Principles and values in international science cooperation.

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I thank you for the invitation to make opening remarks on the importance of developing a coherent principles for research and agreeing these and the associated values as we proceed to enhance scientific and collaborative cooperation across the globe , across different cultures, histories and world views. I congratulate the Commission for initiating this dialogue.

The International Science Council is the world's primary NGO for promoting the global voice of science and integrating the natural and social sciences. It comprises most of the worlds scientific academies, and international disciplinary bodies including the various natural science unions and social science associations. It sponsors many international research programmes, scientific committees and affiliated bodies. It co-chairs the major group on Science and Technology in New York and has deep relationships with many UN agencies. As the voice of science and scientists, it hopes to contribute to this important dialogue.

Covid has shown the potential that comes with effective science cooperation that spans the public and private sector, and crosses global boundaries. In congratulating ourselves on the rapid progress made especially with first generation vaccines although based on decades of basic biomedical science, we should note two things: First the pandemic is far from over, second it adds another stress to a very stressed system where economic, environmental changes and climate change and sadly now conflict create existential risks for the planet and its citizens.

But we should not ignore the issues Covid exposed. The formal multilateral system was slow to respond, the use of evidence in policy making was highly variable across countries. We saw trust or distrust in science become an ideological badge within societies. Disinformation, the overt politicization of science and the variable quality of science communication all affected the response by governments.

And the paradoxes of how science contributes to society and is perceived go further; war and indeed other dimensions of the geostrategic competition are, at their hearts, also a technological competition. Given the pace of technological development, its centrality to nationalistic and geostrategic narratives, and given that any technology can be misused, a core challenge for our species is to define forms of adaptive governance and regulation that would ensure society uses science and technology wisely. That challenge remains very acute and difficult to address in a world of fractured technopoles.

Given that modern science is a global activity, and given its criticality to virtually every challenge we must confront, it is important that we have broadly and globally accepted understandings of the principles that underpin how science is conducted.

It might be helpful to start by defining what 'science' is, for we must test the assumption that science is a global language. The English word science has been in use for at least 600 years, stemming from French which originally adopted it from Latin, basically depicting collective knowledge. It is a word that has been used in different ways and the equivalent words in different languages are not identical.

But the modern understanding of what is science has evolved a long way since the Scientific Revolution and more recently the somewhat narrow Popperian view of falsifiability.

Philosophers of science now define science by characteristics that make it a special from of knowledge: one that is systematically organised and is rationally explicable, tested against reality, and the scrutiny of peers. Knowledge claims and the evidence on which they are based are typically quality assessed and tested against logic and reality within the scientific community. As a result science is not a fixed knowledge system but one that is self-correcting and evolves. The disciplines and boundaries of science evolve – for example it would be difficult to argue that most medicine of the 18th century met these qualities, yet it does so now. Evidence based medical practice and systematic explanations of pathology really only emerged in the 20th century.

Why does this matter? Science, even with its distinctive characteristics, does not exist in isolation from other knowledge systems be they originating from religion, tradition, local knowledge, indigenous knowledge, or the tacit or learned knowledge of different occupations. But in every society, it lives respectively alongside these other knowledge systems and hopefully in dialogue with them. There is much to learn from the scholarship of the post-normal science community in managing these interactions. Hubris can too often emanate from the scientific community, in the belief that they are the sole bearers of legitimate knowledge, an issue so eloquently described by Merton and Polanyi more than 70 years ago yet remains a concern.

Understandings of good scientific practice and ensuring its best transfer via innovation to the economic, policy and societal sectors depends on its integrity and on whether it provides relevant answers to real – if perhaps wicked - problems. This demands that science does not claim that it can answer everything or make decisions on behalf of society: the application of science depends on decisions informed by both individual and group values.

Before I go further It might be helpful to expand on the words principles and values as they are core to this dialogue. Principles can be defined as propositions that serve as the foundation for a system of behaviour or for a chain of reasoning. Some such principles are normative and should be relatively uncontested in the context of this discussion about what science is. The word 'values' itself is both multi-dimensional and is used in multiple ways. Values reflect our judgements and beliefs reflecting and creating our visions of what we want to attain. This implies they can be contested according to one's biases and world views There is a need to distinguish between individual, collective and societal values, and there is a hierarchy of values ranging from those that are not particularly contested to those that are very personal or group-specific. The whole concept of values is both philosophically complex and indeed there is no singular taxonomy to describe them. The JRC report on the topic released last year is a valuable resource.

With this somewhat semantic deviation I shall consider the topic of this dialogue in terms of three distinct sets of considerations: (i) those principles and values that define science, (ii) those that underpin science systems and (iii) those that apply to individual scientists.

