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# BIO TECHNOLOGY

IN THE CZECH REPUBLIC

FLANDERS INVESTMENT & TRADE MARKET SURVEY



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# Biotechnology in the Czech Republic

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**FLANDERS INVESTMENT & TRADE**

## Table of contents

<b>1</b>	<b>Biotechnology in the Czech Republic</b> .....	<b>3</b>
<b>2</b>	<b>Green + White + Red Biotechnology</b> .....	<b>5</b>
2.1	Green Biotechnology – Plant Biotechnology.....	5
2.2	Green Biotechnology – Animal Biotechnology.....	5
2.3	White Biotechnology – Environmental Biotechnology.....	5
2.4	White Biotechnology – Industrial Biotechnology .....	6
2.5	Red Biotechnology – Medicine and Pharmacy Biotechnology.....	6
2.6	Red Biotechnology – Diagnostics and Bioinformatics.....	7
<b>3</b>	<b>CzechBio</b> .....	<b>7</b>
<b>4</b>	<b>BIOCEV</b> .....	<b>11</b>

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## 1 Biotechnology in the Czech Republic

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Biotechnologies represent the important field of modern technologies for the development of the human society in the 21st century. They should represent a guarantee of environment-friendly approach of human civilization to the natural resources, power engineering demands and environment protection. Biotechnologies represent a key segment for the knowledge economy based society. The main fields of the life of society in which the biotechnological innovations can have significant impact are (1) food, nutrition of people and domestic animals; (2) health and veterinary care (solutions for chronic and acute diseases, pathogens, epidemiology, research of new drugs, techniques and materials), and (3) energetics, energy sources, fuel, technologies for artificial photosynthesis.

In the Czech Republic, as well as in EU, the development of biotechnologies is permanently associated with the considerable opposition. It is supposed that the situation will improve with the implementation of projects in the Operational program Research and Development for Innovations in the programming period 2007-2015. New infrastructure will occur with an immense research and development, quite often connected to the international network of research institutions and resources of the highly qualified experts.

Biotechnologies represent a considerable challenge not only for research and innovations, but also for industry and market. Inter-annual growth of the trade volume (composed annual growth rate, CAGR) in the fields of biotechnologies applications is high one among comparable products and services. The concern is especially the application of biotechnology in the medicine, agriculture and in the industrial technologies. The volume of trade in these fields is, however, globally covered by the economically strong, multinational companies (especially in the field of pharmacy), cooperating to a high extent with the academic sphere on one hand and smaller (mostly biotechnological) companies on the other hand. Smaller biotechnological companies play often the role of the “inter-mediator” between the research in the academic sphere and big multinational corporations. The life cycle of small biotechnological companies after the first capital investments (e.g. venture capital) continues often by merger or sale of the company to a big corporation or by acquiring a big research-development contract.

It follows from the above mentioned that the factors which can be split into following three fields participate in the positive development of this field. The first field is the research and development, the second one is the cooperation and transfer of technologies and the third one is the connection of the company to high value/product chains (mostly represented by taking hold at foreign markets).

It should be noted at first that the structure of companies in the field of biotechnologies reflects the development of the Czech society and economics in the last 25 years. This structure consists mostly of small companies and only several middle-sized companies or subsidiaries of big multinational corporations. The investments into the research and development in the field of biotechnologies (or into the field of natural or medical science in a broader sense of world) have been significant for a longer time.

In contrast with it, the structure of biotechnological companies in the Czech Republic does not change, it shows only lower symptoms of the development than we would expect. One of the reasons is the considerable disproportion between the investments of the entrepreneurial sector

into the research and development in the field of natural and medical sciences which were 18%, and the investments of the governmental sector (Academy of Sciences of CR for the most part) and the sector of public universities which are 70% or 43%. During the comparison with other countries (especially with countries similar to CR, as e.g. Austria, Netherlands, Finland) we also, among others, find out a considerably lower number of patents, very low number of new companies (spin-offs or start-ups), low extent of cooperation between the academic and entrepreneurial sector and also a low capacity of risk capital investments. The development of commercial usage of biotechnologies and the development of the company sector of biotechnology depends directly on the research and development and the as quick as possible application of results in practice.

