The dance of maintenance and the dynamics of urban assemblages

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September 7th, 2007, half past six in the morning. While the guys are finishing their cup of coffee, the sheets of paper pile up in the fax machine of the signage maintenance department. The manager takes a look at the pile, quickly sorts the sheets out according to Paris area, and distributes them to the two pairs of maintenance workers. Each piece of paper is a request for a repair of a subway sign among the numerous ones that compose the wayfinding system. In the hands of the maintenance workers, these requests take the form of work orders, indicating the type of sign, a code that identifies the sign's emplacement within the station, and of course the station name itself.

Once the pairs of workers have received the work orders of the day, they take the signs they have to install, which are stored in a specific room of the workshop, and load them into the van. They are ready to go to the first station. Brian has just sorted out the work orders into a successive coherent pile of interventions, and he suggests starting with the replacement of a damaged signboard in Gare de l'Est. When in the station, Brian and Jonathan go over the halls, the corridors and the platforms in search for the defective sign. They carefully watch the content of the various signs displayed in the station, the presence and direction of arrows being especially helpful to locate the one they are searching for. They eventually find the signboard at the crossing of two corridors.

But what exactly is a flawed sign? As any wayfinding system is an arrangement of graphic components, failures mainly consist in a diverse range of visible problems concerning the material composition of signs: a battered enameled plaque, a smashed or broken PVC sheet, a ripped layer or a failing frame inside a lightbox. If some of these failures are obvious, others are subtler such as the presence of minute traces of rust or mold, the display of irrelevant or obsolete information, and even the very absence of a sign. Although different, all of these cases introduce a greater or lesser extent of disruption in the visual environment of the transportation system. This time the flawed sign is easily recognizable for Brian and Jonathan: its colors obviously faded out (figure 1). Jonathan puts it down without any trouble and replaces it with the brand new one in a few minutes. From now on, the network of signs in the station is repaired. The sign does not contrast among the other ones anymore. It has taken back its part in the seamless deictic chain of references that is meant to ease riders' mobility throughout the subway spaces, and the whole city.

This short scene describes a mundane intervention that concerns an object we usually take for granted. Yet, this operation bears witness of a maintenance work that is distributed in sociomaterial practices through which some people in the transportation carrier take care of subway signs (Denis and Pontille 2014, 2015). Though sometimes prosaic, each repair operation that punctuates this maintenance work enacts the daily presence of an apparatus dedicated to the graphical ordering

of an urban setting, an apparatus that plays an essential role in the heterogeneous assemblage of public transportations.
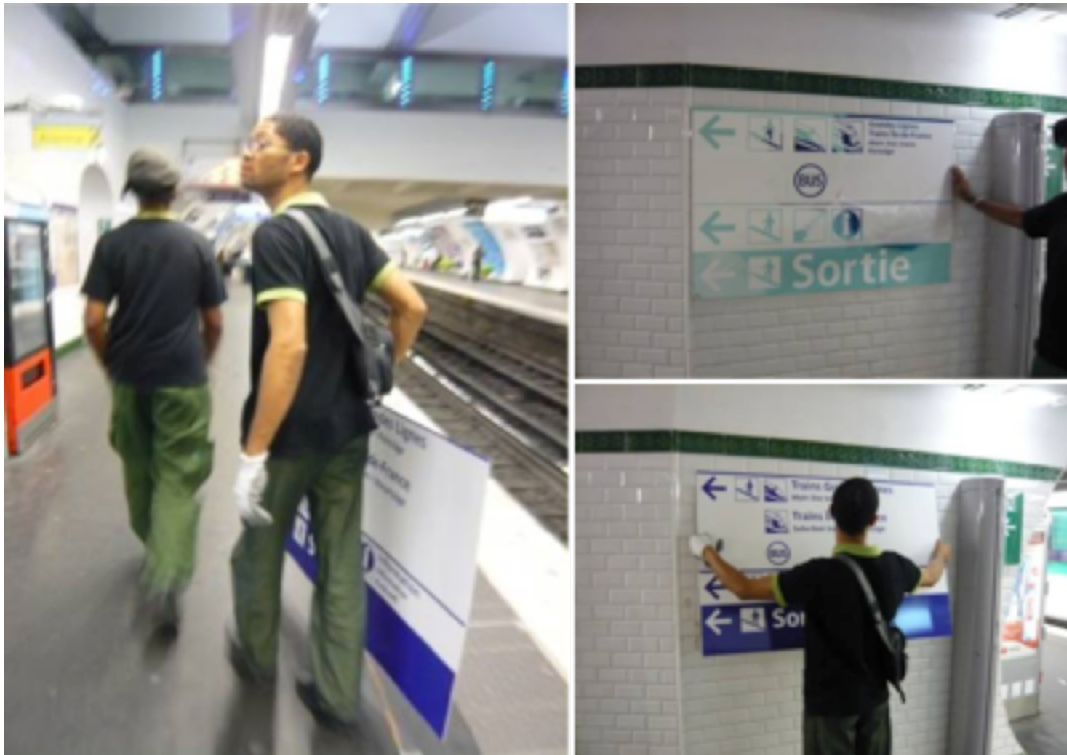
Figure 1. *The replacement of a flawed signboard.* © Photo: Jérôme Denis and David Pontille

