Mody, Cyrus M., The Sounds of Science: Listening to Laboratory Practice, *Science, Technology and Human Values*, 30(2), Spring 2005, 175-198.[1]

Mots-Clés/Keywords (standard (see database))

Stratégies expérimentales; Sciences en général; Techniques et technologies; Aspects tacites; Robustesse; Calibration; SHS; Erreurs; Physique (physique des matériaux)

Domaine Objet/Domain & Topic

Physics (Materials science).

Résumé/Summary

Personal summary

The central issue to this paper is that of the role of sounds and noises – as the physical effects – as shapers and contributors to knowledge making strategies in materials science. Using an assembly of SSK- and ethnography-like remarks of ways of managing and dealing with sounds, noises and auditory phenomena in materials science, Mody's intent is to provide a constructive critique of the current 'oculocentric' "picturing knowledge" habit of speaking in epistemology and science studies (p. 175). He observes how the usual way in current studies is to look at knowledge making as "*seeing* as richly root[ing] the practices of field and laboratory" and a matter of a "complex work done by scientific pictures, charts, micrographs, and other 'traces'" (p. 176). Against this habit, Mody wishes to highlight the importance of non-visual experiences too in experimental practices. In words, he aims at commenting "on how listening, hearing, attuning, and other ear-work are integral to much that goes on in laboratories. Labs are full of sounds and noises, wanted and unwanted, many of which are coordinated with the bodily work of moving through space, looking at specimens, and manipulating instruments." Briefly, and borrowing here Mody's words, "[s]ounds are fully woven into the knowledge that emerges from experimental practices" (p. 176-177).

Summary of the argument by the author

« I hope to show that auditory phenomena have … epistemological consequences even in laboratory contexts where they are not the primary objects of study. I open with an examination of the sometimes undesirable effects of laboratory sounds. Noise can shake and disturb laboratory tools and personnel, and, as a consequence, auditory concerns shape much of the when and where experimentation. By being aware of the sound environment, science studies can gain new insights into the ways experimental spaces are constituted. Next, I describe some of the sounds produced and/or attended to by surface scientists and the ways these are folded into experimental practice. I attempt to show that sound is an integral (if often overlooked) ingredient in tacit knowledge. Surface scientists carefully manage auditory (as well as visual and haptic) cues to liberate different

[1] This paper is referenced in the PratiScienS bibliography under: Mody, Cyrus M., 2005, The Sounds of Science: Listening to Laboratory Practice, *Science, Technology, and Human Values*, 30, 175-198.

kinds of information from their experiments. And finally, these same surface scientists call on their audience's personal auditory (and other sensory) experience to more powerfully convey ideas. » (on p. 177)

Thèses, Organisation de l'Article/Thesis & Argument, Narrative Organisation

The central issue to this paper is that of the role of sounds and noises – as the physical effects – as shapers and contributors to knowledge making strategies in materials science. Using an assembly of SSK- and ethnography-like remarks of ways of managing and dealing with sounds, noises and auditory phenomena in materials science, Mody's intent is to provide a constructive critique of the current 'oculocentric' "picturing knowledge" habit of speaking in epistemology and science studies (p. 175).

The paper is divided in six sections.

Mody's untitled introduction expands on the gist of his argument, starting with the observation that the usual way in current studies is to look at knowledge making as "*seeing* as richly root[ing] the practices of field and laboratory" and a matter of a "complex work done by scientific pictures, charts, micrographs, and other 'traces'" (p. 176). Against this habit, Mody wishes to highlight the importance of non-visual experiences too in experimental practices as this current "oculocentrism" pervading science studies comes at the cost of a lack of exploration of the *other* sensory experiences also contributing to configure and shape, and impact upon experimental practices and their outcomes, that of hearing for instance in his argument, but also those of smelling and tasting too as he later mentions (p. 194). In words, and specifically, he aims at commenting "on how listening, hearing, attuning, and other ear-work are integral to much that goes on in laboratories. Labs are full of sounds and noises, wanted and unwanted, many of which are coordinated with the bodily work of moving through space, looking at specimens, and manipulating instruments." Briefly: "Sounds are fully woven into the knowledge that emerges from experimental practices" (p. 176-177). As such, Mody's aim is thus to rehabilitate "auditory phenomena," that is sounds and noises broadly construed, as also potentially having "epistemological consequences," this "even in laboratory contexts where they are not the primary objects of study" (p. 177).