There was a positive turn in the field of the cooperation and transfer of technologies in the last several years. The reason are finances (their structure undergoes a radical change especially as for the public finances for the research and development), but also the slow change of thinking. On one hand, it is the change of thinking in the academic sphere, where the commercialization of results is not considered for something not pertaining to the academic sphere. On the other hand, owners and co-owners of companies have been accepting new control and business models, e.g. growing feeling of necessity of cooperation. The low extent of cooperation between the academic and entrepreneurial sector follows from many various analysis; however, is it a really low extent of cooperation? If we, e.g. compare the numbers of common projects of research and development of the academic and entrepreneurial sector, the situation in the CR is not bad (e.g. in comparison with Finland).

It seems the more important problem is the low effectiveness than the extent of cooperation. The cause of this low effectiveness is the motivation on one hand where the target of the cooperation is often acquiring the financial means (subsidy), and the missing preparedness of both parties on the effective cooperation. The problem in the academic sector is especially the low knowledge of the value (price) of knowledge and experience (from which follows also the low number of patents and the practical absence of licenses). On the contrary, on the part of the entrepreneurial sector we see as a problem a low knowledge of market and market application or a low extent of the adaptation to the quickly changing requirements of the market.

A specific feature of the Czech biotechnological companies is a quite high orientation on the inland market. Although many companies, including the small ones, sell their products and services also at foreign markets, their development activities are mostly only to a small extent orientated on the extensive development. Biotechnologies, however, are the typical example of the global market and although, from a short-time point of view, the orientation on the more intensive usage of local market may be economically interesting, the orientation on the global markets is interesting from the long-term perspective. A great opportunity is also the connection to global value/product chains. In the field of biotechnologies, the cooperation with some of the big multinational companies may be a target – from the research cooperation through the cooperation in the field of services for the research (e.g. CRO – „contract research organization“) up to the commercial cooperation (e.g. deliveries of the components for the final products).

A more significant development in the Czech biotechnological sector may be expected in future with a highest probability. Unfortunately, we focus exclusively on the financial aspect of the development and we do not devote any attention to the aspects of the development which are of

principal importance for us. These are especially: effective communication, sharing experience and a certain extent of „branch unification or tightness“. Abroad, various forms of the national biotechnological associations are a common platform complying with the most of these conditions.

In the time of the continuing global economic competition, the Czech Republic tries to keep pace with the group of the countries with the most advanced economy and the highest living standard by the transition to the knowledge economics. In future, pillars of the modern knowledge Czech economy should include the molecular biology, biotechnology and additional associated branches, in which procedures of the work with live micro-organisms are applied.

As in 2016, there is still lack of venture capital for innovative projects and investment into biotech research. Czech Republic spend for medical research substandard money, in comparison with other EU states, including many countries of former Eastern Bloc. Czech investment is even less than in Portugal, Greece or Cyprus. There is possible way to improve this situation through private investment. According to estimates, private investors invested into biotech firms about several billions Czech korunas.

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## 2 Green + White + Red Biotechnology

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### 2.1 Green Biotechnology – Plant Biotechnology

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Including plant reproduction & propagation, genetic modification, plant growing & protection, pathogens, genomes biodiversity, agriculture/horticulture and plant cell biotechnology.

The largest attention pays Czech companies to growing conditions and plant protection, reproduction & propagation, plant pathogens and genome mapping. On the contrary, less attention is devoted to genetic modification.

Key players on the field of plant biotechnologies in Czech Republic: i2LResearch Ltd (pest control industry), MycoLab s.r.o. (consultancy & plant protection).