For several years now, at the crossroads of human geography and actor-network theory, ample research has contributed to redefining some of urban studies' traditional themes and to 'decenter' some of its main objects and issues (Farias and Bender 2010). A large part of these analyses have been centered around the notion of assemblage, which has recently come to the fore (Brenner, Madden and Wachsmuth 2011; McFarlane 2011). Borrowed from Deleuze and Guattari (1987), the notion allows for a "non-reductionist" approach to the city (DeLanda 2006). The notion is also useful in describing forms of agency, which "cross the human-nonhuman divide" (Bennett 2005) and insist on the heterogeneity of urban fabric as well as the circumstantial character of its transformations throughout time.

> (…) the concept of assemblage is particularly useful for grasping the spatially processual, relational and generative nature of the city, where 'generative' refers both to the momentum of historical processes and political economies and to the eventful, disruptive, atmospheric, and random juxtapositions that characterise urban space. (McFarlane 2011, 650-651)

This stream of research has called for a true study of the sociotechnical complexity of cities (Ash and Thrift 2002; Brenner 2004; Sonda, Coletta, and Gabbi 2010), from the largest infrastructures (Graham and Marvin 2001; Varnelis 2009) to the most everyday objects (Molotch 2011; Molotch and Norén 2010; Watson 2014). In this broadening movement, the very place of space in the description of urban realities has been largely rethought. Where for most research in geography and sociology, physical territory represented the

unquestioned starting point for any analysis (Cresswell 2004), numerous authors today insist that spatial properties be studied in their diversity as always-temporary, partial results of sociomaterial practices they cannot be separated from (Kärrholm 2007; Latham and McCormack 2004; Latour and Hermant 1998).

Wayfinding systems are paradigmatic of urban assemblages. Intimately linked to urban fabric (architecture, streets, highways, and practices themselves), they play a crucial role in the production of cities as both material and informational environments (Latour and Hermant 1998). Signs, though mundane objects, contribute to "modes of ordering" that perform and maintain "spaces of flows" (Knox et al. 2008) and are essential components of the "machinery of placement" that equip mobility practices (Ash and Thrift 2002). They are part of the devices that "are overwhelmingly important in articulating the corporeal movements of people and their bodies (workers, migrants, refugees, tourists) via complex and multiple systems of physical transportation" (Graham and Marvin 2001, 8).

Yet, to understand such assemblages, a description of signs and their emplacement, even though obsessively detailed, does not suffice. Indeed, simply for remaining in place and thus truly contribute to the graphical ordering of urban settings, signs take work, and especially maintenance work (Denis and Pontille 2014). In this chapter, we propose to explore such work, which remains largely overlooked in the studies of urban assemblages. First, we will foreground the importance of maintenance in the daily existence of wayfinding systems. Second, we will investigate the day-to-day repair activities that the maintenance workers accomplish, and show that they consist mainly in reassembling operations. These operations are largely based on improvisation on the part of maintenance workers, and generally involve new material added to an initial variety of elements. The ethnographical analysis of this aspect of maintenance work makes it possible to understand that the sociomaterial heterogeneity of urban assemblages is a central issue of repair. Furthermore, taking a close-up view of reassembling operations reveals the importance of the inextricably connected operations of disassembling (see Dant in this volume). To be repaired and then reassembled, signs must sometimes be, to a degree, disordered. Repair thus consists not only in (re)producing solid assemblages which appear homogenous, but also implies that objects themselves can deal with cycles of assemblage and disassemblage. Finally, we will show that, in the case of wayfinding systems, repair interventions engage a very specific ecology of visible and invisible (Star and Strauss 1999). As subway signs' "functionality" is a matter of standardized visual qualities, the erasure of all traces of repair is crucial for properly reassembling the wayfinding system. Invisibility of repair is thus not a "natural" consequence of the taken-for-grantedness of the wayfinding system as an infrastructure (Star and Ruhleder 1996), but the result of repair itself and the conditions of its success.

