Seeing Like a City

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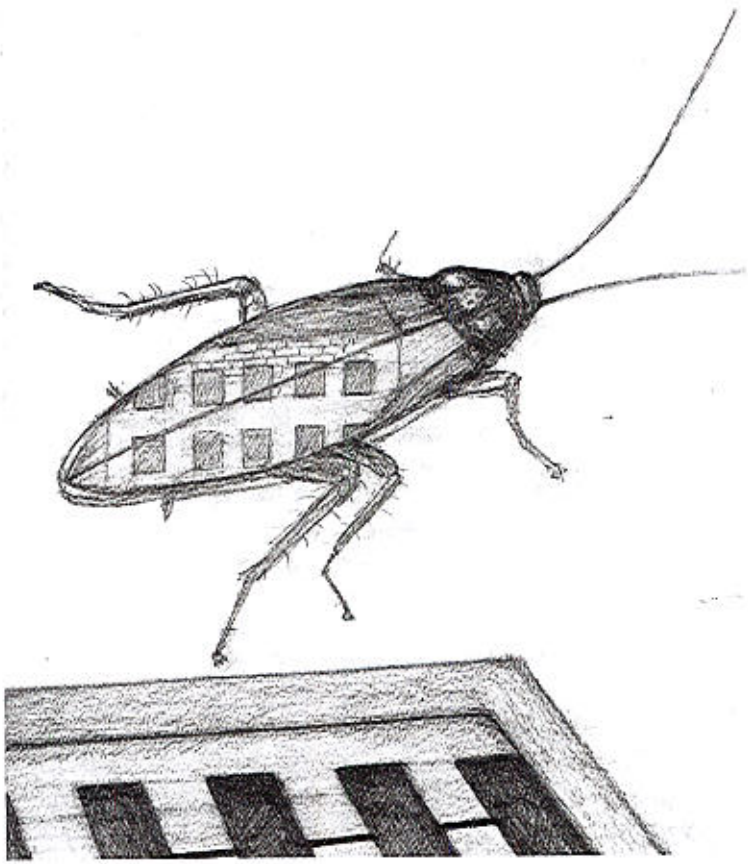
polity



Mirror

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Shifting the Beginning: The Anthropocene

> It may seem impossible to imagine that a technologically advanced society could choose, in essence, to destroy itself but that is what we are now in the process of doing.
>
> Kolbert, 2015, p. 189

> They say that Gothic novels came into being because science and eighteenth-century rationalism were threatening to empty the world of any romance, spirituality or caprice. Two hundred years later the planet is full of technology but utterly irrational. And I don't feel any need for Gothic excitement.
>
> Parks, 2014, p. 252 (used by permission of W. W. Norton & Company, Inc.)

> The real problem is that climate – or the environment more generally – holds us hostage at the same time as it asks for our help.
>
> Sparrow, 2013, p. 81

Infrastructure begat circulation begat the city begat the Anthropocene.

That is the theme of this chapter. It pursues our thesis that the city is an infrastructural entanglement with

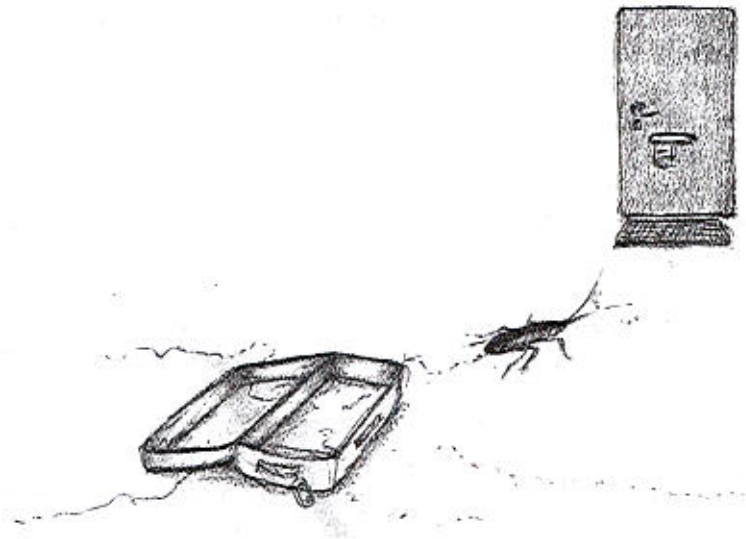
considerable formative agency by showing that cities are one of the main products and producers of the Anthropocene. By this, we do not mean cities are a stable point radiating an urban essence but, instead, recurring moments in the constant rendition and circulation of people and things, moments in which circulation and city constantly reinforce each other in sometimes lasting and sometimes temporary alignments within a 'geologic now' (Ellsworth and Kruse, 2013).

