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We have always done it wrong: the city as complex network, superorganism and more-than-human sentient being. An experiment in interdisciplinary [re]thinking.

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ABSTRACT

This paper draws on an experiment in interdisciplinary pedagogy, which took place in the Winter 2019, during a course on "Digital Technology and Society" at the University of Toronto. During the course, the city was chosen as the main source of inquiry. At the core of this experiment was a concern that current models of the city as "Smart City" have become disproportionately skewed towards the implementation of digital technologies, creating monocultural conceptions that prioritize predominantly anthropocentric top-down visions, and neglect the rich more-than-human layers of networks and naturecultural relationships shaping the city today. This concern has been addressed by a number of scholars such as Shannon Mattern (2016, 2017), James Bridle (2018) and Erik Swyngedouw (2006), while alternative views by new materialists such as Jane Bennet (2009), and human geographers Sarah Whatmore (2005) and Ruth Panelli (2010) among others have better addressed the complexities and the multispecies intersections, unfolding within urban conglomerates, and making up the urban techno-cultural fabric. Students were asked to reflect on the following questions: What is a Smart City? How is the city made smart [1]? Who/what makes it so? Is the city a complex system? Preliminary responses to the above questions reflected an exclusive vision oriented towards technological innovation. Introducing a fluid approach based on evidence from direct observation and in vivo exploration, hands on experiments with non-human others, and crossdisciplinary readings, challenged this perspective and nourished a different view of the city as a much richer, complicated and unpredictable entity where biology and information exist in symbiosis.

KEYWORDS

complexity, networks, computing, biology, superorganism, slime mould, Smart City

Image 1 | A shot from the final workshop on "Superorganism City" with Heather Barnett and Physarum Polycephalum Image courtesy of Maria Letizia Filippi

1 | INTRODUCTION

In December 2018 I received permission from New College (University of Toronto) to design an interdisciplinary course with an experimental mission: offered under the typically generic title "Digital Technologies and Society," the course gathered students from a range of disciplines in Social Sciences and Humanities, Computer Science, Physics and Mathematics. Although the course featured "digital technologies" in the title, I had much broader ambitions. In fact, limiting technologies to the digital, especially in a university context, discourages students from venturing beyond their routine role as users of apps, websites, games, etc.

My goal was to shake them out of their comfortable assumptions, to force them to review their conceptions of digital technologies and to challenge the assumed prominent role of the digital in society,

especially in the special social conglomerate formed by the city of Toronto. Choosing to focus on the city was a natural direction to take. First, the somewhat defined territorial dimensions of the city discourage students from drifting away from the main objectives, giving them a specific topic to focus on. After all, the students involved were users of the city and experienced its spaces, its technologies and infrastructures on a daily basis. We had a powerful case study. Second, the city constitutes one of the best examples of overblown emphasis on the digital. The very attribute Smart City, with its reference to optimizing the functions of the city thanks to digitized and completely automated futuristic infrastructures, enriched by sensors, AI and other (self)monitoring systems, is a testimony to the exaggerated, certainly too exclusive emphasis on digital technologies. We need better models to address the many protagonists and agents involved in the functioning of the city. Third, and finally, the Smart City is also a hot topic in Toronto these days: a very heated debate has been building up since the launch of Sidewalk Labs, a "..Google-affiliated company looking to make urban life more streamlined, economical and green by infusing cities with sensors and data analytics announced plans to build the world's first neighborhood "from the Internet up" on 12 acres of the Toronto waterfront, an area known as Quayside (Barth, 2018)": it was our responsibility to critically think about these issues as users, as recipient of these potential transformations, and as active citizens participating in the life of the city.