We will draw on an ethnography of the maintenance of the Paris subway wayfinding system that we conducted from March 2006 to March 2007. We gathered internal and external documents and we conducted in-depth interviews with designers, employees in charge of the graphical standards manuals, and employees from the signage maintenance department. We also shadowed maintenance workers during their daily rounds in stations and at their workshop, taking photographs in order to document the course of their action (Suchar 1997). These photos were not meant to provide primary materials that would be analyzed after their gathering. Rather, they were conceived of as initial analytical gestures;

means to produce a sequential visual account of maintenance work (Wagner 2006), including the main operations, the gestures, and the tools used during repair interventions.

Signs and their maintenance:
the wayfinding assemblage of Paris subway

In Paris, the wayfinding system of the Régie Autonome des Transports Parisiens (RATP) has been renewed during the 1990s, and has been the object of an ambitious standardization policy that defines a set of signs, and fixes the shape and the materials for each of them (enameled sheet metal, stickers, PVC sheets, lightboxes and, most recently, screens). On the linguistic side, this normalized system of signs was conceived as a modular, hierarchized language, with numerous components that make possible a wide variety of combinations between arrows, icons, words, abbreviations, and colors. These elements were themselves standardized in an attempt to create graphical continuity from one place to another (Denis and Pontille 2014). For example, the color assigned to each subway line remains identical from one sign to another. In the same manner, dark blue writing on a white background indicates the directions of the different lines, whereas white lettering on a blue background is used for the names of stations and exits. Thus, adding to its normalized material features, the wayfinding system introduces maximum graphical consistency. The signs have been imagined in terms of their reciprocal relationships, as elements forming an uninterrupted chain of references that provide riders with what its designers call an "Ariadne's thread" (Wiart, Le Roux and Lomazzi 1998).

Beyond their material and linguistic properties, the objects that make up the Paris wayfinding system were conceived in close relation to the subway spaces. Signs were designed to fit seamlessly into stations' architecture. For instance, their size is adjusted to the RATP's tiling, which is used as a grid for signs' emplacement. Moreover, the presence of signs is meant to divide each station into zones: entry halls with neighborhood and network maps; corridors with directional arrows, subway line numbers and the names of the travel directions; platforms with network maps, connections, station names, and the names of each station exit. This differentiation within sites is applied to the entire network: the same distinct zones are repeated from station to station, thus creating standard spaces despite their architectural disparities. In such a material semiotic assemblage between heterogeneous architectural features and normalized inscriptions, "the distinction between the building and its signs, between the text and the territory, becomes indistinct" (Fuller 2002, 236). Like signs and their graphical components, walls, hallways, stairwells and platforms are essential parts of the Paris wayfinding system's assemblage.

Through such an ambitious policy, the wayfinding system has been invested as a central component of the service that the Parisian carrier provides to its customers. Beyond the genuine transportation of people from one point to another of its network, the RATP now offers to riders a full set of resources dedicated to their fluid displacements in the city. The manifold standardized subway signs are thought as a mobility utility in itself, transforming the transportation spaces into an always-available device that bears a situated intelligibility of the whole network.

Obviously, such a service cannot stand in signs "only", even though highly standardized. To be available all along the transportation networks, signs have to be watched for and taken care of. In 2000, the RATP created a maintenance department fully dedicated to the wayfinding system. At the time of our study, twenty employees were working there, taking care of all the signboards for all the transportation modes, and ensuring the wayfinding system's continuity of service. It was specified in the department's mission that they had to carry out the repairs requested by the station superintendents within 48 hours only. With a crew of six men and a woman exclusively dedicated to subway signs, maintenance work is action-packed. Four of them were intervening in the stations, repairing and replacing the boards, whereas the three others were staying at the shop, repairing old boards or manufacturing new ones. This crew was dealing with an average of 150 interventions per month, in the network of three hundred stations (and supposedly fifty thousand signs, but no one ever managed to count them).

The dance of maintenance

The repair interventions generally work in four steps. First of all, obviously, the flaws in the wayfinding system have to be noticed and reported. This is the responsibility of each station superintendent. Every morning, before opening the station they are in charge of, a form in the hand, they walk all around the corridors, the staircases, the halls and the platforms, looking for any problems: graffiti on the walls, unpleasant odors, rats, furniture damage, homeless people… Signboards figure among the numerous things they have to check. Once the round is finished, they use the form they filled in to create digital requests that are automatically distributed in each specialized maintenance department.

Even if it's part of their official job assignation, station superintendents are not the only ones who can notice failures in the wayfinding system. During their interventions, maintenance workers detect problems as well, performing a supervision "on the spot", beyond the only signboard they are here to repair or replace. If they notice a new problem and have the right equipment, they generally operate right away. If they can't, they create a request themselves, once back at the maintenance shop. Such on-the-spot notifications go beyond the formal organization of work and, when dealing with it, the maintenance workers generally consider they are doing the superintendents' job. Sometimes, after noticing a problem, they go directly to the station superintendent for a quick reminder, explaining both that they discovered a missing or damaged sign and that it should have been reported already.