In certain ways, that story of motility is a stock refrain of geographers. Most cities were originally sited at the confluence of trade routes of one form or another, in places that could service, sell and transport agricultural goods. But then, of course, cities themselves became producers of goods as well as state and religious nodes. But we will put an extra twist in the tail by arguing that this rudimentary circulation gradually led to the laying down of 'infrastructure' – a word first coined in French in the 1870s, which subsequently moved into English usage in the 1920s (Gandy, 2014) – on such a scale that it has changed the planet, producing a world in which infrastructure is no longer an effect but a cause. In turn, the multiple layerings of infrastructure have led directly on to the formation of a geological era, which has come to be known as the Anthropocene: the reshaping of the earth by force of human occupation on a sufficient scale that it can be recognized as a separate geological epoch. In this epoch it can be argued that cities are the true planetary citizens, hive entities sharing responsibility for the earth (Vince, 2014). This acceleration is in many different ways about the extension and subsequent deepening of infrastructure in its multiple forms.

Infrastructure, by our account, does not refer simply to actual physical lineaments. It is also, on one level, caught up with the moments of standardization, technical compatibility, professional rivalry, bureaucratic imperatives, regulatory competences and general dispositions which allow things, quite literally, to fit together and, on

another level, with the different practices of maintenance and repair which allow infrastructure to continue working in at least some form,[1] which continue to guarantee presence. In other words, coherence is hard won and never assured. But if it can be won, a certain logic of governance can follow, at least for a while, in which form and action are inter-related, one far-removed from familiar legislative and other declarative processes but just as potent (Easterling, 2014a; Valverde, 2015). In other words, infrastructure is a structure of contact that also defines what shows up as real at any juncture. It is the gross material of materiality.

In making such an account of infrastructure and the Anthropocene, we will tread some delicate lines. In particular, we will try to avoid falling over the line between genuine and sometimes horrified concern about a world in which every last sliver of natural habitat seems to be under siege into simple doomsaying and equally the line between an appreciation of some of the wonders of 'the human age' (Ackerman, 2014) and a kind of reverse science fiction



Travel

in which the present is described as an age of humanly wrought technological miracles which will inevitably and by extension produce an eco-modernism which will ride to the rescue of the human and indeed everything else on the planet. As Hamilton, Bonneuil and Gemenne (2015, p. 11) argue, the priority now is neither of these nostrums. Rather, it is 'to extend our ability to think and act beyond human experience'.

Shifting the Beginning: The Second Pangaea

Conventionally, cities have been regarded as the product of the Agricultural Revolution that occurred many thousands of years ago. The surpluses of food produced by cultivating wheat, maize or rice – and the food demands of domesticated livestock – allowed cities to come into existence. They produced writing and the outbursts of written creativity that we now take for granted like plays and new forms of music, they produced state bureaucracies complete with files and surveillance, they produced trade with fixed transactions at fixed sites, they produced merchants – and priests and artisans and bookkeepers, they produced monumental architecture, and they produced systematic ways of living together like streets and public gathering spaces and rooftops. It is even argued that they produced the time to allow abstract thought like mathematics.

But cities produced downsides too. For example, it has been argued that settled agriculture was a disaster for the human race. Jared Diamond (2013) has certainly asserted that the agriculture that allowed cities to flourish initially was a catastrophic mistake from which our bodies have never recovered: average height declined by two to three inches, teeth decayed as grain diets bit, epidemic diseases spiralled, and living in close proximity to livestock and to each other allowed new diseases to flourish and kill.

On this admittedly contested account, it then took thousands of years for the human body to recover – it was not until the twentieth century that Europeans regained the same height as cavemen – and by then a host of new 'evolutionary mismatch' problems had arisen like obesity, hypertension, various kinds of cancer, heart disease, type 2 diabetes and fatty liver disease, all of which stem from the fact that the jumble of genetic and epigenetic adaptations in our mainly Stone Age bodies and our contemporary lifestyles are radically out of synch, so producing greater longevity but also increasing levels of chronic noninfectious disease: 'most of the diseases that affect you are triggered or intensified by environmental factors that have mostly become common since farming or industrialization' (Lieberman, 2013, p. 173). In other words, nearly all of these medical problems were set in train in the time when agriculture first gained ascendancy and cities first came on the scene and were then made worse by subsequent waves of urbanization.

