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Hunting for female galaxies and giving birth to satellites: the gendering of epistemic cultures in public discourse on physics and astronomy

Introduction

There are relatively few accounts so far that deal with the gendering of the material sciences such as physics or astronomy compared with the biological sciences. One reason for this deficiency is that gender is no explicit part of the contents and theories of the material sciences and thus seemed more inaccessible to gender scholars' scrutiny in the first instance. However these disciplines are nevertheless gendered. On one hand this concerns social practices and disciplinary cultures at research institutions and at universities.[1] On the other hand, knowledge producing practices and epistemic premises themselves are also gendered, as scholars in the field of gender and physics have pointed out.[2]

In particular those studies which examine the practices of

1 Especially for physics see Traweek (1988, 1997), Lucht (2004), Erlemann (2004), Hasse/Trentemøller (2008) and Pettersson (2011, this volume). The studies of Beaufaÿs (2003) and Heintz/Merz/Schumacher (2004) examined bio-chemistry and meteorology, respectively, but the findings are widely transferable to physics and astronomy. Aspects like institutional structures, temporal and organisational conditions, social practices of daily laboratory life, styles of communication and interactions as well as professional self-conceptions and value systems turned out to be relevant for gendering processes in physics academia.

2 Most of them refer to historical developments (Scheich, 1985, 1993; Osietzki, 1996; Potter, 2001; Heinsohn, 2000; Götschel, this anthology). For contemporary contexts see Rübsamen (1993), Rolin (1999) and Götschel (2006) or, in a broader sense, also Barad (2007). For an overview see Götschel (2011).

physical research and education have demonstrated that *doing physics* can be described as a *doing gender* (West/Zimmermann, 1991). In the light of low percentages of women in these fields, it unsurprisingly turned out that *doing physics* is widely – but not solely – constructed as a masculinising activity.[3]

In this paper I want to argue for the case of physics and astronomy that performatory gendering processes of a scientific discipline take place not only within scientific research, but at least to the same amount in public spaces beyond the laboratories. As many studies in the field of Science and Technology Studies (STS) have argued, sciences cannot be thought of as a hermetically closed space that is separable from other social spaces, but are deeply entangled with society, politics and publics.[4] Hence we have to assume that the gendering of sciences is influenced by and has repercussions on public representations of sciences.[5] Such representations are produced in numerous contexts, among them media, museums and educational contexts, like schools or universities. Indeed there are mutual interrelations between the gendering processes of scientific knowledge and scientific practices within scientific communities and the gendering of its public representations.[6] To argue this I will discuss results of a study I performed on the gendering of physics in public discourse. For the purpose of the study I carried out a discourse analysis of German

3 See in Traweek (1988), Lucht (2004), Erlemann (2004), Pettersson (2011, this volume).

4 See for example the case studies of Hilgartner (1990) or Lewenstein (1995). For more conceptual approaches see Shinn and Whitley (1985) or Bucchi (1998). Especially in the German sociological discourse the political dimensions of the medialisation of science has been discussed thoroughly by Weingart (2001).

5 My notion of representation refers to Moscovici's concept of "social representation" (1984).

6 Studies already done in this area are those by LaFollette (1988; 1990) in the historical dimension and by Flicker (2003) about scientists, including astronomers, in fictional films. There are plenty of studies dealing with public representations of physics or material sciences, but most of them do not take into account the gendering of these representations.

print media and their coverage of the physical sciences, astronomy included. As we will see, the media are important actors in public spaces, so it makes sense to focus a study on public discourses on the media. But before I turn to the discussion of the gendering of physics and astronomy in German media discourse, I will sum up some important insights from feminist studies of science and technology and gender studies on which my theoretical approach is based. This will be followed by some conceptual considerations regarding the role of the media for public discourse and the way the media represent sciences, i.e. physics and astronomy. Coming then briefly to the empirical design of the study in chapter V, I will then turn to the findings of the discourse analysis. The following chapters will deal with the predominant rhetorical styles through which physics and astronomy are presented in the media. Two differing styles are dominating the media representations: an "emotionalizing" one and an "objectifying" one – as I call them. Aside from these two dominating styles, there can also be found rhetorical approaches to representing physics and astronomy in the media that differ from the dominating ones. These quite new ways of presenting physics in the media will be illustrated in the subsequent chapter. Finally, the paper will end with some conclusions and perspectives for future developments concerning the problem of the gendering of physics and astronomy.