Such episodes show that subway signs are not the most important matter in the superintendents' eyes. When it comes to supervision, maintenance work dedicated to the wayfinding system is framed in the maintenance of the subway station as a whole. Furthermore, the fact that the superintendents sometimes "miss" what the maintenance workers consider as noticeable failures foregrounds the difficulties such notifications represent. Flaws in the wayfinding system are by no means self-evident and their mere identification requires specific competencies, a "professional vision" (Goodwin 1994) through which maintenance workers articulate their ability to observe tiny transformations in

their environment and their sound knowledge of the standards (that is the way signs should be in a "normal" situation).

When they proceed from the station superintendent, the requests start another sequence. Distributed to the maintenance workers, these requests describe some problems in the wayfinding system that need to be confirmed on the spot so as to be characterized in more details. Although diagnostic is a crucial operation in many repair activities (Bovet and Strebel in this volume; Dant 2008; Orr 1996; Sanne 2010), it is not at stake in the maintenance work of subway signs. The workers simply confirm or invalidate the relevance of the problem described in the work orders. To do so, they go into the station a first time and take a decision in front of the sign. In some cases, the request is clearly not addressed to the right department. For instance, whereas a "scratchiti" so deeply damages an enameled plaque that it has to be replaced by the maintenance workers, a graffiti merely written on a sign should be removed by the cleaning department. If the failure is confirmed, the repair may be done on the spot, though it rarely happens. In most cases, the repair of the wayfinding system consists in the replacement of signs. Therefore, the first run into the station generally implies taking measurements of the damaged board. To do so the maintenance workers complete their initial work order, confirming the type of sign (PVC or enameled), indicating its precise dimensions, and sometimes drawing its graphic composition and content.

As the form is then passed on to the maintenance department, it is the starting point for a two-step production process. Either the signboard can be directly repaired at the workshop, or a new enameled one has to be ordered from the manufacturers, based on the measurements reported in the form. But nine weeks are needed for the production and the delivery of such an enameled sign. In order to respect the mandatory 48 hours delay, a local team makes a temporary PVC signboard at the shop. Except in particular cases, the next day this temporary sign is put up by the maintenance workers, which closes the case in the information system at the end of their round. At this time, from the point of view of the standardized policy we described above, the wayfinding system is thus temporarily repaired.

When the final signboard is delivered to the maintenance shop, a new work order is edited and another pair of maintenance workers (sometimes the same ones) returns to the station and proceed in the replacement of the PVC one[i].

Repairing the Paris subway wayfinding system cannot be summarized as the automatic replacement of flawed signs with new ones found in warehouse stock. Rather, it is a process punctuated by daily operations that put things back to order into a network of signs never repaired once and for all. Regular interventions set the rhythm of an endless "dance of maintenance", to echo Pickering (1995), who spoke of "the dance of agency." Such a dance is made up of a permanent attention to subway signs, small mundane gestures of repair, and replacement operations that oscillate between provisory and definitive states.

But what do these operations consist in precisely? What does repairing the assemblage of the wayfinding system actually mean?

Reassembling

Let us first take the example of an intervention carried out by a pair of maintenance workers (Michael and Steven) who were asked to replace a damaged PVC sheet inside a lightbox.

On the platform, Michael sets the signboard down. Balanced on the stepladder, he loosens the screws, opens the lightbox and slides out the PVC sheet (see figure 2). The plastic layer covering the words is partly ripped. The extent of the damage did not stand out when it was in the lightbox: the fact that this damage was signaled shows the degree of rigor in keeping the wayfinding system in top-notch shape. During this time, Steven has remained at the bottom of the ladder in order to take the broken sign from Michael. Before continuing the intervention, Steven holds the old and new sheets up to one another, making sure that they are the same size. Without needing a ruler, he confirms that they are indeed identical in dimension. Michael then places the new sheet in the lightbox.

However, he is not completely satisfied: despite the metal grips that he uses to put it in place, the sign is not completely sturdy. Michael could stop there and close the lightbox; after all, both signs are identical and the previous one was hardly sturdier. But there is a risk that it will fall out of the box, and Michael prefers to avoid this possibility. As he explained to us, if the sign were to fall on a rider's head, he and Steven would be held responsible. He wants to find a solution, even if it takes him a few minutes longer.