In "Sound as Contaminant" (p. 179-180) – in a continuation of his argument about 'dirt' as configuring factor in experimental practices in materials science as in his "A Little Dirt Never Hurt Anyone: Knowledge-Making and Contamination in Materials Science" (*Social Studies of Science*, 31(1) (Feb. 2001), 7-36) –, Mody expands on how auditory issues are intimately interwoven into the fabric of making knowledge in materials science, at the very least as auditory phenomena "are an important source of contamination" in the field (p. 178). In this field, indeed, the very deployment of experimental apparatus for the containment of pollutants and contaminants, as dust etc., leads out to the paradoxical making of auditory disturbances. Thus, if pumping apparatuses can allow for clean efficient environments for using STM (scanning tunnelling microscopy) and TEM (transmission electron microscopy) instruments, in the same time, their functioning constantly produces sounds and noises polluting the experimental usage at its core, leading out to pollution – streaks - on the images produced.

In "Sound and Space" (p. 180-184), Mody explores how – although auditory phenomena and related issue may be deemed as pollutant – sounds and noises are however intimately part of laboratory life, allowing among others to circumvent experimenters' boredom (p. 180), leading to an ambivalent status for sounds, in the same time useful to keep researchers alert (conversations, music) as well as the first place to look for problems in case of instruments' breakdown and dysfunction. With the issue of clean rooms coming at the cost of 'nuisance noise' generated by the very process of protecting experiments "from the dirt exuded by experimental bodies and the pollution oozing from an ostensibly hostile and contaminating outside world" (p. 181), the production of (un)wanted sounds comes to be seen as natural, inevitable in the experimental process, and, if possibly, to be controlled as much as possible. This control is achieved through resourcefulness in ways of using spaces around. While some locations for the lab may be inherently auditorily polluting (high floors, locations next to a machine shop, locations next to construction areas, roads, streets...), some are lesser so, such as ground floors, outskirts of cities etc, and thus come as more attractive places where to locate equipment, sometimes even through squatting arrangement. A crucial issue here is that of 'portability', that is, while it may indeed be good practice to 'sound' protect environments using anti-vibratory devices and sound hoods, the issue, more generally, is that equipment should not be set up so as to work properly in specific, protected, environments, but rather so as being capable of functioning in various environments, including sound-pollutant ones. This allows avoiding instrument failures, and related discredit, and also, for instrument makers, to be able to show off novel instruments at fairs and conferences.

In "Sound Effects" (p. 184-185), Mody gives out a catalogue of the sources for sounds in a materials science lab, listing among others about sound issues with pipes filled in with gargling water, compressed air cans blowing dust away, fume hoods, centrifuges, vacuum pumps, activities in machine shops, grinders, air conditioning systems, etc. In a nutshell, "[t]he task of preparing and maintaining the epistemic materials of surface science, and of bringing them under the disciplining gaze of instruments such as microscopes, diffractometers, and spectroscopes, is mechanically complex and noisy" (p. 184) and noise is thus not simply a pollutant to practices in materials science but intimately interwoven to the very fabric of ways of living and doing in the field.

In "Sound Knowledge" (p. 185-192), Mody turns to the gist of his argument, that is, his questioning about whether "do sounds merely surround knowledge making in labs, or are they also bound up in the knowledge that gets made? It should be clear that sound helps lend structure to experiments – where they are done, when they are done, what they look like. But is it epistemologically relevant that the rich visual world described in early laboratory studies ... is imbued with sound?" (p. 186). This, to Mody, leads the narrative to a shift wherein sound comes to be seen *as also "sound-as-experimental-cue"* in addition to "sound-as-contaminant" (p. 186). In materials science, as approached by Mody, contaminating sounds can become clues and tools for yielding "new kinds of data about apparatus and phenomena"; as (contaminating) "controlled sounds" can help yield further results and diagnosis (discussions, sound-based tests for reliability of instruments, etc.), "[t]he line between disrupting sounds and enabling ones has to be negotiated moment by moment" (p. 186). Especially, he argues, soundscape is crucial for the accruing of tacit knowledge in the lab. Specific sounds – the 'whirr' of micrographs, the 'chuck-

