The current status and the future of universities within society

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Introduction

For me, at least, the general question of the current status and future of universities needs to be expanded by adding either ‘within society’ or ‘for society’. Hence I shall address ‘the current status and the future of universities within society’. There are two particular questions which I would like to answer upfront:

• What are universities to prepare for?
• What is different from the past and where must we look for these differences?

Regarding the first question, universities have to prepare a society for the challenges which are ahead of it. Some of the major challenges which have to be tackled in the future are:

• health;
• energy;
• nutrition;
• water;
• global warming.

Although one could feel that these are challenges only with consequences and/or effects for natural sciences, that assumption would be a terrible mistake. These are challenges for all disciplines.

Responding to the second question, compared with a couple of years ago, I see the following differences. Almost daily, our newspapers publicize these challenges, so many people are emotionally concerned and the public debate is dominated, in some countries more, in others less, by fear and by a feeling that science has created these problems and is not ready or not capable to cope with them adequately and in a timely manner.

The world has a population of approx. 7–8 billion, and the aging process is changing the worldwide demographic picture, especially as such a low fertility rate has not been seen in modern times. These demographic trends call for more research and also for practical efforts which should lead to changes in the lifelong organization of our work and career planning. In many, but not in all European countries, the issue can be summarized in three categories:

• belated start of professional life;
• too early retirement from professional life, and;
• too much stress and high workload between the ages of 30 and 40.

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This is the span of years during which career development, continued education, family planning and many other things have to be undertaken in preparation for the later stages of life.

Living into old age is a wanted and welcomed effect of civilization, but it places an enormous pressure on our social systems and especially on the health sector. If we consider just the health sector, we recognize that we need a new attitude to focus research on new fields, such as prevention, as well as regenerative and individualized medicine. Moreover, we have to change our lifestyle in favour of private and individual prevention regimes, and we have to pursue research in many areas that lie beyond classical medical subjects. I am deeply convinced that we have to create new kinds of jobs and that we have to reorganize our professional lives.

It is my conviction that these changes (and I have listed only a few that relate to the health sector) call for a new understanding of how public organizations work together (public–public partnerships), how private organizations work together (private–private partnerships) and especially how public–private partnerships are organized. We need new models of creative co-operation in order to tackle the challenges ahead in a joint and responsible manner.

**Education**

There is no doubt that universities can play and have to play a major role in these restructuring processes. The immediate question which follows is: do we have the people? Do we have enough educated people to cope with the issues listed above? In Europe, the percentage of young people engaged in higher education varies widely. Finland, for example, has been very successful in educating a rather high proportion of students. The same is true for some Asian countries. At least some European countries have to create more opportunities for young people to enter university. But it is important that the students finish their studies with a qualification. In Germany, for example, there are quite a few curricula where more than one-half of the students do not finish their studies with a final examination, and this calls for an output orientation rather than an input orientation of universities.

It is also necessary that we get more students into certain areas, for example, engineering, sciences and medicine, where we have a long-term shortage of graduates. In order to do this, in preparatory school or in high schools we have to create a fundamental interest for natural sciences in order to keep children’s interest for natural sciences ‘alive’ and to prepare them for the decision to study natural sciences later on. The prestigious French Académie des Sciences has been very successful in creating a project called Lamap (la main à la pâte) to increase the number of students in the field of natural sciences. Inspired by the Lamap project, my own academy, the Berlin–Brandenburg Academy of Sciences and Humanities, is now engaged, together with Freie Universität Berlin, in preparing a German version of this very successful French project.

Finally, universities should commit themselves professionally to the so-called ‘market’ of lifelong learning. Modular curricula could give universities enormous opportunities to respond to this need, which, at the same time,
represents an interesting market. For the majority of students in natural sciences and in the life sciences, we should augment their curricula with selected teaching elements devoted to economics and management skills. Also, all students of all disciplines should be trained early in the so-called ‘soft skills’!

Our professional life is more and more determined by teamwork and by co-operation with internal and external partners calling for a specific attitude and ability. Cross-cultural education will be a must in the future, and universities have to prepare students for these challenges. It really means that we need to create a new European elite, which, of course, should have an excellent education within disciplines. But, at the same time, it should be an elite which has acquired leadership skills, value orientation, passion and efficiency. This is necessary in order to legitimate science in a society where the media plays such an enormous role.

