CATALYST
feminism, theory, technoscience

INTRODUCTION

The Processes of Imaging / The Imaging of Processes

Liv Hausken
University of Oslo
liv.hausken@media.uio.no

Bettina Papenburg
University of Freiburg
bettina.papenburg@mkw.uni-freiburg.de

Sigrid Schmitz
Humboldt-University of Berlin
sigrid.schmitz@hu-berlin.de

Abstract

This introduction outlines the main topics of this Special Section on "The Processes of Imaging / The Imaging of Processes" and situates them in their specific theoretical and historical contexts. Drawing on feminist Science and Technology Studies (STS), on feminist New Materialism, and on media studies based in the Arts and the Humanities, we frame the exploratory studies assembled in this collection of essays with respect to the dynamic entanglement of matter, technology, and meaning-making practices. We attend to the question how the construction of scientific images and imaging technologies is tethered to

Hausken, L., Papenburg, B., and Schmitz, S. (2018). Introduction to The Processes of Imaging / The Imaging of Processes. *Catalyst: Feminism, Theory, Technoscience*, *4*(2), 1-23. http://www.catalystjournal.org | ISSN: 2380-3312

hierarchical social relations and discriminatory practices.

Politics of Imaging

This special section of *Catalyst* explores how imaging technologies shape the complex processes through which scientific images are constructed and how imaging technologies drive processes of inclusion and exclusion. The section takes up these questions by bringing together approaches in feminist Science Technology Studies (STS) and feminist new materialisms with perspectives from critical media studies. The articles gathered here offer in-depth analyses of the dynamic entanglement of matter, technology, and meaning-making practices taking shape within and around imaging modalities, such as ultrasound, embryo imaging, sonar, computer tomography, functional magnetic resonance imaging and positron emission tomography.

The assembled articles emphasize the question of how the dynamic and processual qualities of phenomena are captured and recorded and what the implications of such capturing and recording practices are for the relations between the subjects and objects of research. Focusing on the nexus of change and development of living matter and the capturing of the movement and flux of such matter in sequences of images throws questions of animation and liveliness into sharp relief. Feminist engagement with moving image techniques employed in the life sciences suggests that dynamic imagery animates thinking and enlivens a static notion of life.

Live-cell imaging, in particular, came into focus as a method that makes palpable the processual qualities of cellular life by foregrounding the interactive and dynamic processes happening within cells. Live-cell images present life as animate and suggest a conception of cellular life as relational and process-oriented (Landecker, 2012; Myers, 2006; Myers & Dumit, 2011; for a position that challenges this claim, see Wellmann, 2017). However, by stressing the functional and emergent qualities of cellular life, scientific discourse on live-cell imaging risks tacitly re-

inscribing a mechanical model of life and glossing over the labor involved in the making of scientific images (Myers, 2015). Therefore, we need to attend to the manifold steps required to produce a sequence of images in both the wet and dry lab, the politico-economic conditions under which these images come into being, the ways they circulate and are employed, as well as the political projects into which they are enlisted.

In medical and scientific contexts, the term *imaging* is often used to describe particular procedures, modalities and tools for producing technical images (see for instance Bruhn, 2015, p. 127). In this special section of *Catalyst* we would like to broaden this concept to include the productive and constructive aspects of such procedures, modalities and tools. Using the notion of imaging in a broader sense helps us to gloss various practices associated with making phenomena observable and intelligible (see Lynch, 2006). In line with Michael Lynch's conception of visualization, we hold that imaging should not be reduced to perceptual processes (Lynch, 2006, p. 28). Imaging refers to the technical procedures and materializing processes that produce visual displays of information. These images will be studied not as representations of objects but as technical visualizations of phenomena by imaging technologies that do not just present them visually but constitute them ontologically. We suggest the term *processes* to emphasize the need for analyzing step by step how meaning is inscribed in technical images through the dynamic interchange between the procedures, modalities and tools of imaging and the larger socio-cultural context to which they belong. We adopt a constructivist perspective that allows us to consider the *politics* of imaging practices.

