normal light, however, resulted in about 40–50%, sometimes even more, copulating pairs within a period of 10 min. Also, sexually aroused males did not discriminate between the sexes and, besides courting females, showed a persistent courting of males (Figure 2). When the observation tube had only males, or when the proportion of males to females was very high, chains or rings of 4 to 5 males courting each other was observed. Interestingly, the males being followed did not flicker their wings, a behavioural property of normal males. These observations suggest that the sexual arousal in the mutant males, unlike the normal males, is not mediated through female sex-pheromones. Instead, light probably triggers the very initial step of this complex process.

Besides the effect of normal light, observations were also made on the influence of different wave-lengths of light on the sexual activity of mutant males. For this, a rectangular (30 × 30 cm), light proof card-board box was used. It was fitted with a 100 W bulb on the top and an opening in one side wall with sliding shutter to accommodate a monochromatic filter. Monochromatic light was obtained by employing monochromatic filters – approximate band pass 30 nm and wave length coverage of 660–420 nm. Mutant males, approximately 50 in number and isolated within 6–8 h of eclosion, were kept in dark on normal food for 4–5 days. Just before observations, males were transferred, in dark, into empty glass tubes (10 × 2.5 cm) and kept at a distance of about 30 cm from the opening in the box. Flies were observed under various wave lengths of light. Each shift in wave length was preceeded by a 2-minute dark period. Sexual activity measured in terms of acts of courtship-wing vibration and attempted copulation was recorded for 5 min at each wave length. It was noticed that the red and orange part of the light spectrum (wave length 660–595 nm) had no influence on the sexual activity, though males move about normally. Yellow light (wave length 575 nm) resulted in a total of 80–90 attempts of courtship and pseudo-copulation among males (attempts made by individual males were not recorded). Sexual activity at wave lengths up to 515 nm was more or less of the same order as that in yellow light. However, wave lengths nearing violet (420 nm) could induce only 15–20 courtship and copulation attempts. Further, the abnormal sexual activity induced in yellow light (and other parts of the spectrum) could be instantaneously terminated and regained by intermittent exposure to red and yellow light. This finding is of importance and will be of great help in delineating events from the perception of the stimulatory signals through transmission to the nervous system and up to the effects on effector organs.

[8] K. S. Gill, Am. Zool. *3*, 507 (1963).
[9] S. Benzer, J. Am. Med. Ass. *218*, 1015 (1971).

New Robertsonian metacentrics in another 22-chromosome mouse population in Central Apennines

E. Capanna[1], Maria Vittoria Civitelli, M. Cristaldi and Gudrun Noack

Istituto di Zoologia dell'Università, via Celoria 10, I–20133 Milano (Italy); Istituto di Anatomia Comparata dell'Università, via Borelli 50, I–00161 Roma (Italy) and Abteilung für Pathologie, Medizinische Hochschule Lübeck, Ratzeburger Allee 160, D–2400 Lübeck (Federal Republic of Germany, BRD), 21 July 1976

Summary. New centric fusions (Rb 8–14 Rma) have been described in a 22-chromosome karyotype from a Mus musculus population in southern Central Italy. The diakinesis of hybrids obtained by crossing mice with different 22-chromosome complements show a ring-multivalent made up 16 metacentrics pairing arm-to-arm.

In previous papers[2,3] we reported on a population of feral house mice (Mus musculus L.) found in the Central Apennines, characterized by a 22-chromosome complement. This unusual karyotype arises from the 40-chromosome standard mouse karyotype[4] through Robertsonian fusions involving all acrocentric pairs except the smallest autosomal pair, i.e. No. 19 of the standard, and the heterochromosomes. The arrangement of the acrocentric autosomes in forming the 9 pairs of Robertsonian metacentrics has already been demonstred[5,6] by means of a Trypsin-Giemsa banding procedure.

As a consequence of an extensive field study carried out in a large area of Central Italy, mice were observed in southeastern part of the Central Apennines with a 22-chromosome karyotype, but in which the 9 Robertsonian metacentric pairs were found to be different from those previously described in the Apennine mice. These differences, although not marked, were revealed by a careful karyometric analysis. The different morphology of the chromosomes was interpreted as indicative of a different arrangement of the acrocentric arms, i.e. the acrocentric chromosomes of the standard mouse karyotype, in setting up the Robertsonian metacentrics.

The distribution area of this new 22-chromosome population of mice is shown in figure 1; it includes several mountain and hill localities of Molise, the Gargano peninsula and part of nortern Puglia. Karyological studies were carried out in 20 animals collected from 6 different villages. A laboratory imbred strain has been obtained and it is, at present, kept in our breeding station. The animals of this strain have been marked by the code CB, whereas the animals belonging to the strain resulting from the 22-chromosome mouse population previously described[2,3,5] are indicated by the code CD.

