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Openness, Confidence and Trust in Science and Society

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Abstract: In this paper I discuss openness and its converse, closeness, in science and society. Openness is an aspiration which is achieved to varying extents in different situations and by different actors in human culture. I identify confidence (here used primarily in the sense self-confidence) and trust as essential conditions for openness to flourish, and integrity as an overarching quality which fosters openness, confidence and trust. The principal example here treated concerns the views and practice of the physicist Niels Bohr, in his science and in his advocacy of openness in the science-related matter of the international control of nuclear weapons.

Keywords: Openness, Closeness, Secrecy, Bok, Science, Confidence, Trust, Integrity, Bohr

Introduction

IN THIS PAPER I connect openness, in science and in society, with two other qualities which are widely considered desirable and important, namely *confidence* (here used primarily in the sense *self-confidence*, which may be an attribute of a person, a group or an institution) and *trust*. I also identify *integrity* as an overarching quality which fosters openness, confidence and trust. We like openness and respond when we see it in others. Yet its practice requires confidence. This applies to the conduct of science as to the conduct of public affairs and to the conduct of personal relationships. These remarks notwithstanding, I endorse Sisela Bok's (1982, page 9) warning against an assumption that unlimited openness must be an unqualified good and all closeness, or secrecy, is to be deprecated: "A degree of concealment or openness accompanies all that human beings do or say. We must determine what is and is not discreditable by examining particular practices of secrecy, rather than by assuming an initial evaluative stance". This warning is especially pertinent in discussions of the conduct of science. As Bok says on page153, "Denunciation of secrecy is ritualistic in science."

Openness

In this section I provide a brief overview of openness in science by commenting on a selection of aspects and examples of openness and its converse, closeness, in science. A larger corpus of examples may be seen at Cottey (2000).

An ideology of openness. Science differs from other social institutions in that there has been an ideology of openness since the 17th century. Yet this openness has always been subject to restrictions. William Eamon's (1994) *Science and the Secrets of Nature* gives insight into those restrictions. Eamon also writes (1985, in the Conclusion section of his article *From the Secrets of Nature to Public Knowledge: The Origins of the Concept of Openness in Science*), "The debate over secrecy versus openness continues. While denunciations of secrecy in science are almost ritualistic nowadays, the pressures to withhold information are

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greater than ever before, both from outside the scientific community, as increasing numbers of scientists are drawn into military and industrial research, and from within, as intense competition among scientists increases the pressure to make claims to priority of discovery."

Seeking a more nuanced description of science practice than simply open or close I have proposed *Four Levels of Openness in Science* (Cottey 2000) in a spectrum from completely secret to radically open. The levels are:

- *Secret Science:* even the existence of the project is concealed
- *Restricted Science:* publication of the results is subject to strict limitations in respect of timing and level of detail. Most commercial and applied government (including military) science is in this category
- *Circumspect Science:* the scientists publish when the project is complete, but till then are quite 'close'. Academic science, as practised to date, and when not Restricted, is in this category
- *Open Science:* Here this term means a radical kind of openness, an Open Science Project being open from beginning to end.

The first three levels are already established. Steps towards the fourth kind have been taken in the last few years, notably by *Open Notebook Science* (2009) which - "is the practice of making the entire primary record of a research project publicly available online as it is recorded. This involves placing the personal, or laboratory, notebook of the researcher online along with all raw and processed data, and any associated material, as this material is generated. The approach may be summed up by the slogan 'no insider information'."

The internet has expanded radically the scope and practicability of open science. In *Doing Science in the Open* Michael Nielsen (2009) writes, "I believe that the process of scientific discovery – how we do science – will change more over the next two decades than in the past 300 years." Nielsen continues by noting that, in contrast with others' creative use of the internet, "scientists show a surprising reluctance to share knowledge that could be useful to others. This is ironic, for the value of cultural openness was understood centuries ago". The reason, Nielsen says, is that the established system of "subsidising scientists who published their discoveries in journals… now inhibits the adoption of more effective technologies". Paul David, Matthijs den Besten and Ralph Schroeder (2008) express a more cautious view. Their article *Will e-Science Be Open Science?* "examines various aspects of 'openness' in research, and seeks to gauge the degree to which contemporary 'e-science' practices are congruent with 'open science'." The authors declare, "there is evident need for further empirical research to establish where, when, and to what extent 'openness' and 'e-ness' in scientific and engineering research may be expected to advance hand-in-hand."

