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Chromosome Translocations in the Karyotypes of Wild Boars *Sus scrofa* L. of the European and the Asian Areas of USSR

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Summary. The karyotypes of the 80 wild boars of the four subspecies, *Sus scrofa ussuricus* Heude from the Far East of USSR, *S. s. nigripes* Blanf. from Kirghizia (the Middle Asia), *S. s. attila* Thos. from Azerbaijan, *S. s. ferus* from Lithuania, Byelorussia and Central Russia, and the 44 domestic pigs of the five different breeds (Vietnamese Black, Siberian Omskaja Gray, Kakhethian-aborigen Georgian, Mangalica Hungarian, Landrace Swedish), were studied by the Giemsa Banding Method. Differential staining by the G-Method made it possible to identify all the homologous chromosomes of the wild and domestic pig karyotypes as well as to reveal the polymorphism of wild boar karyotypes (2n = 36, 37 and 38), which are determined by the two types of chromosome translocation. Crosses between domestic pigs (2n = 38) and wild boars (2n = 36 and 37) with different chromosome rearrangements might help to clarify the genetic function of the chromosomes A4, B3, B4, B5 and allow their use as genetic markers.

Intraspecific chromosomal polymorphism in *Sus scrofa* L. has been revealed in wild boars from the Central European population (McFee, Banner, 1969), and from the East Asian population (Tikhonov, Troshina, 1971). It has been suggested that the polymorphism is due to centric or Robertsonian fusion of two acrocentrics into a single submetacentric (McFee, Banner, 1969; Tikhonov, Troshina, 1972). The analysis of the cytogenetic features of the subspecies of wild boars inhabiting the European and Asian regions of USSR is of interest because karyotype differentiation may be applied to evolutionary, taxonomic and phylogenetic studies of pigs as well as other domestic animals (Beljaev *et al.*, 1972).

Material and Method

This cytogenetic study concerns geographically very distinct populations of the wild boar representing the following different subspecies inhabiting the territory of USSR: *Sus scrofa nigripes*, 37 wild boars caught in Kirghiz SSR; *S.s. ussuricus*, 20 wild boars caught in the Far East and the Amur region; *S.s. attila*, 8 wild boars, killed in Azerbaijan SSR; *S.s. ferus*, 15 wild boars caught in Lithuania, Byelorussia and Central Russia.

For the analysis of metaphase plates, chromosome preparations were made from a culture of peripheral leucocytes with added phytohaemagglutinin and colchicine (Tikhonov, Troshina, 1972). The preparations were treated with a 0.056 M hypotonic KCl solution. Differential staining was carried out by a somewhat modified technique of Seabright (1972) and Evans et al. (1971). The preparations were treated with a 0.3% trypsin solution for 30–50 sec. at 35 °C, washed and incubated in a fresh 2 × SSC solution for 1.5–2 hours at 56 °C; each slide was stained in buffered Giemsa at pH = 6,8–7,0, for 5–10 min.

Results

All the wild boars of the populations studied had a diploid number ranging from 36 to 38. Most boars of the Middle Asian and West European populations (35 boars) had $2n = 36$, the other boars had 37 or 38 chromosomes in the karyotype. There were no individuals with $2n = 36$ among the Far Eastern and Transcaucasian boars. The number of chromosome arms in all the karyotypes was a constant 64 (NF = 64). Differential staining made possible the identification of all the homologous chromosomes of the karyotype.

Four chromosome groups may be tentatively distinguished in the karyotype of the wild boar (figs. 1, 2): A. Large submetacentrics, B. Acrocentrics, C. Medium-sized submetacentrics, D. Metacentrics. Pair A1: short arms (p) have four dark bands and long arms (q) have eight dark bands. Pair A2: p and q have a band each with a wide light zone visible at the proximal end of q. Pair A3: p has a single dark band and q has two very close bands and a dark band in the centromere region. Pair A4: p has a single dark band near the centromere, q has three bands. The chromosomes of pair 4A are observed only in wild boars with 36 and 37 chromosomes and never in wild boars with 38 chromosomes or in domestic pigs. Pair B1 are the largest acrocentrics characterized by seven dark bands of different widths; where there is pronounced chromosome coiling there may seem to be four bands. Pair B2 has two bands at the proximal end of the arms and three bands at the distal end; between them is a light zone with a very thin band. Pair B3 consists of five dark bands evenly distributed along the chromosome arm. Pair B4 shows three bands, two nearer the centromere and the third located on the distal end. Pair B5 possesses a wide band near the centromere and a thin band on the distal end. Pair B6 has a clear-cut dark band on the distal end. All the chromosomes of Groups C and D

