

## ***Hydropower, feminist technoscience and the Lule River***

### ***Introduction***

A while ago, I was involved in a research project named *Dammed: Security, Risk and Resilience around the Dams in Sub Arctica*. (Öhman et al, 2009) The type of dams that Dammed refers to, are hydropower dams, and hydropower as an issue for feminist research is the topic I would like to share in this contribution. This has to do with a thread left alone many years ago. When Lena Trojer came to Luleå as lecturer – this was in the early 1990's – she brought along a critical awareness of hydropower production. This was from her career as Folk High School teacher and the studies in India that she had done with her students there. One of the rivers targeted in Dammed was the *Lule River*. As the Dammed full project name suggests, this river runs in a Sub-Arctic area, or actually, where it starts the conditions are Arctic. Luleå (or *Lule*, as it is locally pronounced) is also the name of a town at the outlet of this river. Besides having a university – where Lena and I met – Luleå is residential town for Norrbotten County. Norrbotten, as it happens, is where I was born and raised. In the light of the Lule River being heavily developed for power harvesting, between the two of us this awareness could have been a subject of exploration. Yet, we did not talk much about it at the time. As I recall, I was not ready. Now, on this festive occasion, the opportunity has returned.

### ***The Dammed proposal***

The background that the Dammed proposal presented, as to why it was eligible for national research funding was that the concept of dam safety in Sweden was too narrow, as compared to new concepts and methods applied in USA and Australia. Referring to Öhman (2009) it was moreover argued that:

“[E]ven including wider structures than before, the current concept of dam safety still would only take small part of reality into the picture. The socio-technical structures around dams are indeed social, and are as such carriers of images of gender (masculinity), ethnicity, professionalism, specific views regarding scientific expertise and knowledge.” (2)

The aim was thus, to integrate concepts and methodology from different research fields and taking the experiences and points of views from wider groups into account, “in order to develop new understandings and methods for ensuring human security and sustainable development within the sector of large scale dams and thereto connected energy resources” and, the departure was in “the epistemological bases within gender research and feminist technoscience.” (1)

“The issue at stake is first of all to define who the actors are that have the privilege of formulating the discourses on risk, linked to large scale dams, and thus to frame the work that is considered needed to ensure dam safety. Secondly, as dam safety is a narrow concept, based on techno-scientific discourse, gender research is engaged to see how the concept can be elaborated to include human security and how this then can be translated into policy processes, training and education of staff and organizations working within the dam safety arena, as well as how old and new ICT can be used for this purpose.” (1)

The idea of what can be achieved and through what means, was tightly connected to a reading of Donna Haraway's concept *situated knowledges*, which however was interpreted as *situated knowledge* in the proposal text:

“Dealing with the issue of “scientific objectivity”, and the problem of defining whether certain positions can provide a better understanding than others, Haraway has

introduced the term situated knowledge. The intention is to challenge the notion of scientific objectivity and at the same time to balance between constructivism and complete relativism. Haraway's term situated knowledge challenges the established manner of presenting scientific facts as an "unmarked gaze". According to Haraway, "objectivity" is nothing but a device of power-holders in society to present their own views as universal and disembodied, a "gaze from nowhere" – a "godtrick". Haraway means that this "gaze from nowhere" is impossible, the knowledges are always embodied." (Öhman et al, 2009, 4)

The idea of the necessity of a wider concept included not only a multi- or transdisciplinary effort but, also that risks in daily life needed more attention. Building on research that was at the time of the proposal already in preparation by May-Britt Öhman<sup>1</sup>, especially, the Sámi reindeer herders were mentioned, whose reindeer grazing territories are located along the river and around the large dams in its upper parts.

"[W]hile the efforts to calculate and prevent the risks of dam failure and flooding are of great importance, they concentrate on the event that something might happen in the future, which might have specific consequences on different levels. Yet, while the dams constitute an everyday work environment risk to Sami reindeer herders, the risks for reindeer herding communities is not included in the dam safety concept." (2)

So far the Dammed proposal.

### ***Keller and Trojer on feminism, science and technology***

A theme in Evelyn Fox Keller's ground breaking *Reflections on Gender and Science*, is the challenge for feminism to become an agent of change in science. Keller found that:

[D]iscourse about science continues for the most part on two noncommunicating levels: one an increasingly radical critique that fails to account for the effectiveness of science, and the other a justification that draws confidence from that effectiveness /.../ What is needed is a way of thinking and talking about science that can make sense of these two very different perspectives /.../ (Keller, 1985: 6)

In this constructive spirit, Lena Trojer contributed in the early 2000's, with a report on the technical sciences, to a series on gender studies in Sweden that was published by the National Council of Higher Education (2002). Here, Lena Trojer makes a comprehensive statement on feminist technoscience as a productive force in a national research system. The typical trait of gender studies within the technical science, Trojer declares, is that it leaves the study of sex quite quickly, in favour of focusing on the theoretical and methodological fundamentals of the disciplines themselves. She argues that the gender studies environments have a substantial competence for, supporting new types of alliances around technology development. Conclusively, Trojer finds that, the societal relevance of gender studies in technology and engineering consists of its potentials to (63-64, *my translation*):

- broaden knowledge frames and praxis in an increasingly complex reality;
- broaden the basis for influence and interpretations in reality producing standardization processes;
- specify new directions for engineering science applications;

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<sup>1</sup> This work has been presented in, for instance, Öhman (2006, 2016a, b).

