A new chromosomal race of the house mouse, *Mus musculus domesticus*, in the Vulcano Island-Aeolian Archipelago, Italy

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²Marco Corti deceased a few days after acceptance of this paper. We remember him as friend and scientist

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In this paper we describe a new Robertsonian (Rb) race of the house mouse from Vulcano (Aeolian archipelago) through the identification of the metacentric chromosomes. We analysed fifteen mice. All the specimens were found to have the same karyotype 2n/C30. This karyotype is characterized by Rb(1.2), Rb(3.9), Rb(4.13), Rb(5.14), Rb(8.12), Rb(10.16) and Rb(15.17). The differences between the race of Vulcano and the races in a neighbour island (Lipari) consist in the presence of Rb(10.16) and Rb(15.17) in the former and Rb(6.16) and Rb(10.15) in the latter. We discuss the possible hypotheses regarding the origin between these two races including the possible occurrence of a whole arm reciprocal translocation (WART) on the Vulcano island.

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The western house mouse, *Mus musculus domesticus*, is widespread in western Europe and in the entire central and western Mediterranean basin. In contrast to the standard karyotype, composed of 40 telocentric chromosomes, Robertsonian (Rb) rearrangements occur frequently reducing the diploid number to 2n=22 (Capanna 1982) with many chromosomal races found in several parts of the sub-species range (reviewed by Pialek et al. 2005). This Rb formation is due to centric fusion but also Whole-Arm Reciprocal Translocation (WART) between metacentrics or between metacentrics and telocentrics has been claimed as a further mechanism of metacentric formation (Capanna and Redi 1995; Hauppe and Pialek 1997). Structural heterozygotes may suffer different levels of hypofertility up to sterility, depending on the sex and on the type of meiotic configuration observed in the hybrids (Redi and Capanna 1988; Hauppe and Searle 1998; Castiglia and Capanna 2000). Therefore, the role of chromosomal rearrangements in racion and speciation is particularly evident in this species.

As part of a wider study dealing with the chromosomal and genetic variability of the house mouse in Italy, we have investigated the populations of *Mus musculus domesticus* in the Aeolian Islands in relation to historical colonization processes. The study of the chromosomal races in insular systems is interesting because these populations experienced founder effects and may also have experienced a rapid chromosomal evolution due to geographical isolation and to the small size of the colonizing population (Britton-Davidian et al. 2000).

The Aeolian Archipelago comprises seven volcanic islands in the Tyrrenian sea to the north of Sicily (Fig. 1). The archipelago represents one of the most important trading centres in the east and central Mediterranean during the Neolithic, Bronze and Iron Age, and therefore it may provide possible hypotheses in relation to the historical colonization processes in these areas.

A preliminary investigation carried out by Amori et al. (1983) by means of standard stained karyotypes, found metacentric chromosomes in mice from most of these islands. In fact, whereas a 40 chromosome standard karyotype population was found in Salina and Filicudi only, natural hybrid karyotypes were found in Alicudi and Panarea, and mice with 26 chromosomes were found in Stromboli, Lipari and Vulcano (Fig. 1). The Robertsonian fusions of Lipari were characterized by Gropp (1977) as Rb(1.2), Rb(3.9), Rb(4.13), Rb(5.14), Rb(6.16), Rb(8.12), Rb(10.15). Furthermore, Cristaldi and Amori (1988) showed, through the analysis of the meiosis of hybrids between Lipari and Vulcano, the presence of a multivalent chain of six chromosomes at meiotic diakineses, indicating that different metacentric are present in the two islands.

In this paper we present the characterization of the chromosomal race from Vulcano through the identification of the metacentric chromosomes. The identification of the metacentric chromosomes in Vulcano will help establish the colonization pattern within the
archipelago and between it and the other mainland Rb race.

MATERIAL AND METHODS

Fifteen mice were captured from four villages on Vulcano. Mitotic metaphase plates were prepared from bone marrow following HSU and PATTON (1969). To identify the chromosome arms involved in fusions, the chromosomes were G-banded according to SEABRIGHT (1971). Metaphases were acquired using a Photometrics Sensys 1400 digital camera. Specimens are stored at the Museo di Anatomia Comparata, Università di Roma ‘La Sapienza’.

RESULTS AND DISCUSSION

All the specimens analysed were found to have the same karyotype 2n = 26. This karyotype is characterized by the metacentrics Rb(1.2), Rb(3.9), Rb(4.13), Rb(5.14), Rb(8.12), Rb(10.16) and Rb(15.17) (Fig. 2). No structural hybrid individuals were found. Since only two specimens were studied by AMORI et al. (1983), we confirm with a larger sample the presence of a homozygous race in this island. The differences between the Vulcano and Lipari races consist in the presence of Rb(10.16) and Rb(15.17) in the former and Rb(6.16) and Rb(10.15) in the latter.

There are two possible hypotheses regarding the relationships between these two races. First, a race with the common metacentrics (2n = 30) was present on
Vulcano and Lipari. Then, two further different metacentrics originated independently on each island, favoured by geographical isolation, forming the two different chromosome races with a complement of 26 chromosomes. In the second hypothesis, the original race present on the two islands had a complement of 26 chromosomes. This race could have experienced a ‘type c’ WART (i.e. a simultaneous exchange involving two metacentrics and a telocentric, Hauffe and Pialek 1997) between chromosomes Rb(6.16), Rb(10.15) and 17, giving rise to chromosome Rb(10.16), Rb(15.17) and 6. In this scenario, it is not possible to establish with any certainty which of the two races originated first. However, it is likely that the ancestral race is that of Lipari because it is the only island that has always inhabited historically (Cristaldi and Amori 1988) and because the karyotype of mice on Lipari is the same as that on Stromboli (Solano et al., unpubl.).

A WART “type c” is less likely to arise compared to other types of WART because it involves three chromosomes which need to break and exchange arms simultaneously. Moreover, individual heterozygous for “type c” WART will carry a multivalent chain and are likely to be highly infertile (Garagna et al. 1989; Hauffe and Searle 1998). Since the hybrids between the two islands races carry the same type of multivalent chain as would the type “c” WART mutant, fertility analyses of these hybrids are in progress to test the plausibility of this model.

Assessing the origin of the Rb found in Vulcano and Lipari is complicated. In fact, the race on Lipari shares three chromosomes with the Ancarano race from Central Italy—i.e. Rb(1.2), Rb(3.9) and Rb(6.16). Although these localities are geographically distant from one another, these metacentrics could have a common origin. In fact, the colonization history of the major Aeolian islands was characterized by long periods (middle Neolithic and XV-XII century BC) of Appennine culture influence (Adornaro 2000).

Concerning the newly identified metacentrics from Vulcano, Rb(10.16) has been found in Madeira while Rb(15.17) has been found in Greece, and in central and northern Italy. In the future it will be possible to investigate the evolutionary history of Rb chromosomes by examining the microsatellite loci linked to the translocation. In fact, through the analysis of microsatellite markers, we can form hypotheses regarding the independent or common origin of the fusions found on the island (Riginos and Nachman 1999).

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