Whatever the exact case, it is clear that the agricultural revolution has gradually produced a second 'dysevolutionary' human being genetically both of and not of the Stone Age world from which it was originally born as the Anthropocene has taken shape. This is an Anthropocene which has, in large part, depended on the construction of an urban realm dependent on food sources which are only partly suited to the human constitution.

At the same time, because of these dietary changes and greater mobility, mixing has begun to occur at the genetic level, probably at an accelerated level of change because of the demography of cities (Cochran and Harpending, 2009), although it is these relatively slow-moving genetic markers which remain the level of existence that seem to be most obdurate to cities' and infrastructure's powers of catalysis. At other levels, however, more rapid change is often in evidence, at times when it might be thought that change would be slowest. Let's consider each of these levels in turn.

To begin with, at the level where it might be thought that there would be the least impact – the geologic – humankind has moved vast amounts of rock and soil and produced numerous new materials in ways which have etched a permanent detrivorous mark on the geological record: the rocks are now scored and scarred by human activity, the soil is a record of disturbance. Cities and their associated infrastructure have acted as the equivalent of a meteorite strike in the extent of their impact on the earth. Geography was often thought to be an offshoot of geology. But no longer. The two have leached into each other in numerous ways. Human beings have begun to change the planet to such a degree that they have started to create their own geological epoch by building one vast ants' nest which extends both down into the ground and up into the air. When an alien explorer looks back at the earth from millions of years in the future, it will be able to discern a recognizable stratum based on the remains of human habitation, not just buildings but all manner of objects and even some kinds of clothes – which will no doubt be interpreted as external coverings periodically discarded as they grow too tight to fit a growing organism (Zalasiewicz, 2009). There may even be direct marks like footprints.

Then there will be concrete, steel and stone, pipes, cables, boreholes and the like. Then iron and steel and plastic and glass and tile. Then nuclear waste. Then all kinds of associated despoliation and especially the trawling of the seabeds. Though human cities may not yet be quite as impressive as biological cities like coral reefs in their scale and longevity, still humanity is catching up fast and will undoubtedly leave a lasting geological legacy of man-made rock and fossils, a kind of urban aggregate made up of materials dislocated and mixed together as a relocated recomposition (Zalasiewicz, 2009). Such comparisons may seem overly dramatic until the sheer planet-shaping amount of energy that human beings now bring to the party is brought into the equation. To give a point of comparison, the earth receives 170,000 terawatts from

the sun (Morton, 2009). The primary production of the biosphere via photosynthesis is 130 terawatts. The flux of energy from the centre of the earth is about forty terawatts. Our global civilization is powered by around thirteen terawatts of man-made energy arising mainly from the unprecedented levels of energy consumption associated with cities. The point is that human beings already act as an energy source that begins to compare with plate tectonics in its magnitude and force, although whether the harvesting of the earth's resources that underlies such figures is in reality something akin to an enormous unnatural Ponzi scheme remains a moot point. As Smil (2013, pp. 223–4) puts it, taking in just the energy harvested from the biosphere, all of this 'would have been impossible without greatly expanded claims on the biosphere's photosynthetic productivity, without rising harvests of cultivated and wild phytomass and without increasing contributions of animal foods produced by hunting wild mammals, birds, and fishes'.

Then there is the climatic. The geological record will also show other marks and, most particularly, climate change and mass extinctions. Humans have undoubtedly begun to change the chemical composition of the atmosphere. In the atmosphere, carbon dioxide levels are 50 per cent higher than the Holocene mean. We can be almost uncannily accurate about when this process first started: 1784, when carbon from coal-fired industry began to be deposited worldwide. We also know the exact date when this process accelerated: 1945, when radioactive material began to be laid down after Hiroshima and Nagasaki. The effects of climate change are all too obvious from receding glaciers through storm frequency and violence and associated flooding to warming oceans and a parallel sea-level rise which might reach as high as thirty feet per century. Deserts are spreading too.

