36. Segregation on the No. 1 Chromosome Pair in the Black Rat (Rattus rattus) maintained in a Population Room*

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It has been shown that the chromosome number of the Asian black rat (Rattus rattus) is 2n, 42, and the largest No. 1 chromosomes are polymorphic by being acrocentric (A) or subtelocentric (S) in structure (Yosida et al. 1965, 1971a, b, c, 1974; Gropp 1970). The largest No. 1 chromosomes were of an acrocentric type (A/A) in all the animals coming from northern and northwestern parts of Japan, while those from southern and southeastern localities were polymorphic having A/A, S/S and A/S combinations. The border line drawn between the distribution of the A/A rats and that of the A/A, S/S, and A/S polymorphic rats seemed to correspond to the border lying between the heavy snowfall district and the light one in Japan (Yosida et al. 1971a). The three types of No. 1 chromosomes of the black rat was shown to be heritable by some laboratory experiments in the air-conditioned small cages. The segregation ratio of A/A, S/S and A/S types in the animals obtained there was very close to the expectation. A question arises as to whether the segregation ratio of the polymorphic No. 1 chromosomes in the black rat is maintained, or not, under the natural condition in Japan. The animals which were bred in a population room under a non-air-condition were examined for their chromosome conditions to deal with the above project.

Animals. The black rats (Rattus rattus) herein used were offspring of the laboratory-bred ones of Japan-origin. The population breeding started from one pair of these animals, both having heterozygous No. 1 chromosomes (A/S), together with one litter with 4 youngs born to them. Those six rats were released in a room in July. One year later, all animals obtained in the room were sacrificed for chromosome observations. For technical details of preparing chromosome-slides, refer to the author’s former paper (Yosida et al. 1965).

Population room. A population room 430 × 250 × 300 cm in

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size, was set at one corner of the animal house. At the side wall of the room, shelters for nests were partitioned off with boards. Commercial food together with some fresh vegetables, grain and water were given daily. The room was neither heated, nor cooled in the hot and cold seasons.

Results. 1. Polymorphism of No. 1 chromosomes. All the animals had 2n, 42 characterized by 13 acrocentric autosome pairs (No. 1 to 13), 7 metacentric autosome pairs (No. 14 to 20) and the acrocentric X and Y (for detail, see Yosida et al. 1971). The largest autosome pair (No. 1) was polymorphic in animals coming from different localities, with regard to an acrocentric homologous pair (A/A) (Fig. 1a), an acrocentric-subtelocentric heterologous pair (A/S) (Fig. 1b), and a subtelocentric homologous pair (S/S) (Fig. 1c).

2. Chromosome conditions of the black rats reared in the population room. A total of 84 animals was derived from the original 6

![Fig. 1. Polymorphic No. 1 chromosomes in the Japanese black rat (Rattus rattus). a) Acrocentric homologous (A/A) pair; b) acrocentric and subtelocentric heterologous (A/S) pair; and c) subtecentric homologous (S/S) pair.](image)

![Fig. 2. Relation between chromosome types and body length of the black rat maintained in a population room. Three chromosome types (A/A, A/S and S/S) in relation to the body length of the rats are shown on vertical and horizontal axes, respectively. The animals are grouped into three types (small, medium and large) based on their body length.](image)
in the population room after one year. The frequencies of the rats were 27 for the type A/A, 50 for A/S and 7 for S/S. This value was significantly different from the expected one, 21, 42 and 21 ($\chi^2 = 30.95$, $p<0.001$). Thus it is evident that the number of S/S animals is much smaller than that expected, while those of A/A and A/S are larger.

3. **Chromosome types and body length.** The body-length of A/A, A/S and S/S rats was examined. It was shown that the S/S rats varied in body-length from 40 to 150 mm, while A/A and A/S rats ranged from 60 to 200 mm (Fig. 2). On the above basis, the animals were able to be categorized into three groups: The small group below 80 mm length; the medium group ranging from 81 to 130 mm; and the large group beyond 131 mm. Very probably the animals of these groups represent those derived from three generations. It is evident that in each generation the S/S rats are fewer in number than the A/A and A/S rats, and that their body lengths are considerably small in the former in comparison with the latter.

**Remarks.** It was shown that the frequency value of A/A, A/S and S/S rats (*Rattus rattus*) obtained in the population room differed remarkably from that of the rats maintained in the air-conditioned laboratory cage. In the latter, the segregation ratio of the rats with the three chromosome types corresponded to the expected Mendelian one. In nature, the rats secured in northern and northwestern Japan were of A/A type only, whereas those obtained in southern and southeastern Japan were polymorphic involving A/A, A/S and/or S/S types. In the latter districts, however, the S/S rats were very few in comparison with those of the A/A type. Such a geographical difference in frequency of the A/A and S/S rats may be responsible for the cold temperature in winter in northern and northwestern districts of Japan (Yosida et al. 1971a). In the population room, not temperature-regulated in the winter season, some environmental factors, probably low temperature in the winter time, might exert particular effect on the breeding of the S/S rats. This suggestion is also supported by the fact that No. 1 chromosomes in almost all rats secured in tropical islands in southeast Asia were of the S/S type (Yosida et al. 1971b). In the present case in which the number of animals was insufficient for such a survey work, the genetic drift would be considered as another possible cause of segregation distortion. Final answer to this problem is to be derived from a large scale experiment in the future.

**Summary.** The segregation of 3 chromosome types (A/A, A/S and S/S of the No. 1 pair) is studied in the black rat (*Rattus rattus*) maintained in a population room, not air-conditioned. The segregation ratio of these rats deviates significantly from the expected one.
Probably, low temperature in the winter may contribute as one of causes to the distorted segregation.

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