

Włodzimierz Zagórski-Ostoja

IRN¹ Member Profile – Institute of Biochemistry and Biophysics of the Polish Academy of Sciences (IBB)

The article features a detailed profile of the Institute and describes its areas of research, education programs, developed products and services, achievements and recognitions and outlook on the future.

BACKGROUND

The Institute of Biochemistry and Biophysics of the Polish Academy of Sciences was founded in 1957. It has been an independent legal entity governed by its own statute approved by the President of the Polish Academy of Sciences since 1998. Institute is formally associated with Department of Biology of Warsaw University. Mixed teams of researchers from both institutions, working on plant molecular biology, lower yeast molecular genetics and gene expression are located at the Institute laboratories.

The Institute of Biochemistry and Biophysics is situated at the Ochota Campus in Warszawa with three other bio-medical science institutions of the Polish Academy of Sciences: the Nencki Institute for Experimental Biology, the Centre for Medical Research, and the Institute of Bio-cybernetics. This campus also contains Medical Academy of Warsaw a number of departments of Warsaw University. Since 1994 it has been located in new buildings, with a floor space of 12,500 sq. m., equipped accordingly world state of art with modern laboratories, computer systems, and a telecommunication network.

The Institute is managed by the Director, Professor Włodzimierz Zagórski-Ostoja, supported by the Board of Directors, the Scientific Council (composed of scientists from IBB and other Polish centres) and the Trustee Council, consisting of former IBB staff members currently working abroad.

IBB possesses the authorisation to award the degrees of Ph.D. and D.Sc. in the fields of biochemistry, biophysics and genetics.

IBB is divided into eight departments: Bioinformatics; Biophysics, Genetics, Lipid Biochemistry, Microbial Biochemistry, Molecular Biology, Plant Biochemistry, Protein Biosynthesis and six independent laboratories of: Antimetabolites, Biological NMR, DNA Sequencing and Oligonucleotide Synthesis, Fungal Glycobiology, Molecular Biology (affiliated to the University of Gdansk) and Mutagenesis & DNA Repair.

In the Institute there are specialized laboratories for NMR, mass spectrometry, fluorescence spectrometry, DNA sequencing plus several phytotron units, a greenhouse, and a high security radioisotope laboratory.

The Institute's library comprises 140 journals in permanent subscription, almost 16 000 volume collection plus more than 1000 journals on-line and two lines for media preparation.

Several research and educational organizations associated with the Institute are located in IBB quarters: the Polish-French Centre for Plant Biotechnology Research, the IBB Polish

¹ International Research Network – see Kudrycka's article in this issue.

National Node of European Molecular Biology Network (EMBNet), providing access to major molecular biology databases and related programs and information for over 800 scientists in Poland, the Regional Node of the International Center for Cooperation in Bioinformatics (ICCB) under the auspices of UNESCO and also the Interdisciplinary Center for Advanced Computer Modelling - Warsaw University (equipped with Cray computers), the Institute of Experimental Plant Biology and the Department of Genetics - Warsaw University. Each of these organisations complements IBB expertise.

AREAS OF RESEARCH

The scientific interests of IBB include yeast and bacterial genomics, gene sequencing and mapping, regulation of gene expression at the DNA and RNA levels, protein biosynthesis and post-translational modification, fungal glycobiology, mutagenesis and DNA repair, metabolism of nucleic acids, protein kinases, regulation of enzyme activity, protein structure-function relationships, computer modelling of peptides and proteins, NMR and mass spectrometric studies of proteins and peptides, antiviral and anticancer nucleotides, polyprenoid structure and function, nuclear-mitochondrial interaction, molecular plant virology, plant transformation and the molecular basis of plant and microbial biotechnology.

The scientific interests of the Institute have evolved over the years from classical biochemistry, biophysics and physiological chemistry towards the up-to-date molecular biology. The areas of interest include:

Microbial genetics focusing on the areas of sulphate metabolism in *Enterobacteriaceae*, sugar metabolism in *Lactococci* and mechanisms of stable plasmid maintenance. Formal and molecular genetics of lower fungi, traditionally a strong point in the Institute's activity, is studied by several teams.

Yeast functional genomics is actively pursued. Our previous participation in the European yeast genome sequencing effort is followed today by functional analysis of 26 new ORFs, identified by Institute teams. This research is conducted within the EURO-FAN programme.