chuck' of a probe in an AFM, the 'sproing' and 'click' of coils moving, etc. – are to be learned for an efficient training in an instrument. As Mody comments, "[w]hen things run smoothly, these sounds unfold regularly, marking out the running of a clean experiment. Learning these sounds, and the experimental rhythm they indicate, is part of learning the proper use of the instrument" (p. 186). More casually, coordinating visual and auditory cues is very part of the daily ways of researchers with managing the information laid out to them during the functioning of instruments. In time, this leads to researchers tacitly getting to know to distinguish between normal functioning and dysfunction and instruments not running as smoothly as they ought to. Further, using voluntarily produced contaminating sounds can assist testing instruments preliminarily to experiments per se (p. 186-187). In the long term, this learning, in Mody's argument leads out to instrument operators "gain[ing] tacit knowledge about what certain sounds mean and develop an aesthetic relationship to these acoustic indicators," as well as a tendency and taste for making their own equipment and instruments, equipped with auditory control tools, too, for the listening to sounds that will be qualified as 'cool', 'neat', 'beautiful', or, also 'ugly' (p. 188-189). Pointing out that it is a tricky issue how "to sort the aesthetic appeal" of sounds from "their ability to help solve particular experimental problems," Mody then discusses the issue that, compared to visual, longer-lasting, traces, sounds tend to fade into memory and leave out little traces and hints of their occurrences. Still, he argues, sounds, like images and visual cues, can be used to serve the strength of a scientific argument, while being used for instance during experiments, demonstrations or talks in conferences, if there are ways to display out controlled sounds too. As he comments, "[a]uditory experience is personal yet common, so that framing explanations in terms of acoustic phenomena can be a powerful bridge for transferring knowledge" (p. 189-192).

In his "Conclusion" (p. 193-194), Mody summarises his argument – "Sound, then, is pervasive in laboratory life and impinges on experimental experience in surprising and often epistemologically significant ways. [T]his should point to ... the need for a fuller understanding of what *embodied knowledge* might entail" (p. 193). Beyond this summary, Mody also adds up 2 recommendations as suggested by his explorations. 1st, he wishes to highlight the importance of exploring sound issues while at examining scientific practices. As sounds are indeed shaped up and perceived drawing from actors' categories, he suggests that there may be some learning to be gained from exploring sounds in various settings and analysing their (varied) meanings. Especially, he writes, "sound fills and demarcates space, so that studies of the social construction of experimental places would do well to listen to the experimental soundscape. ... Also, sound extends over time, and constructions of time have long been of interest to lab studies," mentioning here Traweek's work on time [Ndt: on particle physics] (p. 193), and also Jakobson's ones in relation to the issue of sound's 'immediacy' as carrier and conveyer of meaning and context. He closes this point by pointing out on how lab studies problematically miss out often on describing labs' soundscapes. Mody's 2nd recommendation (spreading on p. 193-194) is concerned with the broader issue of situated and embodied knowledge, here including tacit knowledge. To Mody, much could be learned about embodiment by approaching this problematically (not so) personal issue of embodied or tacit knowledge through the angle or lens of sensory experiences, visual but also auditory, etc. His argument is on the 'sound'-scape of materials science, but what about medicine and chemistry and their 'smell'-scapes, geology and its 'taste'-scape? In a

nutshell, and Mody's words, "[s]cience studies has yet to track these variations and give them a thick description, however. When it does, we shall understand better how scientific knowledge is forged by all these senses, and how all experimental sense data – taste, touch, hearing, and smell, as well as sight – are ineluctably cultural products" (p. 194).

Démarche/Approach

Assembly of SSK-like case studies on practices of managing and dealing with occurrences of sounds, noises and auditory phenomena in materials science, with the author developing out this issue similarly as the current literature does for pictorial and visual issues. The argument proposed is developed as in opposition, then complement to the current literature wherein images, and visual phenomena are frequently the center of attention.

