

The Role of Fundamental Science in our Society: Do we need a new Enlightenment?

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The Humboldt Foundation celebrates on a regular basis the achievements of Friedrich Wilhelm Alexander Freiherr von Humboldt, one of the true pioneers and perhaps the last great generalist in natural sciences. We just had a Humboldt conference in Dunedin in January this year, very similar to the DAAD meeting here in Auckland. This time, the Dunedin meeting was focused more around Alexander's older brother, Friedrich Wilhelm Christian Karl Ferdinand Freiherr von Humboldt, born 1767 two years before Alexander von Humboldt was born, a German linguist and philosopher, a government functionary and diplomat, founder of the Humboldt University in Berlin, and friend of both Goethe and Schiller. He often stands in the shadow of his younger brother Alexander, but to my opinion this is not justified, as we need again Wilhelm's revolutionary ideas, now more than ever. Let me explain.

Wilhelm von Humboldt was a well-known and highly respected philosopher in his time who published in 1810 the essay "**On the Limits of State Action**". (Just think about this interesting title) In his essay he describes the development of liberalism and the role of liberty in the individual development and pursuit of excellence, where the state or government must not be allowed to limit these actions. Of what Humboldt called the Enlightenment is often closely linked with the Scientific Revolution emphasizing reason, science, and rationality against intolerance. It is the source of critical ideas, such as the centrality of freedom, democracy and reason as primary values to our society. Freedom to teach, the unity of teaching and research, and academic self-governance are key factors associated with his ideas. The German Constitution specifically incorporates academic freedom by stating that "Art and science, research and teaching are free." It embraces the right of professors to determine the content of their lectures, and to publish the results of their research without prior approval, of course within the limits of human rights. In France, researchers and teachers are fully independent and enjoy full freedom of speech in the course of their research and teaching activities, provided they respect the university code of ethics, and the principles of tolerance and objectivity.

I do not know if you agree with me, but I see freedom of research and teaching slowly going out the window. In light of the contemporary moves to transform universities into commercial enterprises by subjecting them to the values of the so-called market force, the traditional idea of a university is to my opinion in great danger. You are being transformed into a **Knowledge Economy** with clear emphasis on the last word, that is economy. Liberal ideas are here combined with capitalism to a new pseudo-philosophy called the "**The Third Way**", which stresses technological development, education, and competitive mechanisms to pursue economic progress and governmental objectives. The

Third Way pushes for growth, entrepreneurship, enterprise and wealth creation and promises greater social justice. It sees the state playing a major role in bringing this about. In the university sector this transformation is already called the **Third Academic Revolution**. Jennifer Washburn writes in her book called *University Inc.*, “In higher education today, a wholesale culture shift is transforming everything from the way universities educate their students to the language they use to define what they do. Academic administrators refer to students as *consumers* and to education and research as *products*. Published work by academics simply become *outputs*.” Robert Zemesky and co-workers write in their book on *Remaking the American University*, “We can no longer expect from the public or its political leadership to be particularly moved by the fact that higher education’s mission is just to educate and conduct research”.

While many of us would perhaps not object to this radical change in the educational sector (I do, but this is another matter), what is simply wrong however is that we transfer these neo-liberal, or should I say neo-capitalistic, ideas without any discussion or debate into our universities, and that at the cost of what I call the traditional non-commercial areas like fine arts, music, the humanities, and last but not least the fundamental sciences. That is we slowly abandon our values traditionally placed on knowledge for its own sake (*L’art pour l’art, la science pour la science*). We seem to easily accept notions like “We have to justify spending tax-payers money by becoming more user-oriented”, or “New Zealand as a small country should concentrate of what is important to our economy and environment”. Even basic science undergoes a face-lift, transforming it into user-inspired or user-driven basic science. This clear shift towards the commercial end of science is not only seen here, but also in other countries, like the US, UK and perhaps more recently in Germany as well. In the UK out-of-fashion departments (such as philosophy and literature, or even chemistry and physics) are threatened with closure. 14,000 redundancies are currently looming over the heads of UK academics in order to save a massive amount close to a billion pounds as a consequence of the current recession. Most redundancies are expected to come from low-income earning faculties like the humanities. In a recent article in “**The Higher Times Education**” entitled “A clear and present danger” it was stated that (and I quote) “Many scholars feel that their freedom to question is in danger of being eroded or even lost. A great many UK academics consider the biggest threats to academic freedom to be increasing commercialism and managerialism. Teaching has been reduced to “box-ticking” and “learning outcomes”, they complain, while research must increasingly be configured around the agendas of others.” Sounds familiar?