- situate itself in technology development and get involved in new solutions;
- contribute to contextualizing knowledge in aid to economically weak countries;
- create a distinct culture within the academic science and technology institutions (discharge the "culture of no culture"), thus clarifying that no research position is innocent;
- develop an epistemological infrastructure relevant for a society dependant on research and technology;
- establish new arenas for the development of understandings of the relationship between research and politics;
- be a catalyst in the negotiations between science and society;
- create dynamic and driving interdisciplinary constellations, and finally;
- be a force for change in our technological academic institutions, and in their efforts to develop their role in our time of increasingly distributed research processes

Electrical hydropower production is currently marketed as one of the “green” technologies. Yet, its history and practice epitomizes virtually each disagreeable trait of science, technology and engineering ever identified by the feminist and gender studies tradition – from violent domination over nature and destruction of biotopes, to expropriation of land with forced relocation of populations and deprivation of their livelihoods, and further, to misogynist and racist practices and mind sets. What kind of an intervention can be made, into such an activity – and what are the premises for an intervention to be meaningful in the way Keller challenges us to achieve? Considering the content and timing of events, Trojer’s list of feminist technologist potentials could have been used as a recipe for *Dammed*. It was not applied in that way, however. Rather, one could say that when putting it together, Lena Trojer captured so well not only the potentials but, also the ambitions of Swedish and perhaps also wider circles of feminist technoscience schools. Therefore, it can be read as a prediction for what was to come. In the same manner, *Reflections on Gender and Science* remains topical. As feminist engineer, when studying technological practices and knowledge, I keep an eye on the relation between critique and, the routes that can be elaborated from it, to alternative paradigms. Applying Trojer’s potentials one could say I look for opportunities to situate feminism in engineering; create distinct engineering culture, and; develop epistemological infrastructure. Neither hydro power nor technoscience is about engineering alone. But, those things are what I read in to my mission as feminist engineer, in a program such as *Dammed*’s.

Another major principle that Keller identifies in *Reflections on Gender and Science* is that, the gendered conceptual and social dichotomy expressed in science – a division of emotional and intellectual labour – is not simply an exclusion of women. It is a “symptom of a deeper rift between feminine and masculine, subjective and objective, indeed between love and power.” (6-7) By pointing to the barriers between public and private, and their onto-epistemological bearings, feminism thus offers a *method* for analysis and, Keller suggests that, the logical extension of the insight that the personal is political is that *science is personal*. (8-9) An example demonstrates how personal/impersonal can be inverted. The accusation that “women always get personal” (possibly, but not necessarily, more usual in the 1960’s than today) is countered by Ellman who states that men always get impersonal: ‘If you hurt their feelings they make Boyle’s law out of it.’ (1968 in Keller 1985, 10) Going one step further in detail, Keller suggests reformulation of basic terms and concepts: “objects” reconceived as “other subjects”, and autonomy as a “dynamic condition enhanced rather than threatened by connectedness to others.” (73) The conviction about the power of tracing and challenging the personal/impersonal, social/scientific, intellect/body divides, is vividly demonstrated in Keller’s own works within the natural sciences and, the results she there both demonstrates and generates. (See, for instance, Keller, 2000, 2005a, 2005b, 2011.) Correlated to her identification of non-communicating academic communities, this methodology is central in the knowledge project Keller pursues. In her terms, for the ambition of building bridges between non-communicating communities the trick is – despite the eloquent turns that critique can produce – not to give in to the

temptation of staying with that. Boyle's law does give a reliable description of how pressure and volume relate in low pressure, high temperature gases (2005a, 10).

The above summary of Trojer's and Keller's suggestions and conclusions can be regarded as the extract of what I am here trying to achieve. In particular during the early years of feminist interventions in the onto-epistemologies of science, there are fundamental parallels in the writings of Evelyn Fox Keller and Donna Haraway. For instance, Haraway's concept of situated knowledges (1988), builds on an analysis very similar to that in Keller's *Reflections on Gender and Science*. Basically it also has the same aims – to at the same time open scientific knowledge production for hitherto excluded dimensions and, remind the feminist community that both science and technology are indeed fields of knowledge, not just “the enemy”, bastions of (socially constructed) masculinity. There are also differences between the two and, there will be reason to further refer to both Keller's and Haraway's contributions in this article. This is however better done after more of its topic has been presented and discussed.