First: In my earlier discussion defining science, we see that it is defined by the core principles of systematisation, empirical observation, independently scrutiny of claims, and explanations based on logic and reality. Furthermore, modern science as it evolved during the Scientific Revolution relies on validation of knowledge claims through collective processes in the scientific community (peer review, publication etc), thus its social structure is an essential characteristic of science. These fundamental principles are what allows it to claim its position as a global knowledge system given its evolution over the last few hundred years .

But the underpinnings of science are not value free as several philosophers, including most recently the philosopher Heather Douglas, have pointed out. Perhaps the most important value judgement in science is that of deciding when there is a sufficiency of compelling evidence to reach a conclusion. We must recognise the inferential gap between what we know and what we conclude: hence the importance of understanding that little in science is ever final. Hence the need for civil contestability of scientific conclusions is an essential part of the scientific ethos, as Robert K. Merton pointed out many years ago. This openness and willingness to revise conclusions in the face of constructive informed critique is core to placing boundaries on what is science and what is not. It distinguishes science as a knowledge system.

Secondly as I have parsed it, while science refers to the knowledge domain itself we must recognise that science operates through a complex ecosystem of funding mechanisms, institutions, including universities, research institutes, the private sector and the publication system. Within this ecosystem there are many values-based considerations – judgements on how much to invest in science or its components, what to fund, who to fund, what to expect in terms of outcomes and inputs and how to assess these. Whether one seeks to strengthen and invest more in so-called mode 1 or mode 2 science is inherently value-based. The diversity of domains and disciplines represented within the science system creates real challenges. The issues of integrity and minimising bias are critical at every stage. As the principles of science demand, transparency of data and results is key. Peer review as known to be imperfect and even sometimes flawed but it still remains essential at the heart of the system. Far greater attention needs to be paid to how we might sustain the quality and integrity of peer review and how it is conducted. Peer review will need to evolve.

The values of equity and inclusivity are key to the modern science system but we must be honest. Whether we explore issues of equity and diversity, of gender and minority involvement or the engagement of scientists from global south, the system still has some significant way to go to meet our aspirations.

Science systems are evolving - for example the emergence of team based research, and of inter- and particularly transdisciplinary research creates real challenges. Current assessment systems do not serve these activities well. Yet much innovation and translation whether in the public or private sector relies on boundary crossing. But we must also recognise that there will inevitably and appropriately be some diversity in the structure and priorities of science systems, reflecting the reality that they must be embedded in the societies they primarily serve.

Many in the developed world stand somewhat surprised that many countries have not been overtly critical of Russia's invasion of Ukraine. One reason is the sense that a conflict in Europe is perceived as being more significant by the global north than elsewhere. What about the many other conflicts in the global south that did not receive similar attention? I mention this because too often science is seen in a similar light even when research extends into the Global South– being conducted for the benefit of the Global North. We have seen this perception in the rise of the call to 'decolonize science': a phrasing which is subject to much politicalizing and misinterpretation reflecting multiple agendas but nevertheless it is an indication that *if science is to be a global good it must be available to and performed by and with all societies*. Science is a global language and endeavour not owned by any one culture or society, even if it is and has been misused by some.

Thirdly we must look to the scientists themselves. If they do not have integrity, there cannot be trust in their truth claims. But incentives in what has become a large industry of public science can sometimes have unintended consequences. Much of the science system, as defined by funders, universities and other providers, and the publication and recognition system focuses on the individual and their outputs. The incentives that arise can induce behaviours that do not support collaboration, mentorship, respect and the cooperation that is needed. The demand of quick outputs leads to poorly developed research protocols and methodologies which are major factors in what has been called the 'reproducibility crisis'. We have developed an intensely competitive and egotistical system when collaboration is increasingly needed. The result is too much noise]] in the production of knowledge. Another consequence, for example in sustainability research, can be expensive duplication and critical gaps,- an issue ISC is trying to address through its Commission on Mission-led Science for Sustainability.

Ensuring alignment across these three dimensions, that is first agreeing the principles and values that define science, second those ensuring robust and evolving science systems and thirdly ensuring that practitioners within the system have the values set that makes their work trustworthy is critical. The three components are needed if we are to have societies that trust science and use it wisely. In this context it is worrisome that very few scientists are trained in these broader dimensions.

As we face a more fractured geopolitical framework, science must work hard to build and maintain the global framework. Science can]be an important track 2 activity to try and repair some of these fractures as it did in the cold war. Science is at the heart of moving ahead on the global challenges that affect us all. In a week when the High Level Political Forum on Sustainability is meeting in New York we must admit that progress on the SDGs, including climate change, has been disappointing This dialogue is a critical set forward. Funders must work more closely together, the values and principles of science must be protected and I applaud those committed to this dialogue. The ISC as the global voice of the science community is enthusiastic to be part of this ongoing discussion.