

Michel Morange, École Normale Supérieure, Paris: “Genome as a Multi-Purpose Structure”

ABSTRACT: After the genetic code had been deciphered, it was widely accepted among molecular biologists that the genome was an internal image – blueprint – of the organism, faithfully transmitted through descent and permitting the reconstruction of organisms at each generation. Nucleic acids were the bearers of information, whereas proteins were in charge of cellular functions.

Already in the 1960s some observations opposed this vision, and the clear-cut separation between information and function. Ribosomal and transfer RNAs had functions essential in protein synthesis, and regulatory sequences in the genome stood at an intermediate position between information and function. The major regulatory role of micro RNAs, the complexity of the regulatory sequences demonstrated by the ENCODE (Encyclopedia of DNA Elements) post-genomic programme, and the importance of epigenetic modifications have more recently contributed to erase the distinction between information and function, the genome and the other components of the cells.

One way to reconcile these recent observations with the obvious importance of genes demonstrated in other communications is to consider that the genome plays different roles that have been progressively associated with it in the early steps of life. To encode the structure of proteins, to regulate the expression of genes by the action of transcription factors or by chromatin modification, and to control the level and translatability of RNAs through the action of micro RNAs are different functional roles that have been gathered on the same material structure, the genome, through a historical process that remains totally unknown. To consider the genome as an ensemble of progressively associated and interlinked functional DNA elements explains why answering the question «What is a gene?» remains so difficult.