1.1 | THE CITY AS CASE STUDY

Alexis Shotwell says it best: "the world exceeds our conception of it (Shotwell, 2016)." This sentence encapsulates the struggle to grasp, sometimes speak of, phenomena and entities that have inevitably become too complex and diffuse to be simplified through a model or a formula, or to be seized and summarized by one discipline. However, current disciplinary specialization keeps using old formula. In fact, the typical approach to complex problems is through focusing on improving skills and technologies, and on intensifying teaching about these technologies, rather than on understanding how different events and forms of knowledge are connected (Bridle 2018). This tendency becomes particularly troublesome when trying to investigate phenomena, entities, or organisms, whose articulation expands well-beyond a single or self-contained circumstance, or that don't sit in a delimited and controlled context but span a number of different domains (for example, the domain of biology and the domain of information technology).

Here, I am reminded of the city. As a multilayered conglomerate of architecture and urban planning, humans and animals, plants and technological infrastructures, biology and information, the city is a worthy representative of such complexity. It is not sufficient to address the richness encompassing the city by means of one discipline only, or to study it using one method, since the intricacies it enacts involves the intersection of myriads of aspects: for instance, infrastructures have to confront, and adapt to, soil formation and geological strata; animals and other critters competing for the territory will end up affecting, in one way or another, the design of its disposal system, its pest control regulation, or even the behavioral patterns of coexistence between humans and non-humans. Similarly, it is not possible to study human behavior or social community in a city, without considering issues of transportation, accessibility, and road maintenance. Furthermore, if we assess the city by focusing on technological innovation only, as if technologies alone were independent from the context they are situated in, we are left with a mechanistic view that does little to give a sense of the complicated patterns unfolding in the city. Examining the city (any city) involves being aware of the multitude of forces – organic and inorganic, human and non-human, computationally-structured and biologically-thriving – interacting and coexisting.

Despite this complexity, the city tends to be the subject of countless interpretations as a mono-dimensional, high tech machinery. This interpretation is the result of utilitarian city planning (influenced no doubt by the Enlightenment and by Jeremy Bentham's doctrine of utility), anti-riot measures and sanitation necessities (a lesson learnt from mid Nineteenth century Haussmann's renovation of Paris (Gandy, 1999)), as well as a good dose of techno-solutionism (as Evgeny Morozov, 2014 reminds us in his critique) and computational thinking (Bridle 2018). As today's city dwellers, and as people observing and studying the city, we have been profoundly influenced by the above principles. When asked to elaborate on how they interpret the term Smart City, my students at the University of Toronto enrolled in this special experimental course immediately mentioned the many new technological Smart devices that have been installed to make the life of citizens more comfortable. But how do we define smart? Was the city not smart before technologies? Who/what makes it smart? Why are we so obsessed with technologies when the city is so much more complicated than this?

In this paper, I am musing about a pedagogical project/experiment I proposed to my students in the aforementioned class. The course encouraged students with a variety of interests and enrolled in programs as disparate as computer science and sociology, mathematics and literature to re-consider the city as a super-entity, or a super-organism, rather than just as a conglomerate of self-contained, discrete, and modular parts and technologies. In addition, the course exhorted them to challenge their current notions of "smartness" and "efficiency". Based on a series of research-creation exercises in computer science and engineering, plant biology and

critical thinking, students mapped and compared the technological and biological systems they found in their exploration of the urban environment. The plan was to help them view the organic and the inorganic, and human and non-human inhabitants interacting in the city, the computationally structured and the biologically thriving within the city of Toronto. In fact, with this course, I argued that it is only through a transdisciplinary approach and through a combination of hands on exercises and critical reflections that it is possible to shake current monocultural notions of the city (and its Smart nemesis).

2 | DIGITAL SMART

It is quite evident that the city is indeed constructed thanks to and by means of intricate networks and relationships, encounters and multispecies exchanges. However, recent portraits describe it using a much less complicated – yet definitely more futuristic – set of computing metaphors: the city, the popular view contends, is an information-processing machine, with its social structure compared to a software and infrastructures and transportation systems to its hardware (Livni 2018). Techno-assumptions (both utopian or dystopian, depending on the approach and the type of critique employed) typically overemphasize the role of technologies in shaping the city. Technologies appear to achieve the same goal: to make the city more efficient. For instance, the ubiquitous presence of mobile, surveillance and signaling technologies is said to have transformed the city into a programmed and programmable entity, a machinery, whose behavior can be predicted, controlled and modulated according to the principles established by some well-intentioned technocrat. AI, the latest obsession of technologists, infrastructure experts, and urban planners alike is said to make cities smart(er).