Hence it is important to learn to communicate properly about issues. There are many inquiries and/or surveys which clearly show that society still places much more trust in scientists, doctors and university professors than in business people, politicians or even in the media. Hence it is mandatory that the younger generation educated in universities is made aware of their responsibilities for transparency and proper communication with society. And, finally, there is a need for understanding the new research processes. In more and more disciplines, there is no well-defined strict separation between basic research (in Germany called ‘Grundlagenforschung’) and applied research (in Germany called ‘anwendungsorientierte oder anwendungsnahe Forschung’).

The new research paradigm

Especially in molecular medicine, the pseudo-separation between basic and applied research is no longer valid or helpful, in particular when coupled with the notion of where the research should take place: “basic research in academia, applied research in industry”. This is no longer true. If, in modern times, we really want to be successful, for instance in molecular medicine, we have to think about following an interactive co-operative research model that transcends institutional barriers. The Nobel Prizes in physics and in chemistry awarded in 2007 show how problematic and doubtful the artificial separation between basic and applied research is. The Nobel Laureates of 2007 have a fundamental impact on what we might call basic research and, at the same time, they have a tremendous impact on what we might call applied research.

Some decades ago, the American President Lyndon B. Johnson asked for an investigation into what extent the intentions to do basic research or applied research are fulfilled. The outcome was rather sobering. Approximately one-half of the intended basic research turned out to be successful applied research, and again approximately one-half of the intended applied research resulted in what we could afterwards call basic research. And if you look back in history, it was Gottfried Wilhelm Leibniz, the founder and spiritus rector of the Berlin Academy of Sciences, who postulated “theoria cum praxi”.

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Public-private partnership is needed to find new therapeutic and diagnostic methodologies, as exemplified in Figure 1. There is a value-creation chain starting from target identification and validation, followed by assay developments, screening, lead development, lead optimization, pre-clinical development, clinical Phases I to III and, finally, the regulatory review. As mentioned before, target identification, lead development and validation all take place both in industrial and in academic (research) laboratories (Figure 2).

However, due to the fact that we know so much more today, the identification of targets has become a very diligent and long-lasting process, with the same also being true for target validation, assay developments, screening and lead development. This has had a number of consequences.

First, the time span from target identification to lead optimization and entering clinical trials has become longer. Opportunities to fail have increased even more, which suggests that a certain degree of industrialization and professionalization of these processes is required. The fact that there is a lot of interdependence between working teams, both in academia and industry, in finding new targets and validating targets makes it mandatory that a fresh look is taken at public–private partnerships. This higher interdependence means that lead optimization in industry is often highly dependent on work being performed in academia, and target research in academia calls for a close interaction with screening labs and lead optimization activities in industry. This clearly creates the need for co-operation.

Secondly, the new conditions clearly call for new consideration of how research money given by the public is being used. Previously, as basic research, such as target identification, was performed only in academia and only then the ensuing work was performed in industry, one could argue that the public sector should sponsor only the very early steps in this process. However, since the

### Value-creating chain in biomedicine

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Available technologies

Public-private partnership in pharma
BBB, blood–brain barrier; HTS, high-throughput screening; MS, mass spectrometry; NMR, nuclear magnetic resonance; PK, pharmacokinetics; SAR, structure–activity relationship.
interval between target identification and lead optimization has become longer and developed into a multi-institutional approach, it is obvious that the public sector has to consider carefully how to modify its research policy, especially regarding research funding. Indeed, this is also true for clinical testing. Many funding agencies pretend that Phase II and Phase III trials already constitute market development activity. The truth is, however, that the failure rates of new drugs in Phase III trials, especially in innovative areas such as oncology and neurology, not to speak of psychiatry, is still 50%, which implies that a lot of clinical research is needed and is performed today in Phase II and Phase III trials. This issue is crucial, since costs are exponentially increasing, especially in the development process for new drugs. So our plea is two-fold:

- First, we have to think more carefully about structuring anew the public–private partnership arrangements. The mentality has to change from ‘donations’ and ‘sponsoring’ into truly transparent research co-operations, with clear rights and obligations for the different partners.
- Secondly, we have to re-shape our funding system when it comes to public funding in those areas where the prime economic interest of industry is not as high, for example, rare diseases, drugs for children and drugs for poor countries. I am convinced that this is a real chance to prepare academia for these upcoming needs, since it would not only help industry to re-think its strategies and to come up with new drugs in these less economic medical fields, but would also be of a high social value. It could and would also help academia to increase clinical research.

