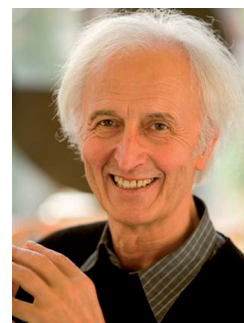


# Fundamental Research Needs Excellent Scientists and its Own Space\*\*

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**"M**y main motivation was to prepare myself to comprehend the phenomena of corporeal things in their general connection; to embrace Nature as a whole, actuated, animated by internal forces."<sup>[1]</sup>

**T**hese are the words with which Alexander von Humboldt introduced his life's work "Kosmos"—a monument to fundamental research—in 1845, and, even today, many natural scientists will probably agree with him: We have made a profession of science because we are curious and, in the spirit of Schiller, do not live *off* science, but above all *for* science.

**F**undamental research itself lives off the scientist's desire to explore new territory, to discover and investigate the unknown in order, finally, to be able to explain it—and this is usually a protracted process, fraught with setbacks.

**B**ecause the subject of research is often difficult to convey to others and its primary goal is initially just to understand the subject better—all of which takes time and money—fundamental research is increasingly encountering pressure to justify itself: it has become vulnerable.

**I**n its recently published discussion paper "The Prospects for Chemistry", the German Chemical Society clearly comes down on the side of fundamental research, but, at the same time, its President, Michael Dröschner, expresses concern about the current situation regarding research policy in Germany and Europe: "... pure curiosity- and knowledge-driven research," he writes, "are in danger of becoming marginalized"<sup>[2]</sup> because the rules of economics are visibly gaining the upper hand. What can we do about it? It is essential to

## Fundamental research is essential

generate awareness amongst people in general that publicly financed fundamental research is neither a luxury nor a subsidy, but a cultural achievement and, as such, marks the starting point of every single value-added chain. How right Sir Michael Faraday was when he responded to Lord Gladstone's query as to whether his expensive, tax-funded research on electricity and magnetism would be of any use by saying "Yes sir, one day you will tax it." Precisely—GPS devices would not exist without Einstein's work on the theory of special relativity. Fundamental research is essential if we are to secure the future because none of the burning issues of the day can be solved without it.

**"D**anger" threatens, but not only from without: in science administration, too, an attitude seems to gain momentum that is so overwhelmingly in favor of project funding that opposing voices

have started to appeal to "fund people, not projects".<sup>[3]</sup> Of course, it would be artificial and counterproductive to try and construct an opposition to this issue because there are themes that are so complex that they can only be addressed by research associations, for example. But here, too, the advocates of programme and project funding have to accept that, without exception, crucial breakthroughs are always the result of a random combination of creativity, intelligence, curiosity, persistence, and serendipity, and that what lies behind major discoveries or inventions is usually the passion of individual people. Just like people in love, they are barely able to provide a convincing explanation for their fervor for science; they may feel intensely passionate about their work but also pace the corridors of their institutes with downcast eyes, sit at their café tables with a peculiar smile on their lips, leap out of bed in the middle of the night to note down an idea, send a message, or quite simply stare at the star-lit sky, reliving the magical sound of a Mozart sonata: dreaming, musing, and perhaps seeming to follow a path as yet unmarked by signposts pointing the way to the pinnacle of knowledge. Precisely because fundamental research is not intrinsically predictable, it is essential to reward those who have the courage to conduct genuinely high-risk research. If we do not do so, in the long run, it will be almost impossible to avoid ending up with mainstream research that lacks imagination and vision. And the danger of locating the majority of our research topics and approaches in familiar territory could become quite serious.

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If one argues for generously funded, excellent fundamental research, one implicitly campaigns on behalf of the individual researcher. Whilst science (and, indeed, culture in general) is like a mosaic composed of many tiny, separate parts, crucial breakthroughs are nearly always the achievement of individuals. Let's make no mistake about it: without Goethe, the definitive "Faust", the "Elective Affinities", and all that incomparably beautiful poetry simply would not exist; without Mozart, we would not have "Così fan tutte"; also without Watson and Crick, the DNA structure would have been elucidated some years later, but the *Nature* article, which has become the icon of the life sciences, would not exist.