### 2.2 Green Biotechnology – Animal Biotechnology

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Including animal breeding, genetic engineering, genome mapping, biodiversity, animal cell biotechnology, animal health care, veterinary diagnostic methods

The largest attention pays Czech companies to the biology of animal cells, genome mapping and biodiversity. Conversely, less attention is devoted to veterinary diagnostic methods and transgenic manipulations.

Key players on the field of plant biotechnologies in Czech Republic: Cayman Pharma s.r.o. (prostaglandin, assay kits, biochemicals, cell signaling, eicosanoids, biomarkers, cyclic nucleotides), i2LResearch Ltd (pest control industry), GEN-TREND s.r.o. (molecular biology, analysis, diagnostics, recombinant proteins).

### 2.3 White Biotechnology – Environmental Biotechnology

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Including microbial ecology, biosafety, microbial functions for degradation/transformation of microbial pollutants, isolation/breeding/genetic engineering of pollutants, microbial degradation,

biotechnological processes for soil & land management, biotechnological processes for water management, biotechnological processes for air & offgas management, microbial cell factories, biological sources of renewable energy.

The largest attention pays Czech companies to biotechnological processes for soil & land management and also biotechnological processes for water management, followed by microbial cell factories and microbial functions for degradation/transformation of pollutants. On the contrary, less attention is devoted to isolation/breeding/genetic engineering of microbial pollutants and biotechnological methods of air pollution control.

Key players on the field of environmental biotechnologies in Czech Republic: Enantis, s.r.o. (consulting and production, enzyme technology, recombinant proteins, biocatalysis, bioremediation, biosensors), LentiKat's a.s. (immobilisation, fermentation, consultancy, enzymatic catalysis, wastewater treatment), MBÚ AV ČR, v.v.i. (physiology, biochemistry, microbial genetics, molecular biology and molecular microbiology, microbial products and their creation), i2LResearch Ltd (pest control industry), ECO trend s.r.o. (environmental services, renewable energy, consulting).

## 2.4 White Biotechnology – Industrial Biotechnology

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Including enzymatic processes, development of bioprocessing techniques (fermentation, immobilisation of biocatalysts, quality control, etc), downstream processing, genetic engineering and production of enzymes, genetic engineering of microorganisms, cell culture techniques, genome mapping of specific microbial genomes, microbial biodiversity in production processes, brewing/dairy/winery.

The largest attention pays Czech companies to the development of bioprocessing techniques (fermentation, immobilisation of biocatalysts) and microbial biodiversity in production processes. Brewing/dairy/winery technologies represent the most important part in this field. Conversely, little attention is devoted to genome mapping of specific microbial genomes and genetic engineering of microorganisms.

Key players on the field of industrial biotechnologies in Czech Republic: Cayman Pharma s.r.o. (prostaglandin, assay kits, biochemicals, cell signaling, eicosanoids, biomarkers, cyclic nucleotides), Enantis, s.r.o. (consulting and production, enzyme technology, recombinant proteins, biocatalysis, bioremediation, biosensors), LentiKat's a.s. (immobilisation, fermentation, consultancy, enzymatic catalysis, wastewater treatment), MBÚ AV ČR, v.v.i. (physiology, biochemistry, microbial genetics, molecular biology and molecular microbiology, microbial products and their creation).

## 2.5 Red Biotechnology – Medicine and Pharmacy Biotechnology

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Including genomics in drug discovery, tissue engineering, bio-nanotechnologies, structure and function of biomolecules, immunology/therapeutic and diagnostic antibodies/vaccinology, therapeutic proteins and oligonucleotides, pharmacy biotechnology, human gene transfer techniques, human genome mapping.

Greatest attention pays Czech companies to immunology/therapeutic and diagnostic antibodies/vaccinology and structure and function of biomolecules.