The co-construction of gender and science: conceptual approach

In feminist studies of technology, processes that foster the mutual construction of technology and gender were coined by the term *co-construction of gender and technology* (see Faulkner, 2000(b); Lohan, 2000). Existing studies of the co-construction of gender and technology analyse in which way activities in technology and in

engineering open up options to practitioners to embody a form of masculinity (Mellström, 1995; Faulkner, 2000(a), 2000(b)) and, vice versa, how technology became masculinised in these construction processes. While Faulkner focused on software engineers (2000(a), 2000(b)), Lohan dealt with the gendering of mundane technologies (2001). So far these mutual constructionist processes were investigated for technologies and gender. Corresponding examinations of scientific fields under the header of a co-constructionist approach are still rare although it seems to be but a small step to broaden the co-constructionist approach to science. Hence in analogy I use the notion of the *co-construction of gender and science*, pointing to the mutual shaping of scientific practices, on the one hand, and, on the other hand, practices that provide options to perform gender. This does not mean that scientific practices are inherently masculine or feminine but rather that they offer a repertoire for the individual to perform gender via scientific practices.

As mentioned most of the empirical research done so far investigates this process of co-construction of gender and physics in the laboratory (Traweek, 1988, 1997; Rolin, 1999; Pettersson, 2011) or in educational contexts (Lucht, 2004; Erlemann, 2004; Danielsson, 2010), but without naming it co-construction. Thus examining the gendering processes in media representations and not in physics research means a second widening of the co-construction approach. A huge body of Science Studies research showed that suppositional spaces of inner- and extra-scientific spaces should not be thought of as distinctly separated. They are rather inextricably entangled with each other, mutually influencing each other with their boundaries under constant negotiation.[7] This entanglement

7 Aside from the studies already mentioned there are also articles on the issue by Nowotny (1993), Shapin (1990). For the case of physics see e.g. Lewenstein (1995), Felt/Nowotny (1997) and Mellor (2003).

of scientific and public spaces shapes the way science is thematised in public discourse.

Therefore processes of mutual co-construction of gender and physics are also not restricted to (intra)scientific discourses in the laboratory. Also in public discourses, the co-construction of gender and physics is "at work" and reproduces a gendering of physics that has repercussions on the co-construction processes within the scientific discipline itself.

"Doing physics as doing gender"

With the concept of *Doing Gender* it becomes possible to explain the gendering of activities that at first sight have nothing to do with gender, as it is the case in physical research activities. The above-mentioned scholars West and Zimmerman coined this notion. They stated that 'gender is the activity of managed situated conduct in light of normative conceptions of attitudes and activities appropriate for one's sex category' (West/Zimmerman, 1998: 169). But *Doing Gender* in their vein does not mean to follow strictly normative, pre-structured conceptions of femininity or masculinity, respectively, but to evolve one's own individual *doing gender*, nevertheless always running the risk of the estimation by others and their norms.

The studies of Beaufaÿs/Krais (2005) and Heintz et al. (2004) follow the concept of *Doing Gender* and employ it in the notion of *Doing Science as Doing Gender*. They focus their attention on the epistemic cultures of scientific research with which junior researchers are confronted within their own disciplines. They adopt it more or less as their own during their higher education phase and their first research experiences.[8] Though not focusing

8 The investigations of Lucht (2004) and of Erlemann (2004) followed a related approach but did not explicitly refer to the *doing gender* concept.

on physics but on bio-chemistry and meteorology their findings are useful for my purpose because it is possible to reconstruct via examining these processes how research and epistemic practices are gendered and how far they are ascribed a variably shaped gendered meaning depending on the discipline. For instance scientific practices with masculine ascriptions allow practitioners to reinforce the masculine-coded parts of their professional identity of being a researcher. The fact that researchers of this very discipline, which constitute a particular variation of masculinity, physics in this case, are for the most part male reinforces and consolidates the mutual attribution of a scientific discipline and gender.

As argued in the last chapter, these gendering processes take place not only within the disciplines themselves, but also in pre- and non-academic social environments such as in the family, schools and the media: For instance, in media representations of physics also human actors appear – physicists, whose *doing science* is described and given a gendered meaning. And interestingly not only human actors are gendered in this sense, also the physical knowledge, machines and even the objects of research play their role in a representation of *doing gender* as *doing physics*. Not only are the physical research practices gendered, but also physical knowledge and even experimental devices are subject to ascriptions of a gendering.