Without discussion, Steven goes back up to the station entrance hall. When he returns, he has newspaper in his hands, which he folds into small, thick squares. Each square is modeled after several folds. Michael positions the squares one by one between each grip and the PVC sheet in the lightbox (see figure 3). The sign is now sturdy and adjusted. Now, the box must be closed again. Once this step is complete, Michael concludes: "Good as new! Now it looks good and it's better for the riders." (July 9th, 2007, Fieldnotes)

Figure 2. *Sliding out the PVC sheet.* © Photo: Jérôme Denis and David Pontille
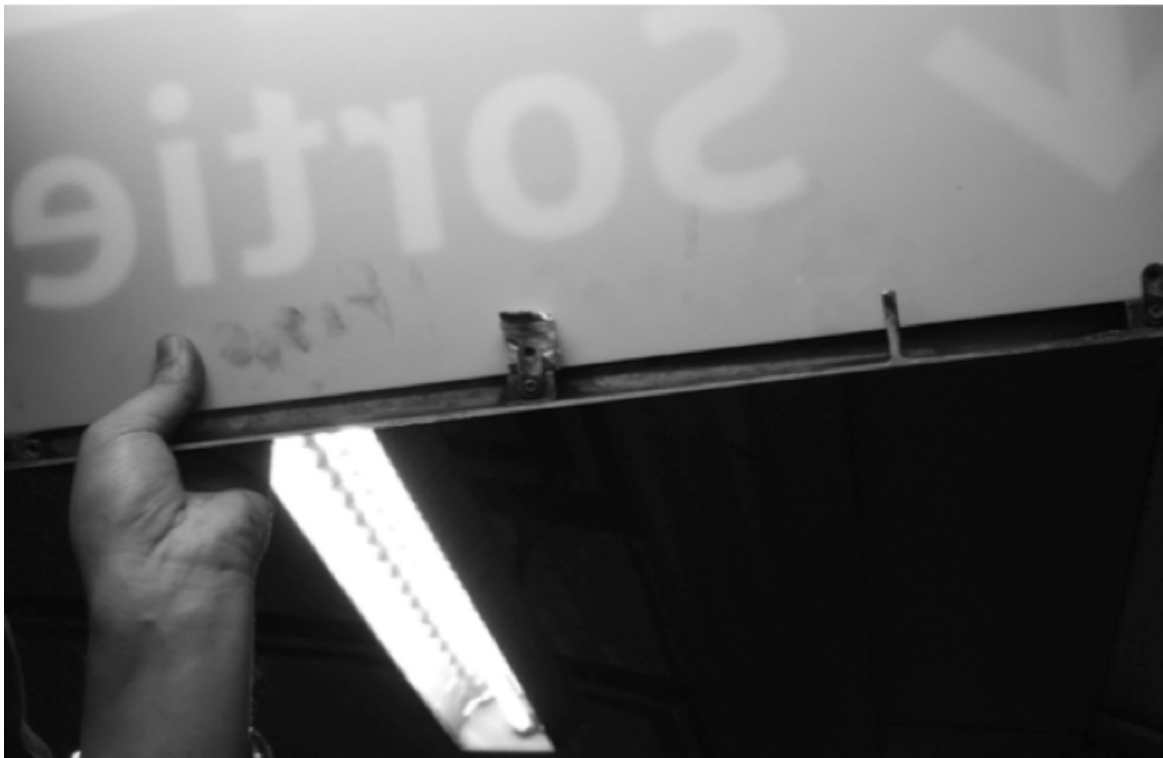
Figure 3. *Fitting the sign into the lightbox.* © Photo: Jérôme Denis and David Pontille

This sequence reveals certain particularly interesting aspects of repair. First, it underlines a well-known dimension: the importance of improvisation and "bricolage" in the completion of repair and maintenance operations (Dant 2010; Henke 2000; Schubert in this volume). By

definition, repair is made of constant surprises and adjustments that go beyond all attempts to rigorously plan things (Orr 1996). This sequence also shows, though, that improvisation is not exactly what is at stake here. Maintenance workers seem to know what to do. Not only do maintenance workers not discuss with one another in order to find a solution to a problem indirectly affecting rider safety, but they also coordinate their respective activities fluidly. Michael had barely noticed that the sign was unstable when Steven left to find the newspaper. Workers deal with routine problems from which they easily extricate themselves, no equivocation needed. And yet, putting newspaper in the box to fit the PVC sheet is a kind of bricolage. Newspaper is a material that is not part of the standard criteria for lightbox assemblage. Moreover, though routine, its use remains invisible once the lightbox has been closed.

Throughout other interventions, we observed the introduction of other, much more unexpected elements whose invisibility was not evident. Improvisation plays an important role in these examples.