The structure of the title of this special section, "The Processes of Imaging / The Imaging of Processes", references the rhetorical notion of chiasm, the ABBA pattern of mirror inversion (see for instance Lanham, 1991). With this chiastic approach to imaging, we highlight the dynamic intra-actions and enactments in the investigated processes. Focusing on *the processes of imaging* allows us to foreground the dynamics of imaging and the ways in which these dynamics are embedded in

established conceptual landscapes as well as to assess how they contribute to changing such landscapes. Examining the *imaging of processes* is one way to attend to the processual qualities of the objects of investigation such as plasticity, movement, temporality, development and the relational dynamics of the objects under study in visualization (ranging from brains and bodies to technologies and social formations). As such, the first part of the chiasm (processes of imaging) does not just transform the second (imaging of processes) but is also transformed by the second. The title signals our approach that involves more than a combination of two perspectives, with one privileging an understanding of the entire processes of imaging, the other indicating a certain interest in the visualization of dynamic objects. Rather, the object in the second part of the chiasm is considered processual, no matter how pre-defined its processual qualities may seem to be. It is produced and reconfigured in the imaging process.

Situating Imaging Practices between Feminist STS and Feminist New Materialisms

This special section focuses on contextualizing the construction and deployment of scientific images within social, political and economic discourses and gauges the implications of referencing scientific visualizations to legitimate power relations in the social sphere. Combining feminist STS research on the powerful effects of images with a feminist materialist perspective opens up a space for critically assessing the discriminatory effects built into imaging technologies as well as for exploring alternative ways of enlisting scientific images in practices of resistance.

Although STS research has examined both the processes through which scientific images are produced and the deployment of images in a variety of social fields, the myth of "objective authority" of scientific images still holds (see Burry & Dumit, 2008). The medical field and the life sciences visualize structures and processes of the interior body down to cellular and sub-molecular levels in colorful digitalized images using

imaging technologies such as ultrasound, functional magnetic resonance imaging, positron emission tomography, and live-cell imaging. The environmental sciences, including geography, employ imaging technologies such as sonar to screen structures of earth, rock, and water and offer fine-grained maps of phenomena ranging from the geosphere to the atmosphere. Astrophysicists use space probes and telescopes to generate data and to detect signals from the far ends of our galaxy that are rendered into "pretty pictures" of nebulae and supernovae for popular, educational and commercial use. Maps, graphs and images constructed with imaging technologies are conceptualized as immutable mobiles (Latour, 1990) traveling between academic disciplines and society that promise to provide more detailed and adequate insight into the objects under investigation.

The idea that enhancing the performance of particular imaging apparatuses by way of technological developments will eventually lead to "better" knowledge and generate more truthful representations of microscopic, macroscopic, and cosmic phenomena is still at the heart of science and society with its regimes of funding and governance (van Dijck, 2005). Yet, as STS research has pointed out, imaging technologies and the images they produce are mutable and imbued with politics and power relations that shape the way we perceive the world and how we think we should act in it. This has been impressively demonstrated, for example, with regard to the scientific and social discourse on climate change (Schneider & Nocke, 2014). This research shows that imaging technologies not only shape and change our experience, knowledge and conceptualization of the objects under investigation, but the resulting images also impact social practices, discourses and power relations.

Feminist science and technology studies scholars have long-standing engagements in offering critical analyses of how culturally shaped meanings and norms are inscribed into imaging technologies and into the processes through which scientific images are produced. They have effectively assessed the political implications of the production, circulation and deployment of scientific images and the roles that imaging

technologies play in the making of race, gender, sexuality, and ability with regard to socio-cultural norms. Scientific images of the gendered body, taken as "facts," invoke gendered narratives that legitimate social hierarchies by manifesting a masculinized sphere of production versus a feminized sphere of reproduction (Martin, 1987). With regard to imaging the human body, Catherine Waldby (2000) has shown how gendered and racial hierarchies have been inscribed into the digitalized repertoire of human anatomy in the Visible Human Project; Kelly Joyce (2005, 2008) pinpointed the gendered assumptions that guide processes of brain imaging; and Amade M'charek (2014) uncovered the racialized history of reference models for gene sequencing, to name a few relevant examples.

Feminist and postcolonial critiques have disclosed the foundations of imaging technologies in colonial, capitalist, and military projects as well as the relevance and use of scientific images for ongoing practices of discrimination. The important work in this field 1) has revealed, for instance, discriminatory practices of body scanning technologies at airports that target transgender or racialized groups (Magnet & Rodgers, 2011); 2) has shown how the enlisting of fetal ultrasound imaging in current bio-politics moves authority in decision-making away from women and relocates it within medicine and science (Roberts, 2012); 3) has identified racialized inscriptions through technologies that construct facial images from DNA sources (M'charek, 2010); and 4) has uncovered how colonial heritage comes to the fore in the use of images of invasive species in anti-migration politics (Subramaniam, 2014).

