

Part One

History

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Introduction

Historical events in early biotechnology comprise fascinating discoveries, such as yeast and bacteria as living matter being responsible for the fermentation of beer and wine. The art of Biotechnology emerged from agriculture and animal husbandry in ancient times through the empirical use of plants and animals which could be used as food or dyes, particularly where they had been preserved by natural processes and fermentations. Improvements were mostly handed on by word of mouth, and groups that maintained these improvements had a better chance of survival during periods of famine and drought. In such processes alcohol was produced and provided highly acceptable drinks such as beer and wine, or acids were formed which acted as the preservative agent in the storable food produced.

In this book we follow how the study of the chemical nature of the components involved in biotechnology first became possible subsequent to the development of chemistry and physics. Serious controversies about the theories both vitalist and chemical, resulted in the reversal of theories and paradigms; significant interaction with and stimulus from the arts and industries prompted the continuing research and progress. Last but not least, it was accepted that the products produced by living organisms should not be treated differently from inorganic materials. Pasteur's work led to the abandonment of the idea which had been an anathema to exact scientific enquiry in the life sciences, namely 'spontaneous generation'. He established the science of microbiology by developing pure monoculture in sterile medium, and together with the work of Robert Koch the experimental criteria required to show that a pathogenic organism is the causative agent for a disease were also recognised. Several decades later Buchner disproved the hypothesis that processes in living cells required a metaphysical 'vis vitalis' in addition to what was necessary to understand general chemistry. Enzymes were shown to be the chemical basis of bioconversions. Biochemistry emerged as a new speciality prompting dynamic research in enzymatic and metabolic reactions. However, the structure of proteins was not established until more than 40 years later.

The requirements for antibiotics and vaccines to combat disease, and chemical components required for explosives particularly in war time, stimulated exact studies in producing products from microbial fermentations. By the mid-twentieth century,

Biotechnology was becoming an accepted speciality with courses being established in the life sciences departments of several Universities.

Basic research in Biochemistry and Molecular Biology dramatically widened the field of life sciences and at the same time unified them considerably by the study of genes and their relatedness throughout the evolutionary process. The scope of accessible products and services expanded significantly. Economic input accelerated research and development, by encouraging and financing the development of new methods, tools, machines, and robots. The discipline of 'New Biotechnology', one of the lead sciences which resulted from an intimate association between business and science, is still the subject of critical public appraisal in many Western countries due to a particular lack of confidence in the notion that improved quality of life will prevail in spite of commercial interest.

The study of the history of science, and specifically that of Biotechnology, should go beyond documenting and recording events and should ideally contribute to an understanding of the motives and mechanisms governing the dynamics of sciences; the role of inquisitiveness in gaining new knowledge and insights into nature, of reputation-building, of the interplay between economics and business; the role of and dependance on theories, the role of analytical and experimental, as well mathematical methods, and more recently computation and robotics.

In the first part of this book the emphasis is on scientific discoveries and results, theories, technical development, the creation of leading paradigms, and on their decay. Industrial problems and political issues, and their influence on and correlation with developments in science are also addressed.

Although biotechnology has historical roots, it continues to influence diverse industrial fields of activity, including food and feed and commodities, for example polymer manufacture, providing services such as environmental protection, biofuel and energy including biofuel cells, and the development and production of many of the most effective drugs.