A lot of ink has been spilled to theorize, criticize, imagine how AI will enhance cities in the not-too-distant future. However, little has been spent to reflect on what exactly smart means and who/what makes something smart (or, the case of many recent projects to modernize and optimize the city, Smart). Shannon Mattern, responding to this matter argues: "..We're transforming the idealized topology of the open web and Internet of Things into urban form." This means that "..If you believe the marketing hype, we're on the cusp of an urban future in which embedded sensors, ubiquitous cameras and beacons, networked smartphones, and the operating systems that link them all together, will produce unprecedented efficiency, connectivity, and social harmony (Mattern, 2017)".

This approach places a disproportional faith in technological innovation. For the techno-enthusiasts and the techno-obsessed, the Smart City is brought about by a combination of sensors, automatized systems, and surveillance technologies, all placed to measure the city's patterns, to monitor its flow and its functioning and to eventually predict how it should work in order to run smoothly. Surveillance cameras and monitoring systems do not seem to be associated with any negative connotation at all: rather than being a potential threatening force (as in the best science fiction dystopia tradition) that can be used as a form of oppression, but a series of useful regulating engine put in place to improve safety and efficiency. Even for the scholar in urban planning and architecture, this rhetoric is difficult to shake off: in a recent conference (to which, ironically Mattern was invited to chime in) at the University of Toronto Faculty of Architecture, critical commentaries on self-driving cars and automated systems inhibited any discussion that might have been generated from thinking past the city as a Smart City of technology ("Urban IQ Test," 2019).

Think tanks and the big tech industry are all focused on how technologies can improve the city. If they could, they would build an entire city from scratch (Mattern, 2016). Cities built with technologies in mind are already a reality: for instance, Songdo, in South Korea, one of the most prominent example of what Orit Halpern calls *Testbed Urbanism* (Halpern, 2015), was billed as the smartest city, featuring an "efficient trash system, an abundance of parks, as well as a vibrant international community—all wrapped in a walkable, sensor-laden showpiece of 21st century urban design (Poon, 2019)". Although newer cities built from scratch or almost are the most desirable, other earlier cities, with their aging infrastructures, can be good candidate. In fact, old infrastructures are somewhat marginal: the Smart City lives in the present and is projected in the future.

The current rhetoric about the Smart City has reduced it to an easily measurable, quantifiable, modular object. This approach not only translates the city into a digitized and digitizable module, but it also purports a notion of technology as predominantly digital. But technology is not just digital. It comprises a number of analog devices and old mechanical infrastructures that were implemented at least since the industrial revolution. This conception also neglects important aspects of the city that actively contribute to or are complementary to its functioning. Animals, human beings and microorganisms and plant systems acting as infrastructures, tend to be dismissed as marginal, uncontrollable and incalculable. However, they do serve the city in many meaningful ways, intersecting with, affecting and facilitating the work of those very technologies that we mistakenly consider as the sole protagonists. Interpreted from this angle, the city is a sort of *tabula rasa*, as if before digital technologies were put in place, urban conglomerates were inefficient, wasteful and incapable of functioning correctly.

It is with the above assumptions that my class on technology and society started. When asked: how can you define a smart city? Students were naturally driven to technologies, inspired by the above rhetoric

circulated across mainstream media, science fiction stories and a visionary cinematic imaginary dreaming of flying cars and media sensory overload. Coupled with today's increasing peruse of apps to find direction and places and leave reviews, such standardized response to questions about the city are quite expected.

3 | UNEXPECTED ALLIES?

