The Centenary Celebration of the Finnish Academy of Science and Letters, 9th April 2008

Main address by Kari Raivio, Chancellor of the University of Helsinki

Thrills and threats – science shaping the future

Kari Raivio

We all have hopes, many of us also fears, about what the future might bring. Who of us would not want to brighten our hopes and to allay our fears with the help of knowledge. Unfortunately, although parliamentary committees, professorships, and research institutes have been established for the purpose, there is no way to obtain real scientific evidence about the future. Some believe that history repeats itself and study the past to find predictive signs for the future. Others project current trends forward, assuming continuity, or build alternative scenarios based upon hypothetical developments. In technology, foresight exercises have become popular. Science fiction writers use their imagination, soothsayers divine future happenings from the flight of birds or the form of tea leaves. Daring predictions are sometimes called visions, although management consultants have debased this term to serve the strategic planning phraseology of companies and organizations. Utopias are visions with an element of the unbelievable or impracticable. Future developments become threatening, when they appear uncontrollable or when harmful side-effects become significant and widely known.

The development of science has been particularly difficult for those bent on predicting things. New breakthroughs are, by definition impossible to foretell, and they may totally change the course of whole fields of research. Applied research that aims at developing new technologies is purposeful activity, and its results could be expected to be more reliably predicted. Nevertheless, there are scores of examples of blunders made by respectable scientists. Lord Kelvin "proved" heavier-than-air flying machines impossible some years before the first flight by the Wright brothers. The Royal Astronomer of Britain, Sir Richard Woolley, declared space travel "utter bilge" just one year before the first Sputnik took Yuri Gagarin into orbit. Putting a large number of scientists and money together for a large applied project can be successful, if building the atomic bomb can be described with this adjective, whereas the pretentious "War against cancer", declared by President Richard Nixon, fell flat because of lack of fundamental knowledge.

Today the fruits of scientific and technological development influence the everyday lives of all citizens, but the negative effects are also becoming more apparent and receive increased publicity. Nevertheless, Finns trust science more than God, judging on the basis of an opinion poll published in 2007. More than two thirds of the respondents feel great confidence towards universities, research institutions, and science in general, but less than half towards the church. Only a fifth of the population has confidence in political parties, European Union, or big companies. Over three fourths follow devel-

opments in science, particularly in matters related to the environment, nature, and medicine, but few are interested in research policy. The quality of Finnish research is considered to be high by international comparison, especially in medicine and technology. The possibilities of science to make a positive impact on individuals and societies are considered particularly good in conquering diseases, improving the standard of living, and solving the problems of the environment and energy production. On the other hand, few expect science to help in reducing unemployment or promoting peace, democracy, or human rights. Two thirds of the population consider that scientific information is used all too little in political decision-making. Two thirds also think that investment in research is productive and that basic research is important, but only a fifth is in favour of allocating research funding only to economically most profitable areas or increasing the influence of business on research policy. The potential negative effects of science and technology do not worry the average citizen.

The quality of Finnish science should interest not only the general public but also political decision-makers and makers of research policy. For these audiences, the Academy of Finland, our national research funding agency, conducts a review every three years. The most recent one was published in 2006 and was mainly based on bibliometry, or the number of publications and the number of citations these received. Finland produces about 1% of the scientific publications of the world, which is ten times our proportion of the world´s population, and the citation impact of these publications is slightly above the average for OECD countries. The highest citation index is achieved in agriculture and forestry and the medical sciences, about 50% more than in OECD countries on the average, whereas technology and humanities are exactly at the average and natural and social sciences below it.

What do such rough evaluations tell about the quality of Finnish science? Although we rank highly in terms of productivity related to population or to investment in research, Finland is not a prominent science nation. We have some, perhaps even surprising strengths, and an umber of world-class scientists. On the other hand, the large volume and poor impact of natural sciences and technology is worrisome, in view of the importance of these fields as engines of the economy and modifiers of future developments.

When the world is full of uncertainty and global competition gets tougher, science and higher education policy is not simple to make. The field has become more complex, because in addition to traditional education and research policies technology entered the scene in the 1970s. Its national flagship Tekes, the Finnish National Agency for Technology, celebrates its 25th anniversary this year. Even more modern is the term innovation, and the bureaucratic language of both the European Union and Finnish authorities has adopted a new term - knowledge triangle – the corners of which are education, research, and innovation. The EU Commission declares that "Modernisation of Europe´s universities, involving their interlinked roles of education, research, and innovation, has been acknowledged not only as the core condition for the success of the broader Lisbon strategy, but as part of the wider move towards an increasingly global and knowledge-based economy." According to the program of the current government of Prime Minister Vanhanen, "Improvement of the productivity and competitiveness of our national economy requires more effective broad-based innovation policies. The main attention will be on education, research, and technology policy…The government considers it important to concentrate on nationally identified strengths in top-level research."

Foresight exercises have been employed to define priority areas for strategic and applied research, technology programs, center of expertise programs, and strategic centers for science, technology and innovation. The resources of Tekes have developed more favourably than those of the Academy of Finland, which is the sole financier of basic research. In 2006 Tekes awarded a total of 465 million euros to collaborative projects of in-

dustry and academia, while the Academy of Finland had to contend with 239 million, over 80 % of it to university research on the basis of competition. The trend seems to continue, because in recent years the proportion of targeted program funding by the Academy has been on the increase compared with researcher-initiated project grants. Applied research conducted in collaboration with companies takes a lion´s share also of European Union funding, and only last year the European Research Council started its excellence-based funding programs for fundamental research with less than one-fourth of the resources of the industrial research programs.