### *The challenge*

Returning to the scope of Dammed, at least in terms of formal access to negotiations and decision processes ‘revealing privilege of formulations’, it seems to me, is a smaller issue at this point. Not only have feminist and gender studies scholars pointed to this as a problem in connection to hydro power projects but also, related to mining and other activities that change the landscape at large scale, and generally to natural resource management – so to speak from water management in arid locations, to fisheries quota. I do not imply that empiric results or theoretical development on those issues would not be needed anymore and, certainly not that political change by default follows research results. The situation is far from explored to the width of its implications. What I mean, in the particular case of a project such as Dammed, is that feminist theory and method is more advanced and established in this realm than with regards to creating platforms for communicating with the people and organizations that handle dam security. With Dammed, certain complications became impossible to ignore, that have perhaps been easier to pass by in other projects of my career. While in some instances, one can focus on visions of what may become,<sup>2</sup> the Dammed scope draws attention to what is, and how to deal with it within an immediate time frame. An unavoidable, urgent challenge is therefore that of non-communicating communities; how to find one's way to an epistemology that supports approaching – as defined in Dammed – ‘staff and organizations working within the dam safety arena’ and with implementation of old and new ICT that is, updates of technical systems for management and maintenance.

Relating to the curriculum of feminist and gender studies of science and engineering, the epistemological opportunities are conditioned by such things as the comparatively limited degree to which feminist scholars have seriously dealt with engineering, and the experiences of technicians and engineers. It is accepted routine to describe engineering as a one-dimensional residence of domination, objectivation, violence, competitiveness, drills, negligence, reduction and detachment. ‘Truths’ are established on a limited empiric basis and thereafter widely reproduced. For instance, much appreciated and quoted Wendy Faulkner claims (2001) that calculation exercises in engineering education act to ‘reinforce an ideology of emotional detachment’. This is presented as an empiric observation of general bearing and as basis Faulkner refers to a single case study published by Sally Hacker in 1989. There is so much in circulation that presumably is ‘known’ that, it permeates theory and the sense of knowledge frontlines. Clear positions are therefore difficult to arrive at, and to maintain. At this point, it is therefore of need to secure that an endeavour of identifying feminist values as compatible with, or thinkable in, engineering and other technical work,

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<sup>2</sup> See, for instance, Udén, 2002, 2010; Udén & Martín Castillejos, 2013.

entails a careful watch on how situatedness, or being compassionate, concerned, involved, and so forth, is expressed in the functions addressed (Udén, 2014). Regarding risk and security around the Lule River dams: even if we choose to see the calculations that decide, how to perform their management and maintenance as imperialist masculinist reductionism, it still remains that some people will have to do them. It is not without consequence if no one does.

### *Being personal about epistemology and the very social socio-technical structures*

The first power plant in the Lule River was placed in the mountain area where the river has its beginnings. This plant, *Porjus*, named after the place and the falls where it was built, was inaugurated in 1915. When this happened, Norrbotten was still predominantly an agrarian society and very sparsely populated. After that, hydropower projecting continued another sixty years, both with expansion of the size of existing constructions and expansion with new dams and plants downstream along the river. This has affected reindeer husbandry, agriculture, farming, and besides the macro scale effects on the landscape, it has had bio effects, for instance, on the fish species in the river. The people who have experienced the changes the hardest, including at a long-term time scale, are the members of the local Sámi reindeer husbandry communities. One reason to this is that they have not given up reindeer husbandry. Besides the appreciation of the husbandry life and the meaning it has to many Sámi, one should be aware that if they do give it up, these communities lose all the rights to land and water that they have, and for all times. Combining those terms, one would imagine there is much people are ready to bear. Öhman has emphasized that risks occur in that lakes/dams, rivers and streams as literarily being *waterways* for the herders and their families and, in that it regularly is necessary to cross them with the herds. It is known since long that the regulation of the water levels makes the access to open water difficult. Öhman also shows that the effects on the ice that these regulations have in the winter are severe and, can pose acute threats to life and security for those that need to pass. In the winter, the ice is traditionally yet another waterway, just of another sort. (2006, 2016 a, b)

The situated knowledges in general that we may want to integrate are developed from being a local living with the engineered river, and within the social and natural context where the security is to be maintained. In Dammed, the experiences of risk and security among the reindeer herders and their families became a main theme in the efforts to widen the dam security concept (see, for instance, Öhman, 2016 a, b). With respect to the original goals, the challenge that remains is to realize a platform where these and other knowledges and experiences, can work together with that of formalized scientific and technological expertise. In accordance with the Dammed methodology, posing a suggestion on how this can be done, should methodologically take stance in a situated knowledge too. Here, it will be mine. As Keller puts it 'science is personal' and I am the scientist here striving to constitute the foundations of an epistemological platform to suit the purpose. Let me start with the here and now, with what in the words of Haraway (1988) is the most concrete aspect of my locality and thereto connected vulnerability.