A disproportionate emphasis on current technologies dismiss the fact that some of these very technologies could not be thriving without older infrastructures in place. For instance, plants have *de facto* functioned as original foundations, literally holding cities in place with their roots and extent. When unscrupulous developers clear entire green areas for mere financial gain, they don't consider the environmental impact that this erasure will have on the territory and on the existing infrastructures, namely the risk of landslides and uncontrolled flooding. Infrastructure engineers and policy makers have acknowledged the major contribution of plants in the city. A recent report published by the Department of Politics and Public Administration at Ryerson University, argue that plants are part of the Green Infrastructure (GI), an "interconnected network of green space that conserves natural ecosystem values and function (Benedict, McMahon, & Bergen, 2006)". The GI approach is described interdisciplinary and holistically, because it requires experts in different disciplines – "urban planning, economics, environmental studies, public policy and public administration"– and combines the use of concrete architecture (hard engineering) and both cultured or conserved green and forestation (soft engineering). In the city of Toronto, this approach has taken the form of complementary mechanical processes to filter and reroute stormwater, and biological processes provided by a series of plants and weed species (Johns, 2018).

New infrastructure never replaces the old ones completely: the introduction of digital sensors and monitoring systems often are additions, or improvement to existing structures, while infrastructures are often expanded to reflect growing population, but are seldom a complete substitution. In this case, the old infrastructure is used as structural basis for new technological improvements.

In the city, non-human others also cover important roles in the shaping and functioning of the urban engine: urban animals have shared the territory with humans and other animals for a long time, sometimes as pest control (like cats in many harbor cities as organic cleaner and rat control) and sometimes as pest (like certainly is the case of the infamous racoons – also known as trash pandas – in certain North-American cities like Toronto).

There are many ways in which humans, animals and other non-human entities have learnt to coexist and have shaped the territory, contributing to the city liveliness and material growth. Erik Swyngedouw for instance sees the city as a "..particular process of environmental production, sustained by particular sets of socio-metabolic processes that shape the urban in distinct, historically contingent ways, a socio-environmental process that is deeply caught up with socio-metabolic processes operating elsewhere (Swyngedouw, 2006)." For him, nature, society and the city unavoidably meet through a heterogeneous and sometimes not fully explicable process brought in by material and other symbolic circumstances. This dynamism goes beyond the city, as even the lamps illuminating the roads at night, or the neon signs at the restaurant entrances draw their energy from power plants and from coal or gas-burning electricity generators.

The city viewed by Swyngedouw has a specific political-ecological and socio-cultural teleology. In fact, while metabolic exchange in the city happens through a variety of human and non-human actors, it remains a profoundly human project (Heynen, Kaika, & Swyngedouw, 2013). Urban planning transformations and reconstructions were made with very human goals in mind, be they to pursue better hygiene conditions (Gandy, 1999), to avoid social unrest, for the purposes of propaganda or in the service of some techno-utopian ideal.

For Ruth Panelli, it is important to acknowledge the complexity and interconnectivity of life beyond the socio-cultural, as "relationships within the everyday, the iconic, and the ethical qualities of sociality are shown to include a set of more-than-human encounters" occurring between people and the non-human (Panelli, 2010). While human life is mediated and facilitated through objects, organisms, infrastructures that are other than human, or non-human, it also becomes entangled with these items, to the extent that it is no longer possible to think of the "human" as self-contained and autonomous. Sarah Whatmore identifies the "more-than-human" as the excess of the human, which is constantly made and remade through assemblages, networks and systems, and is located at the "feverish borders of animal/machine, social/material, flesh/information, cultural/natural (Whatmore & Thrift, 2005)." Accustomed to a world at our service and under human control, we are desensitized to take note that objects can speak back to us even when they are inanimate, often imperceptibly, just by being immersed in their contexts, by 'being with' a specific surrounding socio-cultural environment (Bennett, 2009).

I contend that not only should these aspects be taken into consideration as crucial variants when studying the city as a complex, multilayered and sentient system, but they should also be re-evaluated, and incorporated into today's teaching about technology. The collaborative experiment I ran with students at the University of Toronto was a first attempt in this

direction, one that eventually changed, if only momentarily, the way some of these young individuals approach technology. Walking around the city and simply taking notice of traces of organisms (plant and weeds, but also dogs, racoons, squirrels) or asking where the technologies that power the city originate from and how they can be traced were vital activities that we routinely performed in order to break the linear, uncomplicated, and definitely technophilic assumptions about what makes the city smart.