The fundamental outputs of scientific activity are knowledge claims. Any statement that claims to be a contribution to scientific knowledge must be amenable to detailed public examination and criticism. It is evident that openness is a fundamental condition for the effective operation of this process as may be seen from the following example. In an investigative article with the heading *No Names, No Proof, No Consensus - MPs Jump the Gun in Calling for Action on Mystery Report that Claims Social Services 'Snatch' Children from Parents,* Jonathan Gornall (2006) finds that - "no one - including the MPs demanding action - knows who was responsible for the 104-page document." A report of unknown provenance cannot

be critically examined and therefore cannot even be considered as a candidate for ultimate acceptance into the corpus of scientific knowledge.

Knowledge Claims Are Not All. Science is not solely primary research followed by knowledge claims. Science is a part of human culture and as such it includes the diffusion and validation of new knowledge claims. The tensions between openness and closeness, which exist in all aspects of society, take a special form in the media, which may in some respects be open in a brazen manner but in other respects may be close about their motives and about selection. One kind of openness is demonstrated by The Naked Scientists (2009) who "are a media-savvy group of physicians and researchers from Cambridge University who use radio, live lectures, and the Internet to strip science down to its bare essentials, and promote it to the general public." From this quotation it can be seen that the term naked is used as a marketing device. There is however a connection between nakedness and the openness that is the focus of this article. Scientist broadcasters who "take science questions on any subject live from the listening public" are practising science with a high degree of openness.

The dissemination of science by publication has changed profoundly during the last few decades. Continued rapid development and extension of these changes may be expected in the near future. The changes of this period are linked with new information technology but this is not the whole story. Commerce now has more influence upon many aspects of culture than hitherto. These trends are reflected in the nature of the tension between openness and closeness and find expression in such initiatives as the Public Library of Science (2009) which "is a nonprofit organization of scientists and physicians committed to making the world's scientific and medical literature a public resource."

Part of the long-term processes of disseminating, criticising and selecting what is in the 'science canon' occurs more formally, as science education. As with the other aspects of science, the tension between openness and closeness exists here also. *Open Education and Education for Openness,* although not restricting itself to *science* education is nevertheless a useful source of ideas about openness in science education. On page xvii of their introduction to this volume Michael Peters and Rodrigo Britez (2008) write, "The concept of openness in regard to education predates the openness movement that begins with free software and open source in the mid 1980s with roots going back to the Enlightenment that are bound up with the philosophical foundations of modern education with its commitments to freedom, citizenship, knowledge for all, social progress and individual transformation."

If openness in science is to achieve its full potential it should apply to all parts of science, including the determination of science policy. In *Open Science: Tools, Approaches and Implications*, Cameron Neylon and Shirley Wu (2009) write, "Open Science is gathering pace both as a grass roots effort amongst scientists to enable them to share the outputs of their research more effectively, and as a policy initiative for research funders to gain a greater return on their investment."

As indicated earlier, openness to criticism is a fundamental feature of science and this may be described as a kind of accountability. A further kind of accountability, required in an open, democratic society, is accountability to society for what is done. The following example shows that to be real, not cosmetic, this accountability must exist at an early stage of a scientific project and not when it is too late to have an effect. In 1988 (New Scientist 1988) researchers studying airborne pathogens in farm animals at the Veterinary School of Bristol University, having failed to obtain funding from the normal sources, accepted a

substantial grant from the Ministry of Defence. Some colleagues interpreted this is a shift of focus from agriculture to biological warfare. A bitter controversy followed but the university continued with its acceptance of the grant. This controversy highlights the importance of adequate ethical oversight *before* funding has been obtained.

Conflicts and Tensions. I indicated in the Introduction that openness and closeness, in science as in society, are in a permanent tension. On page 40 of *Secrets* Sisela Bok (1982) writes, "the conflicts between insider and outsider about control over secrecy and openness arise in every form of human encounter. And within each perspective, the same tensions are felt: for outsiders between seeking to probe secrets and refraining therefrom, and between accepting and avoiding what is revealed; and for insiders, between keeping secrets and divulging them, and between seeking to overcome the restraint of outsiders with respect to what is no way a secret, and acquiescing." This dense passage requires some unwrapping. I propose that this can be understood in terms of a *social relationship model.* Openness and closeness always get their meaning from some *relationship*, which takes place in a *social setting* and involves *actors*, who bring with them *attitudes* and who *behave* in some way or another. The whole of what happens is a *scenario*.