This is what happened when Brian and Jonathan attempted to replace a sign that was on the verge of falling down. During an initial station intervention we were not able to observe, two repairmen found themselves in a surprising situation. With abundant detail and no shortage of humorous remarks, Brian and Jonathan explained to us that the sign identified as flawed in the work order had come halfway off the wall. In trying to remove it entirely, they discovered that it had not been placed in its usual frame, but was resting on a frame made of rotting wood. They ended up removing the whole thing, and decided to come back to the station in order to attach it correctly.

Two days later, we shadowed them as they prepared to put the sign back in place. That day, before leaving the maintenance department, Brian asked his colleague for two metal brackets. Once in the station, the team prepared the wall, removing the old screws, drilling holes and filling them with glue cement. Despite a few problems with their electrical tools, they finally fixed the brackets and put the signboard up. At the end of this series of operations, while we were expecting the maintenance workers to leave the station in their van, an interesting thing occurred.

> Brian stops in front of the sign. He seems unsatisfied. Since he riveted the signboard to the two horizontal brackets, two empty holes, without rivets, remain visible on both sides of the board. He points to them, upset. In the terms of standards, the board is not properly put up, and he's afraid that the superintendent would not notice it has been repaired. There's a chance he would not acknowledge that the job has been done. Brian decides to put a screw in each of these empty holes, but it's even worse: the screws do not hold in place. Finally, he begins to clean the sign, which had gradually gotten covered with dust, using a cloth and the sleeve of his sweater (see figure 4). The sign sparkles, as if it had just come from the workshop. Brian smiles: "Here it is, a brand new sign!", adding "The superintendent should not be tempted to look at it too closely". (September 7th, 2007, Fieldnotes)

Figure 4. *Shining the sign.* © Photo: Jérôme Denis and David Pontille

These two sequences show that reassemblage is more than a simple re-establishment of already-present elements. Much on the contrary, what our observation of repair sheds light on is that the boundaries between the signs and their environment are neither frozen in place nor sealed or closed. While the squares of newspaper were added to hold the PVC sheet in place in the first sequence, in the second, glue, extra screws, and, above all, metal brackets specially created for the task made it possible to reinforce the sign to the wall. During their interventions, the maintenance workers constantly consider different material sites, strengthen their composition according to their own criteria, and try to make them hold as a coherent assemblage as best they can. Instead of encountering objects with stabilized boundaries, such as a wall and a sign, they are immersed in a material flux made of multiple layers. In others words, they deal with a dense ecology of materials (Bennett 2004; Denis and Pontille 2015; Ingold 2007).

The wayfinding system repair involves thus reassembling operations that not only move the borders between the assembled elements, but also sometimes transform walls and ceilings just as much as the signs themselves. The second sequence is a particularly good illustration of this. Glue, screws and metal brackets are not just items added between a solid wall and a sign in good condition, though detached from the wall. The discovery of a wooden frame damaged during a previous intervention, then the creation of specially-adjusted metal brackets show above all that the previous sign's assemblage was incomplete. Its visible side, displayed for the riders to see, was in fine condition, but its reverse side, initially made of metal so that the sign could be attached and adjusted to the wall with rivets, had disappeared. This missing half of the sign is compensated for by the

workers; during the repair operations, they create their own version of this other half. By the end of the intervention, the back half of the sign is supposed to resemble the other "whole" (or supposedly whole) signboards in the wayfinding system. This new back half of the sign is the result of an assemblage, some materials of which are different from those of the truly "whole" signs.

The two sequences make it possible to understand the relationships between order and disorder in repair operations, and also shed light on the ecology of the visible and the invisible on which these relationships are based. The repair practices we observed are oriented toward the restoration of a normalized situation, that is, a situation that meets standardized criteria. The maintenance workers strive to get things back to order. In the second sequence, Brian's last gesture and remark show that such "normalization" is clearly a matter of visibility and invisibility. To be considered as repaired, the signboard has to seem brand new. Such visible "newness" draws on two kinds of erasure: the erasure of the "out of order" situation and the erasure of the maintenance intervention itself and all the traces it may leave on the board.

The question of visibility and invisibility is also present in the first sequence, but it is organized differently. While the workers in the second sequence shine the repaired signboard in order to mask the aesthetic imperfections (the holes) resulting from its being incomplete, in the first sequence the workers make sure the PVC sheet is firmly attached in the lightbox, adding elements that will remain invisible. Thus, here, far from being limited to issues of recognition of workers within the formal representations of an activity (Bowker, Timmermans and Star 1995; Star and Strauss 1999; Suchman 1995), the ecology of the visible and the invisible is very directly concerned with objects and the unique assemblage they are part of. In one case, the pieced-together assemblage is hidden inside the lightbox itself, and, in the other, it is masked by the excessive shine of the enameled signboard.

