

## Towards asking adequate questions about knowledge for society

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Science has radically changed the meaning and content of who we think we are over the last 150 years (Comfort, 2019). Even though such changes may cause some caution, it is still customary to highly value and trust science and scientists. Some 80–90% of citizens of developed countries express trust to science. This is of course highly appreciated by scientists. A closer look may provide a different picture and even reveal massive mistrust to science-based developments in specific fields. For example, a study by Imperial College highlighted a few years ago that 41% of French people think that vaccination is dangerous.

A common perception is that scientists must have extremely rich fantasy. Perhaps the greatest science fiction writer of all times Jules Verne (1828–1905) was convinced that in the future science will be ahead of our fantasy. He was correct in another sense: that science may devitalize the fantasy. Since the Enlightenment time, “we have tended to define human identity and worth in terms of the values of science itself, as if it alone could tell us who we really are” (Comfort, 2019).

Developments in biological sciences have cracked much of our DNA code. Genome (or DNA) sequencing has changed from a privilege of a few to a part of mass culture. A person, however, apparently is much more than simply a realisation of his or her DNA in flesh and intellect. This claim has a fundamental justification (Sender et al. 2016). “Even in strictly scientific terms, ‘you’ are more than the contents of your chromosomes. The human body contains at least as many non-human cells (mostly bacteria, archaea and fungi) as human ones” (Comfort, 2019). On the one hand, „tens of thousands of microbial species crowd over and through the body, with profound effects on digestion, complexion, disease resistance, vision and mood. Without them, you don’t feel like you; in fact, you aren’t really you.“ (Comfort, 2019). On the other hand, from the viewpoint of immunology, they are part of us. Being a human thus means a common house with astronomical quantities of „alien“ organisms.

In parallel, it has been commonly accepted that society should mostly function based on facts and universal truths. This feature is often underlined when one talks about decision-making or policy shaping. This position seems to systematically ignore other values as well as emotions and opinions of many people.

Several fundamental developments in science such as the theory of complex systems or theorems of incompleteness by Kurt Gödel signal that we should be careful with such a position. They tell that science generally does not provide and even cannot provide ultimate truth. Science only provides the best available information that is made systematic and generalised in the best possible manner.

Still it is true that science has over millennia systematically expanded the meaning and content of being a human. Without science (and thus science-based innovation) we are probably not able to construct a future worth of living, said once foreign member of the Estonian Academy of Sciences Helmut Schwarz.

However, the promotion of science as the best or only objective means by which society should determine all the values and solve all the problems of society is definitely not the way forward. This position called scientism has basically the same shortages as most of „–

isms“ and generally fails to carry on values of society or scientific landscape. Alfred Adler (1870–1937) commented many years ago: „It is easier to fight for one's principles than to live up to them“.

Peter Drucker, the man who invented modern business management, wrote: „You can't manage what you don't measure.“ Not surprisingly, there are many attempts to measure (the value of) people. These attempts were straightforward some 150 years ago when Thomas Henry Huxley ordered the skeletons of a gibbon, orang, chimpanzee and gorilla to march towards a human (skeleton). This sketch recognised that we are part of Nature but also hinted that we could be the Crown of Nature.

Carl Gustav Jung made things clear by writing: „The world will ask you who you are, and if you don't know, the world will tell you.“ German psychologist William Stern (1871–1938) tried to help the World by inventing a clever quantity to characterise the ratio of the mental and physical age of people.

His American colleague Lewis Madison Terman (1877–1956) multiplied this ratio by the factor of 100. (He possibly liked large numbers.) It is now common to measure single people, various groups and entire populations using the intelligence quotient IQ. It was massively used for the first time during the First World War to separate 1.75 million US military men into five categories. The best were trained as officers. It is not clear whether this helped to preserve the most intelligent persons as in the war the officers are often the most hunted targets.

It is of course convenient to follow the words of George Orwell: „Every generation imagines itself to be more intelligent than the one that went before it, and wiser than the one that comes after it.“ The first half of this self-deception is a side effect of the development of science. Namely, the IQ gradually increased worldwide during the 20th century. This feature is called Flynn effect (Flynn 2012; Pietschnig, Voracek 2015). This trend unfortunately has changed. Analysis of IQ tests of Norwegian young men over 30 years (born 1962–1991) demonstrates that the IQ of the entire population has decreased over this time period (Bratsberg, Rogeberg 2018). In this context, I can only agree with sarcasm of Aldous Leonard Huxley: „Technological progress has merely provided us with more efficient means for going backwards.“

The problem is that „IQ became a measure not of what you do, but of who you are — a score for one's inherent worth as a person“ (Comfort, 2019). This ignores functions like long memory, creative mind or providing connectivity in society. IQ would have been an excellent tool for lovers of indicators and Excel tables to position yourself on the top of the Universe and draw graphs about an increase in the IQ of people and communities. The problem here is that (i) nobody knows how to increase it and (ii) which kind of benefit the increase would provide. Being a *homo socius* means much more than simply the ability to solve logical problems on paper. It is „the capacity for logic, understanding, self-awareness, learning, emotional knowledge, reasoning, planning, creativity, critical thinking, and problem solving“ (Wikipedia). In particular, the capacity to use own experience for the benefit of many. As Aldous Huxley told: „Experience is not what happens to you; it's what you do with what happens to you“.

A corner stone of these features is efficient and long memory that is inherently linked to self-realisation and understanding of who we are. The longer is history, the more we need

to memorise. The memory horizon of much of contemporary science is generally very short. The rule is tough: prove yourself within 2–3 years or perish.

In a more detailed look this principle is severely oversimplified. It is possible to look into patterns that characterise the most influential research (Mukherjee et al. 2017), namely, the „hottest“ publications that served as forerunners in their research fields and impacted the entire field.

Such publications had two major pillars. One was formed from the most important works in the particular research field over last 2–4 years. Another pillar consisted of a long series of references to the major works in the past. This series normally extended over more than 20 years, that is, over at least 1.5 generations of research in the area. If one of these was not there, the publication had no chance to be forerunner in the field. Like Estonian poet Juhan Liiv wrote: „Who does not remember the past, lives without future.“ In order to be strong, the system of roots must not only wide but also penetrate deep into soil.

The roots towards the past usually form a multi-link chain. Contemporary data bases of research publications contain tens of million papers. Most of them have been used (cited) in subsequent publications. From all works cited in this manner, 80% have been used explicitly or implicitly in U.S. patents over the last 50 years (Ahmadpoor, Jones 2017). Therefore, investments into international publications are the core pillar for almost entire technological progress.

Twenty years of identifiable link between the cutting edge knowledge and its foundations is an almost invisible time interval. There exist much longer links between the current knowledge and culture, and the richness of the past. This cluster of links is more like a bunch of chains. The challenge today is not only to preserve and store memory and changes, build new and important knowledge and communicate it to others – that is the essence of science. Additionally to what we say it becomes increasingly important to understand how people and society interprets our results. People who are far from the research amazingly often suggest important interpretations that are overlooked by professional (and very busy) scientists.

Accountability of science has become even wider. It is not any more simply serving society and even not simply driving society. It's about co-responsibility of scientific landscape and society. It's no more about asking challenging scientific questions. It is gradually more about talking to society. And here the core questions are different. In the formulation of the great German climate scientist Hans von Storch we should ask questions like: What society would like to ask? What society already knows (even if it is wrong)? What society thinks it knows? What society would do with the (correct) answer? Answers to these questions will eventually guide us towards feasible solutions to the core question of science: how to construct a future worth of living.

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