Building on Donna Haraway's concept of situated knowledges (Haraway, 1988) feminist STS research has traced the question of the politics of imaging to analyses of the construction processes of making images. It is not sufficient to uncover the deployment of scientific images for discriminatory ends; equally important is the disclosure of the inscription of cultural beliefs and norms into the technical instruments and practices involved in constructing images. Situating the scientific and technological concepts as well as the aims and beliefs of researchers and developers in their cultural milieu opens up a space of critique of the

apparent representational status of images much more profoundly. Images then come into view as “naturecultural” phenomena (Haraway, 2003) that incorporate the processes and meanings with which they are constructed.

The need for in-depth analyses of the multiple entanglements that frame the constitutive processes of phenomena has been taken up in the last decades by parts of feminist STS scholarship within the framework of feminist materialisms (van der Tuin, 2011). Coining the term "intra-action" – to replace the term interaction – Karen Barad explored how the constitution of phenomena always unfolds in a zone of dynamic agential forces (Barad, 2007, pp. 140-141). This notion reframes the assumption that pre-established entities with inherent properties interact with one another. For Barad, subjects and objects are always in-the-making within experimental configurations, and, consequently, she demands that entities that make up an experimental configuration should not be researched separately. Instead, phenomena “come to matter” (ibid.) through the intra-actions of material-discursive practices. The specific enactment of these intra-actions shapes the conditions of possibility for the phenomena that materialize in a given experimental configuration. Intra-active processes establish boundaries within phenomena and these agential cuts – as Barad terms them – constitute the meanings and significance of the phenomena. However, phenomena are always in-the-making and in an ongoing process of exchange and formation, with their outcomes themselves being enacted within the experimental configuration. Barad thus shifts the concept of agency from a humanist notion of intentionality to an understanding of agency as enactment. Adopting Barad’s insights for studying the imaging of processes means to research how the agential intra-actions of matter, technology and meaning-making within a particular experimental configuration shape the phenomenon that is being displayed visually. This research can expose the agential cuts (i.e., the inclusions and exclusions that characterize the particular realization of images in “spacetimematter relations”) (Barad, 2007, p. 178).

Diana Coole (2013) has proposed to take the feminist materialist framework as a "multidimensional ontology" (p. 464) in order to address the political dimension already within analyses of phenomenal constitutions. Addressing the boundary-making intra-actions as a constitutional part of the political effects of phenomena has spurred critical feminist scholarship that analyzes how notions of gender are inscribed into specific bodies and how these inscriptions reinforce practices of discrimination (for an overview, see Hird, 2004) as well as racialization, racism, and colonialisms (Hinton, Mehrabi, & Barla, 2015). The feminist materialist concept of agential intra-actions, we suggest, can also guide analyses of the processes of imaging and imaging of processes. The articles assembled here seek to broaden the perspectives offered by feminist and postcolonial STS by opening up the field to include approaches from postcolonial geography, feminist critical neuroscience, critical media studies, and continental philosophy, to auto-ethnography, and cultural analysis.

Interdisciplinary Crossroads

This special section of *Catalyst* emerged from a working group on "New Materialisms on the Crossroads of the Natural and Human Sciences" in a EU funded research network on New Materialism.[1] The group focused on how to "rework the 'Two Cultures' gap [through] new frameworks of knowing in which different kinds of actors and onto-epistemic practices can be made visible and negotiable."[2] Out of this framework grew an interest in the topic of imaging and in the development of critical terms such as dynamic and agential matter, imaging technologies, and apparatuses of research.[3] This special section of *Catalyst* is among the results of these efforts.

This special section aims to mobilize new-materialist, critically and theoretically engaged feminist interventions for the study of the aesthetics and epistemic status of images and imaging technologies across the visual cultures of science, arts, media, and everyday life. This research

does not belong to any one discipline but represents rather a set of perspectives that may inscribe themselves into a range of disciplines. Rather than present a unified theoretical front or create an inevitable historical trajectory, we aim to contribute to an interdisciplinary *arena* for research on imaging.

For this special section we have solicited and selected in-depth studies of imaging technologies and practices. We will argue for the importance of exploring processes of imaging across the university through a variety of specific case studies. We have collected a small number of such studies here, crisscrossing the visual cultures of science, arts, media and everyday life. We will argue, that instead of treating science and art as two fields in an open terrain where one can travel between, back and forth, along a two-way street (see Subramaniam & Willey, 2017), the diverse practices and discourses associated with these two apparently homogenized and distinct fields (see Jones & Galison, 1998; Subramaniam & Willey, 2017; Werrett, 2008) should be opened up and investigated as parts of the more general sociocultural histories to which they belong.