Key players on the field of medicine and pharmacy biotechnologies in Czech Republic: Contipro, a.s. (active pharmaceutical ingredients, forms and derivatives of hyaluronan, wound healing products, anti-aging ingredients, veterinary products), Cayman Pharma s.r.o. (prostaglandin, assay kits, biochemicals, cell signaling, eicosanoids, biomarkers, cyclic nucleotides), Enantis, s.r.o. (consulting and production, enzyme technology, recombinant proteins, biocatalysis, bioremediation, biosensors), MBÚ AV ČR, v.v.i. (physiology, biochemistry, microbial genetics, molecular biology and molecular microbiology, microbial products and their creation), SAFIBRA, s.r.o. (laboratory, research, development), GEN-TREND s.r.o. (molecular biology, analysis, diagnostics, recombinant proteins), SurfaceTreat, a.s. (plasma surface treatment).

## 2.6 Red Biotechnology – Diagnostics and Bioinformatics

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Including diagnostic antibodies, peptides/conjugates/oligonucleotides synthesis, DNA diagnostics, biosensors & biomonitoring, genome analyses, genome sequencing, bio-informatics.

The largest attention pays Czech companies to peptides/conjugates/oligonucleotides synthesis and DNA diagnostics. On the contrary, less attention is devoted bio-informatics.

Key players on the field of medicine and pharmacy biotechnologies in Czech Republic: Cayman Pharma s.r.o. (prostaglandin, assay kits, biochemicals, cell signaling, eicosanoids, biomarkers, cyclic nucleotides), Enantis, s.r.o. (consulting and production, enzyme technology, recombinant proteins, biocatalysis, bioremediation, biosensors), ), SAFIBRA, s.r.o. (laboratory, research, development), GEN-TREND s.r.o. (molecular biology, analysis, diagnostics, recombinant proteins).

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## 3 CzechBio

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Growing association of 34 biotech companies, renowned research institutions and universities operating in the Czech Republic. Established 18th December 2008.

Apronex s.r.o. offers full DNA/cDNA cloning a plasmid construction services. Recombinant protein expression services include engineering of an expression vector, selection of an appropriate host and identification of the best expression system. They offer custom antibody preparation and production services.

Ascoprot Biotech, s.r.o. is a Czech spin-off biotechnological company specializing on protein expression and purify cation and services supporting applied biochemical and pharmaceutical research. The company also produces DNA standards for agarose electrophoresis.

Bio Agens Research and Development – BARD, s.r.o. is a Czech company which focuses on research, development and production of products containing the *Pythium oligandrum* organism for use in veterinary care and human care related to periodontitis, onychomycosis, foot mycoses, non-healing wounds, candidiasis and also psoriasis, eczema and atopic dermatitis.

Biolnova, s.r.o. is a subsidiary of the Institute of Experimental Medicine AS CR, it operates specialized Business Incubator equipped with clean rooms and provides Good Manufacturing Practice (GMP) services for spin-off companies in biomedicine.

Biology Centre AS CR, v. v. i. performs laboratory investigations on model organisms and ecological field research aimed at solving crucial biological problems and the development biotechnologies (identification and use of bioactive compounds, detection of plant and animal pathogens,



development of vaccines, soil remediation, analyses of aquatic ecosystems, consultancy on nature conservation and environment protection).

BIOPHARM, Research Institute of Biopharmacy and Veterinary Drugs Anti-coccidiosis vaccine Livacox producer, feed mixtures and pharmaceuticals producer. Pharmaceutical service, clinical, pharmacological and other studies. Research of important Eimeria genes and chicken transgenesis.

BioTest s.r.o. is a fully integrated GLP-certified CRO dedicated to preclinical R&D (CVS, CNS, oncology, diabetes, vaccines) and providing complex toxicological program for safety and efficacy assessment of drugs, biologicals, food additives (PHARMA) and chemicals (REACH).

BioVendor – Laboratorni medicina a.s. (BioVendor Research and Diagnostic Products) is a developer and manufacturer of top-quality immunodiagnosics, RT-PCR kits, monoclonal and polyclonal antibodies, recombinant proteins, and custom services. Their mission is to provide researchers with novel biomarkers and related products for early detection of diseases associated with postindustrial societies.