Boden, the town where I live since thirty years, is situated between the two constructions that conclude the engineering of the Lule River, namely the Vittjärv and Boden plants. When I travel the forty kilometres to my job in Luleå, the road follows the river on its final trail to the sea. The way the river and its banks shift with the seasons is something I appreciate a lot. In Boden and the nearby villages – in the area between the two fairly approximate Vittjärv and Boden plants – flooding caused by failing management of the engineered water system is not a daily problem but, let us say it is “not unheard of”. The damages to property and threats to security that do occur tend, according to my every-day insights, to be due to optimization of outcomes going too far, rather than mismanagement of the constructions. This far, the scale of incidents as well as their aggregated impact has been very moderate, in so far as they have not even been close to disturbing the community as such.

Neither the situated, nor the personal is to be understood as 'a knowledge' that exists in a ready format but, as a collection of continually occurring, disappearing and transposing layers of information, emotions, and conclusions. The social of the socio-technical system, participates in the situated, personal knowledge as a platform for the learning. The understanding of the past and its relation to the present and the future is one arena of situatedness. My mother grew up by the shores of another Norrbotten river, the Torne River, one of the few rivers around the Bay of Bothnia that has not been developed for large scale hydro power production. But my father, born 1937, lived during part of his childhood in Porjus. The Porjus settlement developed around the power plant and, as result of the construction and other industrial activities that continued for some sixty years, it was quite lively into the 1970's. However, as so often seems to be the case with hydropower and similar natural resource extraction, the process has put contradictory marks in local culture and identity – not only along the river but in the whole of Norrbotten. The Porjus population is today 1/10 of its mid-1900's size. In my account, the story goes as follows: People get jobs, standards of living. But step by step, the process is reversed when the construction phase is over, the maintenance is streamlined and, the monitoring and operations 'thanks' to new technologies are centralized to somewhere else. My parents met and started a family a bit up north from Porjus, in the mining district. So, the hydropower activities downsize has not concretely affected me. But, in a region characterized by natural resource extraction – hydro power is just one dimension of it – people see this happen time after another. It takes place in different cycles depending on resource, and with the shifts in various world market prices and industrial regimes. It is felt, that revenues are collected far away, while the local communities are left to buffer any sort of impact and fluctuation, including total collapse. The rural livelihoods that locals own and manage are challenged and beaten. People of local descent experience how class issues and racism get intertwined in formal and informal settings, in social institutions and every-day incidents. Repeatedly we note that the land where our families, or neighbours' families, live and make a living, is portrayed as "uninhabited", "wilderness" – and up for grabs. This is shared among us, in many folded social and cultural expressions.<sup>3</sup> So, how to develop an epistemological infrastructure, which is relevant for the experiences known in Norrbotten?

There are several techniques in circulation that can be used to cut corners. An argument for covering bad feelings up could be that when the natural resource extraction was set off in the far north, resources were generated that enabled the foundation of a welfare state in Sweden. And who should not be thankful for that? Certainly, my family has an abundance of reasons to be. The interest, fascination and belief in the good of science and technological progress, has probably not been less among the population in Norrbotten than anywhere else, for that matter. Nonetheless, it still would be a shorting, to imagine laying things at peace with that certain losses are made, while other things are gained. The world does not arrive at a peaceful end where people can settle in and come to terms with what has happened. It continues – and we remain being vulnerable.

Another route readily available is, to join the building of "privileged otherness" claims – to build on the seductive myth that if only the 'other' voices would sound above all, everything would be set right. But, neither suffering nor righteousness runs the dams along this river. Borrowing an expression from Keller, the matter remains that the successful interaction with nature that is at play in running the Lule River hydro power production, is developed and sustained by science and technology. (1985, 1992) Donna Haraway offers even more concrete support in this matter of avoiding simplification and reduction, where she emphasises, through the cyborg figure, a refusal to

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<sup>3</sup> This is a personal account produced solely to be valid with respect to how I have understood local experience and popular discourses and sentiments. For academically validated works the reader may consult, for instance, Hugh Beach (2001), Staffan Hansson (1994), Lars Elenius (2001), Andrea Amft (2000), Curt Persson (2015). The references given are the PhD theses of the authors, or corresponding works. They have also written a number of papers, edited anthologies, etc.

accept any one position or experience as the sole, totalitarian source of knowledge. This is not directed against “science and technology” only but, the refusal is a warning against claiming, for instance, *innocence* as a privileged access point. (1985)

When it comes to dam security, it is out of self-preservation in assorted dimensions that I shy from seeking knowledge in a natural, innocent position. I see a risk to unintentionally support, through my academic status, inclinations that may exist, to interfere carelessly with a management that not only has possibilities to improve but, could as well be brought to deteriorate at unprecedented scale. One might also say that it is out of respect, that I do not take the route of celebrated otherness to develop a feminist epistemology for the engineering in the Lule River. I am speaking here of respect for the knowledge practices developed by people that, have this far done more for me than I for them. They have taken care of the river so that my community has been able to live on. Besides, the mere thought embarrasses me, to be known before friends, family and neighbours for such speech.