Having thus stated that *doing physics* is a masculinising activity, the question comes to the fore of what masculine means in this context. Raewyn Connell points out that there is no single, generalised masculinity but multiple forms of masculinities that differ also in the ascriptions of power. She develops a useful concept of hegemonic masculinit*ies* in plural (1995). The concept better takes into account the fairly different variations of genderings than models of gender that rely only on one, normative, form of

femininity and masculinity.[9] Following Connell, masculinities are not inherent properties of the person, which would be shared by all men in the same way, but rather that these multiple forms of masculinities are historically variable and that they emerge in practices underpinned through institutionalisation and cultural orientation patterns:

> Masculinity represents not a certain type of man but, rather, a way that men position themselves through discursive practices. [...] [It] is defined as a configuration of practice organized in relation to the structure of gender relations. (Connell/Messerschmidt, 2005, 841, 843)

One of the hegemonic masculinities she sees based in an ideology of rationality, which is embodied in the *men of reason* (Connell, 1995). In this vein doing science can be interpreted as performing the sort of masculinity of the *men of reason*. Thus the very epistemic practices which constitute a form of masculinity, offer options for researchers to perform a masculine doing gender by doing and applying these very epistemic practices. What seems to be tautological at first glance fosters the reproduction of the gendered meaning of doing physics as an option for actors of doing masculinity.

Science in public discourse

In order to conceive the notion of the "public" on a theoretical level, several authors conceptualise it as a discursive arena (e.g. Peters, 1994). In this vein the public can be thought of as an arena in which actors who want to be listened to can rise to speak (Pe-

9 Authors from feminist techno-science studies who investigate the co-construction of technology and gender refer to this model of multiple masculinities for a decade (Faulkner 2000(a), 2000(b); Lohan 2001; Mellström 2004). Practising technical activities can be interpreted as performing a form of masculinity by the technical actors themselves.

ters, 1994). The media play a key role in this arena, not only as communicators that circulate statements in the public arena but likewise they are autonomous public actors that co-shape what is going on in this forum. In particular the mass media are seen as being among the key players in the public arena.

The mass media influence the audience and their attitudes towards and their conceptions of science because the media affect not only which topics and actors are selected and thus get attention, but also in which way sciences are represented as epistemic practices, which features of the mediated knowledge are attributed to it, and if it is ascribed e.g. cognitive authority, truth or trustworthiness. Furthermore media have in their hands, whether and, if so, which actors appear in the representations and which aspects of the presented actors come to the fore and which of these get no attention. Having this in mind one cannot expect the media to provide lifelike blueprints of science. Rather the media construct their own images of science while reporting science. But although the media construct their own reality about science with their own means (Weingart, 2001) they are not detached from current socio-culturally entrenched conceptions of sciences. I conceive these ideas as *imaginaries* of sciences since their points of reference are drawn from the very socio-cultural images and their gendering. The media take over those imaginaries of sciences, applying them and therefore also reinforcing them. On the other hand, the media are also a constitutive part of public discourse, as argued above, because journalists are at the same time influenced by public attitudes and imaginaries since they are – as citizens – part of the public. Furthermore the media are subject to an inherent logic of the market. They have to keep their audience in mind, meet their supposed imaginaries' and their readers' expectations concerning science coverage, last but not least for profit reasons. So

the media discourse reveals important traits concerning the gendering of the societal discourses on science. The co-construction of physics and gender is not only shaped in the media but it becomes visible and accessible to empirical investigation.

Reporting physics in print media

Science and Technology Studies have shown extensively that science is as cultural and social as all other human activities. The strand in STS of so-called laboratory studies explored the knowledge-producing practices, including physics.[10] They investigated how scientific facts are constructed and how this construction of scientific knowledge is embedded and also constituted by the practices and culture of physics. Hence neither the knowledge of physics is independent from practices and cultures of physics, nor are the produced facts.

In contrast to these findings, in media representations the social context and conditions of knowledge production have mostly not been taken into account. Instead, scientific research is rhetorically dramatized, knowledge and epistemic practices are emotionalised and research actors are ascribed motivations, competencies and attitudes towards their objects of research. The processes of gendering are interwoven in these very dramatizations and ascriptions and become effective.

Apart from the physical knowledge being produced in the laboratory, also scientific research practices of physics, *doing physics*, is represented. The representations of *doing physics* in media coverage constitute an imaginary of the epistemic culture of physics. In order to explore these representations in media coverage on physics the study consists of a print media analysis of articles

10 The best-known are from Knorr-Cetina (1996; 1999) and from Merz /Knorr-Cetina (1997).

that report on physics. The sample was compiled from five different German print media and their coverage of physics and physicists around the advent of the new millennium, between 1999 and 2001. It consists of one weekly newspaper (*Die ZEIT*), one daily (*Frankfurter Allgemeine Zeitung, FAZ*), both ranked among the German quality press, a weekly news magazine (*Der Spiegel*) and two science magazines (*P.M.* and *GEO*).