The relationships between visible order and disorder made invisible are significantly different depending on who the intervention is aimed at. What these two sequences show is that repair engages not only the riders towards whom the brand new signboard is displayed without a trace of additional pieces (first sequence), but also the station superintendent who asked for the signboards to be repaired (second sequence). As we have seen, cleaning the sign until it shines is a means to avoid the superintendent's close inspection, which would mean he might see the unorthodox solution the workers came up with to fix it. From one situation to the next, that which is masked and that which is made visible is neither aimed at the same people, nor for the same reasons. Worker responsibility toward rider safety is at stake in the first sequence; the signboards' appearance as objects in keeping with the aesthetic standards of the wayfinding system is that which orients the workers' actions in the second[ii].

Finally, these two sequences remind us that repair is not merely re-assemblage. Repairing a signboard, whatever its materials, requires dynamic sequences which invariably include disassemblage. Disassembling and reassembling are the two essential steps in maintenance work. This is very clear at the beginning of the first sequence, when the damaged PVC sheet was removed, but it is also true for the sign in the second sequence, which was on the verge of falling, and thus literally about to "detach" itself from the

wayfinding system. In neither of the two cases did the disassemblage process require complex work: in the first sequence, Michael removed the PVC sheet from its frame without much effort, and, in the second sequence, the signboard seemed to break away from the wall "all by itself." During other interventions, though, things did appear more difficult. The disassemblage operation can be, at other moments, a more significant part of repair.

This was the case when we accompanied Brian and Jonathan on an intervention to replace a PVC sheet inside a lightbox because the information displayed on the sign was obsolete.

The first step of the intervention consists in opening the lightbox in order to take its front side down. This is a delicate operation: perched on the top of a stepladder, Jonathan opens the box and puts his hands behind the frame, trying not to get burned by the fluorescent lamp and trying not to break the whole thing. Once the piece is detached and put on the floor, the next step is quite long. In order to take out the sheet itself, Brian and Jonathan have to remove manually all the sixteen small screws that hold the plaque to the metal frame (see figure 5). Once it's done, they put up the new plaque very carefully and screw back the frame. Finally, they put back the piece in front of the lightbox. After that, Jonathan tells us: "This makes no sense, 16 screws just to get at this sheet. All we'd need is a little trap along here and we could easily get the sign out without even having to open the box up, without needing to take anything out… But they don't think about that. They don't think about us." (July 4th, 2007, Fieldnotes)

Figure 5. *Removing screws.* © Photo: Jérôme Denis and David Pontille

In this sequence, screws are dealt with once again. But when in the earlier sequence, they were briefly considered as a way of masking holes in the enamel sheet metal and making the signboard half appear complete and "closed", here, screws are firmly attached to the metal frame. They are a constraint in the disassembling process. There are many of them, and they guarantee both the solidity of the signboard and the safety of the riders. When the PVC sheet was unsturdy in its lightbox in the first sequence, screws were sorely lacking. But in this last sequence, they represent a true obstacle to quick signboard repair.

This sequence does not only shed light on the importance of disassemblage operations at the heart of repair, though. It also underlines the tension that may exist between the need to produce solid, lasting assemblages, either in the name of a placing signboards everywhere in order to serve rider mobility, or in the name of rider safety, and the importance of designing objects that can still be easily disassembled, which is an essential quality when it comes to repair. The attention paid to disassemblage operations is a way of not remaining limited to the heterogeneity of the elements that make up the wayfinding system in particular, and sociotechnical devices in general. It involves taking into consideration object agency in maintenance work, paying special attention to the material conditions of their repairability (de Laet and Mol 2000; Denis and Pontille 2015).

Conclusion

In studying urban assemblages through the lens of repair ethnography, we have attempted to pursue recent reflections which have demonstrated the interest of a decentered analysis of the urban realities linked to the traditional investigations of urban studies. We have shown that studying the organization of maintenance work, and observing the conditions under which repair is accomplished as closely as possible, allows to go beyond the mere observation that cities are sociomaterially heterogeneous. It notably makes possible to apprehend urban assemblages in their daily dynamics and to investigate the ecology of visible and invisible in which their repair takes place.

The dynamics of assemblages

To paraphrase Haraway (2003), we can therefore say that repair operations show that urban assemblages should be understood as "active verbs". There are two ways of conceiving of this. First, we can insist on the fact that urban assemblages are moving wholes, with always changing borders and components (Brand 1994; Edensor 2012; Jones and Yarrow 2013). We observed notably that the assemblage of the Paris subway wayfinding system is not only made up of permanent signboards with varying shapes and functions, articulated in a complex modular system, but it is also composed of temporary signboards, hung daily to make up for the lack of full repair, given the slow rhythm of production of the enamel signboards. These temporary signs make possible a kind of relative permanence for the system as a whole. Their presence though keeps the Paris wayfinding system from remaining entirely identical from one day to the next.