### ***Interview with a technical consultant***

I called a person who I know as appreciated among peers for his record, in the type of geotechnical and civil engineering deliberations that, seem to continuously take place in connection to the dams and the banks along the river.<sup>4</sup> I told I was getting into a dam security project and, wondered how he saw the topic – in terms of an overall introduction. So, he told that the risk of a dam collapse is understood as a matter of two factors: failing construction, and failure to handle water flows. They cause different types of breakage. For the people involved there are routines for how to organize and act, and they apply to more than hydropower dams. Besides river dams they apply to such as sand reservoirs and tailing ponds. Indeed, as result of an increasing awareness of worst case scenarios caused by exceptional water flows, the area is getting more and more regulated, he said. As I, also this person lives in the river valley. I asked if he is afraid of what can happen. Not really, he said. There already are surveillance systems and, even more instruments investments are being done. Many dams can take some damage and therefore, they allow time for repair. I asked: Do the instruments really help? Can people actually do something with all the data they provide? They do help, he argued. They tell us things we cannot see. But, yes, the owners also patrol the dams.

The Suorva reservoir alone holds 6 billion cubic meters of water. In Boden we are informed that if the major Lule River dams collapse – besides Suorva it is Seitevare – we would have 24 hours to evacuate. We are told the water level would rise to nine meters above the pavement in the city center. (Bodens kommun, 2015) It was as result of informal dialogues that I decided to call this person, as a source to understanding the links between engineering and dam security. The final decision rested on that I had somewhat of an idea of what he does. At some point, it was slope stability calculations for the river banks. Overall, if I remember right, they had to do with measures to meet new requirements on the system's capacity to hold the water flow, would extreme situations occur.

One may wonder what local experience, talk, and anticipations have to do with dam security, such as this technical consultant works with; how it is related to the terms of dam security that he introduced to me. I for one do not speak in favour of more social science, or for instance philosophy, in engineering education in general. The core competences are necessary for all our security and the stability of society, to an extent that is hardly possible to overestimate. Moreover, it remains to be shown that studying sociology or philosophy, leads to enlightened doings. I do argue, however, that the connection between interaction with nature and interaction with people becomes evident if we look at the totality of contacts, deliberations, negotiations, networking, business opportunities, and

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<sup>4</sup> Telephone interview with technical consultant 9 September 2010.

regulatory directives that the technicians and engineers are located within. In certain positions and dealings, it would be more explicit than in other but, it is always there. There is also private life – relatives, people one meet in the grocery store, at parent meetings, in contacts with health care and hospitals – and in the environment that is composed by culture, art, media debates. If Keller's motto 'science is personal' is transferred to 'engineering is personal', it is all too easy to fall into a type of standard interpretation, that produces nothing less than a caricature (typically about engineers: a person with obsessive interest in technology, essentially as compensation for all sorts of social and psychological deviances and shortcomings). Another way is to understand engineers as persons that just like anybody need – are forced to and desire to – relate and respond to society at large, as well as the communities they are integrated in. This demonstrates why Lena Trojer's identification of the potentials of gender studies will, within a foreseeable future, remain pertinent.

### *A problem in the Dammed proposal – a hindsight reflection*

The Dammed project did not receive quite the funding that was applied for. For the call and research fund in question the funding was actually quite high, so there is nothing special to be said on that. However, as the application had not been "overpriced", the cuts meant that the goals had to be reassessed and the ambitions originally stated could not be fully realized. Nevertheless, even if all resources that were asked for had been available, there are some problems already in the staging of the project's theoretical and methodological foundations that would have been necessary to deal with, had there been resources available, before it had been meaningful to attempt addressing people and organizations that work with dam safety in the targeted rivers or, with the new technologies that may be applied.

Haraway's situated knowledges concept can be interpreted as a matter simply of downplaying, for instance, privileges of 'those in power' to formulate dam risk and security discourses. This is where the Dammed proposal, in retrospect, can be said to have had some inbuilt problems. It was proposed to combine and merge academic, professional, and local experiences and knowledge to a new concept of dam security. That we, the researchers had the motivation to engage in knowledge re-creation was evident from the proposal as such. Yet, it was not discussed in the proposal text that, not only among the project's researchers but, among science and technology professionals that we might reach during the project work, would there possibly already exist motives to take alternative stances than dominating discourses would lead to, or knowledge, in the wider meaning that the Dammed proposal argued is necessary to develop.

