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]

R. J. Benirschke

Zoological Society of San Diego, P. O. Box 551, San Diego, (California 92112, USA), 10 January 1977

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].

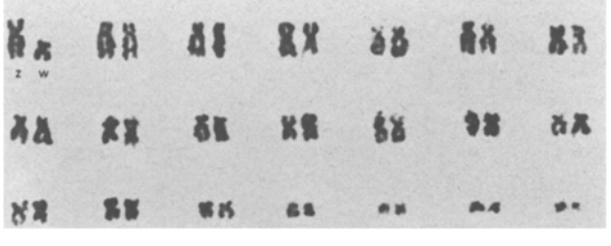

Fig. 1. Partial karyotype of female Sagittarius serpentarius (Sagittaridae); Z, W are only tentatively identified.

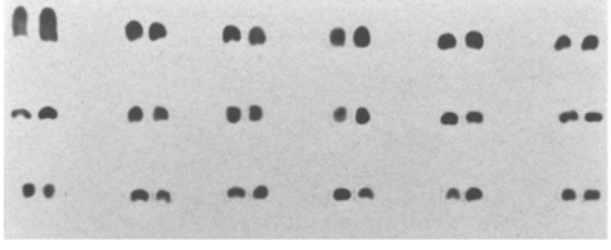

Fig. 2. Partial karyotype of male Cariama cristata (Cariamidae). Sex chromosomes cannot be identified.

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

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(Burroughs Wellcome, cat. No. HA 16) was added to the Cariama cristata culture in the amount of 0.2 ml/5 ml media. The purified PHA seemed to cause less agglutination of the cells than the regular PHA (Difco) which was used on the S. serpentarius cells. The cultures were interrupted with 0.13 ml of 0.001% colchicine added for 1 h and 15 min and then a hypotonic solution of 0.075 M KCl was added for 20 min. The cells were next fixed with 3:1 methanol/acetic acid and slides made in the usual manner.

Results and discussion. The karyotype of the secretary bird, Sagittarius serpentarius, had 36 macrochromosomes of quite large size and a diploid number of approximately 90. The macrochromosomes consist primarily of metacentric and a few submetacentric pairs. Only the first 21 chromosome pairs are shown in figure 1. In several karyotypes prepared there was 1 heteromorphic pair which is assumed to be ZW and shown as the first pair. While the identification of these sex chromosomes must be considered tentative, these elements are consistently different from other pairs, are not unlike what is 2 W in other birds and, most important for the present consideration, they differ remarkably from chromosomes in the Cariama karyotype. Findings of Sagittarius chromosomes are essentially similar to those published by de Boer[2].

The Seriema, Cariama cristata, has approximately 94 chromosomes including numerous microchromosomes of which only the first 21 pairs are shown (figure 2). The karyotype consists of only acrocentric chromosomes with the first pair being easily separated because of its large size. There is a gradual decrease in the size of the chromosomes to the miniature size of the microchromosomes. No dimorphic sex chromosomes could be identified and the bird was, therefore, considered to be a male.

The karyotype of Cariama, composed of only acrocentrics is considerably more primitive than that of Sagittarius. This would suggest that the close relationship of these 2 species by Jollie[4] cannot be supported by karyological studies and that Cariamidae indeed should be considered a separate group.

New inversion of the pair no. 3 chromosome in a black rat

T. H. Yosida[1]

National Institute of Genetics, Yata 1, 111, Sizuoka-ken, Misima 411 (Japan), 20 December 1976

Summary. A Japanese black rat (Rattus rattus tanezumi) with a subtelocentric pair no. 3 chromosome was found in Gotenba, Japan. By comparison of the length in both members of the chromosome pair, and from the G-band pattern, the subtelocentrics seemed to have developed from the original acrocentrics by the pericentric inversion.

Polymorphism of pair no. 1, 9 and 13 chromosomes, with respect to acrocentrics and subtelocentrics, has been found widely in black rats, Rattus rattus, collected in Japan and also in several other countries in East and Southeast Asia[2-6]. Based on measurment of the length of the acrocentrics and subtelocentrics and also on comparison of the G-banding patterns between them, it was assumed that the subtelocentrics had developed by periocentric inversion from the acrocentrics[2-4,6]. Pair no. 3 chromosomes in the black rats collected in several countries in the world, however, was usually characterized by having the acrocentric centromere, so far as the present author examined them. Recently a subtelocentric pair no. 3 chromosomes was found in a black rat collected in Gotenba, Shizuoka-ken, Japan. As this inversion is a new finding in the animal, detail of the karyotype will be reported.

The black rat (Rattus rattus tanezumi) was collected in the field of Gotenba, Shizuoka-ken, Japan. The chromosomes of the rat were observed in cultured cells of the tail tip of the animal by our routine procedure[3]. G-bands staining was used according to the tripsin treatment technique[7], and the C-band was stained by application of a slight modification of Sumner's technique[8].

Chromosome number of the black rat was 42 in the diploid cells, likewise in the other black rats captured in Japan. Basic karyotype of the black rat is generally characterized by having 13 acrocentric autosome pairs (nos 1–13) and 7 small metacentric autosome pairs (nos 14–20) and acrocentric X and Y chromosomes. The pairs no. 1, 9 and 13 of the black rats are remarkable by showing an acrocentric and a subtelocentric polymorphism as already reported[2-6]. The present material showed acrocentric pair no. 1 and 9, but acrocentric and subtelocentric heteromorphic pair no. 13. Out of the heterologors pair no. 13, the pair no. 3 was remarkable in having the acrocentric and subtelocentric heterologous pair (figure 1 A, B). As the lenght of the acrocentrics and subtelocentrics was almost similar, the subtelocentrics seem to have developed by pericentric inversion of the acrocentric chromosome.

The pair no. 3 is remarkable in having its characteristic G-banding pattern as already reported by the present author[9]. From the banding pattern analysis, it strongly suggests that pericentric inversion could have occurred in about one-third of the acrocentric pair no. 3 chromosomes (figure 2, A), and then the subtelocentrics developed.

C-band pattern of the Japanese black rats has been reported by Yosida and Sagai[8]. According to them, the

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