Among the many historical conditions for the development of an interdisciplinary arena for discussions and research on imaging across the university, four parallel developments should be mentioned. The first is the ambition to develop an imaging science across the natural sciences during the 1980s and 1990s. Such an initiative can be seen when the US-based National Academy of Sciences organized a colloquium entitled “Images of Science: Science of Images” in 1992. At this colloquium, Robert N. Beck, a pioneer in nuclear medicine and the founder (1986) and director of the Center for Imaging Science at the University of Chicago, gave a noteworthy lecture where he claimed “the same set of principles, concept, strategies, and methods, may be used to address the generic issues involved in the production and use of all digitized images.” He demonstrated these generic imaging issues through his talk and argued that recognition of these generic issues across imaging modes in a whole range of different disciplines “is giving rise to the new discipline of

imaging science" (Beck 1993, p. 9746). One sign that something was indeed afoot, could be seen when the reputable *Journal of Photographic Science* (established in the early 1950s) was renamed and transformed into *The Imaging Science Journal* (1997 – present).[4]

At the same time, something similar happened in the humanities; this is the second of the conditions for the development of an interdisciplinary arena for discussions and research on imaging across the university that we hope to underline here: During the 1980s and 1990s, we witnessed increasingly interdisciplinary research across media and cultural studies and the various disciplines in the humanities concerned with questions of aesthetics. The most important impulse in this context is the development of the interdisciplinary study of visual media, launched by W.J.T. Mitchell (1986) and others, and now a central feature of the humanities. In contrast to the imaging science initiative in the natural sciences sketched above, it is here less a question of highlighting generic issues across image genres, different media or various art-historical epochs as it is a change of perspective from studies of images as artifacts to questions of historically situated re-examinations of modern visuality. The American art historian Jonathan Crary (1992) provided a decisive contribution to this new perspective on visual culture by analyzing the historical construction of the observer through interweaving the histories of science, technology, philosophy, popular culture, and the visual arts. Lisa Cartwright (1995), among others, adds a feminist dimension to this development, assessing the impact of modernist art on medical imaging in the first decades of the twentieth century by addressing the intersection of scientific and cultural practices with a particular emphasis on cinematic practices in medical studies of and experiments on female bodies.

Intervening in the debate about the formation of a field that came to be known internationally by many names – visual studies, visual culture, image studies, and last but not least, visual culture studies – the Dutch art historian and founder of both cultural analysis and visual culture studies, Mieke Bal (2003, p.19) drew attention to the synaesthetic and

discursive aspects of the visual. Bal foregrounded questions of cultural change and put an emphasis on practices of power and resistance. She urges us to spot and dislodge master narratives and be mindful of practices of visual essentialism that obscure the situatedness of the viewer and equate looking with knowing. Bal's ideas resonate well with what in feminist technoscience studies has been identified as "the view from nowhere" and the call for situated knowledges (Haraway, 1988, going back to Nagel, 1986).

The third historical condition for the development of an interdisciplinary arena for discussions and research on imaging across the academy takes place in what can be broadly referred to as media studies, which during the 1990s witnessed a growing awareness of the materiality of communication, particularly stressed by the two German scholars Hans Ulrich Gumbrecht and K. Ludwig Pfeiffer (1994). Meanwhile, both the concepts of 'media' and of 'communication' were in crisis. In response to the growing integration of information, of communication networks, of media platforms, and of different markets, the simple model of communication between senders and receivers based on an idea of separate media (film, television, newspapers, the postal system) was undermined. For media scholars with an interest in the form and materiality of media, this meant a reorientation and a shift from "medium" to "mediality" or "mediation". Inspired by, among others, the German literary scholar and media theorist Friedrich Kittler, media studies began to take an interest in how the technological logics of mediality influence the way we think of the world, of ourselves, and of the future.

Turning toward materiality and embodiment from a radically different perspective, North-American film phenomenologists like Vivian Sobchack (1992) and feminist philosophers and gender theorists like Judith Butler (1993) contributed to this reorientation towards materiality by stressing embodied vision and a rethinking of the materiality of the body as determining rather than determined, constructing rather than constructed (see also Rooney, 1996).