Next in degree of change are plants. Trees, for example, can live for hundreds of years, eating the sun (Morton, 2009) and strip mining the air of its carbon so as to stay

alive. 4,000 trillion kilowatts of energy reach the top of the atmosphere as sunlight, but only a small fraction of one per cent of that figure is ever captured by the pools of chlorophyll that are plants. That is still enough to turn hundreds of millions of tonnes of carbon dioxide into food and living tissue. In turn, this photosynthetic machinery regulates the planet, for example by adding all manner of material to the atmosphere that becomes the basis of aerosols. So when it is disturbed en masse – as humanity is now doing through forest clearance, for example – it produces all manner of wayward effects about which we often know very little and can influence even less.

Equally, plants have been revealed as active agents in the world. They can see, not in the same way as humans but not as simple cellular ciphers either. They detect light. They translate its varied visual signals into physiologically recognizable instructions. Plants smell too. They sense their own odours and those of neighbouring plants. They even warn each other of imminent insect attacks. Many plants perceive tactile sensation. They almost certainly react to sounds. They know where they are. They even remember certain things like past infections and climatic conditions (Chamovitz, 2012). So the impact of the Anthropocene on plants is many and varied and cannot be reduced to just one-way human impacts. Plants react back.

Finally, there is flesh. Animals are an immensely important element of the biosphere, a 'wildlife' we cohabit with in innumerable ways (Human Animal Research Network Editorial Collective, 2015; Lorimer, 2015). They are crucial to the earth's ability to maintain good running. Consider the total mass weight of living things on the planet. It is estimated to be in the order of 1.7 trillion tonnes, excluding bacteria. The overwhelming majority of this quantity is plant life – probably about 99 per cent.[2] The total human mass is at least about 350 million tonnes. Cows add in another 520 million tonnes. There are about 4200 million tonnes of fish and 2700 million tonnes of ants. Then bacteria weigh in at nearly the same

as all other living things put together, at around 1.3 trillion tonnes[3] (D'Efillipo and Ball, 2013). But these brute numbers underplay animals' influence. For example, the humble nematode worm so beloved of scientists forms a film over the earth that makes it a decipherable entity. The tapeworm and a host of other parasites form an almost unimaginably rich layer of life. And this is to ignore those simple replicants, the viruses: studies have shown that 200 litres of seawater contain over 5,000 different types of virus, that there are more than a thousand viral species in a human stool and possibly a million different viruses per kilogram of marine sediment. In other words, 'take away humans and the present world will... function quite happily as it did two hundred thousand years ago. Take away worms and insects, and things would start seriously to fall apart. Take away bacteria... and the viruses and the world would die' (Zalasiewicz, 2009, p. 192).

Each of these different components of change mixes to differing degrees according to ecological imperatives that vary across the earth's surface. Ecologies change all the time, of course. Genetic soups are churned, sometimes (probably most times) creating more biodiversity. But currently these ecologies are changing at breakneck speed, colliding, miscegenating, collapsing or reforming as short-lived bastard hybrids. Perhaps the major sign of the rate of change is the annihilation of species. Humans are producing a mass extinction on the same scale as the catastrophic extinctions caused by asteroid impacts as they wipe out species directly or simply leave them marooned and so condemned to fade away. Human beings began erasing species, mainly megafauna, in the late Pleistocene, but now the pace has speeded up and encompasses all kinds of animals. 'It is estimated that one-third of all reef-building corals, a third of all freshwater mollusks, a third of sharks and rays, a quarter of all mammals, a fifth of all reptiles, and a sixth of all birds are headed toward oblivion' (Kolbert, 2014, p. 17). Extinction can come quickly. For example, the European invasion of the

USA produced a frightening ecological toll. Take the well-known case of the passenger pigeon. At one time the passenger pigeon was so abundant – one estimate is five billion birds – that flocks of pigeons would blot out the sun as they passed by, sometimes for hours at a time, and their short-lived nesting sites consisted of millions of birds distributed over as much as thirty square miles. From flocks more like battlefronts and colonies resembling cities to a lone individual. By September 1914 the last passenger pigeon had passed away in a Cincinnati zoo. Mass slaughter of a third of the biomass of all species of North American birds – twenty million passenger pigeons on average each year for a century – the loss of forest habitat, and a peculiar susceptibility based on a lifestyle reliant on very large numbers and a good half of a continent to roam over, reduced the passenger pigeon to an environmental will of the wisp and then to naught, taking numbers of species of dependent beetle and lice with them (Fuller, 2014; Greenberg, 2014). There have been many more such extinctions and extirpations, each and every one of them a tragedy of sorts. But it is too late now to shift their beginning. Equally, extinction can happen more slowly, through the genetic introgression fostered by movement.[4]