The second, complementary way to describe urban assemblages as "active verbs" is to highlight their precariousness and vulnerability. Heterogeneous parts do not hold together once and for all after they have been designed or installed. Rather, they are the product of

constantly changing relationships (Strebel 2011, Edensor 2012). In the case of the wayfinding system, signboards, whether "definitive" or "temporary," are always fragile, subject to wear and tear, breakage, even theft (Denis and Pontille 2014, 2015). The transformations we have stressed here are symptoms of the unceasing activities which guarantee an assembled whole. In presenting the dynamics of assemblage and re-assemblage which characterizes the repair of the Paris wayfinding system, we have attempted to illustrate this. Beyond, or rather, short of, the master narratives describing the terrible risks of disaster that each city faces, this unfailing maintenance process reminds us that cities are repaired daily, and incessantly. Rather than focusing the analysis on urban settings and, in particular, on their infrastructures, in pitting normality and crisis or functioning and breakdown against one another:

> we need to be especially mindful of the continuous, invisible work necessary to bring about infrastructural circulation even when infrastructural assemblages are working "normally." (Graham 2010, 19)

Urban assemblages are thus constantly going through assembling and reassembling operations, and these guarantee their permanence and their "normality". This is why maintenance can be understood as a dance: a series of coordinated movements that punctuate the life of the wayfinding assemblages, sometimes through planned and repeated occurrences, other times through improvisations of all kinds.

Performing in/visibilities

Finally, the case of the wayfinding system daily maintenance raises an important aspect of repair: its inscription in a very specific ecology of visible and invisible (Star and Strauss 1999). We have seen that part of repair activities makes visible certain characteristics of objects which, in a way, prove that they are back in working order. This visibilization relies on the erasure of the bodies of the workers, of the traces of their interventions, and the removal of the ingredients added to the assemblage for the sake of repair. The ethnography of repair therefore lets us "surface" (Star 1999) not only the invisible work of maintenance workers, but also the conditions by which it is erased, and the dynamic ecology of the visible and the invisible that fuels the daily existence of certain urban assemblages.

In this respect, the case of wayfinding systems seems very particular. Indeed, such apparatuses mainly operate on a visible basis. The intelligibility of the transportation network is performed by the very presence of the signs to the eyes of all riders. In the case of Paris transportation systems, we saw that, through the standardization of the shape, content and emplacement of subway signs, specific visual qualities have been invested as key ordering operators. Hence, what repair operations mainly do in such cases is to restore the signboards' proper visibility, which is considered as the very condition of the service the wayfinding system is aimed at providing. To perform such a restoration requires making all things that are not initially designed as part of the system invisible, from additional materials to traces of repair.

The flaws themselves, of course, are made invisible in such a process. Yet, to be repaired, they have to be noticed, that is somehow visible. This is an important aspect of the ecology of visible and invisible in which the maintenance work dedicated to such highly visible thing as wayfinding systems is engaged: the visibility of the signs' standardized and harmonized features is relational. It is performed from one repair operation to another, during which failures are visible for maintenance workers and remain, at least they hope, invisible from the riders' point of view. More generally, such an ecology seems to be specific of most of maintenance work, which mainly consists in accomplishing a flow of small interventions, in contrast with major breakdowns that require more substantial repair. In science and technology studies, as in phenomenology, breakdowns and repair situations are usually described as occasions for bringing hitherto unnoticed aspects of the world to light. Infrastructures for instance are ordinarily taken for granted, until they collapse and we suddenly understand and experience their importance and their vulnerability (Graham 2010; Star and Ruhleder 1996; Star 1999). But if this is true from the point of view of the everyday users, it is not from the one of maintenance workers, who deal on a daily basis with the fragility of infrastructures. Maintenance work draws a less contrasted situation where the difference between functioning infrastructures or technologies and broken ones is not binary, but relational. What counts here is not the general visibility or invisibility of failures, repair traces or transformations, but the distribution of people who are supposed to notice them or not.

Acknowledgments

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[i] In the case of signs made of a PVC sheet framed inside a lightbox, the version produced at the shop is the final one.

[ii] In his study of the mutable stone of St Ann's Church, Edensor showed that expectations surrounding the decisions at the heart of repair are multiple, vary throughout time, and may be hotly debated: "Decisions about repair, aesthetic appearance, historical worth, architectural and heritage value may persist as orthodoxy for a period of time or they may be hotly contested. […] Runcorn stone becomes a widely popular building material across north-west England for a time before becoming unsuitable for heavily polluted industrial settings; sandblasting prevails as a repair technique but is discredited; biofilms are left to grow because they are not currently considered to impair aesthetic appreciation." (Edensor 2011, 249).