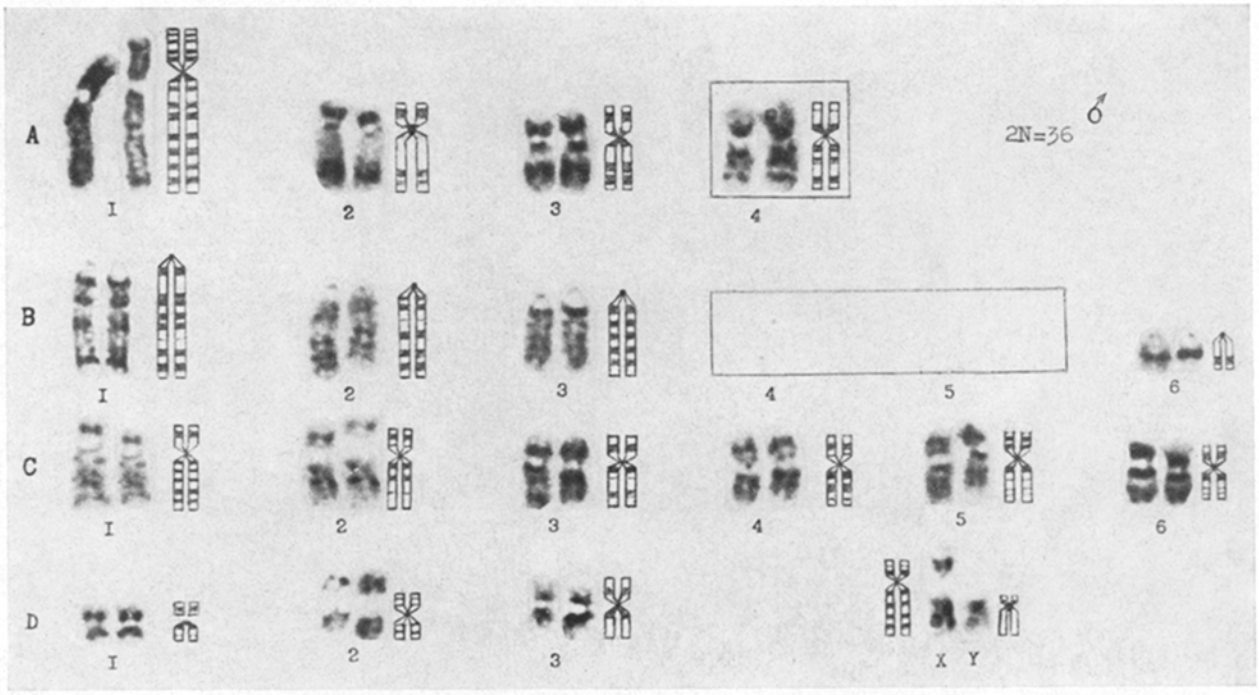


Fig. 1. Differential staining of 36-chromosome karyotype of *S. s. nigripes* male. Formation of the chromosome A4 by fusion of chromosomes B4 and 5B

