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Your excellencies, ladies and gentlemen, friends in Luxembourg:

Let me begin with a thank you for giving me the opportunity to speak here today as the University of Luxembourg celebrates its 10th anniversary. It is a great honour. It has also given me a welcome reason to come back to Luxembourg – where I lived for just over five years between 2006 and 2011 – and meet old friends, among them Rolf Tarrach, today's host.

At the beginning of his presidency, Bill Clinton said, "I used to have a sense of humour, but they told me it wasn't presidential, so I had to quit." Without drawing the parallel too far, I have to admit that being Director of the Nobel Foundation is a little bit like that. There is so much history, so much tradition and so much prestige. I hope I will be able to keep you awake anyway.

Ten years is not a long time in scientific contexts, but it is long enough for much to have happened in the world. A lot of this has been positive. A revolution has occurred in the field of communications, including the growth of the Internet and other media. The production system has changed dramatically and has been internationalised. We have seen striking improvements in living standards in large parts of the world; the number of poor people has decreased sharply, especially in Asia. Our societies have become more open, and democracy has taken root in more and more places. There have also been important advances, for example in what they call the life sciences. Average life expectancy has increased. In the environmental field, too, positive things have happened. Let me give a concrete example. When I left my summer-house in the Stockholm archipelago a few weeks ago, I saw both white-tailed eagles and seals. This didn't happen ten or twenty years ago.

Yet – despite the advances – there are reasons to argue that humanity has never faced bigger challenges than today. In the Baltic Sea, which I just mentioned, lack of oxygen is a major problem. At worse, this sea can die. As the IPCC showed a couple of weeks ago, the climate is now changing rapidly due to emissions. The radical policy changes that are necessary have hardly begun. People are continuing to die unnecessarily in large parts of the world from famine and disease. Nor are the challenges only a matter of nature. Equally important is how our societies function. We are now gradually – knock on wood – getting out of the most severe economic crises the world has suffered, but we cannot bring ourselves to make the decisions needed to prevent future crises. Meanwhile the core of our Western democracies is threatened by xenophobia and decay.

The era in which Alfred Nobel lived had similarities to ours. It was an era of major scientific advances, improved communications, rapidly increasing trade and growing international enterprises – he himself was intimately involved in all four. But it was also an era of great social tensions in the wake of industrialisation and of obvious threats to peace. Alfred Nobel wanted to do something about this.

When Nobel's will was opened in 1896 it came as a big surprise. He declared that what remained of his fortune – after some minor bequests to persons close to him – should be used to endow "prizes to those who, during the preceding year, have conferred the greatest benefit to mankind". By endowing prizes to those who have made breakthroughs in science, written good literature and contributed to peace, he wanted to contribute to a better world. This was the idea behind his prizes.

Much can be said about the Nobel Laureates and what their breakthroughs have meant for humanity. During the past two years alone, while I have headed the Nobel Foundation, several prizes have been awarded to people who dared to swim against the current – sometimes for decades – and who have made major contributions to our knowledge. One of them, incidentally, is Jules Hoffmann, from Echternach.

Among the 838 individual Laureates since 1901, many have made discoveries of very obvious and direct significance. Examples of such Laureates are Röntgen (X-ray technology); Fleming (penicillin); Bardeen, Brattain and Shockley (the transistor); Kilby (the microchip); and Geim and Novoselov (graphene). Others, such as Einstein or Crick and Watson (via their discovery of the structure of DNA molecules), have had a crucial influence

on how we perceive the world. Yet perhaps most common are prizes awarded for discoveries that have a more indirect impact.

Of course, the fact that many discoveries and contributions important to humanity have been awarded Nobel Prizes need not in itself prove that the prize has fulfilled Nobel's desire to contribute to the greatest benefit to mankind. But I believe so. By highlighting the most outstanding research – that which leads to scientific breakthroughs – the prizes help focus attention on science in general and on path-breaking research in particular. For highly-paid professors at the world's best universities, perhaps there are not such strong arguments in favour of continuing with their difficult research. In such cases, the Nobel Prize becomes important, it gives a strong incentive. The international nature of the prize is also beneficial. Before the Nobel Prize, there were prestigious prizes in France, Germany and the United Kingdom for citizens of those respective countries. But none of these prizes enjoyed the same stature. The Nobel Prize underscores that knowledge exists for the benefit of us all. It focuses the spotlight on our shared responsibility for advancing knowledge and development.

(The Nobel Prizes for literature and peace are naturally also important to humanity. The Peace Prize has highlighted crucial contributions to peace and spurred continued commitment. Although I am among those who would have liked to have seen the European Union receive the Peace Prize ten years ago or so, for example – when it carried out its large eastward enlargement – or perhaps earlier when Greece, Portugal and Spain were incorporated into democratic Europe, we can hope that last year's prize succeeded in lifting the nationalist euro debate to a higher level by reminding us of the purpose of the EU.)

(One important aspect of the prize is the independence of the prize-awarding institutions. On the last theme I can't refrain from telling you a story. Even before I began my work at the Foundation I had the opportunity to have a cup of tea in Stockholm with His Holiness the Dalai Lama. He started our conversation by underlining how important it was for the world that we – given the prestige the prize enjoys – had acted with independence and a certain boldness. Of course he was partly thinking about the Chinese situation and how many are now bowing to the Chinese authorities. But it is in fact part of a larger story. Hitler prohibited Germans from receiving the prize. And the Soviets did the same when it was awarded to people the regime did not like, such as Alexander Solzhenitsyn. But this in no way stopped the prize-awarding institutions from doing their work.)