Studies on [Paramecium genome](#) is a novel subject at IBB. Pilot project supplemented over 5000 novel sequences, around 1000 represents annotated genes. The project is done in the frame of Polish-French-German project European Group of Scientific Research (GDRE) under the name of "Paramecium Genome".

Plant molecular biology has become one of the Institute's focal programs during the last 5 years. Plant pathogen genome expression is studied *in vivo* and *in vitro*, appropriate virus-resistant plants have been constructed and patented, and went through field trials under the control of the Ministry of Agriculture (first such tests in Poland).

Plant transformation (*Arabidopsis*, potato, tobacco, carrot, lettuce, maize) has become a standard procedure. Signal transduction is studied with appropriate transformants, the protein kinases involved are identified and isolated in work carried out within EU consortia. A NATO-funded program on oral plant vaccines has recently been initiated. Chromatin function in plant development is analyzed using transformants with reduced levels of histones or carrying foreign histone genes.

Advanced nucleoside and nucleotide chemistry is actively pursued; synthesis of prospective anti-HIV and anti HCV compounds and potent specific kinase inhibitors has recently been achieved.

The study of lipid biochemistry is actively pursued and is focused on biosynthesis and function of polyisoprenoids mainly in protein glycosylation.

The fidelity of DNA repair and mechanisms of mutagenesis induced by chemicals and environmental stresses in bacteria, yeast and plants are the subject of work of our internationally recognised teams of molecular biologists. Recently, these teams have been shifting their interest to human genes that control mutagenesis. The aim of these studies is the understanding of the mechanisms of oncogenesis and ageing.

Gene engineering programmes implemented in all the activities described above, receive support from groups with expertise in the overexpression of proteins in *E. coli*, *S. cerevisiae*, *Pichia pastoris* and Baculovirus systems.

The research of the biophysics groups is focused on structural, conformational, kinetic and thermodynamic determinants of intra- and intermolecular interactions in polypeptide and polynucleotide systems, underlying folding in native forms and biological functions of proteins and nucleic acids. Both experimental (optical and NMR spectroscopy, fluorescence, mass spectrometry, steady-state and fast kinetic methods, electrophoretic and chromatographic techniques) and theoretical computer modelling (molecular mechanics, molecular dynamics and quantum mechanical calculations, threading modelling methods) approaches are employed.

Bioinformatics is one of the most important activities in IBB. Current releases of major molecular biology databases, updated daily, are available on the Institute network, along with tools for analysis. Our internal network permits access to software and data. The Institute network is accessible nation-wide through the Internet, and over 800 molecular biology database users are registered at the Institute mainframe. The quality of our bioinformatics set-up has led to the recognition of IBB as the national node of the *European Molecular Biology Network*, which means that IBB is recognized as the prime bioinformatics facility in Poland. Bioinformatics is also being pursued within a Polish-Israeli program, supported by UNESCO, and co-directed by IBB and the *Weizmann Institute of Science* in Rehovot. As a result of this co-operation, since April 1997, the Institute has been acting as a Regional Node of UNESCO ICCBnet - a network for promoting bioinformatics to biotechnologically developing countries. IBB has undertaken responsibilities of the regional node in Central and Eastern Europe. ICCBnet has been approved as the official UNESCO network by a resolution of the General Conference in November 1997.

EDUCATIONAL ACTIVITIES

The Institute's core activity remains basic research but teams are working towards enabling the transfer of the accumulated knowledge to the higher education system. This has led to a formal agreement between IBB and Warsaw University and the creation of a division of the Institute at the University of Gdansk. These affiliations with university centres have contributed not only to an expansion of the Institute's research activities, but also to a programme of advanced education in molecular biology through The Warsaw School of Molecular Biology, with more than 90 young researchers enrolled for the degree of Ph.D.

Around 30 students per year are completing experimental part of their master theses in laboratories of institute working under direction of university professors and institute team leaders.

