Convergence

Convergence is the latest buzzword in the business world, in particular among companies with a strong focus on research and development. When I first heard it used in this context about a year ago, I found myself neither surprised nor excited; it seemed rather obvious that when diverse things come together—whether it be biology, mathematics, policy or opinion—often unpredicted and novel outcomes will result. Yet, it gains economic significance if diverse industries—for example, a computer chip manufacturer and a biotech company—form transient collaborations to create new products that neither alone would have considered to be part of their remit.

The practical applications of convergent research might best be described by some examples. A stent is a spring or tube that is normally used to mechanically prop open a patient's artery. The stent can also be coated with a slow-releasing protein factor to prevent arteriosclerosis. In this way, three different lines of research converge: material science for the stent itself; biology for the therapeutic compound; and chemistry for the technology to release it into the bloodstream. Another example would be a sensor to monitor a patient's blood pressure and temperature, for example, which would send these data to a remote computer programmed to identify any warning signs and to alert a paramedic unit. Again, different technologies come together to create new products and services.

Not surprisingly, politics and business are abuzz with the possibilities offered by convergence, but what does it have to do with scientists? After all, convergence is another variation of multidisciplinary and interdisciplinarity (Gannon F (2005) Multidisciplinarity: by fiat or need? *EMBO Rep* 6: 1105). Indeed, the important role that bioinformatics has in 'wet' molecular biological research is almost taken for granted these days, and chemists and biologists have also long been collaborating, for example, to

design therapeutic compounds that interact with a specific target molecule.

However, convergence research is more far-reaching than such established research collaborations when it links different businesses that had made a virtue of focusing on their core skills. These growing opportunities for convergence will inevitably affect academia, most notably graduate students and postdoctoral researchers. Around 75% of young scientists will eventually move on to non-academic work environments and are quite likely to join a team or project in which convergence, not specialization, is the norm. Not surprisingly, the training that they received at their university or research institute will very much determine their success in the job market, and PhD students and postdoctoral researchers who have focused on only one area of expertise—even if they have a long list of papers published in top journals—are likely to flounder in an environment that emphasizes interdisciplinary research. If, conversely, they have spent some time in different environments, or if they have acquired technically unrelated skills during their thesis and postdoctoral work, they will have fewer difficulties in finding a challenging and interesting job.

A wider appreciation of convergence research—or whatever the *mot du jour* to describe inter- or multidisciplinary might be—will certainly have a considerable impact on the success and productivity of research itself, whether it is about developing a new product or about finding the answer to a vexing question in basic research. But convergence is not only cooperation at the 'technical' side of science: the perspectives and experience of experts from the social sciences and humanities are increasingly being appreciated. Their involvement is not restricted to product development, such as the design of software that matches intuitive human thought, but it also comes to the fore when analysing further possibilities from convergence research.

Politics is also pinning its hopes on convergence work as a means to reconcile front-line research with public opinion and societal expectations. A new crop of 'convergence workers' now organize joint meetings and debates between various stakeholders with the ultimate aim to allay public fears about research while making scientists more aware of society's expectations and reservations. Such convergence work includes programmes to educate teachers and high-school students about cutting-edge research to foster children's interest in science; philosophers, ethicists and social scientists also join large research projects in the life sciences to provide the link between science and society, to advise and discuss with the researchers or to organize and engage in public outreach programmes. In doing so, these researchers are creating a new research field and new job opportunities at the interface between the life sciences and the social sciences as well as the humanities. This issue of *EMBO reports* therefore starts a Science & Society Series on Convergence Research, to present their activities and highlight their growing importance for the public acceptance of research in the life sciences.

Research is, and should always be, ahead of its time, and convergence research is no exception. The potential of convergence in the development of new products and in public outreach is enormous and will provide valuable, diverse career options for those scientists and engineers who are ready to expand their skills and knowledge into new domains. The old days of a single skill career are now behind us and we have to prepare for this new and complex environment.

Frank Gannon

This Editorial represents the personal views of Frank Gannon and not those of Science Foundation Ireland or the European Molecular Biology Organization.

doi:10.1038/embor.2009.1