Kjetil Rommetveit:
What can history and philosophy of science teach us about the development of a European research Area?

Critique of the received view/The co-productionist perspective.
What Roger just called the received view still lives on in western culture, and it has reality (as already mentioned by Roger, and as I shall return to) in policy strategies such as those of the European Union (Horizon 2020 etc.). However, inside the history and philosophy of the sciences it seems fairly safe to say that the received view has been thoroughly debunked: from hermeneutics (Heidegger), phenomenologists (Husserl) and philosophers of language (Wittgenstein) and pragmatists (Dewey) in the early 20th century, and later (especially) through Kuhn's theory of paradigms through to science and technology studies, but also postmodern and interpretative theories more generally. Problematizing the linear and received view, the report follows up on such theoretical developments by using perspectives from science and technology studies that can be united under the heading of "co-productionist". As stated by historians Steven Shapin and Simon Schaeffer (1985, 332):

Solutions to the problem of knowledge are solutions to the problem of social order".

That is: as long as the West has called itself modern, it has relied on complex mutual interactions between what we called Nature and Society (or science and politics). Main sources of legitimacy in the West have come from either Nature, i.e. the discovery of universal laws of Nature through science; or from Politics and Law, and these are things such as the universal and inalienable rights of Man, democratic representation, and the division of powers. What the co-productionist perspective brings to the table is the systematic study of how these sources of legitimacy and order (in the West) were actually much more closely related (i.e. *co-produced*) than commonly recognised in our institutions and knowledge producing disciplines. Today, as climate change enters the top of political agendas, and as technoscientific innovations are projected as solutions to main political and economic challenges the perspective seems even more pertinent: it is no longer a given that western societies actually try all that hard to separate between science and politics. However, this poses severe questions for legitimacy, but also for societal organisation and collective action to deal with our most pressing issues: if we cannot neatly separate between that which we take to be true (scientific facts) and that which we will or ought to do (politics): how are we to decide on issues of great common concern? When we are stuck with our daily preoccupations these problems do not come into view easily. However, a detour through history and philosophy of the sciences can bring them more clearly into view. As I shall return to towards the end of this talk, and as our report highlights: we are today quite far off when it comes to dealing with challenges of legitimacy and order in ways that can be deemed sustainable and legitimate, in both scientific and political terms.

Although my main purpose is to say something about the present, I shall first make a detour back into history to illustrate how we deploy the the term co-production of Nature and Politics. I rely upon science and technology scholars, such as Steven Shapin and Simon Schaeffer; Sheila Jasanoff and Bruno Latour, but also philosophers Charles Taylor and Stephen Toulmin. In his book on *Modern Social Imaginaries*, Charles Taylor describes the beginning of modernity as basically concerned with the question of *order*, and this quest took place against the backdrop of the thirty years religious war in Europe. Taylor's main protagonists are John Locke and Hugo Grotius. He describes how, in the 17th and 18th centuries "the economy" came to be defined as a separate sphere of action. In the 19th century it became a main

constituent of society, with it's own institutions and even a profession devoted to its study and maintenance, i.e. economists. Other such independent spheres, which also became prominent in the 18th and 19th centuries, were those of the public sphere and representative democracy. The public sphere became seen as an independent site of meaning formation, existing outside of, political society. As with the institutions of representative democracy, the role of the public was to keep checks on the power of the state system, but also to deliberate about issues of common interest.

Following the co-productionist perspective the report complements the account of Taylor by also highlighting how thinkers and scientists generally associated with the natural sciences, such as Descartes, Galilei, Bacon and Newton, were also fundamentally concerned with the same problems of stability and order (as were the political philosophers, cf. Toulmin). Indeed, when Descartes retreated to his study to carry out his meditations on the first principles of natural philosophy (and came up with his famous *Cogito Ergo Sum*), it was precisely because he saw no other way out of the religious and political quagmires of his time. It was there, isolated in his study, that he thought up a new path of progress through rational and indubitable first principles. Sure, the result of his meditations, a specific outlook on nature, was rooted in the new natural sciences. But it was also very much a response to the situation in which he found himself. Descartes sought to drive out irrational forces and superstitions, such as gods, spirits, magic and mystical forces, and to replace them with something that was beyond doubt, strife, and endless discussion; he also very much wanted to end war, and this motive can hardly be seen as separate from his thinking. When he finally arrived at (what he saw as) ultimate certainty, he did not find it in culture or in politics; he found it in Nature and in mathematics: the indubitable properties of mass, extension and movement through which Nature could be fit into a geometric scheme.