As a consequence of such market-oriented policies in tertiary education, a major controversy is taking place internationally, regarding the value of fundamental research in our society. It resulted for example in an international workshop on basic research sponsored by the OECD in October 2001 in Oslo. They concluded that “We face difficulties in the public sector research, in particular due to the increasing demand for accountability. While most scientists are ready to accept a certain prioritization of research topics with regard to socio-economic objectives, most find it difficult to cope with this demand. There should still be a place for long-term research, and private funding of public institutions would only be acceptable under very rigorous conditions.” Furthermore, it was questioned if the distinction between basic and applied research is still relevant. Let’s think about this for a moment.

Science is broadly defined as gathering of knowledge, as Sir Francis Bacon said *Nam et ipsa scientia potestas est - and thus knowledge itself is power*. The word science (scientia, knowledge) might be better described by the German word “Wissenschaft”, which includes not only the natural sciences and mathematics, but also social sciences and humanities. Let me define of what is currently understood as basic and applied research, and introduce a third term which I call commercial science.

- *Basic, fundamental or pure research* is driven by curiosity with the main motivation to expand our current knowledge base. According to Vannevar Bush, who created the *National Science Foundation* in the United States, basic research is performed without consideration to its practical ends. Its object is discovery, which involves both high risk and speculative research, and is often of long-term nature. To give a few examples: mechanistic studies of organic reactions, quantum dynamic simulations of molecular reactions, string theory in theoretical physics, and evolution theory in the biological sciences all belong to basic research. There is no obvious or immediate commercial value to the discoveries that result from basic research.

- *Applied, project oriented or strategic research* is solely driven to solve practical but important problems rather than to create new knowledge. The goal of the applied scientist is (and should be) to improve the human condition. Best examples are the development of anti-cancer drugs, how to cope with the global warming problem, the up-coming energy crisis, or future water shortage, the development of new materials (superconductors, conducting polymers, catalysts, bio-degradable packaging materials, *etc.*), green and sustainable chemistry, and so on. Applied research is of short to long term.

- *Commercial research* is solely driven by maximizing income (or minimizing costs), but can often be to the benefit of the customer (or the end-user to use modern bureaucratic jargon) for example by producing cheaper materials. A good example here is the traveling salesman problem well known in applied mathematics to minimize transport costs, or blending and improving wine suitable for the wider market. Commercial research is often of short-term nature.

There is no doubt that world-wide there has been a clear shift in funding towards the more applied and commercial end of research in our universities, away from the more traditional areas. As a result of this (to my opinion) rather questionable academic transformation toward commercialism, universities in New Zealand and Australia (with a few exceptions, I only mention the ANU in Canberra here or Auckland University) are not doing so well in the international ranking lists of universities. Moreover, let me ask, if all this money on commercial university research is really well spent? Not that I am against applied or commercial science, but according to the OECD, 60% of R&D projects reach technical completion, and only 10% earn some economic benefit. In fact, only few universities in the US are successful in generating the sort of high-tech growth in collaboration with industry we all dream about, despite the enormous time and money spent to boost commercial science. Hence, sentences like “Science makes us rich” (as one Vice-Chancellor in New Zealand recently said) express a rather naïve way of thinking. The fact is, that NZ is no different to the rest of the world, in that our R&D system has

