Eine Reflexion auf diese Sachverhalte muss nicht auf Relativismus oder Beliebigkeit des Wissens hinauslaufen, sie macht aber bewusst, in welchem Maß die Wissenschaft selbst riskant geworden ist und wie sie zu immer komplexeren Konstruktionen getrieben wird. Dies in einer Gesellschaft, die gar nicht anders kann, als sich Risiken zu leisten.

Das Neue der "Neuen Wissenschaft" liegt genau in dieser Erkenntnis, dass trotz aller Unsicherheit der Wissensproduktion die Wissenschaft der einzig legitime Weg ist, Wissen in der modernen Gesellschaft zu erzeugen. Nicht die Verkündung gesicherten Wissens ist ihre Aufgabe, sondern Management von Unsicherheit. Kern dieser Sichtweise ist die Kommunikation über die Unsicherheit und die Revidierbarkeit der eigenen Wissensproduktion im Austausch mit Öffentlichkeit und Politik.

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The Need for Socially Robust Knowledge[1]

by Helga Nowotny, Swiss Federal Institute of Technology Zürich

The science system of the Western civilization is facing irreversible transformations. They affect the relationship between the public image of science and the actual practices within the sciences. In a situation in which scientists are increasingly asked "what have you lately done for us" the alleged purity and objectivity of the sciences have to be reconsidered and we have to rethink the place of people in the knowledge produced by the sciences. I shall argue for the awareness of a more local, historically and socially contingent knowledge production, which – due to this local embeddedness – can lead to a socially more robust knowledge production.

At the end of this century science and technology have become closely intertwined with economic and political imperatives and the anticipation not only of the behaviour of markets, but of the impact and reaction of the public which has become part and parcel of the 21st century view on science and technology. In a world that is increasingly becoming more pluralistic, however, there is little ground for expecting rationalities to converge. The corresponding transformation of the science system is not solely a result of altered size and continuing expansion - increases in the number of researchers and graduate students, of research budgets or increase of knowledge. Rather, the science system has been caught in its own transformative capacity.

Three examples of the altered relationship with society should suffice to illustrate the point: The first shift concerns the role played by science and technology in the political and economic arena. Since the end of the Cold War politicians expect science and technology to be the main driving forces to increase the international economic competitiveness of their countries, and research agenda setting is altered according to the changing priorities, pressing for far greater involvement in societal goals and problems. A second shift concerns public expectations. The culture of autonomy of science is being transformed, irreversibly it seems, into a culture of accountability. Many more social actors want to be heard and participate in what they regard as crucial developments driven by science and technology. The public has become omnipresent as consumers and users of innovative products and processes that science and technology put at their disposal. A third shift concerns the role played by scientific and technological expertise. It has never been as pervasive and as much in demand before, while the public readiness and willingness to contest scientific expertise equally has never been as high. The public authority of science and the legitimation it provides is in decline, while the search for a newly defined legitimatory role is on.

Images of Science and the actual practices

If the undeniable success of science and technology highlights the transformation it has undergone, one of the crucial questions arising from this self-transformative capacity touches upon the relationship between the public image of science and the actual practices. *Will support for science from the public and politicians continue also in the 21st century and on what*

grounds? The conventional arguments of the past are unlikely to carry very far in the future. Economic arguments (esp. in the economics of innovation) have difficulty in coming up with clear-cut empirical evidence showing that investments made in science and technology in one country will yield adequate economic returns that benefit the same country, and short-term expectations of tangible economic returns can not match the production of knowledge as a search process. Political arguments had already to shift ground in view of the altered geo-political situation and of budgetary constraints that have set unaccustomed constraints, especially for the present system of higher education in many Western industrialized countries. Science policy, further, systematically underestimates the complexities and changes in knowledge production. The policy environment forces a modernist perspective also on science policy-makers. They will treat knowledge as a commodity, and precisely for this reason will not get what they want. Cultural arguments contain an additional risk. While it can be argued convincingly that science is still to be considered an important cultural activity, researchers hardly will be satisfied with the levels of support granted for other cultural activities.