In order to enhance public–private partnerships, the creation of ‘clusters of excellence’, and one could also argue a new type of campus university, will be essential. Universities, other academic research institutions, start-up companies and joint laboratories with big industries should all come together in order to form these clusters of excellence. This will lead to a new effort focusing on areas of excellence in universities, while, at the same time, care must be taken that the aspect of interdisciplinarity will not be harmed by this enhanced focus. But, undoubtedly, there will be a higher degree of geographic concentration of such clusters. Not every university will be able to be the source and the centre of a new cluster. This process has taken place in the U.S.A. over many years, but, in Europe, especially in Germany, it is less well-developed.

**Outcome considerations**

If we consider the outcome in our current academic and university systems, David King’s [1] analysis, published in *Nature*, gives us interesting hints as to where we have to place new emphasis in some European countries. Looking at published articles in peer-reviewed journals and the frequency of citation of those articles (Figure 3), it is obvious that some major fields included in this investigation have
developed differently in various European countries. For example, in the U.K., medical and biological sciences are apparently far advanced, whereas in Germany, physical sciences, engineering and also mathematics have a high level of international impact.

If one considers the citation share of 15 EU (European Union) countries and compares them with the U.S.A. (Figure 4), it is quite obvious that again in engineering, physical sciences and mathematics, these European countries have a leading position, whereas in clinical, biological and even in environmental sciences, the U.S.A. is ahead of Europe. I think it would be worthwhile to think carefully if such a status quo is what we want, or if we would like to change this picture. I feel we have to change it with regards to biological sciences, since I deeply believe that, as is often said, we are living in the “century of biology”. This again calls for strategic initiatives in our academic institutions, especially in universities. But it also calls for special efforts to be made in governmental funding of these research areas. The comparisons made by David King make it clear that while we need national actions to this end, concerted efforts at the European level are also needed [1].
Disciplinary strengths in the United States, the 15 European Union nations in the comparator group (EU15), and the United Kingdom


Governmental support

The above reasoning brings me to my final point: if we look at the money being spent by the government for universities per capita of inhabitants of a country, there are large variations: Sweden, Finland and Japan are in a leading position, and Portugal, Greece and Spain are at the other end. Germany is somewhere in the second half of this list. If we want to have excellence, if we want to be competitive with the best universities and academic institutions in the world, some countries in Europe will have to increase their university funding levels (Figure 5). This is especially true if we do not look at a single year only. If we look at development over the last 10 years, we see that Finland and Japan have made tremendous progress, as has the U.S.A., whereas countries such as Germany are rather constant and have not significantly increased their share of research funding in the gross domestic product. Apart from the absolute figures in funding research, it is also interesting to see how strategic, i.e. long-term, spending on research areas is being undertaken: here, again, the U.S.A. has constantly increased budgets for natural sciences, and even more so for life sciences, over the last 10 years.

Research needs long-term financial commitment and this, I think, has been done in an exemplary way by the NIH (National Institutes of Health) in the U.S.A. In my mind, there are some lessons still to be learnt in Europe, as sustainability is an important aspect of research funding.
Conclusions

There are great challenges ahead of us, and I deeply believe that they can be tackled by science if we are prepared to focus our efforts and eliminate classical boundaries between certain public institutions, but also between public and private institutions. Creative public–private partnerships are needed, as well as transparent and proactive discussions with the public, in order to create an understanding of why research is performed and why it needs public money.

Finally, academic institutions have to think in a long-term perspective, probably more than currently, about their strategic positioning, inner academic needs and future trends. In addition, I believe that national academies and European academies can render vital assistance to the great academic institutions in such a necessary process. In doing so, academies can and should argue for increasing involvement of the public in ongoing discussions about the role and benefits of science.

Reference