

Molecular biology and genetics will play an increasingly important role in medicine and the natural sciences in the years to come. As early as 1966, the Austrian Academy of Sciences had introduced these then new disciplines into Austria, with the establishment of the Institute of Molecular Biology in Salzburg. This highly successful and world renowned Institute will close in late 2002, owing to a lack in Salzburg of adequate opportunities for development, and three new institutes for molecular biology research will be set up simultaneously in Vienna. These are:

- the Institute for Molecular Cell Biology and Developmental Biology (IZEB),
- the Institute of Molecular and Cellular Bioinformatics (IMBA) and
- the Centre for Molecular Medicine (CeMM).

The Institute for Biomedical Ageing Research (IBA) in Innsbruck will also be expanded and its research facilities considerably improved. New staff and organizational structures will be introduced in all these institutes to enhance their adaptive capacity, international competitiveness and attractiveness to world-class researchers.

These changes reinforce the Academy's commitment to focusing on research fields that will profoundly influence, and possibly revolutionize, the future development of biology and medicine. The Academy is thus once again showing the way forward for Austrian scientific research, and the benefits of its work will extend also to university research, with its more complex organization and resulting comparative lack of flexibility. It is hoped that this will create the necessary infrastructure for making and keeping Austria internationally competitive in the race for new biotechnologies and the development of new products.

Institute for Biomedical Ageing Research

Broadly speaking, the Institute's work covers the field of immunological and pathological changes in ageing cells; each of the four departments is concerned with a different aspect of the subject.

The Pathology department, headed by the Institute's director, concentrates on the vascular system, and investigates mechanisms of age-related diseases, principally atherosclerosis. A particularly important line of inquiry is based on the interesting hypothesis that atherosclerosis is an autoimmune

disease, in which the stress proteins HSP 60 and 65 play a causal role.

The Immunology department studies immunological aspects of Alzheimer's disease and problems of vaccination in the elderly, in whom the immune response is weak. The aim is to develop a basis for more effective immunization of elderly people.

The Endocrinology department investigates ageing in the male reproductive system and the processes leading to the "male menopause" or andropause. Research will focus mainly on those hormonal mechanisms in which age-related changes lead to prostatic hypertrophy or prostatic carcinoma.

The Molecular and Cell Biology department studies the changes leading to the ageing and death of normal cells, as contrasted with "immortal" tumour cells. Particular emphasis is laid on the means by which cellular senescence, i.e., the limited capacity for cell division displayed by human cells, is counteracted in certain oncoproteins.

The research programmes of all the departments will in future increasingly incorporate methods of *genomics* and *proteomics* and will be based on automated processing of large volumes of genome and protein analysis data.

Institute of Molecular Biology

As stated above, this Salzburg institute will be closed at the end of the year 2002, by which time the work currently being undertaken in the Biochemistry and Developmental Biology departments should be complete. Developmental Biology studies the functional hierarchy of the genes controlling signal activity during tissue growth. Investigations in Biochemistry will concentrate on a protein discovered in the skin secretion of toads; in warm-blooded animals, this protein hypersensitizes the central pain-processing system.

The Cell Biology department will continue its studies of the dynamics of the cytoskeleton, and particularly of the functioning of the molecules initiating and controlling motility and oriented movement of cells. This knowledge is critical to an understanding of embryonic development, wound closure, the immune response in inflammation, and metastasis of tumour cells. Work on the isolation and molecular structure determination of protein complexes will also help determine which of these is responsible for the functioning of the actin cytoskeleton.

The Department of Plant Genetics is known for its work in the field of *gene silencing* in plants. This is an essential mechanism in the development of animals as well as plants. To arrive at a complex phenotype, individual genes must be variously expressed or silenced during ontogenesis. The future task of the department will be to monitor changing gene activities in the well-established tobacco plant and *Arabidopsis* models.

In order to gain a better understanding of the processes involved at the nuclear boundary, it will also be attempted to identify the genes that code for nuclear envelope proteins and for ion channels in the nuclear envelope.

The Developmental Genetics department, which started work only in June 2000, will study genomic imprinting. This process, which is characteristic of mammals, ensures that only one of the parental alleles of a diploid cell is expressed. It is now necessary to investigate the detailed functioning of the imprinting mechanisms, the role played in the origin of disease by a change in expression of the imprinted genes, and the ways in which imprinting influences tumour development in humans.

Institute for Molecular Cell Biology and Developmental Biology (IZEB)

The IZEB will be built in the immediate neighbourhood of the existing Institute for Molecular Pathology (IMP) and the Institute of Molecular and Cellular Bioinformatics (IMBA), currently under construction. It will therefore be affiliated to the *Vienna Biocenter*. Intensive work is under way to establish the organizational structure and define the future tasks of the new Institute. The Academy committee is being advised in this by a specially appointed group of international experts, which has already submitted a preliminary plan. The Institute's main work will consist in fundamental research in molecular biology, studying molecular mechanisms and regulation processes in both plant and animal material.

Institute for Molecular and Cellular Bioinformatics (IMBA)

Now that the chemical structure of the human genome has for the most part been elucidated, the much more arduous task remains of ascribing a

function to each of the defined molecular sequences. Only after this has been achieved will it be possible to understand adequately the development, activities and interactions of the various cell types, identify the changes leading to disease and, in a best-case scenario, search for appropriate pathways for targeted gene therapy in humans. In a research project in collaboration with the firm of Boehringer Ingelheim International GmbH, new techniques will be developed for studying the activity of human cells and their chromosomes *in vitro*, in cell cultures, and even *in vivo* in the human body. As its name implies, the Institute will also concentrate on developing new ideas for analysis and processing of the wealth of data available from genome sequencing in such a way as to extract potentially useful information from it.

Centre for Molecular Medicine (CeMM)

The CeMM will be built close to the Allgemeines Krankenhaus (general hospital containing the university clinics) in Vienna. It will facilitate direct transfer of fundamental research findings to the clinical setting. The Institute will serve to strengthen the existing, but as yet rudimentary, interdisciplinary collaboration of research groups in the areas of molecular immunology, oncology, dermatology, allergology, rheumatology and vascular biology so as to exploit synergies arising from the use of similar methods and also from common molecular biological factors of various syndromes. This is expected to lead to new concepts in pathogenetics, diagnostics and therapeutics, and also to allow practical application of molecular biology findings to patients in a clinical environment. The first phase will concentrate mainly on the development of vaccines suitable for treating tumours, chronic polyarthritis, endocrinopathies and allergies; biopharmaceuticals such as antigens, antibodies, and biological mediators and transmitters will be developed for this purpose, through the use of genetic engineering techniques.

All in all, the programmes of the IZEB, IMBA and CeMM will be so coordinated that molecular biology research can be promoted on a wide front, from fundamental research in molecular biology and molecular genetics using plant and animal model systems, through mechanisms specific to human cells, to therapeutic application in patients.