Descartes principles found their way into the more comprehensive scientific analysis of Newton who, through his three laws of motion provided an outlook on the world as thoroughly governed by eternal and stable laws. More or less at the same time, that is, in the early 17th century, also other philosophers had introduced the concept of law: Gianbattisto Vico would talk about laws of history; Hugo Grotius had introduced the notion of universal laws in jurisprudence and in politics. Clearly also important, political leaders negotiated the Peace at Westphalia, following which peace, law and order could be integrated into international treaties. Neither of these factors can be regarded in isolation: they must be seen as mutually constituting, as establishing a fragile equilibrium, and order. To return to the theme from Charles Taylor: Of lasting importance to western order was the idea of neutral or independent spheres of acting and knowing, and that these spheres of action had their parallels in underlying and non-changing laws of nature. Science would gradually single itself out as an activity sharply separated from politics; the economy was gradually seen as a neutral sphere (i.e. the invisible hand of the market) through which citizens could engage in mutually beneficial competition; law was seen as (in principle) separate from politics and business. In a sense underlying this was the prism of physics, provided by Newton, enabling imaginations of nature as steady clockwork of interlocking mechanisms. The economy was also re-created in this image: it came to be seen as organising mutual interlocking purposes (for mutual benefit), and so mirrored the Newtonian image of nature as a mechanical clockwork. And as for the human being: the economic agent, seen as rational and calculating, had something in common with the scientific observer of Nature. The sciences therefore, and especially those dealing with nature, became mirrors through which both Nature and Society could be imagined as guided by stable laws. This illustrates how it is wrong, as is frequently done, to see natural sciences as simply concerned with facts (although practitioners of the natural sciences, and

others, routinely describe themselves in such terms). It is also wrong to state that science decisively drove out pre-modern cosmology; rather, it replaced it with another. This new, and modern cosmology took physics as a main point of reference, but it crucially also enabled the spheres of law, history, the market, etc. Thus emerged what the report, following philosophers Stephen Toulmin and Charles Taylor, call The Modern Framework:

the decisive accomplishment of the modern framework was that of establishing an ecology of ideas and practices that were mutually balanced against each other. This balance of forces must be seen as highly delicate and in need of constant renewal and care; the most clear-cut articulation of balancing separate spheres was upheld through new political institutions that gradually became based upon a balance of powers. The main function of this balance was not to achieve efficiency and progress (for this, authoritarianism may have more on offer); it came out of the realisation that power may also corrupt, and must be kept in check: by Parliament, by the constitution and the courts, by civil society and the public sphere, p. 57.

The modern framework was not static; rather, it was dynamic and kept changing along with social, political, scientific and natural developments and events. Throughout western history notions of order in the sciences and in societal institutions have been feeding into each other. This even implies that periods of social and political stability, such as the one that emerged after the Peace at Westphalia, have been able to enjoy a relatively stable underlying cosmology as provided by the sciences (in that case Newtonian). Conversely, major social unrest and upheaval have frequently come along with changes to the underlying sources provided by the sciences. Thus, whereas the Newtonian image of Nature prevailed throughout the 18th century, the political and industrial revolutions ushered in a different set of sciences, what Michel Foucault has called the Sciences of Man: Medicine, biology, political economy, statistics, and so on. Towards the second half of the 19th century, ideas about evolution and free markets had settled firmly into establishment thinking. As we know from Foucault, evolutionary theory and political economy came to the forefront of political and social consciousness during the same time, and both fed into the ruling ideology of the European bourgeois class. Ideas about self-interested individuals engaged in competition and the struggle for survival were imagined against the background of mutual advantage through the interlocking mechanisms of global markets, i.e. Adam Smiths notion of the *Hidden Hand*. Ideas about growth and the creation of value percolated back and forth between the life sciences, the theories of social scientists, economists, expanding markets and industries (and, we may add, the ruling ideology). Taken together with the growing prosperity and power of European nations, the idea settled that a rational and positive basis had been established, and that progress would follow in a linear manner. As for the natural sciences: The Sciences of Man did not interfere with the old image of a stable Newtonian universe but were layered on top of it, enabled by an underlying separation between organic and inorganic matter (what the physicist Erwin Schröedinger would later term “complimentarity”). However, in the times just preceding the first world war, the certainties of the Newtonian stable universe were shattered by Einstein’s theory of relativity. The writings of Marx, Nietszche and Freud (and, in mathematics, Gödel) further undermined the notion about an ordered universe guided by stable laws; in stead they postulated dark underlying forces repressed by Modernity and ready to re-emerge at any time, which was exactly what happened (no simple causality intended here!)

