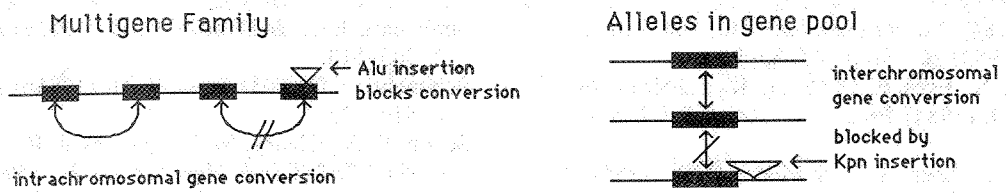

FIGURE 7: Proposed role of transposable DNA elements in modulating gene conversion.

efforts at breeding cows, two such divergent alleles may have been fixed to lead to the structures we have observed.

Just as it can be adaptive to block intrachromosomal gene conversion in a multigene family, sometimes it can surely be adaptive to shield certain alleles from interchromosomal gene conversion. Such a block would be beneficial to an allele that is undergoing a structural shift corresponding to a speciation event. What agent could promote this uncoupling? As for multigene families, an insertion could provide a region of nonhomology that would suppress the formation of heteroduplex DNA. Because they block intrachromosomal gene conversion, it is reasonable to suppose that *Alu*-type elements could also perform this function for interchromosomal gene conversion. Recent studies indicate otherwise. When two genes with overlapping deletions were introduced into cultured cells (Kucherlapati et al., 1984; Small & Scangos, 1983; Rubintz & Subramani, 1985; de Saint Vincent & Wahl, 1983) or incubated with extracts from cultured cells (Darby & Blattner, 1984; Kucherlapati et al., 1985), recombinants were generated in a process thought to represent interchromosomal gene conversion in vitro. A region of nonhomology the size of *Alu* elements did not inhibit recombination in these studies.

The idea that *Alu*-type repeats may block intrachromosomal but not interchromosomal gene conversion implies that these two processes have different mechanisms. Recent work indicates that this is indeed the case in yeast genetics (Klein, 1984; Klar & Strathern, 1984; Fink & Petes, 1984). If this is also true for mammalian systems, one can speculate that a larger region of nonhomology than an *Alu* element is required to block interchromosomal gene conversion. There would be several ways to generate such a large nonhomology. One is via a DNA duplication at least several kilobases in length. The duplicated region would then be out of register with its solo copy in a heterozygous animal and thus be unable to exchange sequence via interchromosomal gene conversion. The duplicated cow pseudogenes are an example.

Long transposable elements might also inhibit interchromosomal gene conversion. There exists just such a sequence, the *Kpn* family of transposable elements (Potter, 1984; Martin et al., 1984; Shafit-Zagardo et al., 1982). This family is composed of long (up to 6-kb) DNA sequences that show a high degree of sequence conservation among orders of mammals. There are about 20 000 copies per mammalian genome of this sequence. According to this scenario *Kpn* sequences would perform a function for allelic genes analogous to the function of *Alu* sequences in gene families. Thus, the two major classes of interspersed repetitive DNA in mammalian genomes would play corresponding roles in directing variation into the evolution of new forms (Figure 7).

Gene conversion plays a profound role in evolution. It promotes the flow of DNA sequences, both among the members of a multigene family and among the individuals of a species. As novel variations arise, they are transmitted and recombined along this two-dimensional network. Specific mechanisms exist to uncouple a gene from this interaction. A fuller understanding of these processes may lead to the solution of three outstanding problems in evolutionary theory: the question of how and at what level natural selection acts on DNA, the question of how isolating mechanisms work at the level of the gene, and the question of how gene variation is related to punctuated equilibria during evolution (Eldredge & Gould, 1972).

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