The distinction between basic research and applied has become much more complex and intertwined than the linear model ever presupposed. Elsewhere, we have analyzed the range of implications that the emergence of a new kind of production of knowledge poses which takes place in the context of application.[2] When potential technological applications attract researchers already in the stage of basic research and hence move basic research closer towards marketability and potential future use, when scientific practices, including their craft-side, have regrouped around computer models and simulation or new kinds of instrumentation and methods, spawning across highly diverse and heterogeneous research sites, and *if it is the problem context which attracts and binds researchers together in a temporary, problem-oriented way, one may ask how relevant the image of a universal, context-free science still is and what purpose it serves. The claim for context-free knowledge, not distorted by partial interests, has however ceased to be a powerful argument for the autonomy of our sciences.* Producers of knowledge have an in-built interest in promoting a form of knowledge that is as uniform as possible across contexts of use, ideally to the point that potential consumers are willing to adjust their interests in order to acquire that knowledge. Consumers, for their part, have an interest to obtain a form of knowledge that capitalizes as much as possible on what they already know and what they want.

The 20th century, despite some validly fought epistemological battles on truth, settled in a pragmatic spirit for the production of what Ziman called reliable knowledge. This could only take place "once we have cast off the naive doctrine that all science is necessarily true and that all true knowledge is necessarily scientific".[3] Truth thus replaced by the search for reliable knowledge invites the empirical question, and not only the epistemological, under which circumstance, on what grounds and pertaining to which kinds of phenomena or questions, reliable answers are expected to be provided. This leads to the assumption that conflicts about reliable knowledge take place on a middle ground, where the claims of science can be seen to be neither fanciful nor beyond reasonable doubt.

The context talks back

Although all these themes retain their pertinance today or have even become more acute, they need to be re-examined anew in view of the ongoing transformation of the science system. As the societal contextualization of knowledge continues, reliable knowledge ceases to be defined in a unversalistic sense and becomes tied to a particular context. It also increases the likelihood that at least some of the knowledge thus produced by science, along with other goods and deliverables, may become socially contested. *A 21st century view of science must embrace not only the wider societal context, but be prepared for the context to begin to talk back. Reliable knowledge will no longer suffice, at least in those cases, where the consensuality reached within the scientific community will fail to impress those outside. In a 21st century view of science, more will be demanded from science: a decisive shift towards a more extended notion of scientific knowledge, namely a shift*

towards socially robust or context-sensitive knowledge.

The claims for the supposedly context-free nature of science arose together with the achievement of modern science to create a relatively autonomous social space for its activities. This proved vital for the further development, for modern science succeeded in emancipating itself from direct forms of social control. In doing so, it presented its cognitive approach and unique social practices, usually referred to as "the scientific method", as the sole way of attaining certainty, culminating in the discovery of objective truth. *Yet, with the growing interdependence of science and its ties with the economic, political and cultural context deepening, the alleged context-free nature of knowledge production became contradicted by the actual diversity and variety of scientific practices and their interdependence with society*. Problem choice is co-determined by the materiality of the scientific field, the availability of certain kinds of instruments and the social settings, in which scientific activities take place. Standards of proof and what counts as having been demonstrated vary across different scientific fields and are equally contingent upon context. *As social studies of science have revealed, the seemingly impersonal structure of science needs to be complemented by another side, which is governed by agency and inhabitated by agents, human and non-human alike*. Their interaction makes for much more interesting and realistic accounts of how scientists work than the post-hoc narratives of the smooth triumphs of scientific achievements.

Such an image of science – in the making – has been widely accepted today, not only by science-policy makers and social scientists, but equally by working scientists. But the frame in which scientific activities need to be narrated and analyzed is even wider, since it includes the public. *Increasingly, science is equated by the public with what it can deliver*. If these deliverables become socially contentious or are actually contested – for reasons connected to risks these deliverables appear to pose – or if scientific developments are perceived to contain threats of undermining values and life styles, then scientific objectivity as the guarantee for knowledge production can even turn into a trap. *Scientific knowledge which derives its legitimacy from having been produced in accordance with the "objectivity" demanded by a context-free image of science becomes severely vulnerable if socially contested*. The outcome may include rejection or demands for alternatives, thus linking the production of scientific knowledge back to a context that is being negated.