Already as she introduces the cyborg figure in 1985 Haraway warns against depending on taxonomies for epistemology. She described how Ronald Reagan's launch of the advanced "Star Wars" defence/warfare system had made feminist engagement in science and technology more urgent than ever. At the same time she accentuated that, being a man in the computer industry is not equal to being supportive of such applications. Haraway is known for her complex way of writing, but in this matter she has been very concrete. Also in the introduction to her *Situated knowledges* paper she warned against simplified onto-epistemological assumptions:

"The imagined" they" constitute a kind of invisible conspiracy of masculinist scientists and philosophers replete with grants and laboratories. The imagined "we" are the embodied others, who are not allowed not to have a body, a finite point of view, and so an inevitably disqualifying and polluting bias in any discussion of consequence outside our own little circles /.../" (1988, 575)

There was not much of hesitation when Dammed was designed, where the knowledge privilege lay – namely with those who constructed and safeguarded the 'narrow dam safety concept'. It was, according to the analysis that motivated the project "based on techno-scientific discourse." Yet,

people and discourse are not the same. Situated knowledge and discourse is not the same, regardless of the subject's access to discursive spaces. In her subtle way, also Keller included already in *Reflections on Gender and Science*, a sub theme of traces of other knowledge traditions co-existing with, or remaining from older days within, the natural sciences. And this is of course what she communicated with her study of Barbara McClintock's work. Keller however avoids theorizing of the communal beyond natural science and the women's movement as an inspiration, while Haraway does not avoid politics in a broad sense, and the messiness of society. Haraway thus offers more guidance on how to approach a situation potentially saturated with unforeseeable variations of situatedness. In the social and geographical contexts that Dammed targeted, it is not possible to see on the surface of a person what s/he might have first-hand knowledge from. Anyone who we as researchers meet may be situated in any combination of the areas we want to include in the new security concept. In what became the actual Dammed project, reindeer husbandry and traditional Sámi knowledge came to be the key area where new, wider experiences and points of views were searched. And, it was not much considered that a "random" person that we researchers might meet can have, say, both experience from what maintenance of hydropower constructions is or, why not, from hydro power engineering *and also* from reindeer husbandry. In a way, this is a bad example, as it seems to implicitly suggest that reindeer herders and technologists are coherent groups that respectively think the same thoughts, draw the same conclusions and generally interpret reality in the same way. Nevertheless, the two positions develop in separate forms of training and through each their own knowledge tradition. My point here is that, for that matter, it is by no means impossible, that individuals have access to both. In fact, it is not just possible but in the Norrbotten context it is probable. Coming to think of it, one realizes that, at least in Norrbotten this combination is fairly common.

Moreover, as important is that, beyond the taxonomic designations of who a person "is" and what s/he therefore knows, there are many reasons why s/he might know about different vulnerabilities, and have many-folded insights into the social character of the socio-technical hydro power production in Sub-Arctic rivers. As nationality, ethnicity and race are acknowledged as basis for all sorts of legitimacy claims, taxonomies are compelling. Yet, our job as researchers is not, to find "clean" knowledge but, to provide a platform where the wider knowledge that we call for can take form – however messy it might be. Perhaps it is better, the messier forms of situatedness we can find? At least potentially, this could mean that the ground is already prepared for advanced and sophisticated conclusions on the socio-technical networks that day by day secure dam security. For people being willing to share such knowledge, we need to ask questions that are possible to answer, or at least hang on to, and we need to be trustworthy with respect to how we handle information we get access to. The reader has a responsibility too, not to run into conclusions. The engineer I interviewed answered to the questions I posed and against the background of a short introduction in a telephone conversation, not to the general project ambitions in the way a feminist scholar is able to grasp them from reading this paper.

### ***Haraway on cyborgs, Keller on humans, self-organization and machines***

At the time of writing, it is the 30 years anniversary of two central publications on feminism, science and technology. Besides Keller's book already mentioned, 1985 was the year of publication for Donna Haraway's *A manifesto for cyborgs*. The cyborg figure was explicitly designed by Haraway to function as support for liberation. It rests, she meant, on the construction of consciousness and, the cyborg is a figure of fiction and lived experience that 'changes what counts as women's experience'. (65-66) It need not be repeated here, how successful Haraway's initiative became, in supporting joint and liberating thought and creativity, among feminists. As engineering takes place at society level, however, there are limitations in the cyborg figure as to explaining and changing the consciousness about it. Cyborgs are, when Haraway writes about them, integrated in global production and consumption systems. But, also where a cyborg physically sits by very similar cyborgs, as does for

instance an engineer in an office landscape, or a sweatshop worker in a factory, Haraway's cyborg figure is an individual. Therefore, talking of cyborgs we end up in individuals. Engineering, cannot take place other than in negotiating and battling systems of territorial dominance, legislation, finance, and so forth. This certainly goes for contemporary hydropower engineering and, the associated distribution of electricity without which it is meaningless. Engineering is about societies organizing their transactions with matter and energy, not persons doing so.

Another figure of thought is provided by the connection Keller makes in an article titled *Ecosystems, Organisms and Machines*, between self-organization and post-humanist theory (2005a).<sup>5</sup> Originally, the concept of self-organization developed in the 1800's, from the study of organisms as bounded bodies, not designed by some external force but, capable of self-regulation and self-generation. Later, studies in physics and mathematics, of nonlinear dynamical systems, led to seeing self-organization in many, many non-animate phenomena too. Of more importance here, is that the concept can be deployed to capture conditions and transitions in ecological systems with animals that are socially highly complex, as well as species less so. Keller's proposition for how to make the term useful in study of human doings, is to redirect the focus from the usual study of human *intentionality* – as a construct of vague relevance to the matter of self-organization – to *agency*. Agency, she writes, is an attribute we share with many – if not all – other organisms. This implies to think of ourselves in the same terms as we think of other organisms that shape their environment by their activities and that build entities that serve as extensions of themselves.

