Karyotypes of rats of the genus *Rattus* from the USSR[1]

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Summary. Karyotypes of 3 rat species of the genus *Rattus* from the Soviet Union have been studied: *R. rattus*, 2n = 38, NF = 60; *R. norvegicus caraco*, 2n = 42, NF = 62; *R. rattoides turkestanicus*, 2n = 42, NF = 70, $NF^a = 66$.

The genus *Rattus* (Rodentia, Muridae) which is the most numerous of the Muridae in species composition, is the focus of attention of many cytogeneticists. This is due to the accessibility of specimens for examination and diversity of karyological material. In addition, the intrageneric systematics of this group is little developed, and along with a variety of morphological forms the group is characterized by different variations of species karyotypes.

All 3 species of the genus *Rattus* inhabiting the USSR were studied karyologically by us. Chromosome preparations were made according to a standard technique[2].

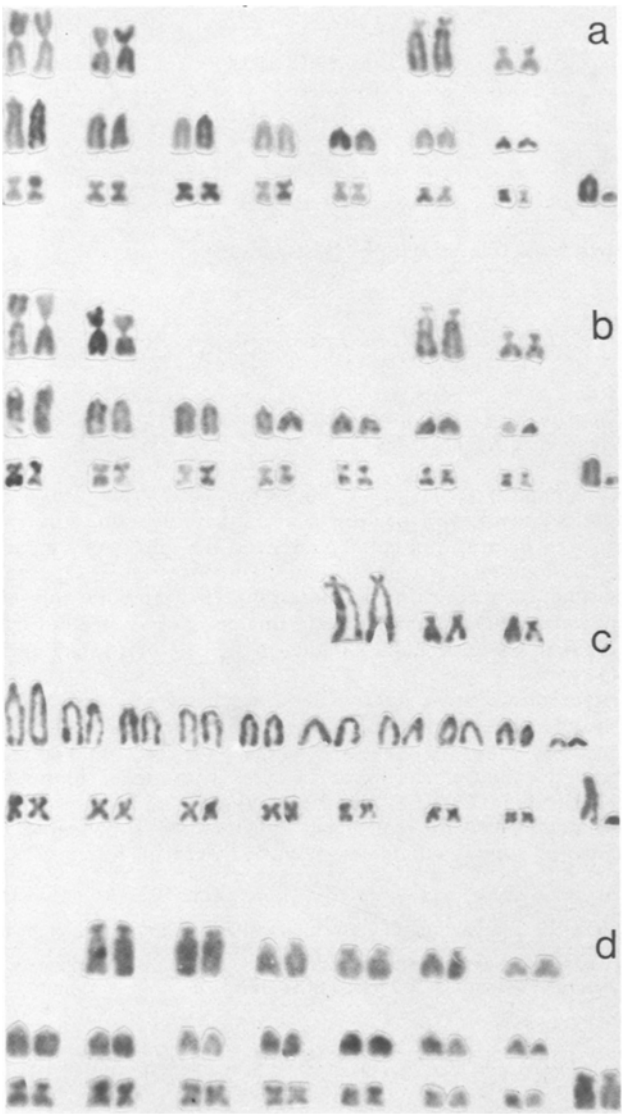

Figure 1. Karyotypes of species of the genus *Rattus*. *a R. rattus* (♂) Moscow Region, 2n = 38, NF = 60; *b R. rattus* (♂) Far East, Primorye Territory, port Nakhodka, 2n = 38, NF = 60; *c R. norvegicus caraco* (♂), 2n = 42, NF = 62; *d R. rattoides turkestanicus* (♀), 2n = 42, NF = 70, $NF^a = 66$.

Rattus rattus. Karyotypes of black rats from 3 locations of the USSR (Moscow region, Prioksk-Terras Preserve; port Nakhodka of Primorye Territory; port Korsakov of Sakhalin) were identical, containing 38 chromosomes: 2 pairs of large and middle-sized metacentric chromosomes, 2 pairs of large and middle-sized subtelocentrics, 7 pairs of acrocentrics and 7 pairs of small meta-submetacentrics; the X and Y chromosomes being acrocentric (fig. 1, a and b).

Chromosome numbers of black rats from the USSR territory were examined for the first time, although they have been described from many other regions of the earth. Black rats are characterized by geographic variability of karyotype (4 chromosome types: Asian, 2n = 42; Oceanian, 2n = 38; Ceylon, 2n = 40; and Mauritius, 2n = 42) and a wide chromosome polymorphism[3–8]. Differences in the chromosome numbers of the 4 types are accounted for by Robertsonian rearrangements either by fusion of fission of chromosomes. In the first 3 chromosome types of *R. rattus*, polymorphism was ascribed to pericentric inversions in 3 pairs of autosomes and to supernumerary chromosomes[9,10]. The presence of the 38-chromosome form of *R. rattus*, in the European part of the USSR is to be expected. A great surprise is the paradoxical fact that the same chromosome form exists in the Far East of the USSR (fig. 2).

R. norvegicus caraco. Norway rats from Primorye, Sakhalin and Kamchatka studied by us karyologically have identical diploid numbers not different from the standard karyotype of *R. norvegicus*[11,12]. The complement comprises 42 chromosomes: 1 pair of large, 2 pairs of middle subtelocentric, 10 pairs of acrocentric and 7 pairs of small metacentric chromosomes; sex chromosomes being acrocentric (fig. 1, c).