Bioveta, a.s. is a Czech producer of veterinary immunobiological and pharmaceutical products. The company meets the criteria of European Union GMP, GLP and GDP requirements. Bioveta currently exports to 50 countries of the World.

BVT Technologies, a.s. concentrates on R&D, production and marketing of thick film electrochemical sensor and biosensor substrates, further products and accessories integrating the sensor to user-communicable results.

CENTRAL EUROPEAN BIOSYSTEMS s.r.o. offers flexible services in genomics: consultancy, standard and custom sample processing, data analysis, array validation, qPCR, PCR array development, Next-Generation Sequencing.

Dyntec spol. s.r.o. is the Czech producer of vaccines and immunobiologicals for veterinary and human usage. They also offer a service of our diagnostical and molecular biology laboratory.

EAST PORT Praha s.r.o. – East Port Company founded in 1992 is a leading provider of laboratory equipment and reagents. With the broad products portfolio they are covering genomics, protein analysis and expression, cellular and tissue analysis, drug discovery, genetic identity, ecology and food industry in Life Sciences, Biotechnology, Genetic Identity, IVF (In Vitro Fertilization) and other DNA testing fields.

ENVISAN-GEM's professional profile ranges from hazardous waste collection and treatment through soil.

EPS, s.r.o. is a Czech company which operates in environmental service. Its activities are based on 4 main pillars: (1) in situ bioremediation; (2) waste management on landfills; (3) anaerobic digestion; and (4) R&D in environmental biotechnology.

EXBIO Praha a.s., is a dynamic biotechnology company focused on design, development and manufacture of highest quality products (antibodies and kits) for IVD and RUO application in the field of analytical flow cytometry, as well as on custom services at affordable prices.

FAVEA, spol. s r.o. is a purely Czech pharmaceutical company under GMP, which aims to assist people in strengthening their health through the application of the latest findings in medicine and

pharmaceutical technology. They offer complex services associated with contract manufacturing of nutritional supplements, cosmetics and veterinary products.

GENERI BIOTECH s.r.o. – premium Czech oligo producer with an individualized approach to molecular-genetic services including cloning, gene expression and specialized eukaryotic recombinant protein production.

IMUNA s.r.o. – is one of the most significant Czech biotechnological pharmaceutical service and producing company, under GMP licence. The main scope of the activities is focused on the following fields: vaccinations on the viral and bacterial base, antistaphylococcal phage lysates and lyophilized tablets.

Institute of Biotechnology AS CR, v. v. i. The primary ambition of this new institute is to develop cutting-edge basic and oriented research on topics opening for diagnostic and therapeutic applications in human medicine. The already operating laboratories develop research in the fields of: Diagnostics for reproductive medicine, Diagnostics of autoimmune diseases, Molecular therapy, Recombinant ligand engineering, Gene expression, Molecular pathogenetics.

The Institute of Chemical Technology, Prague (ICT Prague) is a prestigious university linking advanced research and teaching. The Faculty of Food and Biochemical Technology ranks among leading university centers of food science and biotechnology.

Institute of Molecular Genetics of the ASCR, v. v. i. – basic and applied research in the field of molecular and cell biology. Intensive collaboration with several biotech companies (development of monoclonal antibodies, recombinant proteins).

KRD-obchodní společnost s.r.o. is a research equipment and consumable distribution company. Their R&D facility offers equipment adaptation and contract research services (dHPLC, HRM, qPCR, microarrays, flow cytometry, cellular analysis).