The discourse analysis was conducted on basis of a 'grounded theory' approach (Strauss/Corbin, 1990) and combined with a quantitative survey of the frequency of men and women physicists mentioned in the articles and in figures. The survey resulted in a sample of 545 articles, a huge portion presenting astronomy. Forty-four of the total of 949 physicists mentioned in the sample were women. The main result of the survey shows that women physicists in Germany are underrepresented in the media to the same extent as in research. Female physicists who are represented in the media articles hold a percentage of 4.6%. This number reflects roughly the size of the participation of women in the higher ranks of university research and development at the time the survey was done.[11]

The empirical study showed that physics is covered in different thematic frames. In the science sections of the news press physics is mostly framed as a knowledge-generating enterprise that produces scientific findings that are reported in these articles. Besides this, there are also social frames in which physics is mentioned. These are articles on science policy or biographies of physicists. They are mostly positioned in the social or political sections of the press. In popular science magazines they are virtually non-existent.

11 At the time there were about 5% women in physics who had a *habilitation* which equals roughly the status of a senior scientist and the rank of an associate professor.

It turned out that the coverage of current research in physics and physical knowledge is dominated by two styles of representations of doing physics, which I call *"emotionalising"* and *"objectifying"*. They are found predominantly in the science sections of the news press and the popular science magazines. The representations of *doing physics* are arranged around these two styles and shape the imaginaries of the epistemic culture of physics in the public.

The emotionalising style

Physical research as conquering nature

In the *emotionalising style* physical research is dramatised through the use of emotion-provoking metaphors and literary topoi that stand for physical theories and knowledge as well as for the objects of inquiry. Because of their capacity to create an emotionalising imaginary of physics, I call it the *emotionalising style.*

In a couple of articles metaphors of the field of human reproduction, childbirth and child raising are applied in order to explain cosmic phenomena. Within this complex of reproductive metaphors nature[12] is coded as feminine, especially when referring to astrophysical objects for instance as "mother stars"[13], "mother galaxy" with "star babies" or as a "cosmic uterus" where "the drama of star birth" [14] happens. In assigning symbols of motherhood and childcare to research objects on a metaphorical level, an emotionally affirmative aura is produced.

Parallel to this metaphorisation, objects of inquiry are also de-

12 Under the notion of "nature" I subsume living as well as inanimate nature like materials and outer space.

13 *Die ZEIT* 51/1999, Ulf von Rauchhaupt, "Searching for distant worlds", p.35. All translations done by the author.

14 Both *GEO* 11/2000, Henning Engeln "On the life of the stars", p. 24-52.

scribed as mysteries and secrets that are hidden in nature. This pattern becomes visible in the titles of magazine articles like "The ultimate secrets of the universe" or "The ultimate secrets of the Big Bang"[15].

An even more extreme variant describes outer space as a strange, aggressive world inhabited by ferocious creatures. Metaphors of monsters and death are particularly applied to cosmic objects, culminating in speaking of the universe as hell. These kinds of exaggerations appear e.g. in an article in which energy discharges in the atmosphere are called "hostile energy monsters"[16] or when it is spoken of "galactic cannibalism".[17]

Applying such kinds of metaphors when representing research objects and knowledge results in a dramatised and romanticised landscape in which inanimate nature is also constructed as being alive. It is assigned weirdness and a menacing air. Both groups of metaphors describing nature being applied to research objects, firstly the aestheticized, life-giving female connoted ones and, secondly, those of a menacing nature that is to be battled, result in a Janus-headed imaginary of objects of inquiry. This double-sided imaginary parallels conceptions of nature as an object of inquiry as it has been prescribed in the model of modern science in its early times by Francis Bacon (Merchant, 1980; Keller, 1985; Lloyd, 1996).

In these representations research activities are usually not specified, and descriptions of physical practices remain very general. These descriptions consist of metaphors that do not refer to concrete activities but to emotionalising imaginaries that put

15 Both in *P.M.* 7/2000, Peter Ripota "The ultimate secrets of outer space" p.10 and 5/2001, Joseph Scheppach "What happened before the Big Bang. The ultimate secrets of the Big Bang", p.58.