Apports Spécifiques/Specific Inputs

This paper is interesting in the ways it suggests that the current fashion in science studies to look out for images, pictures and visual signs may lead to lacunae in analyses, that is, coming at the neglect of other bodily issues due to its efficacy and fashionability following on a long trend in the SSK and ethnographic literature.

Additional keywords

Physics, Materials science, SHS, Error, Laboratory ethnography, Contamination and purity, Mary Douglas on pollution and cleansing rituals, Noise and sounds as generator and indicator of (non-)knowledge, Tacit knowledge acquisition and sound exchanges

Commentaires/Comments

1/ This paper is largely based on the premisses of the argument previously developed by Mody in 2001 in his "A Little Dirt Never Hurt Anyone: Knowledge-Making and Contamination in Materials Science" (*Social Studies of Science*, 31(1) (Feb. 2001), 7-36), of which summary is as follows (see previous notice by S. Mols on the paper for PratiScienS):

> "The central concepts to this paper are those of 'dirt' and 'purity'. Mody's argument is an exploration of laboratory practices in a material science lab wherein he shows how 'dirt' – that is contamination to materials under process of being grown and examined –, its occurrences, and the cleaning practices its taking away generates, is no insignificant factor in the lab but rather organising its structure and practices. Against Douglas's argument in which 'dirt' is presented as impediment to appropriately ruled social functioning, and a defect to be corrected through rituals of decontamination, purification and cleansing, Mody argues that, in the case of materials science, 'dirt', *at the same time*, is an impediment to good knowledge-making practices in materials science as well as serves the discipline positively, showing off where things go awry or wrong, and guiding it onto improved practices and treatment of old topics and towards exploration of new ones. The structure of the paper is as follows: 1/ An introduction wherein Mody states out his argument and discusses Douglas's work (p. 7-9), 2/ "What is Materials Science?", wherein he describes his ethnographic work in a materials science lab at Cornell, emphasising the importance of 'dirt' management, under its various forms, to the running of the lab (p. 9-11), 3/ "What Counts as Dirt?", wherein he addresses

> the issue of the various meaning of the concept of 'dirt' in the lab under scrutiny, emphasising the ambiguous status of the issue (p. 11-14), 4/ "Other Modes of Pollution", wherein he addresses the issue of the many kinds of dirt, discussing how these can be endangering knowledge claims (p. 14-17), 5/ "Pollution Ritual", wherein he addresses the consequences of pollution and the ways through which avoiding dirt is "second nature to materials scientists" (p. 17-19), 6/ "Objections and Responses" and "Dirt and Social Danger", wherein he discusses how dirt serves as "epistemological /ontological filter," in various modes and ways in materials science lab (p. 19-28), 8/ "Dirt as Discriminator and Generator of Explanations and Anomalies," wherein he discusses the constant balancing between clean and dirty in materials science daily practices, clean and dirty being variable and changing, and highlights how dirt may have positive knowledge impact, as way to get to "think out of the box" (p. 29-33), and 9/ "Notes": Mody's notes are quite extensive and mention quite in details the literature used for the paper, as well as comment on it."

2/ Surprisingly, for a paper commenting by and large through the issue of embodied knowledge, Mody makes little use of classics on the issue; papers by Haraway for instance are not mentioned in his footnotes.

Bibliographie sur laquelle s'appuie l'auteur/Literature used by the author

Authors by themes

- ✓ Phenomenology of sound: Ihde, Stern
- ✓ Notions of purity and dirt: M. Douglas
- ✓ Oculocentrism and visual issues in scientific practice: Galison, Rasmussen
- ✓ Sound issues in scientific practices: Bijsterveld, Thompson, Jordan and Lynch
- ✓ Studies on materials science: Groenewegen & Peters, Hessenbruch, Hoddeson, Leslie
- ✓ Laboratory studies, ethnography of science: Latour, Traweek, Knorr-Cetina, Lynch...

Examples of cited literature

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- ✓ Henderson, K., 1999, *On line and on paper: Visual representations, visual culture, and computer graphics in design engineering*, Cambridge, MA: MIT Press.
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