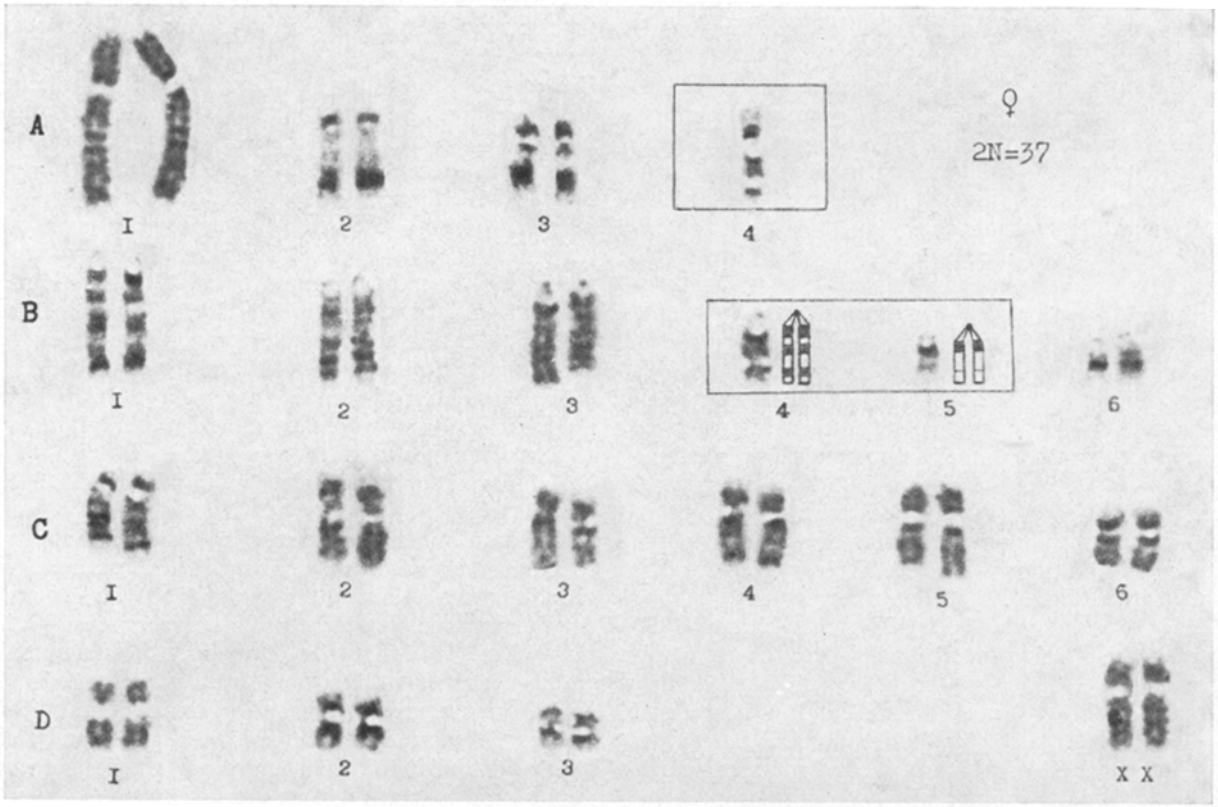


Fig. 2. Differential staining of 37-chromosome karyotype of *S. s. nigripes* female. Formation of the chromosome A4 by fusion of chromosome B4 and B5