16 *P.M.* 19/2000 Wolfgang C. Goede "Satellite destroys tornados", p.42.

17 *Der Spiegel* 6/1999 Olaf Stampf "Searching for star cadavers", p. 244.

physics and astronomy in a stylised landscape of *doing physics* such as solving the mysteries of nature, hunting for the hidden secrets of nature or even as waging war against nature and getting it under control. In this imaginary the astronomers are the hunters and the cosmic objects of observations are their prey: "Planet hunters take prey" or a "big catch".[18]

In many of these metaphorical landscapes, physical research is ascribed an active doing. Since nature is imagined as seeking to hide its secrets, the task of the researcher would be to wrest away those secrets. In the science magazine *GEO* it says that "nature has put a veil on the microworld that can be revealed by physicists with their methods of inquiry".[19]

An extension of the imaginary of secrets that seems to force physicists to exercise a violent act represents physical practice as military action where the researcher tries to battle the research objects, the galaxies:

> 'An Armada of x-ray-telescopes now flying into space is not a casual incidence' astrophysicist Hasinger states, 'the sensational success of ROSAT [i.e. a satellite] encouraged us to take this offensive'. [...] ROSAT became a witness of a galactic cannibalism in which one galaxy devours another. (Der Spiegel 18/1999, "Search for star cadavers", p.245).

These groups of metaphors for doing physics represent it as exercising masculinising practices. Interestingly in this version of *doing science as doing gender,* doing masculinity is performed via cognitive practices, namely producing physical knowledge. But the very metaphors that are applied to doing physics rely on bodily

18 All *Der Spiegel* 22/1999, Philip Bethge, Rafaela von Bredow "Oases of life in outer space", p.238.

19 *GEO* 1/1999, Arno Nehlsen "Who explains the world to us?", p.128.

strength like hunting and battling, which are activities that need involvement of the body. Hence the form of masculinity that is provided in doing physics actually relies on cognitive strength, but on the level of metaphorical representations these practices rely rather on physical strength.

Objects of research being symbolised as female and at the same time threatening, on the one hand, and the figurative stylisations of doing research, on the other hand, construct a specific relation of the researcher to the object of inquiry. These landscapes are arranged in a binary order and reproduce the well-known nature-culture dualism (cf. Lloyd, 1996; Keller, 1985): feminised nature versus masculinised researchers, who are on the offensive.

Due to the described topoi of decoding and manipulation of nature as a battle, hunt and discovery, and furthermore due to the religion-based topos of the pilgrimage, physics is embedded in positively connoted surroundings. These very topoi constitute physical practices as a specific form of masculinity that means active involvement and the control of objects of interest. These metaphors for physical practices reinforce the notion that physical research is a collection of masculinising practices. The applied complexes of metaphors that stand for nature and the universe are congruent with the ideology of Bacon who developed a programmatic foundation for modern science.[20] It is remarkable that these notions and ideas have persisted for such a long time. In contemporary science they are no longer seriously applied in order to argue and legitimate the aim and motivations of science, but the remnants of these topoi from the beginnings of modern science in past centuries, can still be found in popular representations of contemporary science.

20 Bacon conceptualised science as an instrument in order to save mankind, which would return mankind to the original paradisiac state of grace through the control of nature.

Fathers of knowledge and machinery: human actors in the emotionalising style

The human actors that are presented in this style of doing physics are predominantly male. The male physicists who are represented in the texts of these articles are embedded in these landscapes and are ascribed a masculine gendering like adventurers battling nature, or as warriors or fathers. These landscapes offer a repertory for glorifying male physicists as geniuses and as having extraordinary cognitive ability.

Male physicists are often represented as the discoverers of scientific findings and are identified with the knowledge they produce. In the articles, Niels Bohr e.g. is called the "grand old man of physics"[21], Max Planck the "researcher who introduced the biggest revolution in the history of physics",[22] and Stephen Hawking is "the most prestigious physicist since Einstein".[23] Another type is the father of a physical theory or invention like "fathers of quantum physics"[24] of the "father of the computer brain".[25] Those phrases do not work for women physicists because they would end in odd formulations like the "mother of a theory". Thus a gender difference in cognitive brilliance is unintentionally constructed inasmuch as the usual formulations for praising male physicists do not make the same sense when applied to women physicists. In the end, the semantic repertoire for representing male researchers as brilliant is larger and more established than that for female researchers. In addition to that, female researchers are hardly found in these sceneries of doing physics. Some of the few who are presented in

21 *P.M.* 12/1999, Nicolai Schirawski, "On small scales it already works: Beaming", p.56.