Here, in one of the founding countries of the European Union, on the border between the Protestant and Catholic or Germanic and Latin Europe, where both Fois Gras and Sauerkraut is being served, it might be proper to see how Europe is doing in the area of research. In the sciences – physics, chemistry and medicine – Europe was very dominant before the Second World War. For several decades, Germany alone had more Laureates than the United States. During the post-war period, however, the picture is completely different. Based on the countries where Laureates were born, the US today has a total of 183 Laureates in the three sciences, compared to 68 for the United Kingdom, 65 for Germany and 30 for France. If we look at the country where the prize-awarded research took place, the dominance of the US is even greater. In that case, during the past 112 years the US has had far more laureates than all of Europe combined. Also worth noting is Japan's advances in recent years. So far, 15 Japanese have received one of the scientific prizes. And in Asia, interest in cutting-edge research and in the Nobel Prize is enormous. Various countries, including Japan and Korea, have research policy targets connected to the number of Nobel Prizes.

If it were true that Nobel Prizes were the only indicator of Europe's vulnerable position in the field of research, perhaps there would not be reason to be so concerned. But other indicators point unanimously in the same direction. One good example is statistical data showing how often research articles from different countries are cited. Here US dominance is very large. It is also worth observing that among the world's best universities today, according to the best-known ranking lists e.g. the Shanghai rating the ten best includes only two universities in Europe, both located in the United Kingdom. If we add ten more universities only one is European, from Switzerland.

Not surprisingly the largest countries in Europe Germany, France and Great Britain have been the most successful in terms of the number of Laureates. In recent decades this has been especially true of the UK. Viewed in relation to population size over the entire period, things look different. In that case Switzerland tops the list, followed by Sweden, and then by the UK and Germany.

The position of Europe and also of countries within Europe largely reflects the spending on research. Today the US and several Asian countries are devoting larger resources to basic research. Joint European research programmes also largely consist of covert aid to industry rather than serious research efforts.

Alfred Nobel would not have liked this. He thought that we have a shared responsibility for dealing with vital world issues. Despite all of today's economic worries, Europe is the richest continent in the world after North America. This gives us a special responsibility in world affairs.

Having said this, I should underline that many other things besides the amounts invested in research play a role in its results; the correlation between spending and ground breaking research is not perfect at all.

So what does it take to win a Nobel Prize and achieve scientific breakthroughs? George Beadle, who received the medicine prize in 1958, had his own recipe: "Study diligently. Respect DNA. Don't smoke. Don't drink. Avoid women and politics. That's my formula." This might be true at the individual level, although I believe that there are some Laureates who would take exception. Whatever, these are not variables that can easily be influenced by political actions.

Taking a larger perspective, the intellectual environment in a broad sense is important. In concrete terms, it may be a matter of what education and what teachers a person has. A number of Laureates have actually had other Laureates as teachers. There are high schools in Brooklyn that have produced a number of Laureates. The same applies to the secondary schools in Budapest during the early decades of the 20th century. Perhaps less surprising is that certain universities produce Nobel Laureates one after the other. Chicago, for example, has a unique standing when it comes to the Economics Prize. More than 20 Economics Laureates have either been students or researchers there.

Most important for research policy are clear-cut goals and consistent expectations of scientific quality. There should never be compromises on this, as defined by international benchmarking. The same should apply to individual research institutions. Successful research institutions are usually led by strong academic scholars with visions, legitimacy and control over resources.

Good research environments also seem to be characterised by circulation of people and ideas. People should come and go. Recruitment and promotion systems should be coupled with rigorous evaluation systems and mobility should be used as a vehicle for variation. There should be cross-fertilisation between different subjects.

Another important aspect has to do with the division of labour between research funders and universities. External funding should not be allowed to take over totally. It should complement university strategies that drive a culture of quality. There needs to be "protected space" for faculty to pursue independent lines of research under the aegis of resource-rich environments. In general, the health and standing of the research system and its environments need to be a central concern across the political spectrum.

Unfortunately, Europe does not score better on this than on spending. As I mentioned earlier, a small proportion of EU research money goes towards basic research. There is also a lot to do when it comes to research systems. Contacts with other countries are often weak, cross-border movements and sometimes also movements between universities are poor. International benchmarking is used too little, and so on.

However, the establishment of the European Research Council represented a major step in the right direction. The evaluations that have been made show good results. Today the scientific community has embraced the ERC. In addition – and this is also important – the new system helps establish norms and principles that are also of great significance for the development of national research systems. In other words, we have a good model. Let us build on it further, and make sure that a growing proportion of our shared research resources are channelled in this and similar ways.

It is now time to sum up. Today we are facing major challenges. This is true of the world as a whole, but also our own continent of Europe. I share with Alfred Nobel the opinion that the solution to our problems is largely a matter of scientific advances. All of our individual countries, as well as the EU as a whole, have a responsibility for scientific development and advances. We cannot lean back and let others bear this responsibility.

I am convinced that when Luxembourg established its own university ten years ago, you created a better and more solid foundation for building future prosperity. Nobel laureates born in Luxembourg can remain in Echternach and contribute to the development of your country. They will also not have to wear a French hat when they receive their prize from the hand of the King at the Stockholm Concert Hall on December 10.

But it is equally important for Luxembourg to join in and contribute to solving challenges faced by the world as a whole. In the spirit of Nobel, you can contribute to the greatest benefit of mankind.

In closing, let me congratulate you on your first ten years. At the same time, I would like to wish you the best of luck in the future.

Thank you.