Furthermore, the recent Review by Eschenmoser on the chemistry of life's origin demonstrates impressively how much the language and the content of a scientific article can be mutually enhancing.<sup>[4]</sup>

Of course, all groundbreaking changes would have happened at some stage; but even so, it would always have been individuals who came up with the vital idea and battled on boldly, behaving—possibly quite unconsciously—according to Lao Tse's maxim that "if you want to reach the source you have to swim against the current". And if scientists are going to achieve this goal they should not be restricted by too narrowly defined time and target setting—rather, they need funding continuity, space, and trust. This is the demand at the heart of a manifesto entitled "Trust Researchers"<sup>[5]</sup> signed by 13 000 researchers and submitted to the European Council of Ministers and the European Parliament. In Germany, we have already set out along this path: three years ago, we established the Alexander von Humboldt Professorship, and the success of the idea is evidenced by the fact that this funding tool for recruiting world leaders in research is already being emulated in many different places.

However, generous funding is required much earlier on. Junior researchers

should be empowered to act independently at an early stage in their careers; they should not be the servants of established colleagues but be able to operate as researchers and teachers in their own right. Their decision to measure themselves against their peers in high-risk fields needs our moral and material support. And here, too, the Alexander von Humboldt Foundation's sponsorship philosophy is to some extent exemplary because the talents who are prepared to venture off the beaten track in order to try out their unorthodox ideas are the very ones we have been sponsoring for the last 60 years—with a considerable degree of success.

### ***Crucial breakthroughs are nearly always the achievement of individuals***

Despite the undisputed importance of non-university research institutions, it must be emphasized yet again that fundamental research should not withdraw from the universities, nor should this happen because certain politicians entertain specious fantasies about potential benefits for cost reduction. After all, universities have nearly always been places in which the primary aim of all efforts was to gain new knowledge and insights, in which scholarly thought focused on themes and issues which might only reveal their true significance, practical use, or everyday applicability decades later. Today, the danger of subjecting this institution to excessive entrepreneurial activities cannot be ignored; automatically prioritizing projects that have a short time-scale and the potential for quick marketing success reflects an attitude that is spreading like a contagious disease. It is displacing long-term, curiosity-driven research as the core of intellectual activities and practical efforts, and diverging from Kant's principle that "utility is in the first instance only a moment of secondary importance."

For this reason, it is imperative that universities continue to be places in

which teachers teach their students the concept of fundamental research as a cultural achievement. To accomplish this, bachelor's and master's courses—and we are not by any means just referring to chemistry—must impart broadly based knowledge. Specializing too early would be counterproductive because it might produce a well-trained scientific technician, but definitely not a researcher capable of cutting a path into the genuinely unknown.

We should never forget that trust in the achievements of research and the provision of a creative environment constitute the most important assets in science—and without science we are unlikely to be able to construct a future that is worth living. Max Planck's remark that "insight must precede application"<sup>[6]</sup> is still as pertinent as a guideline for action as it has served to this very day as a precept of Germany's Max Planck Society. And the words written by Vannevar Bush, scientific advisor to President T. Roosevelt, in his draft of the Harvard Commencement Speech 1945 should be the creed of all research funding organisations: "Scientific progress on a broad front results from the free interplay of free intellectuals, working on subjects of their own choice, in the manner dictated by their curiosity for exploration of the unknown." Research institutions that act on this principle, such as the Max Planck Society, do not need to be persuaded how true and meaningful this recommendation is.

- [1] A. von Humboldt, *Kosmos. A General Survey of the Physical Phenomena of the Universe, Vol. I*, Hippolyte Baillière Publisher, London **1845**, pp. VII–VIII.
- [2] *Perspektiven der Chemie. Ein Diskussionspapier aus der Wissenschaft für die Wissenschaft* (Ed.: GDCh-Präsidentenkommission), September **2011**.
- [3] J. P. A. Ioannidis, *Nature* **2011**, 477, 579.
- [4] A. Eschenmoser, *Angew. Chem.* **2011**, 123, 12618; *Angew. Chem. Int. Ed.* **2011**, 50, 12412.
- [5] <http://www.trust-researchers.eu/>.
- [6] M. Planck, *Naturwissenschaften* **1919**, 48, 124.