22 *Die ZEIT* 51/2000, 14.12.2000, Ulrich Schnabel, "Physicists swept off their feet", p.37.

23 *P.M.* 9/1999, Peter Ripota, "Can the whole world be comprehended by one formula?", p.52.

24 Both in *Die ZEIT* 13/1999, 25.03.1999, Mara Beller "Whom did we laugh at?", p.59 and 50/2001, 06.12.2001, Max Rauner, „Summiteer of the quantum world", p.38.

25 *FAZ* 236, 11.10.2000, Manfred Lindinger, „Fathers of the computer brain", p. 63.

articles of this style are described either by their competence or by their femininity or in both. The degradation of women works in a very subtle way and is in no case articulated explicitly. Women are often criticised in terms of their bodies, which are seen as not being appropriately feminine. Often, comments on bodily appearance are combined with the degradation or underestimation of the professional performance.

In the following example a female researcher is described in such a double sense, as an astronomer *and* a woman. The article about a project that scans the universe in search of signals from extra-terrestrial life, focuses on the team leader Jill Tarter, who stood as a role model for the heroine Ellie in the science fiction film *Contact* and who was played by Jodie Foster. This relation plays a central role in the conception of the article.

The article starts by describing a film scene from *Contact* in which the levels of the film and of the real research project are interwoven:

> Ellie [protagonist of the film ‚Contact'] is Jodie Foster, beautiful, upright and moreover clever. [...] But in real life Ellie is the astronomer Jill Tarter, whose hottest dream hardly comes true. [...] The real heroine is tired. Tarter's hair is grey, the skin is pale, the eyes are narrow behind the glasses. Once, as one could imagine from the features of the fifty-five-year-old woman, she must has been as beautiful as her alter ego from the screen. Now exhaustion lies around her – not a bit of the Hollywood-heroine driven by the struggle for truth. Unlike the woman in the film she has already struggled half a life, never winning. (Der Spiegel 18/1999, "Soulful or obsessed", p.249)

In these first lines an incompatibility is constructed between following a traditional feminine role model and being a scientist. It is constructed through mediating that once she was an attractive

woman, but since she turned to astrophysics, she has forfeited her attractiveness and on top of that she is failing with her project, which allegedly does not make sense. This rhetorical technique of interweaving both characters, the real and the film character, is applied throughout the article text and warrants the comparative moment where Jill Tarter always draws the short straw. In the end, she is seen as unsuitable for doing physics. One central rhetorical element that is used to attest her unsuitability and ends in her degradation is introducing her as an embodied person. It is the display of the body where her failure becomes visible. The embodiment of male physicists is much rarer an issue in articles than that of women.

The unsuitability of women in physics is also stressed in other articles and with other rhetorical patterns. It is never spelled out directly but the female researcher is – so to speak – the origin of an epistemic disturbance. This becomes apparent in one episode about the physicist Chien-Shiung Wu, who is described in two of the media in the sample, both of which represent in a similar way the consequences of Wu's work in the (male) physics community. The passage as published in the quality weekly *Die Zeit* is:

> In 1956 the trust of the physicists in the perfect balance of nature developed a crack when the Chinese (female) physicist Wu proved that the radioactive decay of cobalt is by no means symmetrical. (Die ZEIT 14/1999, 31.03.1999, Ulrich Schnabel, "The unbalance of the world")

The science magazine *P.M.* writes in a similar vein stressing the consequences of Wu's finding as throwing nature off balance:

> Breaches against the imperative of symmetry were seen by the clerical scholars of the Middle Ages as the work of the devil. Even in 1956, it was

> shocking for the modern physicists that an experiment of their colleague Chien-Shiung Wu of Columbia University shook their trust in the power of symmetry: Putting radioactive atoms of cobalt-60 in a strong magnetic field, they emit electrons. [...] Unexpectedly, more electrons flew towards the south than to the north. (P.M. 3/2001, Sabine Schwabenthau, "Symmetry: Is it the handwriting of God?")

Both the weekly *Die ZEIT* and the magazine *P.M.* construct the extraordinariness of this finding via the assumed reactions of the male colleagues.[26] The meaning of Wu's findings is deduced from the alleged emotional reactions of the physicists: they were shocked, it says, losing their trust in the perfection of nature as well as in the power of symmetry. Representing Wu's discovery as epistemic disturbance that disturbs the harmony between the (male) physicists with the laws of nature shows it as challenging the relationship between the researcher and his object of inquiry. Here the female researcher does not fail as the one of the first example but nevertheless she is constructed as being unsuitable.

