



## RNA and gene control in bacteria

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## **Preface : RNA and gene control**

Maude Guillier & Francis Repoila

The study of RNA has led to fundamental discoveries in molecular biology and genetics. RNA is central to the decoding of genetic information, playing a role both as the messenger (mRNA) and as the major component of the apparatus that carries out protein synthesis (tRNA and rRNA). RNA also performs crucial functions in gene expression, as illustrated by transcribed RNA sequences that are spliced out (introns), or by RNAs with catalytic activity (ribozymes). With the more recent discovery of regulatory non-coding RNAs, and the identification of control elements within mRNAs that do not require "classical" regulatory factors (riboswitches), RNA has become a major and unavoidable player in the control of gene expression in all domains of life. In bacteria, it is involved in adaptation processes and in the responses to environmental cues. The breadth of functions and roles of RNA in bacterial gene regulation is the focus of this special issue.

The first chapters illustrate the different pathways of the biogenesis of regulatory RNAs, and the mechanisms for controlling their activity via ribonucleases and RNA sponges. The diversity of molecular processes mediating RNA regulation is then highlighted in chapters devoted to riboswitches, antisense RNAs, and base-pairing RNAs, as well as to the protein co-factors involved in RNA regulation, such as ProQ, Hfq or Rho.

In parallel to the diversity of modes of action, multiple roles have been described for regulatory RNAs in bacterial physiology. This is exemplified in this issue by the role of RNAs in the carbon-nitrogen balance and in heterocyst formation in cyanobacteria, the link between bacterial growth and RNA metabolism and the possible function of RNAs in host-pathogen interactions via extracellular vesicles.

Importantly, the discovery and the understanding of RNA functions have greatly benefited from technological developments and, conversely, also provided grounds for the establishment of new technologies. A chapter discussing the strengths and weaknesses of the recent advances in high-throughput methods applied to RNA also features in this issue.

The current fundamental knowledge presented here is the result of a body of work carried out in various laboratories around the world. They are intellectually elegant and exciting. Nevertheless, the reader should keep in mind that the study of RNA continues to have applications in medicine and industry; RNAi technology or the use of CRISPR in genome editing are just a couple of obvious examples. Furthermore, as illustrated by the authors of this collection of articles, we still have a lot to discover and understand within the RNA world.

## Biographical sketches

Maude Guillier did her PhD studies on the translational feedback control of ribosomal proteins synthesis in *Escherichia coli* at the IBPC in Paris with Drs. Claude Chiaruttini and Mathias Springer. She then started to work on small RNA-mediated regulation as a post-doctoral researcher in the lab of Susan Gottesman at the NIH, USA, from 2004 to 2008, where she studied the role of sRNAs in modulating membrane composition. She continued to develop work centered on bacterial RNA regulation after she moved back to France. She is now a PI at the IBPC in Paris and her major research interests focus on the interplay between transcriptional and post-transcriptional regulatory circuits as well as the mechanisms of control of bacterial translation.

Francis Repoila started to work on regulatory RNAs more than 20 years ago as a post-doc in the laboratory of Susan Gottesman (NIH, USA), where he contributed to the first systematic discovery of sRNAs in *Escherichia coli*, and their involvement in bacterial adaptation in response to environmental cues by working on the thermocontrol of the RpoS sigma factor. Since his return to France, as a Research Associate, he has contributed to the discovery of sRNAs in Gram-positive bacteria: in *Listeria*, in Pascale Cossart's lab (at the Pasteur Institute), and in *Enterococcus* at INRAE (at the Micalis Institute). Since a few years now, he investigates switches enabling enteric bacteria to become pathogens within the intestine, by global dynamic approaches where RNA is a key compound to decipher regulatory pathways.