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Why Do Sex Chromosomes Change So Quickly?

Sex genes and sex chromosomes, at different paces of evolution

Being male or female is decided from the womb. And in most cases, the key is held by sex determination genes on the sex chromosomes. The genes connected to sexual development have evolved remarkably little along the evolutionary of our race. Opposite sex determining genes, sex chromosomes are among the most fast changing bodies of the genome. The team made by Sander van Doorn (Santa Fe Institute, USA) and Mark Kirkpatrick (University of Texas at Austin, USA) has attempted to come with an answer to the enigma of the rapid evolution of the sex chromosomes. The researchers show that sexual conflict can lead to new configurations of the sex-determining genes on sex chromosomes. This extends the current theory on the origin of sex chromosomes, showing how sex determination can jump from a previous sex chromosome to an autosome (non-sex-chromosome), which turns into a new type of sex chromosome. The team puts these evolutions on genes with sexually antagonistic selection. If, for example an autosome presents two such genes, this is translated through the fact that some versions (alleles) of a gene boost rather the fitness of males than that of females, while other alleles that of females in the detriment of the males (such genes are even supposed to be involved in homosexuality). The other gene could control the sex of the individual. Natural selection connects the two genes: the allele boosting male fitness will be encountered more often accompanied by the allele of the other gene responsible for producing a male. The new association male-making, male-benefiting (or female-making, female-benefiting) genes can turn dominant on one population, and finally replaces the previous pair of sex chromosomes. Genes affecting differently the fitness of the sexes are common in nature. To test this hypothesis, researchers should investigate sexually antagonistic genes on a chromosome immediately before and after that chromosome turns into a sex one. This could be found in closely related species which possess different types of sex chromosomes. In this case, one species would have a recent set of sex chromosomes, while the other would possess the ancient sex chromosomes, and the state of the chromosome could be assessed right before the change.