In the second sentence of the quoted passage, *within each perspective* means 'for a given actor'. The sentence refers not to an outsider-insider relationship but to the inner tension felt by a single actor. The actor may be an insider or an outsider, and may be in a social setting of concealment or revelation but in each of the four situations feels a tension between a response marked by openness and a response marked by closeness.

The following table displays the eight responses (four pairs in tension) in the order in which they are mentioned by Bok.

Actor's Status	**Social Setting**	**Actor Feels Tension between ...**
Outsider	Concealment	Probing into the secret ... and not probing
	Revelation	Accepting the information ... and avoiding it
Insider	Concealment	Keeping the secret ... and divulging it
	Revelation	Overcoming outsider's resistance ... and acquiescing in outsider's resistance

The general situation can, however, be more complex than this, for it may be necessary to take into account further tensions, since opposing qualities can co-exist in the actor's status and in the social setting.

Confidence

Idealism. Most scientists advocate and aspire to a model of conduct of science that is highly idealistic. It was described by Robert K Merton (1968) and has become enshrined as the Mertonian Norms. In an influential article first published in 1942, Merton declared, "Four

sets of institutional imperatives - universalism, communism, disinterestedness, organized scepticism - comprise the ethos of modern science." Summarized briefly, these norms mean - scientific knowledge transcends variations in human cultures, scientific knowledge is not private property, the search for scientific truth abjures all special pleadings, and truth claims are subjected to rigorous testing.

In the subsequent decades more has been learned about the extent to which these ideals correspond to the actual conduct of science, though our knowledge of deviations from the Mertonian norms is still very patchy. Scientists are rarely found with a smoking gun in hand. When they are the public and other scientists are intensely curious. A corner of a veil has been lifted.

I suggest that openness in science is desirable not only for narrow reasons connected with efficiency of extending reliable knowledge in specialised areas. Openness about scientists' ideals and the cultural pressures (from without and within) to which scientists are subjected is desirable because it helps scientists themselves, as people, to be psychologically grounded, connected with reality.

In a culture more open about those pressures, the unfortunate Jan Hendrik Schoen might not have sleepwalked into "the biggest fraud in physics" (Eugenie Samuel Reich 2009). According to Samuel Reich's article *The Rise and Fall of a Physics Fraudster*, Schoen had an "amiable, eager-to-please nature" (page 26) and he "cultivated an aversion to disagreements that became so extreme that his early work included almost no discussion of conflicting observations. Instead, he forged agreements, one number or result at a time, as if trying to stay in compliance with science."

Openness and Confidence. Evidently, Schoen lacked the self-confidence to acknowledge data that appeared to disagree with expectations. He slipped by small degrees into fraud. And by its nature fraud is covert. It is closed, the antithesis of openness. To practise openness requires a high level of self-confidence. A scientist or scientific institution cannot jump from a much lower level of openness and confidence to the highly idealised Mertonian norms just by desiring it, or even by intellectual conviction that such a jump is desirable. A level of openness higher than is normal in a given society is, for most individuals, groups and institutions, *scary*. It requires courage. This is true of groups and institutions as well as individuals.

I endorse the recommendation of Joseph Agassi (1981) on *The Ills of Excessive Standards.* This is the heading of Chapter 34 section 2 of his book *Science and Society,* in which he advises one to relax, to be undefensive, to learn to raise the level of one's conduct to a comfortably higher standard, thereby permitting the raising of the standard again by just a little so as to cause further improvement with no excessive tension.

Openness and confidence must increase together, in small steps, never far apart. The 'small steps' approach advocated by Agassi is appropriate because it is realistic, and leads to slow, steady progress, whereas idealism is likely to end in failure.

Trust

In writing of trust, I do not mean indiscriminate, naive trust. I refer instead to a willingness to believe or accept a proposition, or to make a choice, on the basis of meaningful, albeit incomplete, evidence. Without trust of this kind, no social compacts can ever be made. Such trust is provisional. It involves taking a risk but the cost of extreme mistrust is much greater. This approach is summed up in the aphorism 'trust and verify'.

