The cell: between constraints and stochasticity

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Abstract

"Double Session: The Nature of Cellular Complexity (Kupiec, Gandrillon, Paldi, Ojalvo, Nicholson, Matlin)" Since the beginning of molecular biology, it has been postulated that genetic information is transferred to proteins via their tri-dimensional structure, allowing them to interact specifically with other molecules. Molecular specific interactions are in turn thought to be the basis for the formation of molecular networks (protein, gene or metabolic networks) underlying cellular processes. In contrast to this prediction, data obtained over the last forty years show that interactions between biological molecules lack specificity and are immensely varied, with one molecule able to interact with a large number of partner molecules. As a consequence, instead of forming specific networks, molecular interactions are subject to large combinatorial interaction possibilities and to extensive stochastic variability. Taking this aspect into account modifies our understanding of biological organization. Molecular networks are not the cause but the result of cellular processes because these latter restrict the stochastic variability of molecular interactions. The making up of an organism, instead of being a simple bottom-top process in which information flows from genes to phenotypes, is both a bottom-top and top-bottom process. Genes provide proteins, but their stochastic interactions are sorted by selective constraints arising from the cell and multi-cellular structures.

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