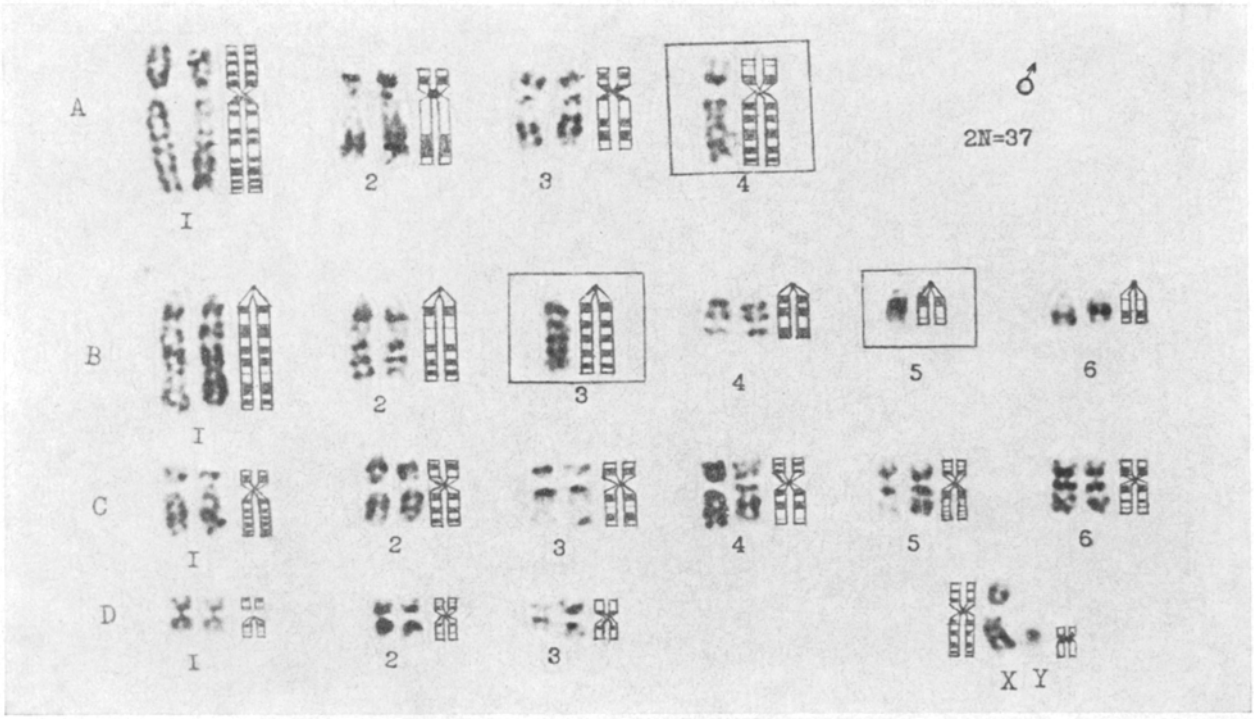


Fig. 3. Differential staining of 37-chromosome karyotype of *S. s. ferus* male. Formation of the chromosome A4 by fusion of B3 and B5

and the sex chromosomes also exhibit peculiar banding patterns.

The comparison of figs. 3, 4, 5 shows that the two domestic breeds studied, one of European origin (Landrace) and the other of Asian origin (Vietnamese Black), have very similar banding patterns. Comparable karyotypes have been observed by Hansen (1972) and Gustavsson *et al.* (1972), who have investigated mitotic chromosomes by techniques different from the one used in this study.

In pair A4 the banding pattern of the short arm is identical to that of pair B5, while the pattern of the long arm is identical to that of B4 (figs. 1, 2). This gives grounds for assuming that submetacentric A4 is the result of the translocation-centric fusion of acrocentrics B4 and B5. Wild boars with such karyotypes have been found among *S. s. nigripes*, *S. s. ussuricus* and *S. s. attila*. Boars with a 37-chromosome karyotype for Middle Asian, Far Eastern and Transcaucasian populations are heterozygous for this translocation (fig. 2).

Karyotype analysis of *S. s. ferus* (Lithuanian SSR) demonstrated karyotype similarity between the banding patterns of the short arm of A4 and the banding patterns of the B5, whereas the banding pattern of the long arm A4 was found to be similar to that of B3 (figs. 3, 4). Thus, this is a second way of forming the wild boars' submetacentric chromosome A4, which is never observed in karyotypes of domestic pigs. The high occurrence of boars with these two translocations indicates their normal viability and fertility.

Thus, the differential staining of metaphase chromosomes and the maintenance of banding patterns made it possible to localize two types of interchromosomal translocation rearrangement in wild boars of different subspecies. The formation of morphologically different chromosomes as a consequence of two types of centric (Robertsonian) fusions, which was observed in all the four populations of wild boars, is noteworthy, if one takes into account that karyotypic polymorphism does not occur in domestic pigs of different origin. This is probably related to the fact that, a large chromosome number ($2n = 38$) increases the number of linkage groups of genes and thereby enhances combining variability in conditions of natural and artificial selection.

The data obtained characterize a significant intraspecific divergence of wild boars from distinct geographic zones and give further grounds for referring the four subspecies studied to a single species — *Sus scrofa* L. The two types of formation of new submetacentrics from non-homologous acrocentrics in wild boars have broad genetic implications in that crosses between domestic pigs ($2n = 38$) and wild boars with different chromosomal rearrangements might help to clarify the genetic function of newly formed chromosomes and allow their use as genetic markers.