1 Senior author's present address where the reprint requests have to be sent: Prof. E. Capanna, Vertebrate Zoology, Institute of Comparative Anatomy, via Borelli 50, I–00161 Roma (Italy).
2 E. Capanna, M. V. Civitelli and M. Cristaldi, Rend Accad. Naz. Lincei, ser. 8, *54*, 981 (1974).
3 E. Capanna, Chromosomes today *5*, 83 (1976).
4 Committee on Standardized Genetic Nomenclature for Mice, J. Hered. *63*, 69 (1972).
5 E. Capanna, M. Cristaldi, P. Perticone and M. Rizzoni, Experientia *31*, 294 (1975). Notice that the identification of the Robertsonian metacentrics Rma 3 and 5, as it appears in this note, has been proved uncorrect by further observations. The exact identification and definitive nomenclature of the CD Robertsonian metacentrics is reported in reference 6.
6 E. Capanna, A. Gropp, H. Winking, G. Noack and M. V. Civitelli, Chromosoma *58*, 341 (1976).

A T-G-banding experiment, reported elsewhere[6], elucidates the characteristics of the new 22-chromosomes karyotype by means of the identification of the acrocentrics of the standard mouse karyotype involved in forming the CB Robertsonian metacentrics. It uses cultured cells from 14-day-hybrid embryos obtained for cross CB type males and female mice of the NMR1 laboratory strain which have a standard 40-chromosome complement.

The banding pattern of the CB karyotype clearly demonstrates that only one metacentric chromosome of this set corresponds to one element of the CD karyotype, i.e. the metacentric autosome made up by the centric fusion of the chromosomes No. 13 and 16 of the standard, which, in a previous paper[5], was indicated as Rb (13.16) 9 Rma, but according the definitive nomenclature[6] is to be indicate as Rb (13.16) 13 Bnr.

Other Robertsonian metacentrics which characterize the CB karyotype develope from centric fusions summarized as follows[7]: Rb (1.18) 8 Rma; Rb (2.17) 9 Rma; Rb (4.11) 10 Rma; Rb (6.7) 11 Rma; Rb (3.9) 12 Rma; Rb (8.14) 13 Rma; Rb (10.12) 14 Rma; Rb (5.15) 3 Bnr.

It is worthwhile pointing out that the Robertsonian fusion (5.15) present in this last metacentric of the CB set characterizes a metacentric chromosome of the karyotype of Mus poschiavinus, namely the chromosome 3 Bnr of the Gropp et al.[8] identification.

Analysis of the meiotic pattern (diakinesis) of the CB × CD hybrids further confirmed the non-homology of the Robertsonian metacentrics present in the karyotypes of the two 22-chromosomes strains. In fact, the different arrangement of the acrocentric arms, deduced from the banding study, a priori suggests the presence in the hybrid meiosis of a large ring-multivalent made up by 16 Robertsonian metacentrics, i.e. 8 chromosomes from the CB karyotype alternanting with 8 elements from the CD chromosomal set. Male meiosis of nine CB × CD laboratory hybrids have been studied by means of the air-drying procedure proposed by Evans et al.[9]. As was foreseen, the diakinesis was seen to be characterized by a large ring-multivalent (figure 2) formed by 16 chromosomes pairing arm-to-arm. A bivalent formed by the pairing of two 13 Bnr, a small bivalent resulting from the pairing of the acrocentric chromosome 19 and the sex bivalent were also observed.

Interesting information emerges from these observations: 2 independent 22-chromosome populations of house mouse exist, and come into contact with each other, in a restricted area of southern Central Italy. This observation is not unlike that of Gropp et al.[10,11] who demonstrated the presence in the Rhaetian Alps of 2 Robertsonian transformed population of house mice, i.e. Poschiavo and Mesolecina valleys, independent as far as the acrocentric arrangement in forming the metacentric is concerned.

There are, however, several differences between our findings in the Apennines and those from the Rhaetian Alps. The first concerns the size and the geographical isolation of the populations. In fact, the Alpine populations are small and are found in well separated valleys, whereas the Apennine populations described here live

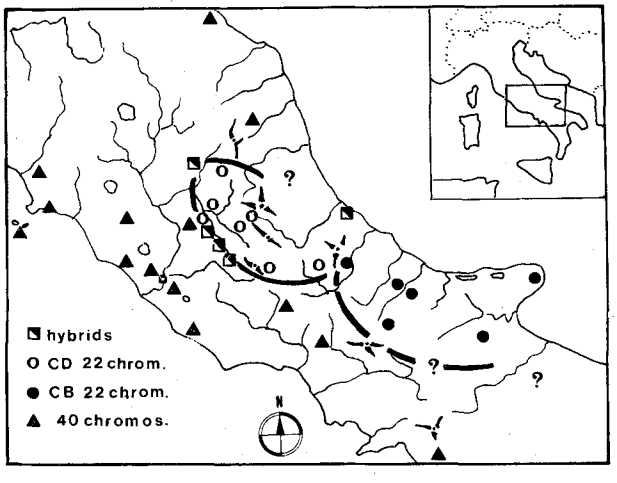
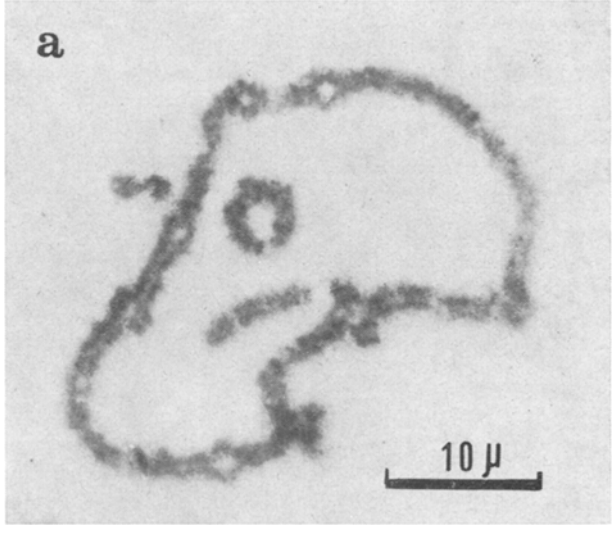