TECHNOLOGY DEVELOPMENT PROJECTS

IBB is developing basic research towards advanced R&D projects. The Institute implements new procedures and supplies new materials created by modern molecular biology. During the last few years, the IBB teams:

- Created a nation wide system for potato virus detection by molecular hybridisation. This cost-effective system, relying on a series of specific DNA and RNA probes, effectively supplements the Polish phytosanitary system. The successful pilot programme, started in the eighties, with over 2000 potato test plants, permitted the standardisation of safe testing systems. Today the implemented system covers the whole country, with over 120,000 samples, received during last ten years from phytosanitary services and potato seed producers, tested in the IBB dedicated laboratory.
- Constructed over 300 novel potato transformants, selecting several lines as prospective new cultivars resistant to local PLRV and PVY variants. These new variants underwent field tests and were supplied to the state potato seed producing agency (Institute of Plant Breeding and Acclimatisation). New cultivars may be introduced into production, depending on the decision of the appropriate authorities regarding GMO policy.
- Developed a unique collection of the lactic acid bacteria (400 strains) derived from local small dairies. The collection contributes to the preservation of bio-diversity created in this important branch of food production. The Institute is negotiating the purchase of the collection by the Danone-affiliated company.
- Performed diagnostic DNA sequencing on order for several clinics. The identification in the Polish population of new mutations that cause anaemia in humans has improved diagnostic procedures.
- Diagnosed Loesch-Nyham syndrome in new-born babies for obstetric clinics.
- Offered a unique catalogue of polyisoprenoids, supplied on order world wide, to clinics and laboratories.
- Participated in the national effort computer network development, creating a country-wide bio-informatics network with over 800 end users. The network distributes, among others, EMB-net resources. The cost of this activity is covered by special funds from the State Committee for Scientific Research.

Currently, the IBB teams work on:

- Molecular diagnosis of myopathies linked with mitochondrial dysfunction's - in collaboration with medical clinics.
- An oral plant vaccine against *Helicobacter pylori* in collaboration with the Thomas Jefferson University in Philadelphia.

SPECIALISED SERVICES

- Proteomics platform equipped with two mass-spectrophotometers

- National GMO detecting laboratory (in organisation)
- Sequencing of DNA and Oligonucleotides Synthesis
- The molecular biology databases for around 800 local users
- Regional Strain and Plasmid Collection

EVALUATION SYSTEM

IBB PAS activity is supervised by the Scientific Council, with 52 members representing different Polish scientific institutions and nominated by the Polish Academy of Sciences.

Recently activities of the institute are under supervision of the CEMB Advisory Board comprised of leading European molecular biologists.

The biannual evaluation of the institute is carried out by the Scientific Council with support from the Trustee Council consisting of former IBB staff members holding permanent positions in foreign scientific institutions.

Biannual institute reports are submitted for judgment to the State Committee for Scientific Research (KBN). Each scientific project financed by other sources is controlled by independent referees.

The institute is recognised by State Committee for Scientific Research as one of the two best scientific institutions in the field of biology in Poland.

The IBB *Centre of Excellence Project* was selected by the European Commission independent referees in 10th place from 185 proposals, winning 47 points out of a possible 50. The IBB PAS was also accepted as a Marie Curie Training Site - Education and Research in Molecular Biology.

Researchers from IBB are also involved in the Project of Centre of Excellence for Multiscale Biomolecular Modelling, Bioinformatics and Applications (MAMBA) coordinated by the Interdisciplinary Centre for Mathematical and Computational Modelling of Warsaw University. The project deals with novel, multi scale biomolecular modelling methods, along with genomics and proteomics approaches, as well as simulations of metabolic pathways, being in the area of interest of modern molecular biology and biotechnology European research institutes, as well as biotechnological and pharmacological companies.

FUTURE

The Institute's aim is to use its potential by implementing new programs, solving specific problems indicated by end-users operating in the areas of bio-medicine, food production and environmental protection. We believe that in biology, there is no sharp distinction between basic and applied research. Applications have to stem from a sound theoretical background. On the other hand, identifiable end product(s) of market value, resulting from a research program is a built-in test of the robustness of the employed methodology. The Institute is in the process of gradual transformation into a centre, where synergy between theory and application work towards achieving the highest scientific standards.

The integration of advanced learning with economic awareness is one of the Institute's most important goals. The development of a new generation of scientists, able to integrate

these two modes of thinking and to function proficiently in an open society, is significantly augmented by enhanced European visibility of the institute. IBB has been selected as a **Centre of Excellence in Molecular Biotechnology** in the 5th Framework Program, and **Marie Curie Training Site - Education and Research in Molecular Biology**.

CONTACT

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