Finally, the fourth condition for the development of an interdisciplinary arena for discussions and research on imaging across academic fields is the turn to technology in feminist and social studies of science. Feminist philosophers of science explored the gendered character of technology (Harding, 1986); numerous feminist scholars conveyed the idea of technology as an aspect of identity and embodiment (Balsamo, 2011; Davis, 1995; Haraway, 1991; Hayles, 1999; Turkle, 1984), and argued for the significance of everyday life technologies (Cowan, 1976). In the 1980s and 1990s the more mainstream social studies of science also turned to technology (Woolgar, 1991), which is vital in this context because it attracted scholars from social science and the humanities unfamiliar with feminism and/or science studies but interested in the technologies of media and everyday life.

With this fourth historical development the circle may be seen to be closed and the conditions present for interdisciplinary studies of imaging across, in principle, all academic spheres: 1) the possibility of identifying generic issues across imaging modes, genres and media; 2) a fundamental understanding of historicity and sociocultural situatedness of the observer; 3) a particular attentiveness toward the materiality of mediation, and finally, 4) an imperative understanding of the social and cultural implications of technology.

Drawing on these developments, we are not just addressing an interdisciplinary field but a heterogeneous landscape of disciplinary and interdisciplinary subfields. We aim to foster interdisciplinary contact and exchange between these various perspectives. This, we argue, can be acquired best in research based on concrete case studies.

Assembled Articles

Taken together, the framework offered by feminist materialisms and visual culture studies provides a number of tools that open up innovative and creative ways to look at, think through and theorize the multiple

relations between dynamic and agential matter, meaning-making processes and imaging technologies involved in the construction of images. Within the broader framework of STS, the combination of in-depth analyses of processes of imaging with research on the politics of imaging can generate insight into discriminatory effects as well as inspire alternative modes of image construction.

Two of the articles assembled in this special section speak to the question of how capitalism informs imaging technologies and analyze how scientific imaging practices inscribe normative ideas into human bodies, brains and the division of cells at an early stage of embryo development. In their article, Hannah Fitsch and Kathrin Friedrich critically engage with specific imaging technologies (fMRI and CT) as technologies of normalization. The authors show how ideas about the body and the brain changed in the late nineteenth and in the beginning of the twentieth century and came to rely on a model of calculability. They assess what role the turn to mathematical models and algorithm-based calculation played with regard to this change. Inspired by a feminist materialist background, Fitsch and Friedrich pinpoint how the concept of computational rationality intra-acts with scanning technologies and algorithmic computation throughout the production processes of digitalized images. The latter then serve as standardized maps or templates of bodies and brains that curb diversity.

In her article, Lucy van de Wiel shows how imaging technologies such as time-lapse embryo imaging tie into neo-liberal economic practices. The author discusses how *in vitro* fertilization (IVF) industries employ techniques such as photomicrography and embryo imaging (an embryo screening technique) to unlock new target groups. Photomicrographs of embryonic cells lure fertile women into pre-emptive fertility treatment involving egg freezing. Time-lapse videos of dividing embryonic cells are offered to clients of fertility clinics as an "add-on" in the IVF cycle for selecting the most “viable” embryonic cells for further development. These interventions in treatment rationales reconfigure the various timescales involved in the monitored reproductive process,

reinforce gendered notions of reproduction and imply pre-emptive overtreatment, constant monitoring as well as physical and financial risk.

The processual nature of imaging, however, also opens up possibilities for using scientific images towards political ends, especially to fuel forms of resistance against discriminatory power relations. *Ashton B. Wesner* in a study of land measured using digital sonar technology, attends to Indigenous oral poetry as an alternative modality to relate to land, and demonstrates how the enlisting of the pictorial outcome of sonar measurements in the frame of settler colonialism and claims to "American Innocence" come to be reconfigured for liberating purposes when appropriated by Native people in oral performances at Celilo Falls, Oregon. The author shows how Native poets at Celilo Falls employ the oral production of meaningful sound in the recital of poetry as a way to intervene into a debate about land rights that places trust in visual evidence as it is offered through sonar imaging.

One further article addresses the complex interplay between digital imaging procedures and alternative modes of expression and/or diagnosis as well as other sensory modalities. Karolina Kazimierczak, in her contribution, asks: How do multimodal modes of expression or diagnosis and sensory modalities other than the visual both complement and challenge the evidence ascribed to the images that result from technical imaging procedures? Karolina Kazimierczak's paper incorporates the haptic into the diagnostic apparatus aiming at the detection of breast cancer, a diagnostic apparatus that relies on ultrasonic imaging. To point out the complex entanglement of the various sensory modalities involved in breast cancer examination, the author analyzes the technical processes in which sound waves in ultrasound become transduced into light waves. Ultrasound, she continues to show, is employed in tandem with diagnostic modes that involve touch. To underscore her point, the author mobilizes an understanding that she gained through auto-ethnographic experience as a patient in a breast cancer examination ward. It is via effectively accentuating this attunement to alternative sensorial modalities in medical diagnosis that Kazimierczak

challenges the predominance of the sense of sight in analyses of contemporary clinical practices.