The other major sign of change is movement. Things move around in the Anthropocene to a greatly heightened degree, whether we are talking about minerals, atmospheres, plants or animals. So far as plants and animals are concerned, what is happening currently has been likened to a 'new Pangaea' (Kolbert, 2014). The old Pangaea was a supercontinent – all of our present continents merged together – which existed three hundred million years ago and which slowly broke apart, causing a divergence among species as they were split off one from another. Even with the phenomenon of long-distance dispersal, no species could move very far or very quickly, causing a degree of stability. Now species no longer need to move under their own power. It is as though Pangaea has been reformed: 'humans are running geologic history backward and at high speed' (Kolbert, 2014).

Of course, plants and animals move and then mix in new combinations all the time. In a time of climate change as species move into new domains, this may hardly be news. But summarizing recent scientific research, de Queiroz (2014) argues that epic journeys by plants and animals – so-called long-distance dispersal – have always been a norm of life and a key driver in evolution: plant seeds were carried in the plumage of ocean-going birds, frogs and mammals as large as monkeys were cast this way and that by driftwood and icebergs, tiny spiders drifted hither and thither on storm winds, and so on. These journeys may have been flukes but their consequences were not. But all that said, it is clear that human beings have redistributed a large part of the earth's flora and fauna, sometimes gradually, sometimes through ecological blitzkriegs. They have reassembled large parts of the biosphere so that what is native and what is not has become a loaded question, often linked to all kinds of strange variants on nationalism (Thompson, 2014). But, whatever the case, the photosynthetic machines we call plants have regularly swapped countries and continents. Take the case of Britain. Probably about 12,500 species of plants have been introduced into Britain through history, although only about two hundred count as fully established. Britain only had 35 native tree species a few thousand years ago, but many hundreds of others have now been added to the roster. So-called invasive species have become a major modern preoccupation, although only some of them have proved to be as ecologically disastrous as they are often painted (somewhere between 11 and 39 introduced plants currently count as pests in Britain) (Thompson, 2014). Indeed, as the British tree example shows, many introduced plants have increased biodiversity in positive ways. In cities, in particular, most species have been introduced. (Indeed, it is possible to argue that in cities even native plant species are exotic in the sense that they have colonized an artificial environment.)

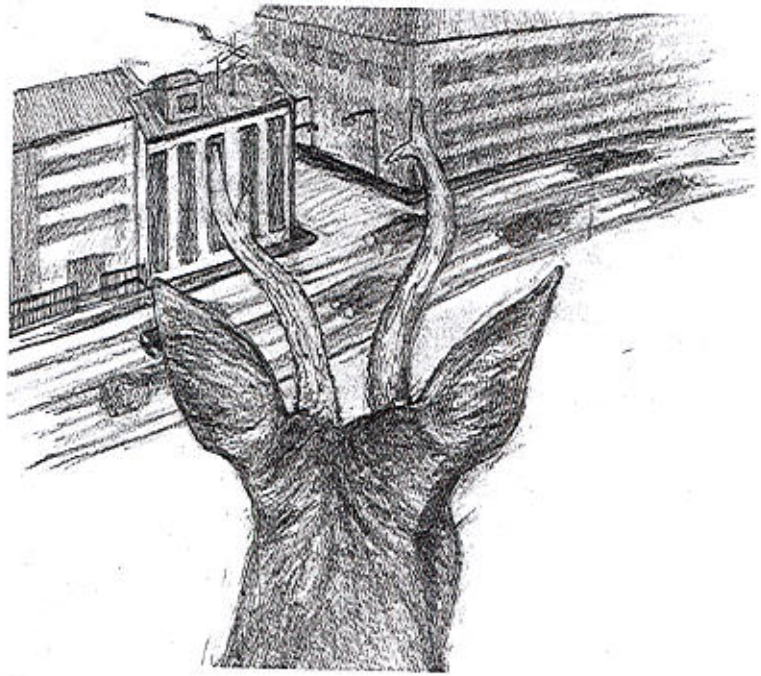
Animals have been even more spatially promiscuous. Take the humble rat. The rat has piggybacked with