Fig. 1. Map of the distribution area of the 22-chromosome mice in southern Central Italy. Black circles indicate CB-22-chromosome populations, white circles indicate those with a CD-22-chromosome karyotype. Triangles indicates 40-chromosome mouse populations and black and white squares show hybrid populations between 40- and CD-22-chromosome mice.



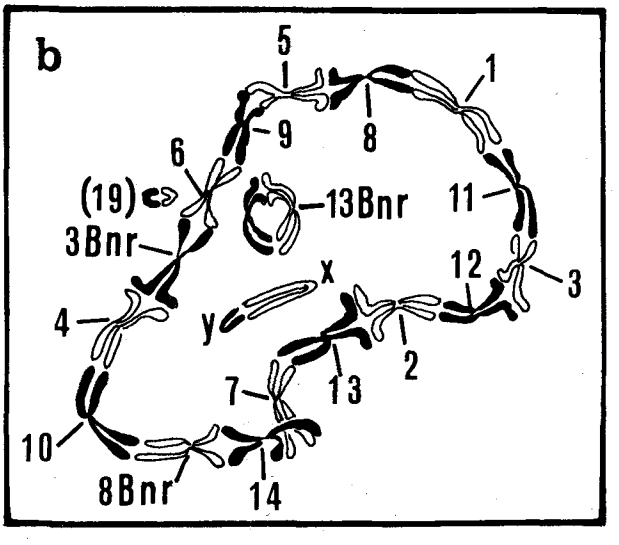


Fig. 2. A ring-multivalent (a) in the diakinesis of a laboratory hybrid obtained crossbreeding CB-22- and CD-22-chromosome mice. The drawing (b) interprets the ring formation: white chromosomes = CD set, black chromosomes = CB set. Numbers indicate the Rma metacentrics, in brackets the number of the standard 40-chromosome karyotype.

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.

7 The symbols given to the Robertsonian metacentrics are according to the recommendations of the Committee on Standardized Genetic Nomenclature for Mice, meetings of 2, 9 and 20 November at Howell.
8 A. Gropp and L. Zech, Nobel Symp. *23*, 118 (1973).
9 E. P. Evans, G. Breckon and C. E. Ford, Cytogenetics *3*, 289 (1964).
10 A. Gropp, U. Tettenborn and E. von Lehmann, Cytogenetics *9*, 9 (1970).
11 A. Gropp, H. Winking, L. Zech and H. Müller, Chromosoma *39*, 265 (1972).
12 E. Capanna, M. V. Civitelli and M. Cristaldi, Theriologia (in press).
13 A. Fatio, in: Faune des vertébrés de la Suisse. I° Histoire naturelle des mammifères. Ed. H. Georg. Geneva 1869.
14 G. S. Miller, in: Catalogue of the Mammals of Western Europe. Br. Mus. (Nat. History). London 1912.
15 E. Mayr, in: Population Species and Evolution. Harvard Univ. Press, Cambridge (Mass.) 1970.

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

S. Chakrabarti and A. Chakrabarti

Department of Zoology, Hooghly Mohsin Govt. College, Chinsurah 712 101 (W. B., India), and Department of Tumour Biology, C. N. C. R. C., Calcutta 700 026 (W. B., India), 5 May 1976

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

1 S. Chakrabarti, Proc. 2nd All India Cong. Cytol. Genet., p. 23 (1975).
2 S. Chakrabarti and A. Chakrabarti, Proc. 63rd Session Indian Science Cong., pt. III, p. 155 (1976).
3 K. H. Rothfels and L. L. Siminovitch, Stain Technol. *33*, 73 (1958).
4 G. K. Manna and S. Chakrabarti, The Nucieus *13*, 167 (1970).
5 M. Crippa, Chromosoma *15*, 301 (1964).
6 S. Chakrabarti, Proc. 1st All India Cong. Cytol. Genet., p. 127 (1971).
7 S. Chakrabarti, C. I. S. *17*, 7 (1974).
8 S. Chakrabarti, Genen Phaenen *16*, 1 (1973).