R. rattoides turkestanicus. The karyotype of this subspecies from Tadjikistan was described by us. The diploid set is made up of 42 chromosomes which can be divided into 3 distinct morphological groups: I = 6 subtelocentric, II = 7 acrocentric, III = 7 small meta-submetacentric pairs.

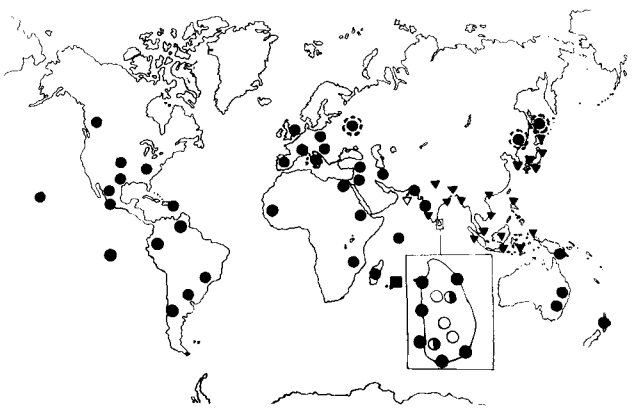

Figure 2. Geographic distribution of four chromosome types of *Rattus rattus*. Symbols: ▼, Asian type, 2n = 42; ●, Oceanian type, 2n = 38; ⊙ our data; ○, Ceylon type, 2n = 40; ■, Mauritius type, 2n = 42; ▽, hybrid population, 2n = 39 (2n = 38 × 2n = 42); ◐, hybrid population, 2n = 39 (2n = 38 × 2n = 40).

The X is a subtelocentric chromosome of middle size (fig. 1, d). This description conforms perfectly with the one previously given by B. Kral from Tadjikistan[13]. Besides, karyotypes of *R. rattoides* were studied in India, Nepal and Afghanistan. They differ in the number of subtelocentric autosomes: 4 in India and Nepal, 7 in Afghanistan[14,15]. Such differences in chromosome morphology seem to be due to pericentric inversions.

A similarity in chromosome morphology and polymorphism by pericentric inversions in a number of homologous pairs of autosomes of the species of the subgenus *Rattus* mentioned above testifies to their common origin. Cytogenetic comparison between species of this subgenus substantiates the leading role of Robertsonian rearrangements (fusions-fissions) and pericentric inversions in the evolution of their karyotypes.

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Inhibition of tumor-induced angiogenesis and of tumor growth by activated lymphocytes

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Summary. Inhibition in angiogenesis (neo-vascularization) and of growth of a tumor piece graft in the anterior chamber of the eye of mice have been observed in the presence of activated syngeneic lymphocytes.

It has been shown that when a piece of a malignant tumor is placed in the cornea of a rabbit, it induces vaso-proliferation from limbal vessels towards the tumor graft[2]. This phenomenon is known as tumor-induced angiogenesis (TIA). Auerbach and his co-workers have shown how allogeneic lymphocytes can induce angiogenesis (LIA) at a s.c. site[3] and in the cornea of adult mice[4]. In this study, we observed that syngeneic lymphocytes, activated with a polyclonal stimulator like concanavalin A, were capable of inhibiting vasoproliferation and growth of the tumor graft when a piece of mesenteric lymph node containing activated lymphocytes was placed along with a tumor graft in the anterior chamber of eye of a mouse.

The anterior chamber of the eye of a mouse, instead of an intra-corneal pocket, was chosen as a site of grafting for convenience of placing the bigger mass of 2 grafts, and the site is known to favor growth of a graft[5] including foreign antigen-bearing implants. Moreover, we observed similar type of vascular reactions when the tumor graft was placed in the cornea or in the anterior eye chamber; only a difference in the degree of vaso-dilatation was noted during the first 3–4 days, slightly higher in the case of grafting into the cornea.

Male albino Swiss mice of 8–12 weeks of age were used throughout the study. They were obtained from Indian Institute of Experimental Medicine, Calcutta, and from colonies maintained in our Center with pellet food of Hindusthan Lever Ltd, Bombay, and water ad libitum.

Tumor pieces for grafting were obtained from rapidly growing tumors (diameter, 2 cm^2 or over) in Swiss mice,

Degree of different reactions and occurrence of tumor in the presence of different combinations of grafts in the anterior eye chamber of mice

Group	Type of grafts	No. of animals	Degree of different reactions (percentage of cases with initial reaction)* Vasodilatation Days after grafting 4	8	12	25	Neo-vascular sprouting Primary 4	8	Secondary 12	25	Growth of grafts 4	8	12	25	Percentage of tumor occurrence
A	Tumor only	27	++ (88)	+++	++	+	++ (88)	++	++ (81)	+	+ (85)	++	++	++	70
B	Tumor + stimulated lymph node	25	+ (60)	±	±	−	+ (56)	±	− (84)	−	± (76)	±	±	−	12
C	Tumor + normal lymph node	21	++ (90)	+++	++	+	++ (80)	++	+ (71)	±	+ (90)	++	+	+	57

*The percentages (in parentheses) have been calculated in reference to the reaction on the 4th day in all cases except for secondary neo-vascular sprouting, where the reaction on the 12th day has been considered.