

## A Possible Duplication in the X Chromosome of Man

The hypothesis of GALTON<sup>1</sup> on the origin of the sex chromosomes of mammals suggests that an unbalanced translocation occurred between the homologous members of an autosomal pair, to produce 2 chromosomes of unequal size, the X and the Y. On this basis, we proposed<sup>2,3</sup> that the mammalian X chromosome should contain a duplication and undergo internal pairing and crossing over during male meiosis I.

Evidence supporting our hypothesis has been reported by us in 8 primate species<sup>2,3</sup> including the tarsier (*Tarsius syrichta*), the dwarf galgo (*Galago demidovii*), the squirrel

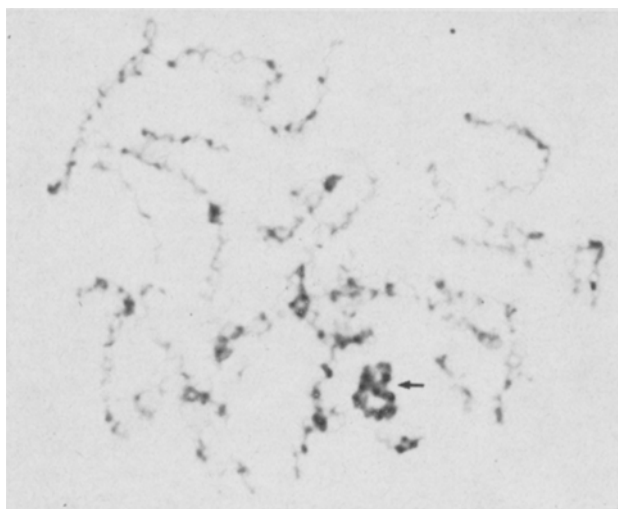
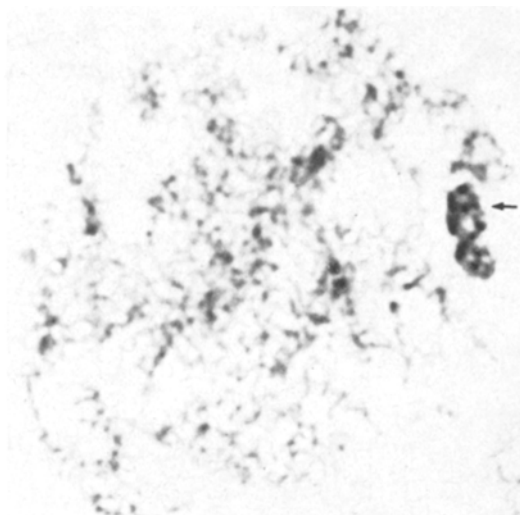
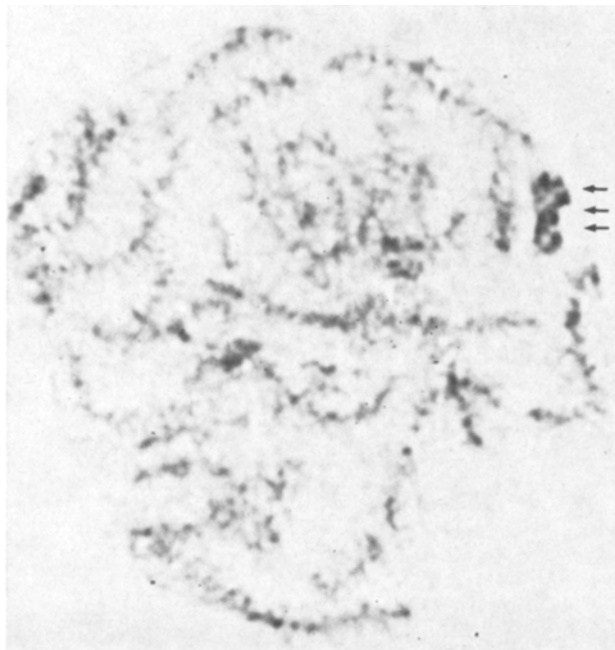
In man (*Homo sapiens*), the results are similar to those in other species (Figure). During early prophase I, the heterochromatic X chromosome bends at the middle and exchanges can be observed within it. These exchanges appear in leptotene, before chiasmata are visible in any of the autosomal bivalents, and terminate by late pachytene or early diplotene. Thus, the terminalization asynchrony reported in other primates<sup>2,3</sup> also occurs in man. As in other primate genera with submetacentric X chromosomes, the morphology of the X chromosome of man during prophase I suggests that the duplicated segments are placed in different arms of the X.

As we have indicated before<sup>3</sup>, normal meiotic products of internal pairing and crossing over within the X chromosome should be expected under the following conditions: (1) if the duplicated segments are placed in different arms of the chromosome, they should be inverted relative to each other and terminal; (2) if they are placed in the same arm – as would be expected in species with acrocentric X's – they should be inverted relative to each other and adjacent, whether terminal or not<sup>4</sup>.

**Résumé.** La morphologie du chromosome X humain pendant la prophase I – comparable à celle qui a été décrite pour 8 espèces de primates – suggère l'existence d'un «crossing over» dans le chromosome X de l'homme, du à un dédoublement possible de ce chromosome, résultant du transfert d'un autosome sur son homologue. Ce serait l'origine des chromosomes sexuels de type X-Y dans les mammifères.

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Early prophase I in male meiosis of man. The X chromosome is clearly identifiable, bends at the middle, and exchanges can be observed within it (arrows).

monkey (*Saimiri boliviensis*), the rhesus macaque (*Macaca mulatta*), the japanese macaque (*Macaca fuscata*), the pigtail macaque (*Macaca nemestrina*), the stump-tail macaque (*Macaca speciosa*) and the Celebes ape (*Macaca cynopithecus*) niger).

<sup>1</sup> M. GALTON, Lancet 2, 1397 (1966).

<sup>2</sup> J. EGOZCUE, Experientia 24, 1275 (1968).

<sup>3</sup> J. EGOZCUE, Folia primat., 11, 1 (1969).

<sup>4</sup> This work was supported in part by a grant of the Consejo Superior de Investigaciones Científicas, and by a research grant of the Ministerio de Educación y Ciencia.