Mitotic and meiotic studies in a bull carrying the 1/29 and 9/23 Robertsonian translocations

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Robertsonian translocations are the most commonly reported chromosome anomalies in cattle. The most widely spread is the 1/29 translocation reported at high frequencies in numerous breeds worldwide. In contrast, the other Robertsonian translocations have been reported only as sporadic cases (Berland *et al*, 1988).

Recently, a *Blonde d'Aquitaine* bull was detected as a heterozygous carrier of two different Robertsonian translocations and the chromosomes involved were identified using R-, G- and C-banding techniques (Cribiu *et al*, 1989). Synaptonemal complex behavior was also analyzed for the same animal (Bouvet and Cribiu, 1990). In the present report, banding results and kinetochore appearance in both trivalents are compared.

The karyotype of this bull included 58 chromosomes: the X and Y chromosomes, 54 acrocentric and two submetacentric chromosomes with different lengths and centromeric indices. The G- and R-bands, according to the Reading and Jouy-en-Josas conferences (Ford *et al*, 1980; Di Berardino *et al*, 1990), showed that chromosome pairs 1 and 29 and pairs 9 and 23, respectively, were involved in the two translocations. The C-banding technique revealed the presence of two constitutive heterochromatin blocks in the pericentromeric region of the 9/23 translocated chromosome and only one block on the long arms near the centromere of the 1/29 translocated chromosome (fig 1).

In surface-spread spermatocytes of the 1/29, 9/23 translocations-carrier bull, two autosomal synaptonemal complexes with submetacentric kinetochores were noted, whereas the other autosomal complexes had terminally located kinetochores and the X–Y bivalent was easily identifiable. The trivalents appeared to show complete

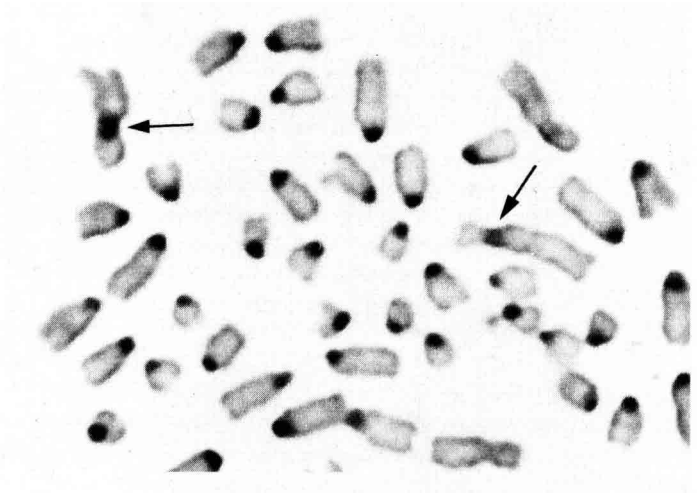

Fig 1. C-banded chromosomes showing one block for the 1/29 and two blocks for the 9/23 translocations in the same animal.

synapsis and to have a *cis*-configuration. The average arm ratios for the 1/29 and 9/23 trivalents were 2.71 ± 0.53 and 1.54 ± 0.27, respectively.

The 9/23 trivalent appeared to have a more separated kinetochore area than the 1/29 trivalent in most of the cells examined (fig 2). The two trivalent figures remained independent and did not associate with the sex vesicle.

The 9/23 translocation is the third Robertsonian translocation reported in the *Blonde d'Aquitaine* breed (Berland *et al*, 1988).

The C-banding method revealed a basic difference between the 1/29 and 9/23 translocations. One block of juxtacentromeric constitutive heterochromatin appears on the long arm of the 1/29 translocation, whereas two blocks are present on the 9/23 translocation, as reported for the 21/27 translocation by Berland *et al* (1988). The presence of one or two blocks would suggest different chromosome rearrangement formation mechanisms. In the first case, one of the chromosomal breakpoints involves the short arms of one chromosome and the other is on the long arms of the second chromosome near the centromeric region. In the second case, the breakpoints involve only the short arms of both chromosomes.

The difference in the separation of the kinetochore area between these two bovine Robertsonian translocations seems to confirm the presence of one or two heterochromatin blocks noted by C-banding in mitotic spreads. A similar misalignment of kinetochores after synaptic readjustment has previously been reported in the red kangaroo to be due to the presence of an extra C-band in one homologue of a submetacentric autosomal chromosome pair (Sharp, 1986).

