in fairly large areas that are not always montainous, but, as in the case of the CB population, the 22-chromosome mice spread to the plains of Northern Puglia. This circumstance assumes a certain theoretical interest, since we[12] had previously attributed an important rôle in setting up the homozygous Robertsonian populations, to the compartmentalization of the montainous environment, on account of the possible geographic isolations into small animal communities, and consequently of genetic drift.

Yet another difference concerns the taxonomic aspect. The Alpine populations belong to 2 different species, Mus musculus the mice of Val Mesolecina, and Mus poschiavinus Fatio, those of the Poschiavo Valley. All the Apennine mice, on the other hand, belong to the Mus musculus species. This circumstance, however, becomes irrelevant due to the fact that the validity of the Fatio's species[13], i.e. Mus poschiavinus, was re-evaluated solely on the basis of the cytological difference (2n = 26), whereas from a purely morphological and taxonomical point of view[14], it was considered synonymus with Mus musculus L. But, at present, as more and more evidence emerges about an extraordinary Robertsonian variability of the mouse karyotype, this taxonomical separation loses any logical justification. Nonetheless, the problem of the systematic evaluation of each house mouse population appears very complex. The interpretation of each Robertsonian population of house mouse as a 'species incipientes'[15] would be too easy a solution of a puzzling evolutionary problem. All the biological characteristics of these mouse populations have to be carefully evaluated before such an explicatory hypothesis can be proposed.

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Spontaneous Robertsonian fusion leading to karyotype variation in the house mouse – first report from Asia

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Summary. The occurrence of spontaneous Robertsonian fusion leading to 2n = 39 chromosomes (NF = 40) in the house mouse (Mus musculus domesticus) has been reported for the first time from Asia. 3 phenotypically normal female mice collected from 2 distantly located populations of India (Tripura and Calcutta) show centric fusion in somatic chromosomes between pairs 2 and 16, and 8 and 14 respectively. C-banding analysis revealed that the (sub)metacentric has been originated by fusion between the broken/eroded centromeres of 2 telocentric chromosomes.

Though the analysis of karyotype of different laboratory strains of mouse has been the subject of a large number of studies, the house mouse, Mus musculus domesticus has received as yet very little attention in the karyological literature of mammals. Recently, in course of our investigations on the karyotype of the common house mouse[1,2], an interesting incidence of spontaneous centric fusion has been noticed in 3 female mice. 2 of these 3 females were collected from our house at Calcutta, West Bengal, and one from Agartala, Tripura. These 2 Indian states are widely separated from each other by Bangladesh. The somatic chromosomes of the female specimens (weighing about 18–20 g) were prepared from bone marrow by following the colchicine-citrate-acetic alcohol-air drying technique and were stained in Giemsa by using the phosphate buffer of a pH of 7.2[3,4].

The normal diploid complement of Mus musculus domesticus consists of 40 rod-like telocentric elements of which the first pair may be designated as 'marker chromosomes' due to their remarkable length in comparison with other elements[1,2] (figure 1). After a critical examination of 50 metaphase complements from each of the 3 phenotypically normal individuals, it was confirmed that these 3 females are actually heterozygous for a centric fusion with a 39-chromosome karyotype (NF = 40). Of these, 38 are original telocentric and one is submetacentric (figures 2–4). The latter originated by centric fusion of 2 telocentrics belonging to groups II and III[5–8] or more precisely a) between chromosomes belonging to pairs 2 and 16 in the specimen collected from Tripura (figure 4), and b) between chromosomes belonging to pairs 8 and 14 in the females collected from Calcutta (figures 2 and 3).