The cosmology established through the Sciences of Man (economy and the life sciences), of free markets and competitive evolution, continued to thrive also after the two world wars, and also co-evolved with the strong growth experienced by western societies in the post war

period. In this period science and technology have grown radically along with industries and government through what US president Dwight Eisenhower termed the industrial military complex (and, as we point to in the report: Eisenhower meant this as a warning).

"Akin, and largely responsible for the sweeping changes in our industrial-military posture, has been the technological revolution during recent decades. In this revolution, research has become central; it also becomes more formalized, complex, and costly. A steadily increasing share is conducted for, by, or at the direction of, the Federal government. Today, the solitary inventor, tinkering in his shop, has been overshadowed by task forces of scientists in laboratories and testing fields. In the same fashion, the free university, historically the fountainhead of new ideas and scientific discovery has experienced a revolution in the conduct of research. Partly because of the great costs involved, a government contract becomes, virtually, a substitute for intellectual curiosity. For every old blackboard there are now hundreds of new electronic computers. The prospect of domination of the nation's scholars by Federal employment, project allocations, and the power of money is ever present – and is gravely to be regarded. Yet, in holding scientific research and discovery in respect, as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite", Eisenhower 1961

Directly after the end of World War II president Franklin Roosevelt had written to the head of the US Office of Scientific Research and Development, requesting a report on the use of research for peaceful means and purposes. The resulting report, authored by Vannevar Bush, who was Roosevelt's scientific advisor, was called *Science – The Endless Frontier* and outlined how *without scientific progress no amount of achievement in other directions can insure our health, prosperity, and security as a nation in the modern world*. This was the beginning of state sanctioned research, development and innovation, which was qualitatively new, at least on the scale with which it now came about. Post-war science in the West deviated from the 19th century ideology of free markets through the central role ascribed to the government in providing the impetus for growth. It did not, however, question the assumptions of growth or competitiveness as such. Quite the contrary, it inserted scientific research at the very heart of the growth project: *Science – The Endless Frontier*. From this it projected a linear model of societal and economic benefit to emerge from basic science: as long as the scientists were provided with sufficient funding and freedom to experiment, they would also provide competitiveness and growth.

This model of linear growth has continued to flourish up until the present. It has been thoroughly refuted as too simplistic through empirical analyses by scholars in science and technology studies and innovation studies. It has been contradicted and ridiculed through proclamations of new eras such as postmodernism and post industrialism, by social scientists, philosophers and activists in the environmental and ecology movements. It has also been contradicted by policy developments themselves: According to the ideals of *Science – The Endless Frontier* governments were after all expected to provide generous funding to the sciences, but thereafter to leave them alone. This is not how today's performance-driven innovation economy works; rather, great resources are spent on measuring and guiding the impacts of scientific research on industrial innovation, and industry itself plays strong roles in guiding basic research, -for instance through the European technology platforms, and through expert groups and extensive lobbying.

However, a profound problem to which the report devotes some attention is this: in spite of strong efforts to usher in the so-called knowledge-based economy (i.e. through radically

upscaled efforts in fields such as biotechnology, ICTs, nanotechnology, robotics, artificial intelligence, ecotechnologies and neuroscience), severe problems attach to this policy project. To quote some main points from the report:

- The bioeconomy and the "information society" are not necessarily providing sustainability: biofuels increasingly compete with and take up land and energy from food production (Bowyer 2010); Cloud computing has been calculated to increase CO2 emissions due to the need to power servers and facilitate wireless access to the cloud (CEET 2013). It seems, then, that rather than replacing old forms of energy production, these technologies are inserting themselves at the top of existing energy regimes based on fossil fuels.

- Whereas technological progress has been steadily increasing, indeed accelerating, this has not translated into general welfare and jobs. In a much-discussed paper, the US economist Peter Gordon (2012) has argued that growth until the 1970s could rely upon a wave of useful innovations (such as electricity, combustion engine, running water, indoor toilets, communications, entertainment, chemicals and petroleum). Since that time, however, growth has been steadily slowing, in spite of the rapid spread of computers, the Internet and mobile phones.