Reliable scientific knowledge is reached above all by consensibility and consensuality within the scientific community. But the number of social actors who share and participate in the kind of social knowledge that is increasingly mingling with what is regarded as scientific knowledge, has increased dramatically. Moreover, these actors have competencies and claims to expertise of different kinds and in different degrees. Must and can consensuality remain restricted to scientists alone? *The divide between experts and a lay public has become blurred whenever one speaks of users and producers of knowledge. Their interaction is considered an important precondition for technological innovations to occur*. Can reliable knowledge be made more context-sensitive and robust by integrating it with social knowledge?

To sum up: Conventional arguments about a context-free and universalistic science and its objectivity are unlikely to have much appeal in the future. The basis on which the authority of science rests is increasingly becoming decoupled from its metaphysical foundations, just as the monopoly of science to define the reality of the natural world is loosening. Rather, the authority of science becomes more closely tied to concrete practices, their results and impact. Reliable knowledge, although it will remain a solid criteria to strive for, will be tested not in the abstract, but under very concrete and local circumstances. If science is to avoid becoming stuck in the objectivity trap, it has to develop greater context-sensitivity. The reliability of scientific knowledge needs to be complemented and strengthened by becoming more socially robust. If we are ready to accept the fact that the image of a universal, invariant and context-independent science is becoming irrelevant for all practical purposes and it is the specific context, in which knowledge is produced, taken up and transformed, which matters, we must strive to heighten context-sensitivity and to spread its awareness. The necessary changes pertain to the

ways in which problems are perceived, defined and prioritized, which has implications for the way in which scientific activities are organized. Problems are no longer confined within disciplinary boundaries and increasingly knowledge is produced in the context of applications. Criteria of scientific excellence no longer stand alone. If the image of a universal science can no longer be maintained, a greater context-sensitivity implies also admitting a greater diversity of scientific practices, which take place in specific settings, evolving over time. A fresh view on this diversity is not only part of the social reality, but also a strength to be exploited.

The place of people in our knowledge

What then is the place of people in our knowledge? Do people appear as passive subjects or as active agents? Are they represented at the micro-level or at the macro-level? Implications as well as policy recommendations vary not only with the questions asked, but with the place assigned to human agents – as do the motives behind each research agenda.

But not all fields of knowledge lend themselves to put people in, although all knowledge must in the end be somehow related to people. Today, there is a genuine urge to participate in a democratically responsive manner in scientific and technological developments which carry serious consequences for society and the individual. Participation is a form of appropriating otherwise arcane knowledge through and for the agora. The shift from a culture of scientific autonomy to a culture of accountability, although never smooth and easy, is a case in point. But accountability per se is still too reactive and in danger of being interpreted in a formalistic and bureaucratized way. In contrast, many studies of public controversies and the changing interface between science and society have indicated that new knowledge is being produced in the hybrid spaces opened up through the interaction between experts and the lay public. Conceptualizations of risk, for instance, have been transformed in the course of the long, public contestation over issues like nuclear power. The active participation of highly educated activist groups in AIDS research, to cite another example, has led to redefinitions of the statistical reasoning which underlies clinical trials.

Far from being a mere nuisance or a necessary, but bothersome price to be paid for the democratic demand of greater accountability from an institution which has perhaps irreversibly lost part of its previously held legitimacy, *contestation of scientific and technological knowledge co-induces and produces a transformed and enlarged definition of knowledge*. In order to respond, scientific knowledge has to become even more reliable which entails its being made robust in very different contexts and sites of contestation. This can only be achieved by acknowledging that objective knowledge is the result of a process which renders it inevitably partial and contextual. It is inherently incomplete, but it can become better suited for and made to fit the particularities of specific locations, instances, and conditions in which it is produced, applied, contested or negotiated. *Such an enlarged notion of reliable knowledge starts from the premise that there cannot be any one 'objective method', nor any abstract appeal to the laws of nature, which would dispense from allowing itself to be drawn even further into the special configurations of the context which demands more, and not less, robust knowledge.*