I believe that acknowledging the above complexities is not only important to achieve a more nuanced, more mature and sophisticated comprehension of how the city moves and transforms. It is also necessary to move away from the deterministic ideas that technologies in general, and the digital specifically, are the most prominent actors in the pursuit for the city improvement. Technology, Bridle reminds us, "..is not made entirely – ex nihilo – by humans. it depends, as does our own living (bacteria, food crops, building materials, clothes and companion species) on the affordances on non-human species…technology can be an excellent lesson in the agency of non-human actors, from rocks to bugs, whenever they obstruct or permit, chew through or short out, our lines of communication and power (Bridle 2018)".

We need a holistic approach that makes us aware of the contribution that humans and non-human others, the green and concrete infrastructure, the biological and the informational domains, natureculture play in shaping and transforming complex systems like the one expressed through the city.

4 | TESTING OUR ASSUMPTIONS

As I mentioned at the beginning of this essay, the first items that students mentioned when asked what is a Smart city were technologies: self-driving cars, smart homes, various surveillance technologies etc.. are all popular technological innovations potentially making the city [digitally] Smart. But what if we looked beyond these technologies? What are other aspects involved in forming and transforming the city? The only way to look beyond the obvious was to perform direct observations and *in vivo* experiments. Each week students would embark in physical explorations (a modern day psychogeography, a form of "drifting" in the tradition of the Situationist International) followed by discussions and mapping exercises, and even scientific experiments to analyze aspects of the city they had not paid attention to. Students considered, among others, invisible and apparently ethereal technologies like the "cloud" (whose materiality, they discovered, leaves a great impact on the territory); cumbersome but hidden (literally buried underground) infrastructures like the sewage system; the trajectories taken by electrical circuits behind the sockets we use to charge our devices; the unseen individuals (and other critters) enabling the functioning of, and maintaining the city; and the complex network of green infrastructure and concrete canals regulating storm water in the city. These topics invited students to re-consider the city as a complex network of digital and non-digital technologies, old mechanical apparatuses, human and non-human actors, rather than just as a conglomerate of self-contained and modular digital technologies.

The city, seen with these new eyes, appears to come to life as a super-organism, a conception not too dissimilar from popular portrayals of the city before the capitalist urbanization turn. If we compare the circumstances of today's Smart City to the mid-1800 reform of Paris, we can see analogous patterns at play. In his study of the major architectural and sanitary transformation of Paris, Gandy explains how Haussmann had employed a "holistic conception of the relationship between the body and the city, which drew on a series of organic analogies to compare the new city with a healthy human body." Yet, ideas of efficiency and order trumped holistic approaches. According to Gandy, "Nadar's photography, and his passionate advocacy of the progressive potential of technological innovation in society, hold important implications for our understanding of the often-contradictory dynamics behind capitalist urbanization (Gandy, 1999 p. 25)".

The gradual conceptual transformation of the city from a "healthy body" into an "efficient machine" seems to come from the fascination of the technological innovation shown in many visual and photographic portrayals documenting the new city. In later years, cinematic portrayals in feature films like Metropolis and the more recent Blade Runner, the Fifth Element all manifest a – predominantly visual – obsession for the magic of cityscapes' automated and AI technology. Thus, my first mission with the course was to encourage students to look past visual tropes and stereotypes and to pay attention to items that we don't see or that are not initially obvious (because they are not part of the predominant visual vocabulary highlighted in movies and other visual fantasies).