- Brynjolfsson and McAffee 2011: *"there has been relatively little talk about role of acceleration of technology. It may seem paradoxical that faster progress can hurt wages and jobs for millions of people, but we argue that's what's been happening… computers are now doing many things that used to be the domain of people only. The pace and scale of this encroachment into human skills is relatively recent and has profound economic implications. Perhaps the most important of these is that while digital progress grows the overall economic pie, it can do so while leaving some people, or even a lot of them, worse off"*

Another complicating factor, to which the report also devotes considerable attention, pertains to the emergence of a different scientific world view, or what we may call new twists and turns to the technoscientific framework. More or less during the same period of time as the knowledge economy was starting to be implemented (i.e. since the early 70s), another set of sciences have emerged within a different narrative and a different cosmology that, to great extents, question the entire premises upon which the western economy and industry have been based since the 19th century. This cosmology first became known under the heading of ecology, and was initially connected to what became known as the movement of that name. The message of ecology blended in nicely with images of earth from the Apollo space craft: when seen from the moon the earth seemed fragile and vulnerable. A landmark event came with the 1972 report *Limits to Growth* (Club of Rome), which argued that the Earth's ecosystems were fast approaching their limits, and that global collapse could be expected around the mid 21st century. Shortly after that James Lovelock published his *Gaia hypothesis*, stating that life on earth has co-evolved along with the Earth's biosphere, and so is crucially dependent also on such geo-physical conditions as provided by Earth systems (hydrosphere, biosphere, atmosphere, lithosphere, heliosphere). Darwin, or subsequent evolutionary thinkers, who all proceeded on the assumption of development of individuals in a given environment, had not considered this interconnection between life and its geophysical conditions. However, adding the impact of growth and competition on the biosphere, and so changing the Archimedean point of view of analysis (i.e. from the point of view of global systems), has triggered grave concerns with the present course of developments. What started out with ecology and later evolved into Earth systems science and climate science, is now also

seeping into other fields of research. In 2000 the Dutch Nobel winning chemist Paul Crutzen proposed the concept of a new geological epoch, called the Anthropocene. The Anthropocene denotes the period of geological time in which human activities are recognized as having significant and lasting impacts on earth systems (geological, atmospheric, bionic, hydrologic, etc.). Crutzen identified the beginning of the Antropocene with the industrial revolution and, especially, with the increasing concentrations of CO2 in the atmosphere caused by it. *"The Anthropocene could be said to have started in the late eighteenth century, when analyses of air trapped in polar ice showed the beginning of growing global concentrations of carbon dioxide and methane" (Crutzen 2002).* Since then, the term has caught on, and in 2008 the Royal Geological Society of London proposed incorporating the term into the formal geological epoch division (Zalasiewicz et al. 2008). The notion of the Antropocene can also be found in other disciplines, such as archaeology, history (Big History) and ecological economics. The main point I want to make, however, is that both the Gaia hypothesis and the concept of Antropocene, are crucially opposed to the cosmology established by science, technology and industry arising in the 19th century, as they proceeded and accelerated in the post-war period, and became central to the knowledge economy from the 1970s and onwards. The Antropocene inserts its diagnosis at exactly that point in time, i.e. the industrial revolution, when the Sciences of Man established themselves, and so can even be construed as taking direct aim at these sciences and their related modes of socio-economic and political organisation.

In our report at least two decisive conclusions are drawn from these observations. One is descriptive and interpretative, in the sense that it deals with some of the basic categories through which we perceive of reality, significantly how science is allowed (or not) to inform main policy regimes. The second is related but refers more to how legitimacy and order were established through mutually constituting spheres of acting and knowing, in Nature and in Society, in Science and in Politics.

First, there is a genuine sense in which we seem to be stuck between different paradigms or scientific frameworks. We have seen how there has been previously in the history of the west transitions from pre-modern to science-based frameworks, and then transitions in terms of how different sciences, but also changes inside the sciences themselves, have been co-produced with societal developments and political regimes. Fundamentally, the sciences of man, i.e. life science and economy, enabled new imaginations of societal order, as it were feeding into a first wave of capitalist expansion and globalisation. It may seem that we are today living a similar transitory phase, in which the geo-based sciences come to set the agenda to greater degrees. The point here is not that "we need to take climate science seriously", although I tend to agree with that statement. The analysis is one of the western moral and political imaginary (and institutions) as crucially dependent on the co-production of science and society, nature and politics. Each time the West remade itself, its ideas and its institutions, change tended to be mirrored and mediated through changes in the underlying scientific base. This base never worked according to the strict prescriptions of science, to its numbers and methods. But science provided a crucial repository for the construction of a wider cosmology, of which political and legal institutions were also part. For this purpose, mathematical rigour and empirical exactness were never enough; what was necessary was the capacity of science to serve as a resource, a wider framework, for conceiving of the place of humans in the world.

