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editorial

Beyond the horizon

During the past 150 years, biology has seen many revolutionary advances and the development of technologies that have sparked new questions and resulted in fresh insights. Advances in optics and lens-making brought great improvements to light microscopy in the nineteenth century, which, in turn, enabled biologists to observe life at the cellular level. The resulting discovery of bacteria as disease-causing agents spawned the field of microbiology and revolutionized medicine. The electron microscope, developed by physicists, is now mainly used by biologists to study the structures and processes that occur inside the cell, which has put cell biology at the forefront of research. At the macro-level, the sequencing of whole genomes and the use of powerful computers and sophisticated algorithms now enable biologists to study life on a larger scale and have generated whole new fields of research, such as genomics and proteomics.

But, in many ways, biology has stretched technology to its limits. Many scientists have access to equipment and databases that allows them to test ideas and produce a lot of information fairly quickly. This has produced a flood of publications, but these do not necessarily provide major new insights into how life works. Technologies, such as those used in genomics and proteomics, are helpful in generating data, but the number of possibilities and parameters in a given experiment are limited and so too, therefore, is our horizon of thinking. We are somehow still at a 'textbook' level of understanding, which blocks further leaps of intuition that are needed to understand life and that could come from a fresh reassessment of the information available.

What is needed in current biological research are completely new ways of thinking to generate truly novel concepts. Some of these may be found with the helping hand of scientists from other disciplines, who have a different mind-set to biologists. Clearly, today's research is already becoming more multidisciplinary—the collaboration of computer scientists and biologists in bioinformatics being one example, and the fusion of molecular biology and physics to develop new microscopy techniques being another. But these joint ventures generally aim at improving existing technology and do not take a step back to look at biology from a different angle.

A new perspective could arise from the 'king of scientific disciplines': mathematics. For most biologists though, mathematics, and to some extent physics, are just distant memories from their early days at university that, apart from statistical methods, are rarely put to use. Nevertheless, the editors of *EMBO reports* wish to encourage studies at the interface between these two specialities—and others—because we feel that they will become increasingly important. In this and upcoming issues, we will therefore feature several scientific papers that venture into the unknown territory between biology and the other sciences. As some of our referees commented, they "surely will challenge the thinking of some of the readers."

In this issue, Victor de Lorenzo and his co-authors (page 994) have applied mathematics to the problem of environmental pollution and present new perspectives on the networks involved in biodegradation. Clearly, pollution remains a major problem not only due to a lack of will to gain control over our wasteful lifestyle, but also because of insufficient global scientific insight. De Lorenzo *et al.* now take a closer and more comprehensive look at whether microbes could actually do all the 'dirty' work for us and have analysed how a network of organisms, enzymes and (toxic) compounds actually interacts. The model they present here is based on a systems-biology approach to explain how microbes deal with toxic environmental pollutants.

Alisdair Fernie and his colleagues (this issue, page 989) also take a systematic approach to the complex problem of whether and how transcript profiles correlate with metabolic profiles. Our knowledge of transcription factors and, to some extent, entire biochemical pathways has increased enormously, mainly thanks to genomics, proteomics and the use of microscopy techniques that have yielded an unprecedented amount of data. But these techniques cannot address the next level of research, that is the linkage between the events at DNA level and the ultimate biological consequences. Again, mathematical models could solve this problem, and Fernie *et al.* have used such an approach to combine two biological systems to identify candidate genes that alter metabolic profiles.

A third paper by Matthias Weiss and co-workers (this issue, page 1000) attempts to explain how proteins that are bound to larger structures, such as vesicular membranes, travel within the cell. Current techniques to analyse these events are either based on the bleaching of fluorescently tagged molecules and measurement of the recovery time of the fluorescent signal or on determining the inherent Brownian movements of proteins. Weiss *et al.* compared the available methods using an experimental model that specifically addresses the question of the binding and the movement of individual proteins within and between cellular compartments.

These are just a few examples of how biological research is increasingly becoming interdisciplinary and how this can open up completely new fields of research and vistas of understanding. These papers therefore should not only challenge the reader but should also show that molecular biology today comprises much more than the current disciplines usually defined by university department and institute names. We hope that they will be as inspiring for our readers as they were for the referees and the editors and that they will encourage more such papers in which biology meets, challenges and learns from other disciplines.

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doi:10.1038/sj.embor.embor945