Several reports on spontaneous centric fusion in laboratory mouse strains have been published from time to time by

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Species	Localities	2n	Total number of fusion metacentrics (no. of chromosomes involved in centric fusion)	References
Mus musculus domesticus	Tripura, India	39	I (2+16)	Present paper
Mus musculus domesticus	Calcutta, India	39	I (8+14)	Present paper
Mus musculus	Central Apenine, Italy	22	I II III IV V VI VII VIII IX (6+1) (8+3) (11+7) (15+4) (10+9) (18+2) (17+5) (14+12) (16+13)	Capanna et al.[19]
Mus musculus	Rhaetian Alps, Switzerland	28	I II III IV V VI (3+1) (14+2) (12+4) (8+7) (11+10) (16+13)	Gropp et al.[18]
Mus musculus	Rhaetian Prealps, Switzerland	35	I II III (17+16) (11+10) (12+4)	Gropp et al.[18]
Mus musculus	Rhaetian Alps, Albula, Switzerland	38	(12+4)	Gropp et al.[18]
Mus poschiavinus	Rhaetian Alps, Val Poschiavo, Switzerland	26	I II III IV V VI VII (3+1) (6+4) (15+5) (13+11) (12+8) (14+9) (17+16)	Gropp et al.[15]
Mus musculus	Lab. strain	39	I (16+6)	Léonard and Deknudt[9]
Mus musculus	Lab. strain	39	I (19+9)	Evans et al.[10]
Mus musculus	Lab. strain	39	I (17+8)	Baranov and Dyban[12]
Mus musculus	Lab. strain	39	I (19+5)	White and Tijo[11]
Mus musculus	Lab. strain	39	I (17+4)	Chakrabarti[14]

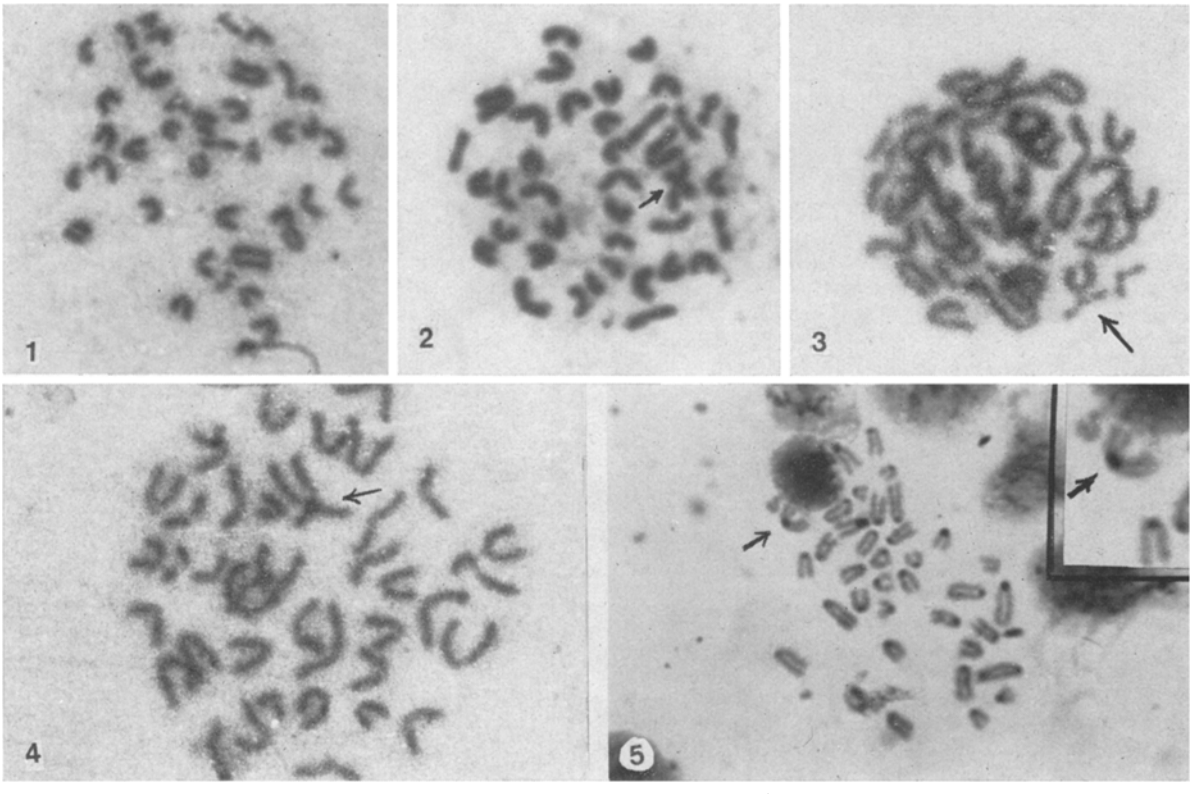

Fig. 1–5. Photomicrographs of somatic metaphases of female house mice (Mus musculus domesticus). *1* Normal metaphase with 40 telocentric chromosomes. *2–4* Metaphases of 3 heterozygous females each with 38 telocentrics and one submetacentric chromosome (arrowed). *5* C-banding of a metaphase of a heterozygous female showing the fused centromere of the submetacentric chromosome (arrowed).