struggled in the past (and still does) to successfully commercialize the outcomes from applied research that emerge from our research institutions. According to the OECD our performance on the number of international patents is less than satisfactory in comparison to the rest of the world. Perhaps we should listen to *Haldor Topsøe*, chairman of the Denmark-based catalysis and high-tech company that bears his name, as he recently warned: “If in your science you only look for business, then you risk finding neither knowledge nor business”. In other words, we need more long term research and a good mix between both applied and basic science for a major scientific breakthrough which earns us the millions we all dream of. But we should also remember Vannevar Bush who once said: “We must strengthen the centers of basic research which are principally the colleges, universities, and research institutes. These institutions provide the environment which is most conducive to the creation of new scientific knowledge.” And Wilhelm von Humboldt wrote 200 years ago, “Science is the recognition of the invisible in the visible. Limiting science to the collection of facts with emphasis on applications only, becomes merely hollow and empty”. Albert Einstein once said: “I have little patience with scientists who take a board of wood, look for its thinnest part, and drill a great number of holes where drilling is easy.”

So, how on earth did we end up in this for academics highly unsatisfying situation? Here I mean the strong push towards applied science and commercialization. No doubt, the current recession puts universities under enormous financial constraints grasping for any additional revenue they can get. In such difficult times politicians listen to questionable messages like the one propagated in John Horgan’s book “The End of Science” published in 1996, which caused an international debate in science policy. Horgan says: “Fundamental science as we know is coming to an end because it is close to achieving its final goal, explaining all of nature.” Books and opinions like the one expressed in Horgan’s book, have led to the interesting but debatable notion, that money should therefore be shifted towards the applied and commercial end of science as basic science is more or less done and finished. This surely is utter nonsense, as we still do not have a theory of everything in physics, still don’t understand how high-temperature superconductors work, have no idea how and why the big bang started, do not understand how chemical and biological evolution started on our planet, don’t understand the origin and cause of some of the most common forms of cancer, and so on. It may be that there is a limited amount of funding available for basic research world-wide and particularly within New Zealand, and competition to obtain research grants is ever growing. But we are perhaps at a turning point right now and have to ask: Should we loose our international competitiveness by mainly supporting applied and commercial sciences at the cost of fundamental science?

Let me conclude now by pointing out what I believe should be discussed and debated in this country:

- Most countries have different pools of money for fundamental and applied research. Should we even distinguish between fundamental and applied research, should we not just go for excellence irrespectively if it is applied or fundamental? Nobel-Prize winner Gerhard Herzberg once said “I don’t know the difference between applied and basic science, I only know the difference between good and bad science.”

- Universities world-wide are pushing towards commercialization of research. Employment of new academic staff is more and more focused on links with industries. If universities become little more than industrial outlets, will they be able to generate new knowledge and innovation and remain competitive in a global education market? Should we not distinguish ourselves from the strategic research carried out at New Zealand's Crown Research Institutes?
- Is academic freedom under threat by pushing researchers more and more towards the applied and commercial end of science?
- In order to preserve excellence at universities, some countries provide extra funding to very few so-called elite universities. Could this funding model work for New Zealand limiting the resources only to few well-financed research-led universities which stay internationally competitive?
- University courses concentrate more and more on strategically important subjects, for example nanoscience or biotechnology, and more recently on commercialization aspects of science, clearly at the cost of fundamental knowledge. Courses at universities are more and more tailored towards specific needs and subjects to suit the future market instead of teaching the fundamentals. Are students not missing out on a good and broad education?
- And finally academic staff in humanities world-wide are dwindling, as they earn little to no income from industries. This creates a significant imbalance across the many disciplines. We have to protect arts and humanities and perhaps fund them in a more balanced way compared to the sciences.

I leave you with these thoughts. I do believe that it is about time to critically discuss and analyze these issues. To my opinion, New Zealand needs to rethink its science policies to strengthen the support for fundamental knowledge. I conclude with Alexander von Humboldt who once said "Nature is perfect till man deforms it". You can interpret this sentence in many ways. Thank you.

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