. Chromosome studies of 1 species of Cariamidae and Sagittarius show great karyological differences and tend to dispel the suggestion of a possible relationship between the families.

In the class Aves, there has been much doubt as to the exact interrelationships of the various suborders of the diurnal birds of prey. In a recent paper, much cytogenetic evidence was presented by de Boer[2] for the heterogeneous nature of the Falconiformes. It was suggested that, in this order, the Cathartidae, Falconidae, Accipitridae and Sagittaridae be considered separate groups because of the great dissimilarity in their karyotypes. The lack of cytological data on the Cariamidae, however, has made it impossible so far to discuss the relationship between Sagittarius and the Cariamidae[3].

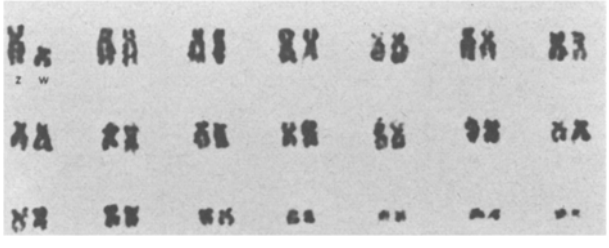

Fig. 1. Partial karyotype of female Sagittarius serpentarius (Sagittaridae); Z, W are only tentatively identified.

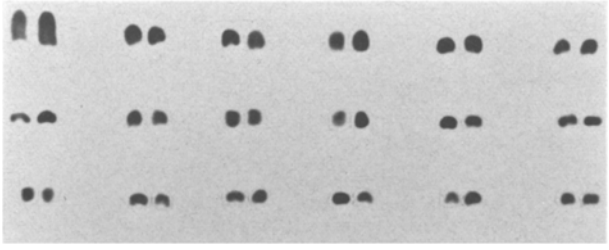

Fig. 2. Partial karyotype of male Cariama cristata (Cariamidae). Sex chromosomes cannot be identified.

It has been suggested by Jollie[4] that the Cariamidae, consisting of the 2 South American species Cariama cristata and Chunga burmeisteri, may be closely related to the single African representative of Sagittaridae, the secretary bird, Sagittarius serpentarius. This suggestion was based on similarities in phenotype and behavior. Others[5] group the Cariamidae with the order Gruiformes and consider them more closely related to bustards and extinct giant cranes. De Boer[2], while hinting at the desirability of settling this dispute, did not have material of Cariamidae available for study. To further these comparisons we studied 3 S. serpentarius and 1 male Cariama cristata held at the San Diego Zoo.

Material and methods. Blood was taken from a brachial vein of 3 Sagittarius serpentarius and 1 Cariama cristata at San Diego Zoo and centrifuged at 500 rpm for 10 min and then cultured at 37 °C. Purified phytohemagglutinin

1 This work was done at the research department of the San Diego Zoo with the cooperation of Dr Arthur Risser and Eleanor Sekulovich.
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