different investigators[9–14]. A divergent finding on the occurrence of 7 pairs of metacentrics due to Robertsonian fusions has also been reported in tobacco mouse, Mus poschiavinus from Switzerland[15]. Previously it was generally accepted that the wild populations of house mouse have a fairly uniform karyotype of 40 telocentric chromosomes[16]. But recently the occurrence of variable metacentrics (2–9) due to Robertsonian fusions has been reported from different regions of Switzerland[17,18] and Rome[19]. So far as we are aware, there is no report on the occurrence of Robertsonian fusion in any of the house mouse populations of Asia. This first report on karyotype variation due to Robertsonian fusion in house mouse from two widely separated localities of Eastern India will add further cytological data to the problem of chromosome polymorphism of the species and the probable trend of its evolution.

It is somewhat difficult at present to suggest with confidence whether the occurrence of Robertsonian fusion in these three specimens collected from 2 distantly located populations is accidental or has any evolutionary significance. But it is evident from different research reports published in recent years that, like laboratory strains, the wild populations of house mouse also tend to undergo centric fusion relatively easily. Moreover, the data compiled in the table also indicate that in most cases the fusion has taken place between chromosomes belonging to groups II and IV[5–8] in laboratory strains and between groups I and IV[1,2] in wild populations of mouse.

Recently an extensive review on the causes and consequences of Robertsonian exchange has been published by John and Freeman[20]. But it is not very easy to conclude how these fusion (sub)metacentrics have originated in our material. Although the rods of mouse have been variously christened as acro- or telocentrics, according to the choice of individual authors, yet by whole mount EM studies Comings and Okada[21] have confirmed that the rods of mouse are telocentric in nature with no evidence of a short arm. It is, therefore, quite plausible that the (sub)metacentric in these 3 female specimens has originated either by a simple breakage reunion event within the centromere itself, or else is due to fusion between 2 eroded centromeres. The results of our C-banding analysis (figure 5), by following the technique suggested by Sumner and Evans[22], and the absence of any minutes or any supernumerary like elements are also in support of this view.

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On the location of the tetrapyrrole macrocycle of chlorophyll a in phospholipid vesicles and in hexadecane

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Summary. The state of chlorophyll a in phosphatidylcholine vesicles was examined. The results indicate that the chlorophylls are present in monomeric form. A kinetic study of chlorophyll reactions with $K_2S_2O_8$ and piperidine showed that these substances react with the porphyrin rings of pigments located on both vesicle faces, most probably within the polar headgroup region.

Artificial membranes containing chlorophyll have been used as models for the study of photosynthesis[2–4]. Since the membranes reproduced certain spectroscopic characteristics and photochemical reactions of in vivo systems, investigations were undertaken towards the elucidation of the chlorophylls arrangement in the lipid layers. Steinemann et al.[5] reported the preparation of a lipid bilayer (BLM) containing chlorophyll a (Chl-a) and suggested that the pigments are localized on both membrane faces with the tetrapyrrole macrocycle either a) in the 2 membrane-solution interfaces in contact with the aqueous phase, or b) inserted into the phospholipid core. The location of Chl-a in a bilayer as it is predicted by the first model is thermodynamically unstable. It suffices to note that one edge only of the macrocycle (figure 1) may eventually have contact with a layer of water[6].

Recently, a spin label study of Öttmeier et al.[7] on chlorophyll-containing phospholipid vesicles favoured the presence of Chl-a porphyrin within the polar headgroup region; and Katz et al.[8] remarked that the best location for antenna and special pair chlorophyll aggregates in the

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