Institute of Microbiology AS CR, v. v. i. The research carried out at the Institute of Microbiology covers microbial physiology, biochemistry and genetics, molecular biology and molecular microbiology, microbial products and their synthesis and production, biodegradation activities of microorganisms and symbiotic relations in biological models, and new biotechnological processes. Another research area includes physiology and regulation of innate and acquired immunity mechanisms, investigations of ontogenetic development of these mechanisms in conventional and germ-free models and the study of causality and possible therapy of tumor and autoimmune diseases. The outcome of these studies is reflected in the development of special and unique compounds such as pure enzymes, enzyme inhibitors or antibodies.

Labina, spol. s r.o. Company is focused on complex furnishing of the laboratories of all types. Accomplishing of technological project documentation for the laboratories. Delivery and assembly of laboratory furniture.

LentiKat´s a.s. is a specialist in the field of immobilization of microorganisms and enzymes into the form of robust Lentikats biocatalysts. Such biocatalysts can be used in many biotechnological processes, mainly biotransformations.

LONZA BIOTEC s.r.o. Custom Manufacturing's industrial production facility in the Czech Republic offers custom fermentation services to supply APIs and intermediates for the biopharmaceutical, pharmaceutical and nutrition markets.

Protean s.r.o. is a private R&D company producing advanced diagnostics based on DNA microarray biochip. The technology has a potential to be easily implemented in more advanced high-throughput screening tests for various infectious diseases. It detects both aerobic as well as anaerobic pathogens including antibiotic resistance markers. The biotech division offers DNA cloning and sequencing services, and production of recombinant proteins from various organisms. Protean produces antigens from wild type clinically relevant European strains of *Borrelia* for the development of highly sensitive ELISA tests for Lyme disease. Protean provides also public genetic services for tick-borne infection analysis and gum disease pathogen testing.

Proteix s.r.o. offers full DNA/cDNA cloning and plasmid construction services. Recombinant protein expression services include engineering of an expression vector, selection of an appropriate host and identification of the best expression system. They offer custom antibody preparation and production services.

SEVAPHARMA a.s. is the Czech pharmaceutical producer under GMP whose initial production dates from the mid-20th of the last century. Assortment can be divided into 3 areas: Allergens vaccines as diagnostic and treatment of allergic conditions; Immunomodulators as normalization of disturbed immunity; Bacterial & Viral Vaccines as regular vaccination of children. Pharmaceutical manufacturing equipment contains: lyophilisation equipment, fermenting equipment, hot air and steam sterilization equipment, homogenizing drum, ultrafiltration and filtration, dispensing equipment, water extraction, tissue cultures, cultivation of viruses and dialysis etc.

Top-Bio, s.r.o. is the Czech biotechnology company specialized on R&D and manufacturing of advanced high quality tools for RNA and DNA isolation and analysis. Key products involve DNA polymerases and other reagents for polymerase chain reactions (PCR) and new generations of master mixes for simplified and robust PCR and quantitative PCR (qPCR).

ÚJV Řež, a.s., Division of radiopharmaceuticals is the Czech company specialized in research, development and production of radiopharmaceuticals specimens for human medicine. The preparations the Institute manufactures are supplied to a vast range of nuclear medicine facilities in the Czech Republic and abroad. The division offers labeling of antibodies and other proteins by radioisotopes, development of analytical, immunochemistry and radiochemistry methods, biological testing. They are accredited for preclinical studies on small laboratory animals in GLP mode and treatment with GMO.

VIDIA spol. s r.o. the Czech company specialized in research, development and production of diagnostics for human medicine and environment. The company produces IVDs for diagnosis of infectious diseases, kits for research use (anti-Vimentin, anti- $\beta$ III tubulin, Neurofilaments-L, H) and kits for environmental screening (detection of PAHs, steroid hormone, BPA etc.).

VUAB Pharma a.s. is a Czech pharmaceutical company located near Prague in Roztoky. Its history is coming back to the mid of 20th century and nowadays is focused to (1) Biotechnological production of Nystatin (API for antimycotic medicaments), (2) Production of generic products - final dosage forms (dry injections), (3) The development and production of new platinum specialties - intermediates, APIs and HAPIs for production of drugs for oncology diseases.