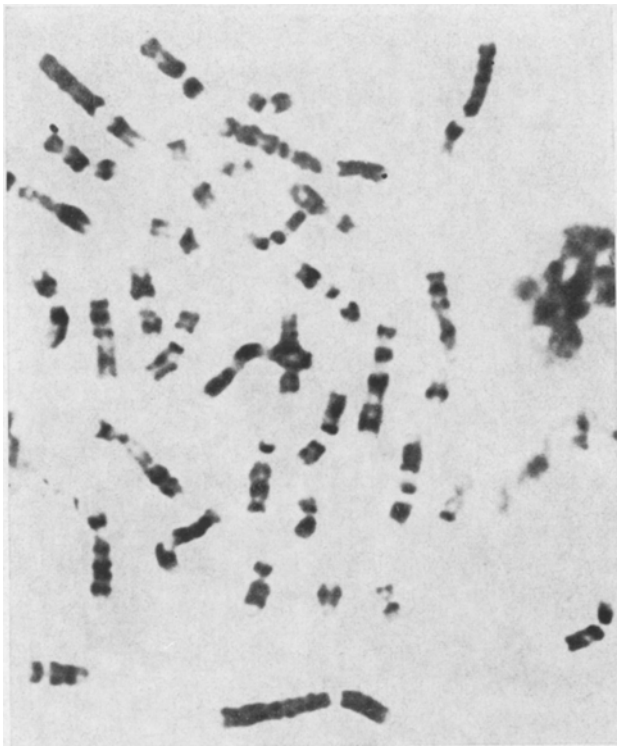
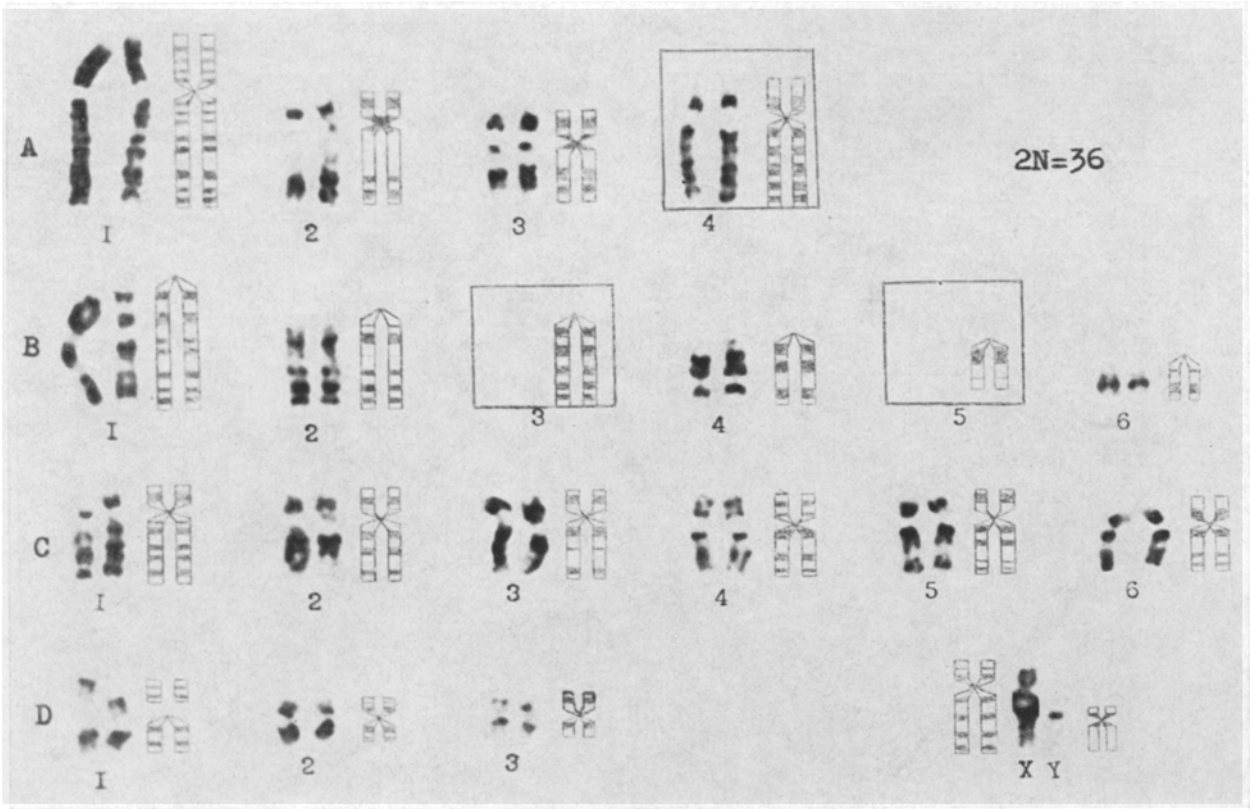


