Personalia

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Scholar, inventor and businessman: Charles R. Cantor at his 60th anniversary

Terms and abbreviations such as pulsed-field gel electrophoresis (PFGE), sequence-tagged sites (STS), triplex affinity capture (TAC), human genome project (HGP) and pharmacogenomics are well known for people involved in the genome mapping and drug development. Charles Cantor is one of the few who are behind these innovations and breakthroughs [1–4].

Cantor started his research in early 1960s, entering the area of life sciences at the time of the Big Bang in this field – the discovery of the DNA helix and the genetic code. Results of his first study – an original approach to the problem of sequence determination in nucleic acids [5] – was published when he was 22 years old. Just two years later, he obtained his doctorate for studying the optical and spectral properties of oligonucleotides, thus becoming one of the youngest PhD graduates.

Since then, Cantor has published almost 330 peer-reviewed articles and has been granted more than 50 patents. He also co-authored the famous three-volume textbook on biophysical chemistry [6], which thoroughly describes the structure and function of biological macromolecules as well as techniques for their study. This book has been translated into many languages and one of the volumes was reprinted in 1997. Recently, Cantor has published his second book – the first textbook on genomics [7]. His distinguished career spans the fields of chemistry, biochemistry, molecular biology, biophysics, genetics, molecular biotechnology and bioinformatics (Cantor is one of the prophets and proponents of this field).

For almost 40 years in science, Cantor has made important contributions to our understanding of the solution structure and spectroscopy of nucleic acids, proteins, protein–nucleic acid complexes and cellular organelles, and the sensitive detection of biomolecules in a variety of settings. He has pioneered in the separation and physical mapping of whole chromosomes, including those of the human genome. Cantor is well known for his success in identifying biological problems that are resistant to conventional analytical approaches and then developing new methodologies or techniques for solving these problems. In his numerous interviews and essays, he reflects about the progress in life sciences [8–12].

Charles R. Cantor

Charles Robert Cantor was born on 26 August 1942 in Brooklyn, NY, USA. He obtained his PhD degree in chemistry from the University of California, Berkeley (UCB) in 1966. Cantor then began teaching students at Columbia University (CU), New York, going from Assistant Professor to full Professor (1972) of Chemistry and holding joint professorial appointment in Biological Sciences. In 1981, he was appointed Professor (Higgins Professor since 1988; Faculty of Medicine) and Chairman of Genetics and Development at the same institution (College of Physicians and Surgeons), as well as Deputy Director for Education at the CU Comprehensive Cancer Center. In 1985, Cantor became Deputy Director for Biotechnology of this research center. From 1988 to 1992, he worked at Lawrence Berkeley Laboratory as Director of Human Genome Center and Senior Biochemist. During this period, Cantor was concurrently Professor of Molecular Biology at UCB (1989–1992) and Principal Scientist of the US Dept of Energy (DOE) Human Genome Project (1990–1992).

In 1992, Cantor established the Center for Advanced Biotechnology at BU becoming its Director, a position he still holds. At this university, Cantor has served as Professor of Biomedical Engineering and Biophysics (1992) and Research Professor of Pharmacology (1994). He was also elected the Chairman of BU Biomedical Engineering Department (1995–1998). In 1998, Cantor became the Chief Scientific Officer of Sequenom (http://www.sequenom.com) while still maintaining his laboratory at BU.

Cantor is a member of the National Academy of Sciences of the USA (1988) and the American Academy of Arts and Sciences (1988), and an honorary member of the Japanese Biochemical Society (1990). He is also the recipient of many prestigious awards: Eastman Kodak Award (1965), Fresenius Award in Chemistry (1972), Eli Lilly Award in Biological Chemistry from the American Chemical Society (1978), Biochemical Analysis Prize of the German Society of Clinical Chemistry (1988), ISCO Award for Advances in Biochemical Instrumentation (1989), Herbert A. Sober Award from the American Society for Biochemistry and Molecular Biology (1990), and the Emily M. Gray Award from the Biophysical Society (2000). This year, he was nominated as Biotech Genius by *Discover* magazine.

Cantor is scientific advisor and consultant to several biotechnology and pharmaceutical companies and a member of the editorial boards of many scholarly journals. His long-standing passions include traveling, jogging, gardening, wine, fine dining and cats.

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Until recently, Cantor assumed that his life as a researcher would belong to the academic 'ivory tower' only. Now, however, he believes that the modern biotechnology industry could be a more favorable environment for the present-day life scientist. Accordingly, in 1998 Cantor joined Sequenom (http://www.sequenom.com), a German–US biotech startup company where he is involved in industrial genomics developing automated MS systems for high-throughput SNP analysis.

Acting as the Chief Scientific Officer at Sequenom, Charles Cantor is currently on a sabbatical from Boston University (BU). Yet, at his 60, Cantor is enthusiastically and concurrently hitting two targets: industry and academia. He remains active in the Human Genome Project through membership in a number of the project's advisory committees and review boards, and his Boston research laboratory continues to be active, and Cantor himself works there frequently during his visits to Boston.

Cantor's current research interests lie in molecular genetics and pharmacogenomics, genetic and protein engineering, and nanoengineering and microrobotics. These include the development of new robust methods for DNA sequencing and PCR analysis, the design of bacterial strains suitable for environmental detoxification, making detectors capable of recognizing specific single molecules, and construction of synthetic gene networks.

Charles once said that his dream is to make enough money from current business to spend afterward on doing what he likes most – learning about the origin, evolution and nature of life. On the occasion of Charles's diamond anniversary, let us wish him good luck in this dream!

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The dilemma of process development

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Process development helps get drugs to market faster, and is therefore crucial for company success. Although not every candidate makes it to market, they all consume process development resources. Where should development resources be deployed to maximize output of the drug pipeline: on the late-stage candidates nearing the market, on the most promising candidates, or on every candidate? In the face of a high clinical trials attrition rate, drug developers must adopt strategies that resolve the dilemma of process development.

The dilemma of process development

Most drug candidates never reach the market. Only 7–28% (depending on therapeutic class) of new molecular entities that start on the path to commercialization are expected to become products [1]. The high attrition rates of drugs under development, coupled with severe time pressures, confront process research and development groups with a dilemma. Although process development resources must be used to make clinical supplies under tough deadlines, the developer does not want to delay the approval of potential blockbusters in other programs by working on the commercialization of dead-ends.

The new compounds being brought to market are more complex and difficult to manufacture, and yet the time period of late-stage development has been seriously compressed in the past ten years. This is because of changes in regulatory requirements and the need of the pharmaceutical industry to develop better drugs at a faster pace to remain competitive and satisfy growth projections [2]. The commercialization effort for each drug candidate is an enormous scientific and technical undertaking, in the clinic, the laboratory and the factory. Establishing a supply chain, and the necessary manufacturing procedures, to make a potential new drug is part of the commercialization process and an important part of the drug regulatory approval process. Process development is commonly viewed as an activity that saves costs and capital in manufacturing

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