“Consider, for example, beaver dams; bird nests; any of Scott Turner's wonderful examples of tunnels built by earthworms that serve as accessory kidneys; the bubble gills built by aquatic beetles; the horn-shaped burrows of crickets that amplify song; or homeostatic termite mounds.” (1073)

In other words, we can think of the machines we create as simultaneously extensions of ourselves and effects of human agency on our environment. And, notably, a theory that relates to nature and ecology does not for that reason imply harmony or success. This far, Keller's analysis is clear. However, in the first instance, the post humanist position Keller suggests might be interpreted as that what an engineer does is comparable to what a beaver does, when either of them builds a dam. But, the self-organization of a species, with the exchanges and flows of materials, substances and energy it engages, is a matter of what happens on system level.<sup>6</sup> (Salmi, 2000) This means that in the assessment of an engineering accomplishment, the system in which it has taken place is the unit of analysis, not the singular accomplishment, not the singular human (engineer, technologist). This is implicit through the theoretical underpinning of Keller's analysis, but not outspoken in her text. The same goes for birds, beavers and termites, for that matter. In other words, if we think of engineering as one among the practices through which human societies deal with their actualities it is, in an every-day sense, to conceive it as another expression of what happens in nature, all around us, all the time. (Udén, 2013) As Haraway (1985) strived to achieve with the cyborg figure, Keller's more recent post humanist extension-agency ontology of humans and machines, can do the job as basis for feminist involvement in technological matters. In the same manner as the cyborg, it goes beyond the defensive, aggressive and innocence/victim positions that we – willingly or not – are entangled

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<sup>5</sup> This content is fetched from my working paper *Towards implementation of feminism in engineering: The relation to nature and Keller about self-organization* (Udén, 2013).

<sup>6</sup> Even though it is implicit in the paper, this is not emphasized by Keller (2005a). The particular aspect of energy and material flows in ecological systems, including human industrial systems, is more thoroughly discussed by, for instance, Salmi (2001) who, for his understanding of ecology, refers to Holling et al (1995) and Holling and Sanderson (1996).

with. Haraway goes well together with Keller in this respect. They complement each other. Haraway puts a very outspoken trust in the differentiation within and plurality among people and, the value and potentials of their knowledge – men's as well as women's. This, of course, is a requirement for Keller's project of a new onto-epistemology that makes sense of feminist critique within science and vice versa, but, she more indicates than explores the possible motives that may be summoned.

Against the background of the issues raised by *Dammed*, my interpretation of Keller's post-humanist agency theory would be something like the following: Among the artefacts that require surveillance and maintenance of considerable scale, that is, attention organized at societal level, are the type of constructions that currently are labelled large dams. On daily basis as well as in long term strategies, human society interacts with nature, in relations that represent opportunities and security as well as threats and risk. Technology is one dimension of how we make use of opportunities, including how we broaden the scope of opportunities available to our respective societies. Likewise, technology is a sub set among the answers that we present to threats that occur in or from the natural environment, be it of acute or long term character. Where the conditions are altered by humans, technology and artefacts make factors alongside natural conditions, and, the different dynamics of society and life.

As far as this can be done, we need be aware of and administer this complexity. In no way is it a matter for science and technology alone. I write about engineering because it is the area I know and have an interest in improving. To give an example from another area, scholars at Luleå University of Technology have experienced that, it is increasingly appreciated that law and juridical praxis sensitive to the totality of local circumstances, are constituents of 'green' electrical power production. (See, for instance, Ek & Matti, 2015.)

### ***People, water systems and dams in Norrbotten – other stories***

Obviously, the agency of creating extensions that Keller delineates is, neither bound to engineers specifically, nor in a general sense to formally educated professionals. My claim is rather that, engineers have a specific role in *contemporary* society, for implementing technology. It is a valuable quality of the post humanist self-organization theory that, the engineering profession with its help can be positioned as one example among many organizational measures that have occurred for that purpose, throughout time and space. This openness, the larger scope, can be utilized for locating the theory, and thereby for building a situated epistemological platform together with researchers, professionals and stakeholders.

Returning to history, the starting point in so many accounts of water systems and technology in Norrbotten, is the construction of the first 'large dam'. But dams as such were not unknown in Norrbotten, until that moment. In an inventory by Törnlund (2010) 886 dams built prior to 1950, were noted, not counting hydropower dams in current use. With respect to the purpose of damming the majority, almost six hundred, were made in the second half of the 19th century for log-driving. During this period, locally in Norrbotten characterized both of a developing industrialization and agrarian expansion, Norrbotten's population grew with a factor of four. In 1900 the population had reached 135 000. Simple calculations lead to the insight that for a period of time, for every 200 persons in Norrbotten, there was one dam for log driving purposes. Other dams were constructed by farmers and settlers for agrarian water management, and yet other where made for saw mills, ironworks, flour mills, and more. Almost one hundred dams in Törnlund's inventory are power and regulation dams. With regards to technology, Törnlund found that irrespective of the dams' purposes, their construction and the materials used were the same during each period of time.