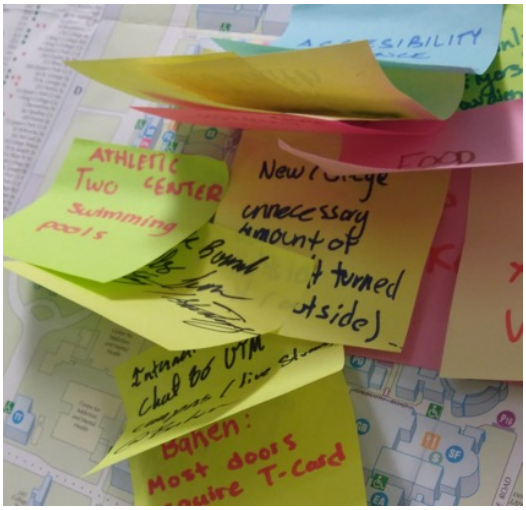

Image 2 | Mapping exercise: students walked around campus with a map taking notes of the technologies they ignore

During the course, we considered four broadly-defined topics connected with the sense of sight: 1. The City we don't see; 2. The Hidden Armies; 3. Invisible Networks; 4. more-than-human networks. Taking advantage of the university urban location, we chose to explore areas that were in the proximity of, or inside the university, wandering a few blocks outside campus to make further comparisons. However, the experiences occurred in each section did not only include vision. In fact, exploring a city as a superorganism is a profoundly multisensorial experience. This became evident as soon as we started our observations on-site: sounds and smell had an impact on the way we interpreted different areas. Engines running and machinery humming, signals beeping and pipes echoing were not the only items we could hear. They often came together with birds chirping, passers-by walking and people chatting in the background. Similarly, the peculiar smell of each building, the changing scent emitted by the green areas as opposed to the faint smell of exhaust near main intersections, the pleasant aromas of cafes, restaurants and food trucks mixed with the gasoline spitted by their generators. Unlike visual stimuli, which can be captured, albeit only partially, with cameras and videos, audible, haptic and other sensorial details could not be seized without experiencing the location directly: therefore, in addition to in-class conversations, this course required several visits outside, in the field.

4.1 | THE CITY WE DON'T SEE

In this section of the course, we explored a small stretch of the University of Toronto campus as active part of the city of Toronto. Students walked around in groups, following familiar pathways, but this time their task was to pay attention to technologies, apparatuses and other functional items that we usually take for granted and that therefore we ignore when we transit nearby. Once back in the classroom, we located the items on a map and discussed the surprising items we had never seen before. Starting from digital technologies, and ending with non-technological, yet functional objects, such as the garbage bin and the occasional broom forgotten in the corner of the corridor, students listed items populating the campus they see on a daily basis but that they apparently never noticed as part of their routine. Suddenly, the campus had turned into an entity foreign to them, ready to be re-discovered.

For instance, while we are all aware that a variety of hardware and software allows 24 hours connectivity across the university campus, nobody had actually bothered looking for modems and routers which apparently were plainly visible once the eyes wandered off habitual trajectories. Next to them, perhaps a testimony to the general neglect affecting these objects, keener observers could spot the occasional spiderweb: the position of these tech items and the faint warmth they emanate must have appealed mama spider who had decided to incorporate them into her home furniture. Students were surprised to find out that a space they had assumed would accommodate solely human beings, can contain a variety of species which has adapted to the architecture, undisturbed and rather discretely. This is the case of birds nests on roofs, the occasional bird entering the hallways of departments and gyms, or the ubiquitous racoons making their nests in some undisclosed holes somewhere in the basements of older buildings.

During their preliminary exploration, students also discovered that technologies and object had not been used exclusively for the purposes they thought: this was the case of the buttons they had instinctively pushed to gain access to buildings. clearly marked with a wheelchair sign engraved in them these buttons were not there for their random curtesy. Most students had not noticed what these buttons were really for. In addition, they had no idea that these buttons were routinely easing the work of janitors, service workers, and contractors.

4.2 | A HIDDEN ARMY

It was probably during their first explorations that students noticed signs of a variety of objects that did not look like they fit, and that seemed to have been randomly left behind. Brooms and cleaning supplies, loose cables and other work utensils pointed to a small army of workers we usually don't see, either because we don't pay attention or because they are literally hidden from us. Located in the basement or in well-hidden areas of university buildings lie utility closets and janitors' offices. These are the headquarters of those who make sure that the university is cleaned and well-functioning. They are the maintainers.