Let us take a time trip 50 years back, when the Finnish Academy for Sciences and Letters made preparations for its 50th anniversary, and imagine how today´s science and innovation policies would have worked. A global epidemic of polio was just spreading into Finland. Aurora Hospital in Helsinki was the national center for treating respiratory paralysis, for which a device called the iron lung was available. One hundred patients were admitted for this treatment, and of them 40 died or remained dependent on respirator therapy. The problem was clearly severe and national measures had to be undertaken. There was great need for creativity and innovativeness, but fortunately a national innovation strategy had been formulated. Technology industries and the University of Technology, then the only one in the country, surveyed the available options and considered the technological properties of the iron lung quite unsatisfactory. By investing in new technology it would be possible to develop a machine that was smaller, less energy-consuming and more gentle to patients, whereby the hospital would need less space, use less electricity, and treatment results would improve. Besides, the polio epidemic was global, and market research conducted by the experts of the School of Economics and Business indicated that the new iron lung would have tremendous commercial potential, particularly if the best academic design know-how was harnessed to the project. In this field a strategic center for science, technology and innovation was obviously needed, and the business sector was eagerly collaborating in the project, as long as the taxpayer footed the bill and the IP-rights stayed with the companies. Tekes launched a technology program called ILEH ("iron lung to every home"), the Academy of Finland did its share by allocating center of excellence funding and a graduate school to this important field. By demand of and guided by industry, the teaching programs of universities and technical schools were modified to provide this promising export branch with labor in sufficient numbers and with the correct skills profile.

Despite the brilliant visions of a global breakthrough, this scenario was never realized in Finland nor anywhere else. After painstaking work and many disappointments, basic scientists finally succeeded in growing the poliovirus under laboratory conditions. After hearing of this Nobel-prize breakthrough, virologist Jonas Salk became convinced that a vaccine could be developed. Just in 1955 a study was completed that showed his vaccine highly efficient. Thus started the eradication of polio from the world. The market for iron lungs disappeared, but the vaccine did not become a commercial success, either. When Salk was asked, who owns the rights to his invention, he was somewhat surprised and said that it belongs to humanity, because "you cannot patent the sun, either".

Public investment in technology programs is certainly justified. It has been found to leverage, not inhibit, private investment and thus it serves economic development and benefits society in general. However, it is essential to consider the balance of the whole research and innovation system, and not put excessive weight on the short-term interests of quartal economy. It is certain that if the needs of viable and dynamic basic research are neglected, new fruitful ideas will not be born and also applied research gradually becomes paralyzed to a state that cannot be salvaged, even by an iron lung. Coupled with the basic research function of universities is the education of new generations of "knowledge professionals", who leave the universi-

ty and enter working life. Through them society can benefit from all the scientific information generated in the world, not just the one percent produced in Finland. To fulfil their obligations, universities must be allowed to enjoy the autonomy and freedom of teaching and research guaranteed by the constitution. Excessive management by the state will suffocate dynamic development, humble subservience of industry will lead towards Hamburger University, operated in Chicago by McDonald Corporation.

But are the Finns right in thinking that scientific information is used all too little in political decision-making? I contend that they are! Information is available, even in excessive amounts, but it is scattered, inconsistent, of doubtful quality or simply wrong, and difficult for a lay person to understand. The government is supported by the prestigious Council for Science and Technology. However, its functions do not include critical analyses of existing scientific information to underpin current agenda issues, and its unanimous recommendations are not always taken seriously, even though the most important cabinet ministers are members, chaired by the Prime Minister. Most ministries have one or several research institutes that conduct surveys and scientific studies on their respective fields, but they do not produce critical reviews of the current status of research. The Academy of Finland is mainly responsible for allocating public research funding, which it does with methods that have been internationally praised, but its reviews on the status and quality of Finnish research are too general from the point of view of single policy issues. In recent years, several think tanks have been set up by public subsidy, but they are affiliated with political parties or other interest groups, and their objectivity and competence are not always guaranteed.

Academies of science are organizations that invite their members on the basis of merit alone, and they are independent of political and other ideologies. In many countries, academies have an official status as advisors of the government and the general public in issues related to science. The traditions in the USA and UK are over one hundred years old, but in recent years the science academies of, eg., Canada, Sweden, and Germany have been requested by their governments for aid in analyses of scientific issues. During its centennial year, the Finnish Academy of Science and Letters will initiate a new activity. The most competent national experts will assemble and analyse the available up-to-date reliable research data and report their conclusions in a language that a lay person can and will want to read. The task is not easy because the scientific community is seldom unanimous and our knowledge base is far from complete. Nevertheless, the Nobel Prize-winning International Panel on Climate Change is a good example how an impartial and competent analysis gradually achieves a broad acceptance and appreciation, without trying to simplify problems or express final judgements. I believe that in a smaller scale and from national terms of reference the Finnish Academy can, during its second centennial, help put the thrills and the threats of science in their proper perspective.