human beings wherever they have journeyed on the earth's surface. Indeed, so numerous and well adapted to almost any conditions are these fellow travellers that they might well claim to be the main beneficiaries of human evolution (Zalasiewicz, 2009). The Pacific rat (*rattus exulans*) has travelled all around the Pacific, but its travels have been as nothing compared with the Norway rat (*rattus norvegicus*), actually from China originally, which has become common almost everywhere. Or take that living fossil and geographical adventurer, the ubiquitous cockroach. The average New Yorker is most likely to encounter the German cockroach, which probably originated in South-east Asia, while the 'American' cockroach is actually a native of Africa. Rats and cockroaches – these are the main winners in the competition to colonize cities because they are so well adapted to adaptation. There are other examples too: mice, foxes, feral cats, deer, bears, camels (in Australia), houseflies, bedbugs and lice, even the humble snail. And that is before we light upon the case of domesticated dogs and cats. On one estimate, there are an estimated one billion dogs in the world and, like cats, they are an integral part of what cities are, companions in leisure and in misery, at least when they are not feral.

Of course, an extraordinary range of animals has been, for large swathes of history, the main means by which human beings have moved from place to place (Sturgis, 2015). This fact brings us neatly to that subset of animals known as human beings. Human movement has been a constant of history with consequent results such as genetic mixing. As human population sizes have increased and more and more mixing has taken place, so favourable mutations have been generated on an increasing scale. Even in the Bronze Age populations of less than sixty million were creating favourable mutations every four hundred years (Cochran and Harpending, 2009). The rise of agriculture forced more mutations to occur against a background of more and more population movement. It is worth noting that through history there has been a link

between the mass movement of human beings – hastened by the increasing density of infrastructure, which allows that movement to take place more and more easily – and genetic mutation. If migration has been a constant condition of human history, it has picked up in pace and volume since the nineteenth century as movement has become easier and less hazardous. Each itinerant community arrives with its own genetic inheritance and spreads favourable mutations, as they mix in larger and larger cities in ways that are only starting to become clear.

To summarize, in the Anthropocene, as far as plants and animals are concerned, movement has become a natural state, hastened by infrastructure – what's under the hood, so to speak – which has become more and more adept at moving things around the second Pangaea.



View

The Background Becomes Foreground

A good part of the reason for this motile state of affairs is the unremarked and mainly urban landscape that we pass every day which forms a second nature: power lines, concrete pavements and tarmac roads, street lights, manholes, traffic signals, mobile telephone towers, endless doors and windows, signs regulating movement – all the paraphernalia of city streets and industrial landscapes, in other words (Hayes, 2005). For many of us, this is what place is, not Heidegger's hut in Todtnauberg thrumming with the righteous glow of authenticity – a set of artificial networks with no real end point or finish line through which and on which we pass and are passed. These networks have produced a part of the planet that is ever in motion. The world is threaded with roads and cables, undergirded by pipes and tunnels and culverts, saturated by wireless signals, loaded down with all kinds of built infrastructure, and heated up by all manner of energy sources. It is crisscrossed by airline routes, lit up by innumerable street and other lights, and shaken by all manner of artificial sounds. And this infrastructure is composed of actual, physical 'stuff' that cannot be reduced to a discursive difference. As Bryant (2014, p. 5) puts it:

> Whether or not a commercial district grows as a function of the amount of energy available to that zone from the power plant is not a signifying or cultural difference. Whether or not people begin to die or move away as a result of pollution produced by garbage, coal-burning power plants and industrial waste is not a signifying difference. Whether or not people vote you out of office because they're angry about traffic congestion is not the result of a signifier. To be sure, there are social relations here insofar as it is people that produce all these things and people that are flocking into the city, moving away, or voting you out of office, but the point is that the form the city takes is not, in these instances, the result of a signifier, a text, a belief or a narrative alone. It is the result of real properties of roads, power lines, pollution, and so on.