Since the behavior of both trivalents is identical during the meiotic prophase, size difference between the chromosomes involved and the presence of one or two blocks of pericentromeric heterochromatin do not seem to alter the meiotic process.

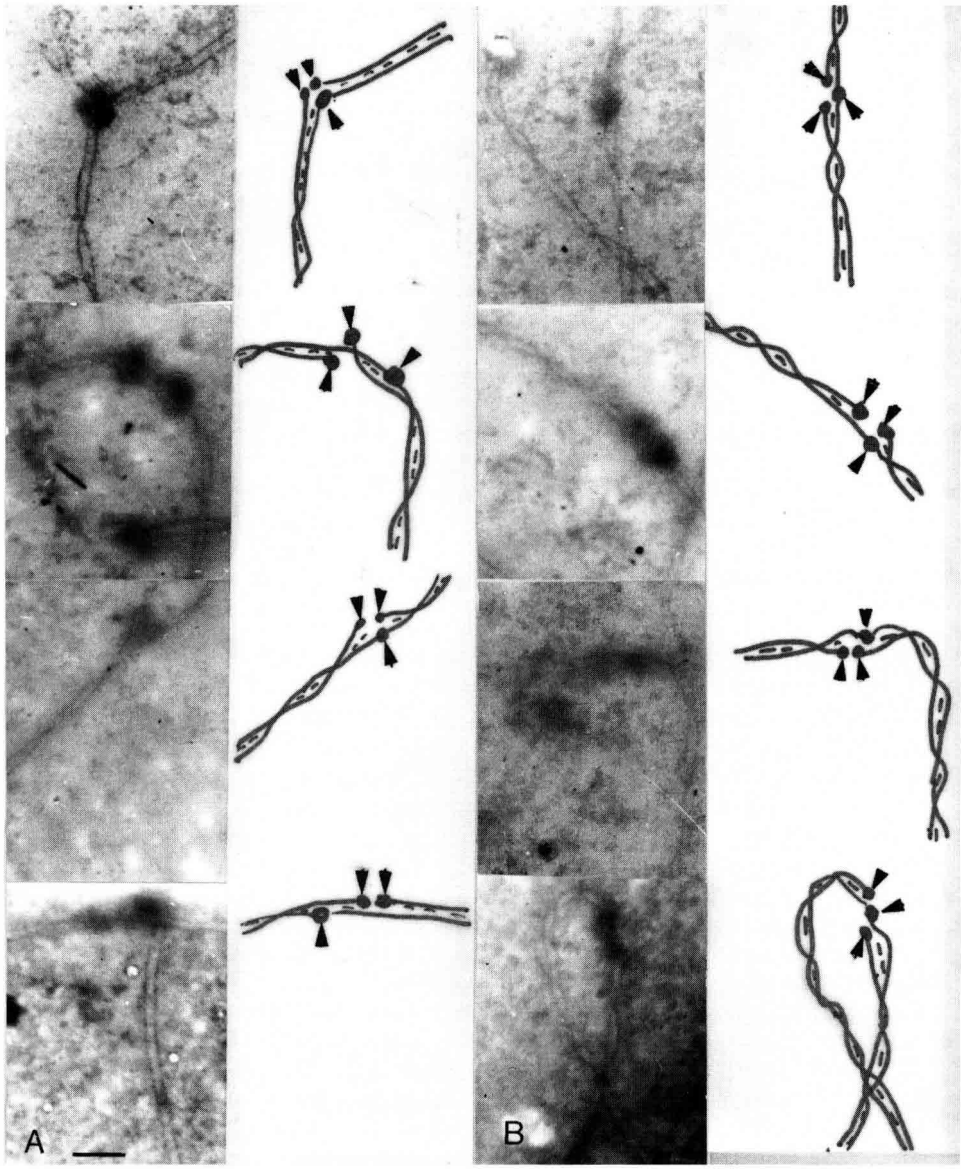

Fig 2. Synaptonemal complexes from the 1/29, 9/23-carrier bull, in four different cells, showing the kinetochore area of the 9/23 trivalent (left) to be more separated than that of the 1/29 trivalent (right) in the same cell. Phosphotungstic acid (PTA) stained. Bar = 4 μm.

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