Image 3 | Janitor's tools. A common view at universities and public buildings. the person performing these tasks, however, is nowhere to be found during regular office hours

According to Russel and Vinsel "At the turn of the millennium, in the world of business and technology, innovation had transformed into an erotic fetish (Russell & Vinsel, 2016)". This means that the new, the innovative, the high tech is always kept in the

foreground as desirable and as a symbol of prestige. The rest is physically kept in the background and hidden as a distraction. While high tech is paraded as a flashy jewel craving for attention, the army of servers and cables, the pipes and sewer system running underground, the electrical wire allowing streets to be lit and safe are taken for granted.

The same is reflected in the social ranking of the individuals working in these industries. Those who work with new software and hardware technologies are celebrated as innovators; those who make sure that the system runs smoothly and intervene to fix system bugs or issues requiring fixing damage to property are de facto invisible workers and occupy a much lower spot on the social ladder. Even though "Maintenance and repair, the building of infrastructures, the mundane labour that goes into sustaining functioning and efficient infrastructures, simply has more impact on people's daily lives than the vast majority of technological innovations" the former are often featured as creative, the latter work at night or after hours, only leaving traces of their presence at street corners or in university corridors.

4.3 | INVISIBLE NETWORKS

Despite their massive and overwhelming density of cables, servers and drawers, ports and pipes, triple-secured alarm systems, cooling engines and multiple backup systems connected to fire department and police, data center at the university of Toronto are proverbially hiding on plain site. In some way, a data center suffers the same fate as the myriads of maintainers and caretakers working in the city and at the university. Most data center in Toronto are either unmarked or hidden on google map. There is more than one reason behind this secrecy: although the content of data center is confidential and thus has to be inaccessible, their cumbersome sizes and their environmental impact clash with the current ideas that data are stored in a magical as much as ethereal cloud. For the sake of our course, visiting a data centre was a mind opener for most students as they not only could see with their incredulous eyes the sheer expanse and the materiality of the cloud, but they could also experience the coordinated connectivity, the integration of different types of energetic sources (electricity, air, data, water, waste) running through thousands of cables, wires, pipes, all working together to allow information to be managed and stored securely and reliably.

It is at this point of our pedagogical journey that students started developing a more sophisticated sense of how heterogeneous systems may connect and function in a symbiotic manner: digital technologies, infrastructures and human and non-human activity are complementary. They do not exist in a vacuum but are the product of often complicated and delicate entanglements.

Intrigued by the uncanny similarities that sometimes very different systems manifest, students started drawing connections naturally: the underground pipes and other infrastructural networks certainly show patterns comparable to the roots of trees running under our feet (Heijden, 2016); the digital and AI networks making personal home devices like Alexa function (Crawford & Joler, 2018) are as complex, globally diffused, and unsustainable as the intricate networks formed by the production, dissemination and recycling of technological devices such as cell phones (Brophy & de Peuter, 2014).

Image 4 | Cables at a Data Centre

4.4 | SUPERORGANISM CITY AND MORE-THAN-HUMAN NETWORKS

To bring all the reflections and the findings formulated so far in the course together, I invited Heather Barnett, an interdisciplinary scholar and artist who has been working with both organic and computational complex systems to join our class. Although she has experimented with the behavior of ants and other organisms capable of high levels of organization, Barnett is best known for her work with Physarum Polycephalum (or slime mould), a protist sporting a bright yellow hue, with a rather interesting set of features: despite missing a central nervous system, the organism is able to sense and branch around, creating networks between given points in order to fetch food or escape danger.