Some comment is needed on the Mertonian norm *organised scepticism*. If taken to excess, analogous to the extreme mistrust just mentioned in the general social context, scepticism becomes corrosive scepticism. Then no beliefs and no rational choices are possible. No science is possible because no propositions are wholly certain. Indeed, no knowledge is possible. Properly applied, organised scepticism requires evidence but does not demand entirely incontrovertible evidence. So, in science, as in general social affairs, discriminating trust and willingness to take judicious risks, is necessary.

On page 36 of *Responsible Conduct of Research* the connection between openness and trust is made by Adil Shamoo and David Resnick (2003) - "openness is a key principle in research ethics. Scientists should share data and results (1) to promote the advancement of knowledge by making information publicly known; (2) to allow criticism and feedback as well as replication; (3) to build and maintain a culture of trust, cooperation and collaboration among researchers; (4) to build support from the public by demonstrating openness and trustworthiness."

Openness, Confidence, Trust

Openness and trust are *social relationships*. An open person, group or institution is open to what is outside. The level of openness which exists in practice is strongly influenced by social norms, with an amount of internal variation reflecting the degree to which the society is pluralist. The same applies to trust and to the converses, closeness and mistrust. On the other hand, confidence (in the sense used in this paper, that is, self-confidence) is an attribute of the person, group or institution.

Openness, confidence and trust go together. Confidence and trust are needed to practise openness, but in a close (secretive) society the needed confidence and trust cannot be created just because they may be desired. These desirable attributes grow together, no one of them being far out of step with the others.

Niels Bohr's Open Letter to the United Nations. In his *Open Letter to the United Nations* Niels Bohr (1950) proposed international "openness as a primary condition for the progress and protection of civilization." Bohr was a successful champion of an open, collaborative, personal and international way of conducting scientific research. He built up the Institute for Theoretical Physics in Copenhagen to be a Mecca for theoretical physicists. He played a key role in the early researches in nuclear fission and he appears to have recognised and stated the dangers of nuclear proliferation earlier and more clearly than anyone else.

Another condition important for Bohr is *confidence*. In the *Open Letter* he uses the word no fewer than thirteen times. It is significant, however, that Bohr uses this word in a sense and in contexts when *trust* would be virtually synonymous. He refers, for example, to an "atmosphere of mutual confidence which would be essential for co-operation" between nations. Indeed the word trust does not occur at all in the Letter, although a converse, *mistrust*, does, three times. Bohr's message was not widely heard or accepted, neither in 1944 when he gained interviews with US President Roosevelt and British Prime Minister Churchill, nor for the rest of life. The Open Letter had little impact, partly because the Korean War started only a few weeks later. Other factors explaining the limited take-up of Bohr's ideas are - their radical nature, his tiresome prose style and his patrician approach. He did not get involved with others' peace initiatives lest his grand idea be diluted. Henrik Erno and Peter Henrik Bang (1986) comment in their paper *Nuclear Armaments – A Challenge to Science*,

"Bohr appealed to the common sense of the politicians of his time, without considering that many of them were determined to develop nuclear weapons in order to achieve political goals ... it is not always enough to have the right ideas. You must also build a majority on your side." (page 311)

Among this multiplicity of factors, a major reason for Bohr's failure to be heard was an error concerning the relation between openness and mutual confidence (by which Bohr means trust). (I have a somewhat more detailed account of this in Cottey 2006.) From the *Open Letter*, it is clear that Bohr assumes that openness would lead to trust between nation-states in the new nuclear age. With sixty years of hindsight we can see that the nations' failure to move towards nuclear openness derived primarily from a lack of trust. In practice, if openness and trust are to move forward, they must do so together. This idea applies in all areas of human relations, including the conduct of science.

As for confidence in the sense that I am foregrounding, this concept is not apparent in the Open Letter. There is no sense that people, groups and institutions, including nation-states, might need *self-confidence* in order to overcome suspicion and move on to *mutual confidence*. I suggest that this lacuna contributes to the fact that the ideas in the Open Letter received, and still receive, relatively little attention.

The Open Letter, though its subject matter is international relations, has a connection with openness in science, beyond the obvious connection of being on a science-related topic. I pointed out, in the section on Confidence, that the practice of openness requires courage. This is true even in the relatively 'cool' domain of science, where the stakes are often no higher than the reputation and the (modest amount of) turf of an individual scientist, scientific group or institution. How much greater is the courage required of individuals, departments and nation-states if they are to practise a higher than normal degree of openness in the tense, competitive arena in which international relations are played!

