

# 70

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# **History of Modern Biotechnology II**

**Volume Editor: A. Fiechter**

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Advances in Biochemical Engineering/Biotechnology reviews actual trends in modern biotechnology. Its aim is to cover all aspects of this interdisciplinary technology where knowledge, methods and expertise are required for chemistry, biochemistry, microbiology, genetics, chemical engineering and computer science. Special volumes are dedicated to selected topics which focus on new biotechnological products and new processes for their synthesis and purification. They give the state-of-the-art of a topic in a comprehensive way thus being a valuable source for the next 3–5 years. It also discusses new discoveries and applications.

In general, special volumes are edited by well known guest editors. The managing editor and publisher will however always be pleased to receive suggestions and supplementary information. Manuscripts are accepted in English.

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## Editorial

Over the last few years an alternation of generations in industry and the universities has taken place in Europe. Thus many of the leading biotechnologists in Europe who have been part of modern biotechnology during the last 30 years have already retired or will retire soon. The new and upcoming biotechnologists work on the basis of these efforts and often do not know much about the historic development after World War II, which brought us to the state of the art that we are now dealing with. When Prof. Dr. Armin Fiechter – one of these leading European biotechnologists – presented me with his idea of editing a special issue of the *Advances in Biochemical Engineering/Biotechnology* on the “History of Modern Biotechnology” I was extremely impressed to have the chance to review and summarize the historical development over the last 30 years. Prof. Fiechter is the first choice for this task, since he is the founder of the *Advances in Biochemical Engineering/Biotechnology* and not only did he help mold modern biotechnology but he has also been a continuous observer from the very beginning.

Prof. Fiechter succeeded in contacting biotechnologists from all over the world in order to summarize their points of view, especially in his own research areas, in different contributions. It was one of the main aims that personal views should also be included in the manuscripts in order to show how modern biotechnology was developed after World War II and how personal contacts, personal efforts, and personal opinion formed this research area. This generation of biotechnologists first succeeded in bringing together different areas of science to make this interdisciplinary research area into a powerful new technology. They had to overcome the hurdles existing between the different areas of science, especially biology, chemistry, engineering, mathematics and biochemistry and they had to build an international network to make biotechnology an international success.

These two special volumes (69 and 70) cannot be a complete detailed summing up of all biotechnological activities. However, these spotlights give a good overview. In particular this personal reviewing should give insights into the difficulties which had to be overcome and should give information about why certain decisions in the development of biotechnology were made. Our generation is sometimes confused as to why different developments were not speeded up or why it took so long to see that a certain direction in biotechnology was wrong. Several political and social obstacles are not well known any more. Thus, this special edition tries to give also an insight into these developments for a better

understanding and act as a memorial to the scientists behind this development and their personal achievements in this success story called modern biotechnology.

I would like to thank all authors for helping Professor Fiechter to bring his idea to a successful fruition. It is their achievement that very different areas of biotechnology in different countries were brought together in a way to show the development of biotechnology in research, its industrial application and the personal and social involvement. I hope that these books will find a large number of young and older readers to present new insights into the roots of modern biotechnology.

Hannover, August 2000

Thomas Scheper



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## Preface

The aim of the *Advances of Biochemical Engineering/Biotechnology* is to keep the reader informed on the recent progress in the industrial application of biology. Genetical engineering, metabolism and bioprocess development including analytics, automation and new software are the dominant fields of interest. Thereby progress made in microbiology, plant and animal cell culture has been reviewed for the last decade or so.

The Special Issue on the History of Biotechnology (splitted into Vol. 69 and 70) is an exception to the otherwise forward oriented editorial policy. It covers a time span of approximately fifty years and describes the changes from a time with rather characteristic features of empirical strategies to highly developed and specialized enterprises. Success of the present biotechnology still depends on substantial investment in R&D undertaken by private and public investors, researchers, and entrepreneurs. Also a number of new scientific and business oriented organisations aim at the promotion of science and technology and the transfer to active enterprises, capital raising, improvement of education and fostering international relationships. Most of these activities related to modern biotechnology did not exist immediately after the war. Scientists worked in small groups and an established science policy didn't exist.

This situation explains the long period of time from the detection of the antibiotic effect by Alexander Fleming in 1928 to the rat and mouse testing by Brian Chain and Howart Florey (1940). The following developments up to the production level were a real breakthrough not only biologically (penicillin was the first antibiotic) but also technically (first scaled-up microbial mass culture under sterile conditions). The antibiotic industry provided the processing strategies for strain improvement (selection of mutants) and the search for new strains (screening) as well as the technologies for the aseptic mass culture and downstream processing. The process can therefore be considered as one of the major developments of that time what gradually evolved into "Biotechnology" in the late 1960s. Reasons for the new name were the potential application of a "new" (molecular) biology with its "new" (molecular) genetics, the invention of electronic computing and information science. A fascinating time for all who were interested in modern Biotechnology.

True gene technology succeeded after the first gene transfer into *Escherichia coli* in 1973. About one decade of hard work and massive investments were necessary for reaching the market place with the first recombinant product. Since then gene transfer in microbes, animal and plant cells has become a well-

established biological technology. The number of registered drugs for example may exceed some fifty by the year 2000.

During the last 25 years, several fundamental methods have been developed. Gene transfer in higher plants or vertebrates and sequencing of genes and entire genomes and even cloning of animals has become possible.

Some 15 microbes, including bakers yeast have been genetically identified. Even very large genomes with billions of sequences such as the human genome are being investigated. Thereby new methods of highest efficiency for sequencing, data processing, gene identification and interaction are available representing the basis of genomics – together with proteomics a new field of biotechnology.

However, the fast developments of genomics in particular did not have just positive effects in society. Anger and fear began. A dwindling acceptance of “Biotechnology” in medicine, agriculture, food and pharma production has become a political matter. New legislation has asked for restrictions in genome modifications of vertebrates, higher plants, production of genetically modified food, patenting of transgenic animals or sequenced parts of genomes. Also research has become hampered by strict rules on selection of programs, organisms, methods, technologies and on biosafety indoors and outdoors.

As a consequence process development and production processes are of a high standard which is maintained by extended computer applications for process control and production management. GMP procedures are now standard and prerequisites for the registration of pharmaceuticals. Biotechnology is a safe technology with a sound biological basis, a high-tech standard, and steadily improving efficiency. The ethical and social problems arising in agriculture and medicine are still controversial.

The authors of the Special Issue are scientists from the early days who are familiar with the fascinating history of modern biotechnology. They have successfully contributed to the development of their particular area of specialization and have laid down the sound basis of a fast expanding knowledge. They were confronted with the new constellation of combining biology with engineering. These fields emerged from different backgrounds and had to adapt to new methods and styles of collaboration.

The historical aspects of the fundamental problems of biology and engineering depict a fascinating story of stimulation, going astray, success, delay and satisfaction.

I would like to acknowledge the proposal of the managing editor and the publisher for planning this kind of publication. It is his hope that the material presented may stimulate the new generations of scientists into continuing the rewarding promises of biotechnology after the beginning of the new millenium.

Zürich, August 2000

Armin Fiechter

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