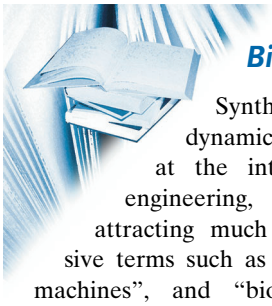

Chemical Synthetic Biology

Synthetic biology is a dynamic new area of research at the interface of science and engineering, which is currently attracting much attention with impressive terms such as "artificial cells", "living machines", and "bio-bricks". In its most popular meaning, synthetic biology "… seeks to use *natural* parts of biological systems […] to create assemblies that do things that are *not* done by natural biology",[1] for example, the biotechnological production of fuels or fine chemicals. In contrast, the synthetic biology performed by chemists has the opposite aim: "… to use *unnatural* molecular parts to do things that *are* done by natural biology", and thereby to reach a chemical understanding of life.[1] The book *Chemical Synthetic Biology* is an up-to-date collection of review articles edited by Luisi and Chiarabelli, which aims to give a topical survey from the second (chemical) point of view, asking questions such as "why is this type of molecule used in living organisms, and not another one?", "how and why have those molecules that constitute life been selected?", and "at how great a degree of molecular complexity can cellular life arise?"[2]

From reading Luisi's and Chiarabelli's book, we learn that chemical synthetic biology provides both the intellectual framework and the toolbox to tackle these questions in a way that is quite simple: "Synthesize alternative forms of the molecules, complexes, or networks found in living nature, and see whether there are reasons why a certain route may not have been chosen during natural selection."[2] Some examples of this rationale are the investigations of nucleic acid structures derived from hexoses instead of pentoses (Eschenmoser), of nucleic acids with peptide instead of sugar-phosphate backbones (Nielsen), and with alternative or additional base pairs (Benner), as well as studies of enzymes from reduced-letter alphabets (Yanagawa), and the synthesis of functional proteins with sequences that do not exist in nature (Chiarabelli). It is clear, however, that the sum of answers provided by all these seminal studies does not at all explain the phenomenon of "life". To understand life it is necessary to go beyond synthesis-based thinking into areas such as systems analysis and the theoretical and experimental reconstruction of complex and dynamic networks. Examples of important contributions to this field include studies on a synthetic genetic code (Wong), the setting-up of synthetic replicators (von Kiedrowski), and work on "minimal ribosomes" (Nierhaus) and on "minimal cells" (Luisi).

The unique collection of review articles presented by Luisi and Chiarabelli is an excellent source for understanding both the emergence and the importance of chemistry-based synthetic biology, as distinct from the more popular and applications-orientated bioengineering research in this field. The contributions are well-selected and are clearly divided into parts that reflect different stages of molecular and structural complexity. Although such a collection of articles is usually not as easy to digest as an integrated story, it is definitely worth reading through the whole compendium. Besides the actual scientific information, it also offers insights into some of the authors' personal views and experiences. As a whole, the book provides thought-provoking discussions that help one to sort and evaluate the prospects and risks of a synthetic biology which—at least since Venter's attempt to create a bacterial cell controlled by a chemically synthesized genome[3]—has raised much clamor in the press and public. To conclude, I enjoyed reading Chemical Synthetic Biology.

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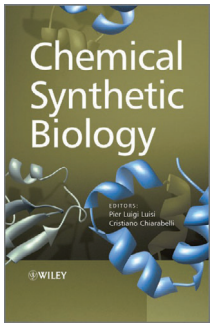
[1] S. A. Benner, F. Chen, Z. Yang in *Chemical Synthetic Biology* (Eds.: P. L. Luisi, C. Chiarabelli), John Wiley & Sons, Hoboken, **2011**.
[2] P. L. Luisi in *Chemical Synthetic Biology* (Eds.: P. L. Luisi, C. Chiarabelli), John Wiley & Sons, Hoboken, **2011**.
[3] D. G. Gibson, J. I. Glass, C. Lartigue, V. N. Noskov, R.-Y. Chuang, et al., *Science* **2010**, *329*, 52–56.



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