The articles assembled in this special section of *Catalyst* all constitute exploratory thought-movements. They address questions that grow out of the encounter with tangible phenomena and the experience of specific situations and offer answers to these questions that have theoretical relevance beyond the specific analyses. The case studies presented exemplify the aim of our larger project to attend to the social, cultural and political dimensions of imaging practices through careful analysis of both the ways in which processual phenomena are rendered palpable using imaging technologies and the processes in which scientific images are constructed, circulated and deployed. In line with this project, the articles foreground the political dimension of imaging practices, open up anew the discussion on how imaging technologies perpetuate cultural values and beliefs, and suggest avenues for further research on practices of resistance that occur in conjunction with or in response to imaging practices.

Acknowledgments

This Special Section was came into existence in association with the EU COST Action IS1307 “New Materialism: Networking European Scholarship on ‘How Matter Comes to Matter’”. We thank the members of our working group for inspiring discussions on this topic. We would like to offer our special thanks to Contact Editor Natasha Myers for invaluable input during the development of this special section and for detailed comments throughout all the texts. Her willingness to give her time and expertise generously has been very much appreciated.

Notes

[1] The Action Grant “New Materialism: Networking European Scholarship

on 'How Matter Comes to Matter'" (2014-2018) was financed by the European Cooperation in Science & Technology's (COST) funding scheme that supports Europe-wide networking activities among researchers, engineers and scholars. The working group brought together scholars from the humanities, practicing scientists and feminist scholars with a background in the natural sciences.

[2] The aim of the working group was to develop "new materialisms at the boundaries of the human and natural sciences." See the working group's abstract on the website of the COST action: http://newmaterialism.eu/working-groups/working-group-2/about. Retrieved 28 May 2018.

[3] In order to develop these topics and terms, we organized a workshop at the 7th Annual Conference on the New Materialisms in Warsaw, 21-23 September 2016, to which we invited potential contributors to this special section to present and discuss their ideas.

[4]Available at https://www.tandfonline.com/loi/yims20

References

Bal, M. (2003). Visual essentialism and the object of visual culture. *Journal of Visual Culture 2*(1), 5-32.

Balsamo, A. (2011). *Designing culture: the technological imagination at work*. Durham, NC: Duke University Press.

Barad, K. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning.* Durham, NC: Durham University Press.

Beck, R. N. (1993). Overview of imaging science. *Proc. Natl. Acad. Sci. USA,* 90, 9746-9750.

Bruhn, M. (2015). "Visuality, visualizing, imaging." In Bredekamp, Horst; Vera Dünkel, & Birgit Schneider (Eds.). *The technical image: A history of styles in scientific imagery* (pp.126-129). Chicago, IL: University of Chicago Press.

Burri, R. V., & Dumit, J. (2008). "Social studies of scientific imaging and visualization." In Hacket, Edward J., Olga Amsterdamska, Michael E. Lynch & Judy Wajcman (Eds.): *Handbook of science and technology studies* (3rd ed.) (pp. 297-317). Cambridge, MA: MIT Press.

Butler, J. (1993) *Bodies that matter: On the discursive limits of "sex."* New York, NY and London: Routledge.

Cartwright, L. (1995). *Screening the body: Tracing medicine's visual culture*. Minneapolis, MN and London, GB: Univ. of Minnesota Press.

Coole, D. (2013). Agentic capacities and capacious historical materialism: Thinking with new materialisms in the political sciences. *Millennium—Journal of International Studies* 19, 451–469.

Cowan, R. S. (1976). The "industrial revolution" in the home: household technology and social change in the 20th century. *Technology and Culture, 17*(1), 1-23.

Crary, J. (1992). *Techniques of the observer: On vision and modernity in the nineteenth century*. Cambridge, MA: MIT Press.

Davis, K. (1995). *Reshaping the Female Body: The Dilemma of Cosmetic Surgery*. London, GB and New York, NY: Routledge.

Gumbrecht, H. U. & Pfeiffer, K. L. (Eds.). (1994). *The materialities of communication*. Stanford, CA: Stanford University Press.

Haraway, D. J. (2003). *The companion species manifesto: Dogs, people, and significant otherness.* Chicago, IL: Prickly Paradigm Press.