Infrastructure, in other words, consists of all of those objects that allow human beings, cars and trucks and boats and planes, water, sewage and other waste, oil, electricity, radio signals, information, and the like to flow from one place to another, to become mobile, to circulate. Mainly they consist of continuous conduits of one form or another but, increasingly, as wireless has become more common, these conduits have broadened out into signals transmitted from and received by masts, although the principle remains much the same. And this infrastructure is concentrated in cities because:

> cities require flows of energy and matter in order to maintain their organization and resist entropy. Cities, of course, require stone, brick, wood, plastics, metals and a variety of other materials out of which to build and maintain infrastructure. However, cities also require flows of energy to persist across time. They require wood, coal, electricity, the power of water and wind to heat homes, run transportation, and sustain various technologies. Yet they also require caloric energy. People must eat. (Bryant, 2014, p. 101)

The point is that the earth's surface has become a hundreds of kilometres high and at least four kilometre low anthropic stratum which is a bit like a Swiss cheese in its make-up, a stratum through which pipes and cables crawl, under which tunnels and boreholes and mineshafts bore down into the earth, on which all kinds of reservoirs and power sources hold sway and over which aeroplanes and satellites and wireless signals fly back and forth like Hermes, and nearly all of this activity is connected to the demands of cities.

This stratum may be thicker or thinner, but that it is remorselessly increasing in density is not in doubt. At the last G20 summit, for example, world leaders pledged to

invest some sixty trillion dollars into new infrastructure by 2030. The International Energy Agency has estimated that, between 2015 and the middle of the century, more than fifteen million miles of new paved roads will be built worldwide (Nijhuis, 2015). Since 2007, China has carpeted its territory with nearly 20,000 kilometres of high-speed railways and wireless. In turn, the effects on the environment of infrastructure construction have often been drastic. Roads fragment habitats with clear effects on species loss. In one study, it was found that fragmented habitats lose an average of half of their plant and animal species within twenty years, and that some continue to lose species for thirty years or more.

So generic is all of this physical infrastructure that we take it for granted, at least until it goes wrong – think of the burst water main or the power cable brought down by an ice storm, or the missed delivery. Or think of much greater breakdowns of the kind occasioned by warfare; or by events like earthquakes or tsunamis or volcanic eruptions.[5] Equally, we forget that infrastructure has its own history: in effect, it is the history of a certain set of decisions made in the past about how to move things about, often based on military logistical principles, which have become a closed loop which is able to conceal its essentially political nature. To begin with, infrastructure is the history of changing the urban environment we live in. There are many examples of how infrastructure has performed in this regard, from heating to air conditioning (Basile, 2014), from piped water supply to piped music. But take the case of artificial lighting. Night-time is no longer another country, dark and forbidding. Thanks to reliable and constant artificial illumination produced by large industrial power networks, the 'sphere', to use Peter Sloterdijk's term, that we inhabit has expanded its orbit. Fingers of light stretch everywhere. The process began in Britain, which became a gaslight society when the first public street, Pall Mall in London, was lit with gas in 1807. Electric lighting arrived in 1878 but did not find

its way into homes on a large scale until after the First World War. Artificial light has now spread all over the world, producing new apprehensions of how and what can be seen (Otter, 2008). But we should not overestimate this process of enlightenment: for many people in the world the dark is still dark. For example, in India in 2012, the largest electrical blackout in human history left 600 million people without power and therefore light. But discussing the blackout, Drèze and Sen (2013, p. 9) wryly noted that the media had neglected an important fact. 'Two hundred million of those 600 million people never had any power at all.'

Then, it is the history of how we are able to move about. This time, take the case of the humble lift upon which tall buildings rely for sustenance. Although records of lift design date back to Roman times, lifts (or 'ascending rooms') were first commonly used in the nineteenth century when hydraulic, steam and electric power were all used as sources of lift. In 1852, Elisha Otis introduced the first safety lift, which prevented the cab from falling if the cable suspending it broke, and in 1857 the first such passenger lift was installed in a building which still stands in the SoHo neighbourhood of Manhattan. The first office building to have passenger lifts, the Equitable Life Building, was completed, again in New York City, in 1870, and prefigured the growth of the late nineteenth-century commercial 'skyscraper' (a term first used then) and the consequent transformation of the skyline of many cities. The adoption of lifts had many consequences, apart from creating recognizable 'downtowns'. For example, before the use of lifts, most residential buildings were limited in height to about seven storeys. The wealthy lived on the lower floors, while the poorer residents lived on the higher floors, and were thus required to climb many flights of stairs. As exemplified by the modern penthouse, the lift reversed this stratification (Bernard, 2014). Now, as buildings have become ever taller (with a one-kilometre-high tower planned in Saudi Arabia), so lifts have become

increasingly complex. Of course, they need to be faster (with speeds of up to eighteen metres per second) but they also need to include sky lobbies where passengers can change lifts to reach higher floors, and means of increasing capacity like double-decker lifts or multiple cabins in the same lift shaft.[6] The verticality of the city, rising not only far up into the air, but also digging deep into the ground, has yet to be properly grasped as a constitutive background (Graham, 2016).