The objectifying style

Contrary to the emotionalising style the *objectifying* style is based on a different approach of covering physics in the media. In examples of this style the coverage of physical research is solely legitimated through intradisciplinary relevance. Hence the decision regarding which topics of physics to deal with and which not is drawn from the importance and the significance the topics would be given within the physics community. Unlike the emotionalising style, entertaining aspects in the selection of physical themes are no issue. Consequently aspects of physics research that might be relevant as entertainment from a standpoint outside of science

26 GEO 2/199, Klaus Bachmann "The long struggle for the vacuum", p. 78.

are not considered. Concerning the style of representing physics it is not an aim to emotionalise physics in order to make it more attractive to readers, but more to inform about new findings that are judged to be highly relevant within physics, not to the public. Thus the above-described topoi such as battle or adventure that served to appreciate physicists and entertain the reader are not applied in this style.

On the contrary, the research actors are nearly invisible. Instead of describing physical practices metaphorically, writers have the research objects act. There is a tendency to detach research from the humans who do this research. Doing and acting physics seems to be ignored. So a conception of doing science becomes visible that is based on the assumption that the knowledge produced does not depend on and is detached from the researcher. Instead it seems to have an agency of its own. In the following examples scientific objects act, and physicists are presented as being witness of this acting. The first example describes an experimental laboratory setting:

> At such low temperatures the atoms moved very slowly and their De-Broglie wavelength was so long that many atoms overlapped in the cloud. Therefore the atoms were able to harmonize their quantum-mechanical behaviour without coming too near one to each other, which would have easily turned into a conventional condensation of the gas cloud. (*FAZ* 235/2001, 10.10.2001, Rainer Scharf, "Particles in an icy trap")

The particles are communicating with each other and seem to pursue an aim, avoiding being condensed. In another example of a science magazine a physicist is cited that he "is fascinated by the fact that the pure energy 'knows', which particles it may transform

to".[27] Here, too, objects of inquiry are ascribed agency and an ability to interact grounded in cognitive processes. Thus in a way they are also animated like the objects of research in the emotionalising style.

Though research is a deeply social endeavour, practised and enacted by humans, the objectifying style of reporting physics pretends that science is allegedly shown here as 'real'. But the style cannot show so-called 'real' science since physics is represented in a completely decontextualised manner inasmuch as social contexts of research are ignored. Not only the social embeddedness of research is ignored, even the actors who do science are mostly effaced. The alleged objectivity in this scenery is evoked by this very invisibleness of the research actors, replaced by the agency of matter itself, the object *of* research becoming the subject *in* research. In those rare cases when humans appear in the texts, they are stylised as the passive observer witnessing nature revealing her secrets, as coined by Donna Haraway as the "modest witness" (1997). This style that erases the humans who do research fosters the epistemic ideals of physics, such as objectivity, rationality, neutrality and universality. Physics is represented as an entity that acquires objective, universal and neutral findings about nature, detached from societal categories like class, race and gender. This is reflected in the rhetorical style that gives physical research an atmosphere of being unemotional, sober and plain. These representations epitomise, precisely because of their omissions of human agency, the ideal of objective rational thinking, which offers an opportunity to reassure a sort of masculinity as being one's own to those who want to share this ideals and beliefs. Male physicists

27 The commonality is unusual inasmuch both print media belong to different media genres, have different audiences, and cover science from different perspectives and last not least because the magazine *P.M.* is rather a tabloid contrary to the quality paper *Die ZEIT*.

are not glorified directly via some topoi of admiration of their cognitive competence but indirectly via constructing doing physics as gaining objective knowledge about nature that only can be gained by the cognitive brilliant "men of reason" (Connell 1995). So this ascription of doing physics point to a masculinising doing gender.