Fig. 4. Differential staining of 36-chromosome karyotype of *S. s. ferus* male. Formation of the chromosome A4 by fusion of B3 and B5



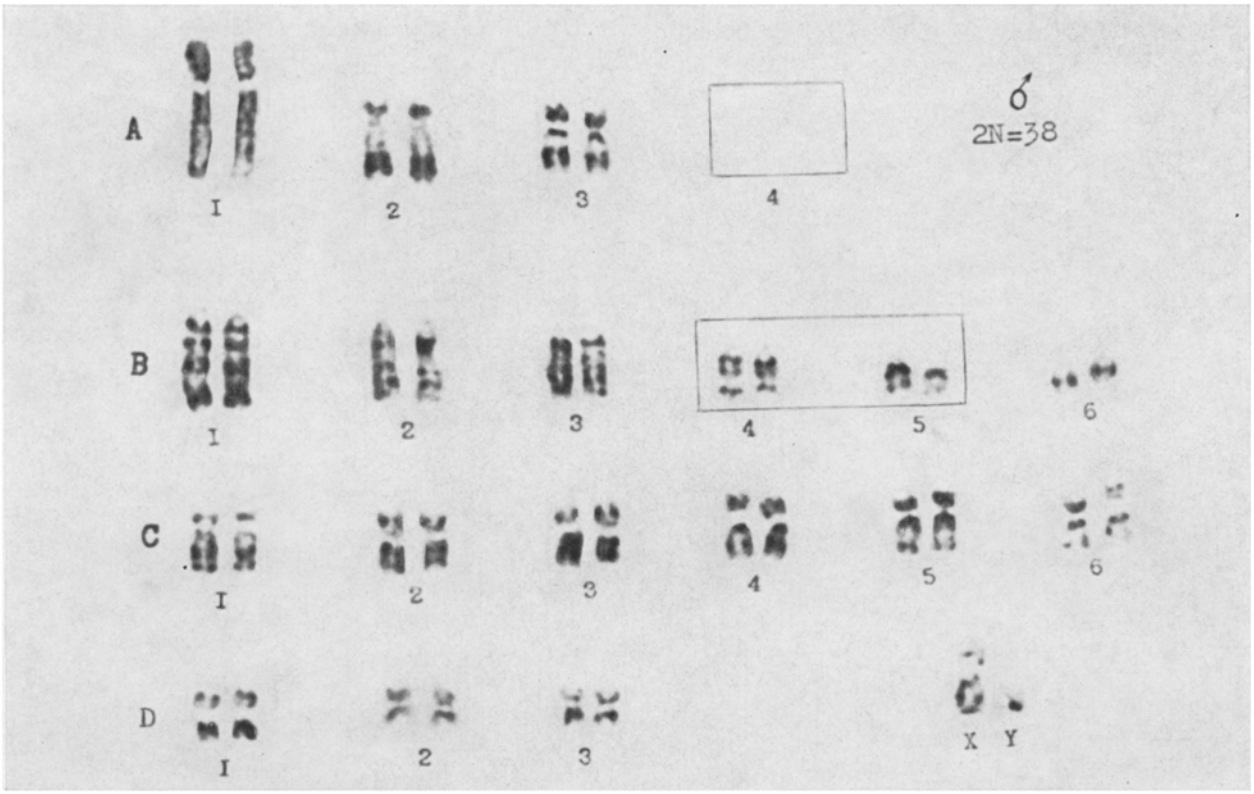


Fig. 5. Differential staining of 38-chromosome karyotype of domestic Vietnamese Black breed male

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