BIOCEV is a joint project of six institutes of the Academy of Sciences of the Czech Republic (Institute of Molecular Genetics, Institute of Biotechnology, Institute of Microbiology, Institute of Physiology, Institute of Experimental Medicine, and Institute of Macromolecular Chemistry) and two faculties of Charles University in Prague (Faculty of Science and 1st Faculty of Medicine). The project's goal is to establish European Centre of Excellence in biomedicine and biotechnology.

Research & development represents one of the three basic pillars of project BIOCEV. Research & development performed in BIOCEV is focused on the selected areas of biotechnologies and biomedicine. The scientific scope of BIOCEV has been divided into five research programs, each of them dealing with a number of separate research projects. The programs and projects have been designed to form a mutually integrated system of synergistic links inside BIOCEV.

- (1) **Functional Genomics:** The genomes of humans and many other species have been completely sequenced; nevertheless the knowledge of genome sequences as such does not shed light on questions concerning the functions of these sequences. Among the unanswered questions are those regarding the functions of most of the genes that encode proteins; the number of these genes is estimated to be 20 000. In order to describe biological functions of a gene, an informative modification (mutation, for instance a conditional deletion) must be inserted into the genes. In order to annotate the function of human genes, functional (pheno)genomics needs to be combined with comparative genomics.
- (2) **Cellular Biology and Virology:** This program includes four synergic and mutually complementing sub-programs: Eukaryotic Microbiology, Biology of Cancer Cells, Virology and Structure and Differentiation of Mammalian Cells. These sub-programs cover a large spectrum of eukaryotic cells ranging from the unicellular pathogens (parasitic protists) and unicellular eukaryotes forming multi-cellular assemblies (yeasts) to mammalian cells and tissues, as well as interactions between eukaryotic cellular structures and simple intracellular parasites – viruses.
- (3) **Structural Biology and Protein Engineering:** This program is focused on research of novel biotechnologically, diagnostically, and medically important biomolecules, proteins and nucleic acids that are constructed using state-of-the-art methods of molecular biology and protein engineering. Structures and properties of the studied molecules are analyzed by complex biophysical methods, such as advanced mass spectrometry and crystallography. Understanding structures of the studied molecules and their mutual interactions helps us to modify them to increase their desired biological activities so that they can be used for diagnostics of diseases, as drugs or as advanced materials.
- (4) **Biomaterials and Tissue Engineering:** The program is focused on advanced trends in medicine aimed at usage of sophisticated tissue prostheses systems composed of synthetic materials combined with specific biologically active compounds and cells for regeneration and replacement of diseased tissues and organs or for controlled drug and gene delivery targeted to specific tissues and cells in diseased organism. The program feasibility is guaranteed by the close collaboration of “synthesis” teams concerned with the development and synthesis of artificial carriers for cells, therapeutics and diagnostics, and “biomedicine” teams concerned with applications of cells, including stem cells, development of bioartificial

grafts for tissue engineering, and testing therapeutic and diagnostic systems. The basic common activities of the “synthesis” teams consisting in synthesis of polymer materials with attached biologically active components will be based in general on investigation and testing interactions of cells and tissues with the biomaterials directed to specific medical applications.

- (5) Development of Diagnostic and Therapeutic Procedures: This program includes a spectrum of projects covering reproductive medicine, diabetic complications, autoimmune and selected tumour diseases, inherited metabolic disorders, and study of heme pathology and of the effect of lack or excess of gaseous signaling molecules. The unifying element of all the projects is the study of the pathological condition of a cell, that is, finding out the causes of this condition, profiling the expression of the chosen genes, detecting changes in the localization and modification of the chosen proteins and identifying other molecules that relate to the induction of the pathology, furthering the development of new procedures for the prevention of the disease and creating new methods and diagnostics for monitoring the process of the disease and tools for the molecular therapy of the accompanying pathological condition.