From the 1800's to 1920 the spillways were made with timber, while from 1920 cement was used and from the 1930's also prefabricated concrete blocks. Rock, stones and pebbles, together with soil have always been used for the constructions, but the techniques developed with time. (As it

happens, also in Suorva such a technique is applied.) Furthermore, Törnlund comments that, a single dam in principle can be used for several purposes and, the inventory gives a number of examples of this multi-purpose practice. However, especially log driving dams could raise conflicts, as they disrupted the conditions for operating other dams, that is, other economic activity. To sum up, both the construction and management of dams and, experiences of different technologies and their consequences are part of Norrbotten's history, with or without the large dams.

### *Conclusion*

Once upon a time there was ... Within a situated post humanist agency platform for the Lule River, the relevance of highlighting the local history of damming practices does not rest on people having memories of them, or even on people having been told stories about them by family and elders. Neither is it a quick fix that erases the contradictions in the experiences that are individually and collectively held in the Norrbotten communities. It is a suggestion for one way to start. Placing the beginnings, not in one but, several 'other' points of time, locations, communities and livelihoods has the purpose to recondition the terms for knowledge creation. This follows the central theme in Keller's general approach to what feminist thinking – not only can but *should* – bring to science itself: a counterpoint to the seeking of hierarchical, simplistic 'laws', pointing to multiplicity, fine-tuned entanglements, things that take place in several dimensions and not all of them grandiose. (1985, 1992) One might also say that it is a measure to bring out the cyborgs that are part of us and, that Haraway described; *monsters* that do not depend on "original unity, fullness, bliss and terror /.../ the task of individual development and of history." (2004, 9) Keller's post humanist agency theory can indeed be combined with other feminist theory and methodology, working at intersections and different levels of detail.

Suggesting this theory as basis for feminist involvement in dealings with risk and security around large, technical constructions and systems partly has to do with the need, to find a platform that works well in, and together with, the feminist and gender studies tradition. Partly, it is about having an overarching story that feels topical and up-to-date with current scientific discourses, to which staff and organizations working with dam safety, and technologists from different fields can be invited to contribute. All types of risk assessment and security work are embedded socio-economically and political-culturally. More or less, there will be contradictory understandings of the technological enterprise, as that indicated for Norrbotten above. In the very time of finishing this article, the Samarco Mineração SA catastrophe, with two mining dams breaking, speaks volumes about that. To judge from media reports, dozens were killed, several hundred displaced and the freshwater sources of hundreds of thousands got poisoned. The immediate reports on this catastrophe indicate active malpractice against better knowledge. If so, the calculations were there but, enough many people at positions still to be revealed did not care.<sup>7</sup> Contrary to mining where dams are somewhere to put waste, in hydropower production dams generate money. Thus, even for mildly responsible owners the incentive to secure the management and maintenance is there in quite another way. Nevertheless, the palette of what could go wrong is wide. Management of the water flows must be delicately tuned with the environment. Typically daily weather fluctuations need attention, as they have very direct effects. Yet, there is so much more. Negligence in maintenance is also a risk. As with so many of the housekeeping chores, it is not before maintenance is *not* done, it is noticed.

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<sup>7</sup> This article is concluded literarily in the time of the catastrophe why scientifically validated assessments are not available. The preliminary conclusions I draw build on media reports quoting State prosecutor Carlos Eduardo Ferreira Pinto saying that it was officially noted in 2013 that the actual positioning of mining waste could undermine the dam structure's stability. See, for instance, Kiernan and Lyons, 2015: "The report had already highlighted the fragility of these structures and the necessity of an increased rigor in monitoring them." (Kiernan and Lyons, 2015)

To finally return to how Lena Trojer identified the societal relevance of gender studies in technology and engineering, the theoretical starting point suggested in this article, is exactly that: it is a starting point. That humans like other species create machines, as extensions of themselves, to multiply their agencies, is not in itself a guideline for how we should strive to design those machines, or our agency on this planet (and beyond). The understanding of science and engineering as personal is one of the greatest gifts feminism has to offer. As in good manners for public speech and dinner conversation, it should here be recalled that personal and private are not same. The deep and advanced knowledge gathered within feminism, from dealing with separations of public/private, love/power, emotion/intellect, etc., etc., as part of public life, is exactly what generates the momentum for contributions to handling the increasingly complex and, increasingly dangerous techno-social challenges faced by humanity in the near future and today. This, Lena, is what I am now ready to say. Please accept my congratulations, on the festive occasion, to your most meaningful and fruitful career as Professor and feminist activist!

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