— (1991). "A manifesto for cyborgs: Science, technology and socialist feminism in the 1980s." In Haraway Donna. *Simians, cyborgs and women: The reinvention of nature.* (pp.149-181). New York, NY: Routledge.

— (1988). Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies*, *14*(3), 575-599.

Harding, S. (1986). *The science question in feminism*. Ithaca, NY and London, GB: Cornell University Press.

Hayles, N. K. (1999). *How we became posthuman. Virtual bodies in cybernetics, literature, and informatics*. Chicago, IL: The University of Chicago Press.

Hinton, P.; Mehrabi, T. & Barla, J. (2015). New materialisms/new colonialisms. *Proceedings of ISCH COST Action IS1307 New Materialism working group two New Materialism on the Crossroads of the Natural and Human Sciences*. http://newmaterialism.eu/content/5-working-groups/2-working-group-2/position-papers/subgroup-position-paper-_-new-materialisms_new-colonialisms.pdf. Latest access: 21 June 2018.

Hird, M. (2004). Feminist matters. New materialist considerations of sexual difference. *Feminist Theory*, *5*(2), 223-232.

Jones, C. A. & Galison, P. (Eds.). (1998). *Picturing science, producing art.* London, GB New York, NY: Routledge.

Joyce, K. A. (2005). Appealing images: Magnetic resonance imaging and

the production of authoritative knowledge. *Social Studies of Sciences*, *35*(3), 437-462.

— (2008). *Magnetic appeal: MRI and the myth of transparency*. Ithaca, NY: Cornell University Press.

Landecker, H. (2012). The life of movement: From microcinematography to live-cell imaging. *Journal of Visual Culture*, *11*(3), 378–399. https://doi.org/10.1177/1470412912455622

Lanham, R.A. (1991.) *A handlist of rhetorical terms* (2nd ed.). Berkley, CA: University of California Press.

Latour, B. (1990). "Drawing things together." In Lynch, Michael & Steven Woolgar (Eds). *Representation in scientific practice* (pp. 19-68). Cambridge, MA: MIT Press.

Lynch, M. ([1998] 2006). "The production of scientific images: vision and re-vision in the history, philosophy, and sociology of science." In Pauwels, Luc (Ed.). *Visual cultures of science: Rethinking representational practices in knowledge building and science communication* (pp. 26-40). Lebanon, NH: University Press of New England.

Magnet, S. & Rodgers, T. (2011). Stripping for state. whole body imaging technologies and the surveillance of othered bodies. *Feminist Media Studies, 12*(1), 101-118.

Martin, E. (1987). *The woman in the body: A cultural analysis of reproduction.* Boston, MA: Beacon Press.

M'charek, A. (2010). Fragile differences, relational effects. Stories about the materiality of race and sex. *European Journal of Women's Studies, 17*(4), 307-322.

— (2014). Race, time and folded objects: the HeLa error. *Theory, Culture and Society, 31*(6), 29-56.

Mitchell, W. J. (1986). *Iconology: Image, text, ideology*. Chicago, IL and London, GB: University of Chicago Press.

Myers, N.(2006). Animating mechanism: Animations and the propagation of affect in the lively arts of protein modelling. *Science Studies 19*(2), 6-30.

— (2015). *Rendering life molecular. Models, modelers, and excitable matter*. Durham , NC and London, GB: Duke University Press.

Myers, N. & Dumit, J. (2011). "Haptic creativity and mid-embodiments of experimental life." In Frances E. Mascia-Lees (Ed.). *A companion to the anthropology of the body and embodiment* (pp. 139-261). Hoboken, NJ: Wiley-Blackwell Publishing.

Nagel, T. (1986). *The view from nowhere*. New York, NY: Oxford University Press.

Pauwels, L. (2006). *Visual cultures of science: rethinking representational practices in knowledge building and science communication*. Lebanon, NH: University Press of New England.

Roberts, J. (2012). *The visualised fetus. A cultural and political analysis of ultrasound imaginary.* London, GB and New York, NY*:* Routledge.

Rooney, E. (1996). What can matter be? *American Literary History, 8*(4), 745-758.

Schneider, B., & Nocke, T. (Eds.). (2014). *Image politics of climate*

change. visualizations, imaginations, documentations. Bielefeld, DE: transcript Verlag.

Sobchack, V. (1992). *The address of the eye: A phenomenology of film experience*. Princeton, NJ: Princeton University Press.