Reflexive tendencies through criticism

Apart from both styles of reporting physics discussed here there are also critical accounts of physics. A number of articles present physics and physicists in social contexts. Among those are articles about science policy, biographical accounts of famous historical physicists and even articles that deal with gender equality in a historical context. In some cases they lead to more reflexive accounts of physics. Ironically they refer to the very constructions of the emotionalising style of physics and partly reflect the topoi of conquering nature that served to symbolise physics as masculinising. In critical accounts those topoi are overstated and re-interpreted as inadequate and abnormal features. The topos of the reclusive genius is now re-interpreted as ivory-towered and being far from reality. In the following examples in *P.M.* physicists are criticised for their alleged omnipotence, reproached for hubris or accused of neglecting their ethical responsibility:

> But wonders do not suffice for physicists. They want more. (P.M. 10/1999, Vanessa Müller, "X-ray glasses makes atoms visible", p.41)

> The physicist Dennis Papadopoulos is the father of HAARP [a project acronym]. He denies all danger of the military project. [...] [It] already arises that HAARP is in no way so harmless as Papadopoulos would like it to be. (P.M. 5/1999, Manon Baukhage, "The HAARP-Project", p. 32).

Most physicists being criticised by journalists this way are male, probably because they are those who were originally ascribed those features of cognitive omnipotence. The topos of the creative father is re-interpreted as an omnipotent fanatic who stubbornly pursues all his technological visions regardless of potentially dangerous consequences.

In some portraits of physicists which are not part of the science sections in the media but positioned in sections that deal with social life, attributes like social reclusiveness and rational thinking are not criticised but replaced by complementary attributes like socio-political commitment, intuition and creative irrationality that are mostly coded as feminising. While in these ruptures of masculinising stereotypes the reputation of the physicists portrayed is contested, the new, positively connoted attributes effect an overstatement of the persons portrayed.

Female physicists are never target of these criticisms, reproaches or accusations. Contemporary female physicists who are being portrayed as being successful in science are ascribed attributes that do not correspond to the conventional styles. They are rather ascribed communication and social skills, belonging to a traditional feminising field of competencies. Those attributes the women are assigned are argued as representing entrepreneurial and management skills that the contemporary scientists should possess.

Neither the tendency of ascribing new – potentially feminising – attributes to male physicists nor portraying successful female physicists as having the required management skills for a career in science, has led to a substantial change in the imaginaries of physics.

Beyond the dominating styles – overcoming gender?

Judging the significance of both the emotionalising and the objectifying styles and their ruptures, one must take into account that, despite all the shifts in the ascriptions, the rhetoric of the emotionalising style dominates the science coverage. The objectifying style seems to be restricted to a few quality papers such as the *FAZ* in this sample and the science magazine *GEO*. Also the ruptures of the dominant topoi that can be observed are rather rare.

On the rhetorical level the styles differ substantially. But they have some features in common:

First, research objects of inquiry have agency in both styles. In the emotionalising one, nature acts as a hostile power. In the objectifying style, nature acts instead of the researchers; moreover it seems to obey the laws of physics, which are then witnessed by the researcher.

Second, doing physics is constructed predominantly as a number of masculinising practices in both styles. They are consistent with findings of feminist historical studies dealing with gendered ideology of science. In the emotionalising one, doing physics is constructed as masculinised practices that are imagining nature as feminine and threatening. In the objectifying one, objectivity and rationality and neutrality are mediated as a form of masculine thinking.

Third, both styles ignore the social contexts of research. The social conditions of knowledge-making processes are erased. In the emotionalising style research in physics is re-contextualised in metaphorical contexts like battles, hunting and secrecy. In the objectifying one, research is de-contextualised and shown as generating universal and objective knowledge that fosters the factuality of the knowledge of physics. In the emotionalising style the decon-

textualisation makes it possible to detach physics from mundane life, to transform and recontextualise it in fictional spheres.

Summing all this up, both styles are characterised by decontextualisation, a masculinising gendering and agential objects of research. In these styles of representing physics, male researchers can be seamlessly embedded in sceneries of doing physics as doing masculinity. Thus gender and physics are co-constructed neatly as masculinising. Female researchers, on the contrary, remain the exception and are even subtly decried. The intertwining of imaginaries of nature and physics research via the dramatization of actors result in inadequate imaginaries of female physicists because the landscapes of doing physics are oriented towards constituting physics as masculinising practices. Furthermore some of the stylisations of physicists would not work since topoi as giving birth to experimental or observational devices do not make sense being enacted by women. In these topoi gender is already embedded as a physicist conceptualised and mediated as masculine. Here the dilemma becomes visible that masculinising landscapes and dramatisation of doing physics inhibit female physicists from being as taken for granted as male physicists.

In the more reflective articles the co-construction is subject to changes in the mutual ascription of doing masculinity with doing physics. These few ruptures of the dominant styles might point to a slowly transformation towards a degendering or least re-gendering of doing physics in more manifold ways which might overcome the sole construction of physics as masculine or might even incite a de-gendering of public representations of physics.

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