Slime Mould has been used to map the worlds' transport networks, migration routes and desire paths, and has been used to theorize network-based systems in computing (Adamatzky A., 2015). Students were involved in a collective public experiment which mapped the nearby neighborhood

with the assistance of the slime mould. Using topographic maps of the area printed inside petri dishes they performed two different perspectives: a human-centred approach that used streets, human needs and goals vis-à-vis barriers and accessibility, and a slime mold perspective that used these streets and barriers in completely different ways and for different purposes. Participants had to reflect on their own behaviors as human beings and to embody and anticipate the behavior of other organisms living in the area, judging from its configuration, its barriers and its communication system. Accompanying students were also local artists interested in interspecies relations, a mycologist and a computer engineer interested in comparing the networks formed by fungi and the ones unfolding through electronic circuits; a performing artist and a group of kids attending with their parents.

5 | CONCLUSIONS

With this project, using a combination of critical texts, direct observation and open discussion, I strived to transmit the intricate ways in which various types of technological and non-technological items converge to form the conglomerate we call the city.

My goal was to encourage students to move away from the assumptions that a. technologies alone are responsible for making the city smart and b. that all technologies are digital. Furthermore, I aimed to transmit a sense of the interconnectedness and profound interrelation of all actors contributing to the urban space. Overall, students became especially aware of the value that each of these actors brings to the city. However, I believe that this outcome was achieved only thanks to the interdisciplinary nature of the exercises and the experiments they performed. The final experiment with Physarum Polycephalum was particularly instrumental in confronting and challenging preconceived ideas of intelligence as emerging from different life forms and social configurations (the community makes a neighborhood safe and therefore smart, not a security camera installed randomly) and networks as a dynamic structure that neither emerged from the advent of digital technologies, nor is it exclusively a digital feature. Indeed, we have always done it wrong! We need better interdisciplinary models to better understand the multiplicity of a complex system like the city.

ENDNOTES

[1] In this essay I distinguish between Smart City, that is, the city as a sort of brand name, a city dominated and enhanced by technology, and the smart city, that is, the city made smart by a series of intersecting relationships, by the work of communities, the entanglement of animals, plants and architecture and a variety of more or less active actors.

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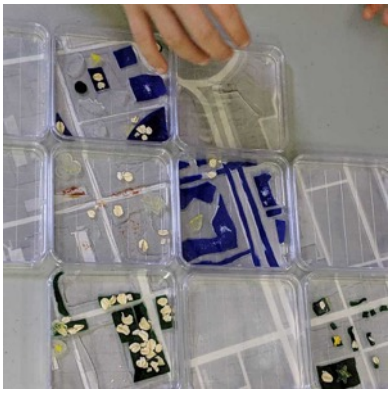

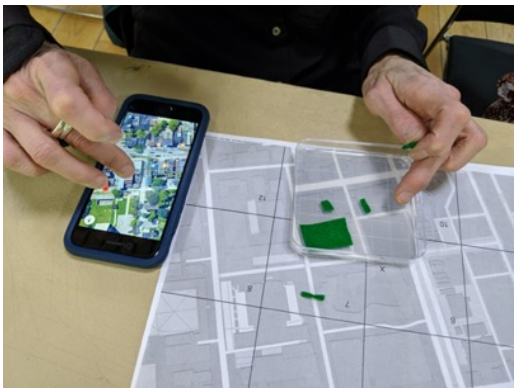

Images 5, 6 and 7 | Some moments of the workshop with Heather Barnett

BIOGRAPHICAL INFORMATION

Roberta Buiani (PhD Communication and Culture, York University) is a media scholar, artist, and curator based in Toronto. She is the co-founder of the ArtSci Salon at the Fields Institute for Research in Mathematical Sciences and co-organizer of LASER Toronto. Her recent SSHRC-funded research creation project draws on collaborative encounters across the sciences and the arts to investigate emerging life forms exceeding the categories defined by traditional classification. Her artistic work has travelled to art festivals (Transmediale; Hemispheric Institute Encuentro; Queens Museum; Myseum of Toronto), and science institutions (RPI; the Fields Institute). Her writing has appeared on *Space and Culture*, *The Canadian Journal of Communication,* and *Antennae* among others. With the ArtSci Salon she has launched a series of experiments in "squatting academia", by re-populating abandoned

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