IMBA
Institute of Molecular Biotechnology
of the Austrian Academy of Sciences

Josef Martin Penninger – an exceptional researcher poses many questions and finds decisive answers

Josef M. Penninger is one of the world's leading mouse geneticists and immunologists. Using so-called "knock-out mice" – mice in which preselected genes are inactivated through genetic modification – the 40-year-old Austrian scientist identifies the function of the gene and the proteins controlled by it. Thereby, conclusions can be drawn on the molecular origins of diseases and new methods for diagnosis, prevention and therapy of diseases that cannot be treated effectively, if at all, at present, can be provided. The main focus is on cancer, cardiopulmonary and autoimmune diseases.

Through his work, Penninger not only opens up new prospects in molecular medicine but also provides answers to questions that could not be more existential.

For example, the question of life and death
Right at the start of his career, Penninger managed to isolate the AIF gene and to describe its function. AIF is the gene that tells cells when to die; it is responsible for cell death and hence for all life on this planet. If AIF can be controlled, tumours and dysfunctional immune systems can be managed more effectively than with conventional methods possibly enabling patients to be healed without major interventions and chemotherapy.

Or the question of when everything will be discovered that can be found.
When other renowned scientists believed they had already discovered everything of interest in the well-researched gene CD45, Penninger was able to extract a further secret from it. Thanks to him we know today that, apart from its other functions, CD45 also controls the immune system. This opens up possibilities for improving the chance of healing autoimmune diseases or enabling recipients of a transplanted organ to live without heavy medication. Even the fight against cancer and heart disease could benefit from this discovery in view of the important role T-cells play in multiple diseases.

Or the question of whether everything could be entirely different from what we have always thought.
The suggestion that heart attacks could be caused by a flu-like virus sounded very farfetched at the time. A cold, a heart attack – and that's it?! No one could believe it.
Josef Penninger, however, proved that heart diseases can sometimes be contagious: When the gene p56Lck is active, the infection with a specific virus can be sufficient to trigger a heart attack. He also showed for the first time experimentally that bacterial infections can lead to heart diseases.

Or the question of whether healing could in fact be "quite simple"

Penninger discovered that the gene OPGL controls the calcium release from bones. This is not only important for mobility, but also for milk production during pregnancy. That's why OPGL is highly active in pregnant women who require calcium for their unborn babies. And this is also the reason why so many more women than men suffer from osteoporosis – a connection that appears obvious, but was ignored for a long time.

Additionally, Penninger showed that OPGL monitors the amount of bone-eating cells in our body. It is, in fact, the master gene for bone loss. These new findings explain not only why around 300 million women suffer from osteoporosis but also why many diseases such as leukaemia, asthma, arthritis, diabetes, cancer metastases or AIDS cause bone loss. Since the increase of OPGL that occurs in these conditions weakens the bone substance, new drugs that act on this system could help millions of people. Penninger has already been able to prove in animal experiments that osteoporosis and arthritis are healable.

Or the question of what scientists can discover if they are allowed to conduct research

Josef Penninger's research group is currently studying a new strategy to prevent infectious lung diseases such as SARS. The very promising starting point for this research, the gene AC2 had been already discovered by Penninger in 2002 in the course of his research on heart diseases. At that time already, Penninger was able to demonstrate that ACE2 can control blood pressure and cardiac function.

However, ACE2 also acts as a receptor for SARS, since the virus attaches there. SARS is an extremely lethal virus that causes pulmonary oedema, with the result that patients virtually drown in their own lung fluid. This change in the lung function is also the reason why so many people died from Spanish influenza or the new bird flu that has emerged recently. Abound 50 per cent of patients with acute pulmonary dysfunction die because there is no drug available at present that promises rapid and reliable treatment of pulmonary oedema. The aim now is to determine the precise connection between SARS, the lung and ACE2 so as to be able to establish a basis for developing an adequate drug to combat these lethal dangers.

Finally the question of where and how top-level research can be carried out

Thanks to his intuition and ability to see the bigger picture, Josef M. Penninger has been able to extract secrets from the basic building blocks of life. Even as a student his approach was an interdisciplinary one: while studying medicine and immunology at the University of Innsbruck, he also took courses in art history. On completion of his studies, Penninger lived and worked for 13 years in North America, initially at the Ontario Cancer Institute in Toronto and then, from 1994 to 2003, as Principal Investigator at the Amgen Research Institute at Princess Margaret Hospital in Toronto.

In 2003 he returned to Austria to set up the Institute of Molecular Biotechnology of the Austrian Academy of Sciences (IMBA). A true cosmopolitan, Penninger, who has been married to his Chinese wife Liqun Zhang since 1997 and is a father of three, seeks now to follow the North American model and to strengthen the links between academic research, industry and the public sector.

Currently, Josef Penninger is Full Professor at the Departments of Immunology and Medical Biophysics at the University of Toronto, Professor of Genetics at the University of Vienna, Austria, and Honorary Professor of the Chinese Academy of Sciences/Peking Union Medical College.

He has received various prizes and honours, such as the Highest Talented Award from the Rotary Club Innsbruck (1990); the Anton von Eiselsberg Prize for best medicine-related scientific work in Austria (awarded for data from his thesis in 1991); the William E. Rawls Prize for outstanding contribution to cancer research from the National Cancer Institute of Canada (1999); Top Ten List of the most cited researchers in the world (2000 and 2001); Young leader in Medicine in Canada (2000); Canada's Top 40 under 40 (2001); Canadian Research Chair in Cell Biology (2001); Young Canadian Explorer Award (2002); listed among the ten most promising scientists in all fields of science in the world by Esquire magazine (2002); Elected to the Austrian Academy of Sciences (2002); International Research Prize in Bone Research (2003); Austrian Scientist of the Year Award (2003); Austrian of the Year – Austria04 (2004); Elected to the German Academy of Sciences Leopoldina (2004); appointed Young Global Leader by the World Economic Forum (2005).