Integrity. The linked qualities discussed here - openness, confidence, trust - lie under an overarching quality, *integrity*. To practise science with integrity is to be *whole*; to have a grounded, robust connection with the direct objects of study and with the social context of the work. Here, social context includes peer assessment, patronage, the media and applications of the work.

This may seem an impossibly tall order, but some kind of perfection is not meant here. An understanding of what I do mean can be got by considering some of the human qualities which indicate a lack of integrity, a lack of grounded, robust wholeness. These qualities are of two kinds. One subverts the scientific ethos in relation to knowledge claims. Those qualities include dogmatism, polemic, special pleading, hype, indoctrination, narrow-mindedness, tunnel vision, inattention to the relevant, denial of the obvious, compartmentalisation, wishful thinking and fraud. They bespeak human anxieties and tensions that get in the way of the generation of reliable knowledge.

The other kind of lack of integrity subverts the scientific ethos in the human relations aspects of scientific work. The qualities include secretiveness, duplicity, backbiting, plagiary and egotism. When they pertain to individuals they bespeak some degree of division in the personality. They can also be characteristics of groups or institutions, in which case we may speak of a culture of secretiveness, etc.

Far below these examples of egregious lack of integrity, there exist lesser deviations from complete wholeness. Such is the human condition. Although some special persons are widely recognised as heroic, the hero always has some imperfection. Bohr was highly intelligent,

wise and public spirited, yet he also had some quality which prevented his wisdom on the control of nuclear weapons from being heard. This is indicated by a patrician attitude, extreme obscurity of speech and writing and inflexibility about ideas. The Open Letter to the United Nations has well over 5000 words but it lacks social inclusion. In the context of the entire Letter, the invitation to individuals in the final sentence - "The efforts of all supporters of international co-operation, individuals as well as nations, will be needed to create in all countries an opinion to voice, with ever increasing clarity and strength, the demand for an open world." - is not convincing. A similar division between rhetoric and reality may indeed be observed at the heart of the United Nations (1945) itself. The Charter starts with the ringing phrase "We the Peoples of the United Nations …" and the top of every page of the website bears the label "Welcome to the United Nations. It's your world".

Divisions, deficits of integrity, may also be found in science. The four elements of the ethos of science identified by Merton are themselves coherent but the ethos as stated - although an accurate description of what most scientists believed at the time (the 1940s) and to a great extent still believe today - is incomplete. It says nothing about any aims of science other than the production of knowledge.

This discussion of Bohr's Open Letter shows that intellectual integrity is not enough. A wholeness deriving from a coming-together of openness, self-confidence and trust in a broader social sense is required, if meaningful progress is to be achieved towards so noble an aim as an open world.

Conclusion

I suggest that *openness* is connected intimately with *confidence and trust,* and that these three qualities are aspects of *integrity* (or *wholeness*). Under fertile social conditions *openness, confidence and trust* thrive together in a *nexus of integrity*. Conversely, under adverse conditions contrary qualities - *closeness, insecurity and mistrust* - reinforce each other in a *nexus of division*. In any real society (which could be an institution, a nation-state or a culture) conditions for integrity and for division co-exist so that even if one is dominant, the other exists as a minor trait.

Science is widely held to be valuable in three main ways - it is beautiful, it is a search for truth, and it is useful. I add a fourth way that is less noted … science is 'cooler' than most other human activities. All contrary pressures notwithstanding, the Mertonian ethos (communalism, universalism, disinterestedness, organised scepticism) is observed to a meaningful extent. This contrasts starkly with some other activities, such as competition for resources, territory and power, in which raw passions overwhelm integrity. In the practice of science, emotions are to be found (for example, curiosity, joy, pride and a level of competitiveness) but raw passions are absent or restrained. In this ambience, a nexus of integrity can and does flourish. The intellectual and practical fruits which follow show the value of the Mertonian ethos. While this approach cannot be transferred unchanged to 'hotter' areas of human culture, its success in the less fraught domain of science can be a beacon. Science can promote the optimism and courage needed to develop constructive approaches in other, more heated aspects of human relations.

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I am a physicist, who has long worked also in areas connected with the social responsibility of the scientist. This includes a study of nuclear physics education and contributions to science ethics. I am an active member of Scientists for Global Responsibility. I am interested in the connection between the personal and the professional.

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