At present it seems that the West is capture to (at least) two diverging grand storylines about it's broader fate, to competing techno-scientific cosmologies that cannot be easily squared.

One continues to proclaim the endless frontier and growth as the solution to our most pressing problems, the other proclaims decisive limits to growth and looming disaster if we do not change course. One takes as it's starting point individuals engaged in competition and the struggle for survival; the other emphasises the fundamental interconnectedness of biological life and civilisation with Earth Systems. The main knowledge policies of the West, and of the EU, are still embedded within economic and political institutions that have their roots in the 19th century (and, in terms of ideas, in the 17th century). Increasingly, however, we may ask to what extents these ideas reflect the reality in which most people live: we see few prospects for continued growth through emerging science and technology, the new technologies do not provide employment as promised; there are increasing certainties about climate change, increasing incidences of man-made natural disasters, such as Fukushima, floods in Pakistan and elsewhere, or the hurricane Sandy. That is, as growth and welfare continues to decline, as global disasters seem to make up larger parts of media representations, and as energy scarcity is looming, the images promoted by the geo-sciences, the Anthropocene, climate science etc. seem to be better able to make sense of the world in which people live. It is likely, therefore, that they will also gradually come to inform the making of our institutions, but the shapes these may take we can only just begin to grasp.

Finally, there is a real sense in which continued pressure for growth and competitiveness in the face of increasing scarcities of basic resources, may provide a recipe for disaster. If the situation is not somehow remedied, societal differences and inequalities may only be exacerbated by ever-more desperate chase of surplus value and industrial dominance (cf. fracking), and we are likely to see further deteriorations of fundamental rights and increases in uses of science and technology for repressive purposes, as revealed by the recent NSA scandal of massive government surveillance into the affairs of citizens.

The next point concerns legitimacy. We saw that the western modern order, and legitimacy, became predicated on a balance of different spheres of knowing and acting, thus also controlling, supplementing and keeping each other in check, as it were. However, as we describe in the report there is a real sense in which, under current innovation regimes, different spheres of knowledge and action tend towards collapsing into each other. We saw this by following some main developmental traits in the field of jobs and the information economy: whereas in the early 1990s there would still be an opening in main EU policy documents towards seeing jobs and ever-more automation through computers and machines as potentially conflicting goals, gradually the two came to be seen as part of the same problem: innovation and growth for industry. Similarly, we briefly describe how, in the 1980s ecological sustainability was not seen as part of any innovation regime, and how environmental policies were sometimes also seen as opposed to policies of development and modernisation, what became known under banners such as "ecological modernisation" and "sustainable development". Increasingly, however, the two have come to be seen as part and parcel of the same equation, to the extent that there seems to be no contradiction or conflict of interest involved whatsoever. Again, the potential and on going collapse of spheres of knowing and acting, may come with main implications for legitimacy of knowledge policies. These are broad developments that rise immediate and long-term demands for ways of ordering sciences and societies in ways that may be deemed both ecologically and democratically sustainable.

This makes for a major dilemma: if the West is to continue to claim reliance on science and rationality, it may have to remake many of its basic institutions and assumptions (and of course this must be done globally). If what I have said in this talk has something going for it,

it is not a mere question of listening to the facts of the climate change researchers; it is also a matter of a re-imagination of basic scientific and political institutions. Politics will have to engage with nature and scarcity of resources, and a lack of growth, and other sectors of society will have to adapt: the economy, transportation, housing and construction and energy production all may have to change whereas at the same time safeguarding our most cherished political and legal institutions. Of course, Europe and the US may very well continue their push for ever-more growth and competitiveness. But in that case they may also be leaving some of their most cherished institutions behind, and so also those very things that made the West into what it was.

A plea for deep innovation:

(Cf. the report Taking The European Knowledge Society Seriously, Felt, Wynne et al. 2007).

- transition to a geos-guided paradigm, taking into account scarcity of resources and lacking sources of economic and technological growth

- taking into account the democratic challenge, i.e. including people, citizens and communities, in processes to change societies

- re-connect science with the grand challenges as they work out on the level of those concerned, and connecting previously un-connected sciences disciplines and sectors of societies.