Just as the universality of the nation-state turned out to be an illusion, despite the fact of its formal spread around the world, so has it been impossible for science and technology to maintain the social function of providing social consensus within liberal democracies. *In the eyes of many citizens science and technology are equated with the products and results they deliver*. They have become goods, access to which should be democratically regulated and allotment of which should also be fairly distributed. What should be produced and how, especially in view of potential risks, is therefore also seen to underlie democratic decision- making. It is difficult to see how in the face of this widespread utilitarian-instrumental relationship to science and technology, which is reinforced by a similar attitude on the part of political leaders which value science for its value-adding capacity only, the claims to a special epistemological status of science can be maintained in the future. Autonomy of science as a rallying cry will not carry far in the agora, nor will the insistence

on its inherent universalism and on an objectivity which deems itself beyond reproach. *What citizens are interested in, is the concrete embodiment that science and technology assume in their daily life and concerns*.

Nevertheless, science is still seen as the trouble-shooter par excellence. There is no problem which at some point does not escape an appeal for a scientific-technical solution – even if such solutions are nowhere yet on the near horizon. It should be clear by now, that the modern times of Big Projects, Great Narratives, Universalism and Unification, of Big Problems and Big Solutions, are over. Also trouble-shooting has to assume more modest, localized and realistic position and proportion. It too is part of that interactive network of knowledge and practices that are distributed over universities, laboratories, governmental offices, non-governmental organizations, media rooms, electronic networks and individuals in many different sites in society. Hierarchies in decision-making have not disappeared, but they have become somewhat more flat.

In this interactive and heterogeneous sea of changes, once more local clusters stand out. Scientific autonomy needs to be preserved, since it is a sine qua non precondition for the formation and perseverance of scientific identitites, but it will be a highly localized autonomy – to be argued and fought for in every instance and to be maintained in every research project worth its name. Scientific objectivity will need to be preserved, because it too is a sine qua non condition for reliable scientific knowledge to be produced. But it will not suffice in itself, since there is no global scientific objectivity, no set canon of rules to be followed which will guarantee the truth or reliability of the outcome. *Scientific objectivity will have to become localized and contextualized, fitted into the specificities of each case in which it might be and most likely will be challenged. It will succeed, if the outcome is more robust knowledge – robust also in view of the many heterogeneous factors, expectations, challenges and contestations which are now, wrongly, labelled non-scientific.*

Notes

[1] Abridged version of "The place of people in our knowledge" published in European Review Vol. 7, No. 2, 247-262 (1999).

[2] *M. Gibbons, C. Limoges, H. Nowotny, S. Schwartzman, P. Scott & M. Trow*, The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies, London, Sage, 1994.

[3] *J. Ziman*, Reliable Knowledge: An Exploration of the Grounds for Belief in Science, Cambridge, Cambridge University Press, 1978

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Der Wandel der Wissenschaft

von Günther Frederichs, ITAS

Die Debatte über neue Formen der Wissenschaft ist kontrovers. Auf der einen Seite wird darin ein Wandel der Wissenschaft gesehen. Auf der anderen Seite gibt es eine oft emotional gefärbte Ablehnung, die sich dagegen verwahrt, den in Jahrhunderten entwickelten wissenschaftlichen Leistungsstand leichtfertig aufs Spiel zu setzen. Häufig wird bezweifelt, dass die neuen Formen überhaupt noch Wissenschaft sind. Der vorliegende Beitrag versucht zu zeigen, dass heute ein Stand der Diskussion erreicht ist, der eine sachliche Auseinandersetzung über diese Fragen erlaubt. Es wird untersucht, inwieweit in den neuen Formen ein wissenschaftliches Potential angelegt ist und ob dieses geeignet ist, aus dem gegenwärtigen Dilemma der Wissenschaft herauszuführen.

1. Neue Formen der Wissenschaft

Die heutige Diskussion über Wissenschaft hat in ihrer Intensität und in der Offenheit für unkonventionelle Konzepte in einem Maße zugenommen, wie man es noch vor zwei Jahrzehnten kaum für möglich gehalten hätte. Besonders