Subramaniam, B. (2014). *Ghost stories for Darwin: The science of variation and the politics of diversity*. Champaign, IL: University of Illinois Press.

Subramaniam, B., & Willey, A. (2017). Introduction to science out of feminist theory part one: Feminism's sciences. *Catalyst: Feminism, Theory, Technoscience*, 3(1), 1-23.

Turkle, S. (1984). *The second self: Computers and the human spirit*. New York, NY: Simon and Schuster.

van der Tuin, I. (2011). New feminist materialisms. *Women's Studies International Forum, 34*(4), 271-277.

van Dijck, J. (2005). *The transparent body: A cultural analysis of medical imaging.* Seattle, WA: University of Washington Press.

Waldby, C. (2000): *The visible human project: Informatic bodies and posthuman medicine*. London, GB and New York, NY: Routledge.

Wellmann, J. (2017). Animating embryos: The *in toto* representation of life. *The British Journal for the History of Science*, *50*(3), 521–535. https://doi.org/10.1017/S0007087417000656.

Werrett, S. (2008). Art and science: Historical perspectives. Science Studies Network Colloquium, April 21 2008. http://courses.washington.edu/ uwsts/ docs/SSNet-Werrett-Art-&-Science.pdf [Retrieved June 18,

2018]

Woolgar, S. (1991). The turn to technology in social studies of science. *Science, Technology, & Human Values* 16.1 (Winter), 20–50.

Bios

Liv Hausken is Dr.art. and Professor of Media Studies at the Department of Media and Communication at the University of Oslo and head of the interdisciplinary research group Media Aesthetics. She seeks to engage the arts and the humanities in studies of everyday technologies and their significance in the production of knowledge and power. Relevant publications in English include: "Media Aesthetics" in *Oxford Bibliographies in Communication* (2018), "The Media Aesthetics of Brain Imaging in Popular Science" (Mößner and Nordmann (Eds.), *Reasoning in Measurement*, 2017), "The Archival Promise of the Biometric Passport" in Blom et al. (Eds.) *Memory in Motion*, (2016), "The Visual Culture of Brain Imaging" in *Leonardo: Journal of the International Society for the Arts, Sciences and Technology* (2015), and "Forensic Fiction and the Normalization of Surveillance" (in *Nordicom Review* 2014). She is also the editor of *Thinking Media Aesthetics. Media Studies, Film Studies and the Arts* (2013).

Bettina Papenburg (Dr. Phil., M.Sc.) is Assistant Professor at the Department of Media and Cultural Studies at Albert-Ludwigs-University Freiburg, Germany. She held a Marie Skłodowska Curie Postdoctoral Fellowship at the Department of Media and Cultural Studies at Utrecht University (2009-2011). Her research interests lie at the intersection of media theory and aesthetics, cultural studies, science and technology studies, gender and queer studies, theories of perception and affect, visual culture, and the grotesque. She is author of *The New Flesh. The Grotesque Body in the Cinema of David Cronenberg* (in German, 2011), co-editor of the volume *Carnal Aesthetics: Transgressive Imagery and Feminist Politics* (IB Tauris, 2013) and a special issue of Discourse: Journal for Theoretical Studies in Media and Culture on *Motion Pictures. Politics of Perception* (2014), as well as editor of the Macmillan *Handbook Gender: Laughter* (2017). She is currently working on her second monograph tentatively entitled "Affect and Evidence: Visualizations in the Life Sciences and Popular Culture".

Sigrid Schmitz (Dr. habil.) is a trained biologist whose research and teaching focuses on how gender aspects frame knowledge production in the life sciences and in technological developments, and how scientific knowledge

impacts social gender relations, particularly covering gender aspects in brain sciences and contemporary neurocultures, body discourses in neo-liberal society, and feminist epistemologies. She edited *NeuroCultures. Feminist and Queer Perspectives on Current Brains Discourses* (Zaglossus, Vienna, 2014, together with Grit Höppner). She headed the Forum of Competence "Gender Studies in Computer and Natural Sciences" at the University of Freiburg, Germany (1999-2009), held the Chair of Gender Studies at the University of Vienna (2010-2015), and was visiting professor for "Gender and Science" at the University of Graz, Austria, the Humboldt-University of Berlin and the University of Oldenburg, Germany. Recently, as member of the joint project "Gendering STEM digital", she and her team at the Center for Transdisciplinary Gender Studies at the Humboldt-University of Berlin are developing interactive Open Science Modules for transferring knowledge and promoting a reflective discussion about gender aspects into STEM fields.