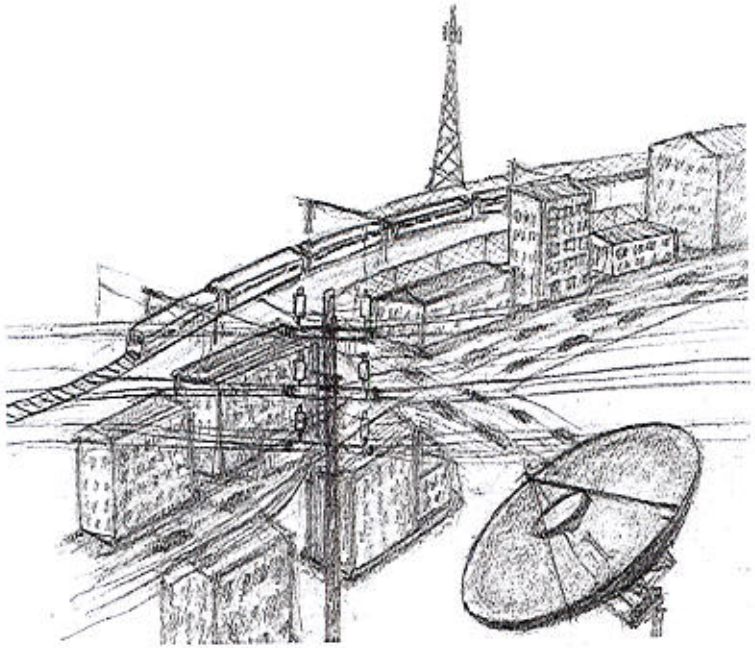
Then, it is the history of how we move things around, quite literally. Take the case of maritime trade, a global infrastructure that has existed for many millennia. Europe, for example, has been a trading zone since at least 9000 BCE. But instead of amber, soapstone and shells brought overland or by sea and made into necklaces, bangles and the like (Cunliffe, 2011), our very bodies are now maps of global trade. Shirts, T-shirts and blouses from Thailand and China, coats from Malaysia, spectacles and contact lenses from Germany, watches from Switzerland, shoes from the United States: each of us is a lesson in exchange, a world in miniature. And we live in places chockful of stuff that has transited from other places by sea and still contains those places' echoes. Maritime trade depends upon a forest of rules and regulations which range from the international law of the sea to the humblest health and safety inspections and regulations, which includes the 100,000 freighters on the seas at any one time carrying nearly everything we eat, wear and work crewed by an itinerant population numbering in the hundreds of thousands (George, 2013) and which also includes the ports, full of specialized equipment ready to load and unload the containers which are the basic grammar of maritime trade (Levinson, 2006). And infrastructure has all kinds of other effects too. Most particularly, in allowing people to move, it allows all kinds of communities to spread out across the world. So there is the serried history of the diasporas that have arisen out of population movement, striking in their extent. In large part, the history of countries like Australia

and the USA is the history of wave upon wave of diasporic communities. Migration has been a constant condition of human history, but it has picked up in pace and volume since the nineteenth century as movement has become easier and less hazardous. All kinds of discontinuous diasporic spaces have been created, many based on simple economic incentive but some the result of concerted state and state-related action like ethnic cleansing (Osterhammel, 2014). But movement is also born out of other imperatives too – like tourism, religious observance (consider the hajj) and all manner of other motives.

So ubiquitous is infrastructure like lighting – New York has over 250,000 street lights which are gradually being replaced with LED bulbs – and lifts – New York has at least 64,000, according to the city's buildings department – that this infrastructure has become an accepted feature of the landscape. In turn, it has spawned sites which can themselves be counted as infrastructure: ports, airports, railway stations, service stations have all become stock scenes of human conduct, places where we expect certain classes of movement drama to play out – meetings and farewells, temporary sojourns where it is possible to eat or refuel, places to gather and disperse, uneasy encounters and serendipitous meetings – against a background which is made as predictable as it can be, from the identical architecture to the uniforms. Augé (2009) once called them 'nonplaces', but as a description that is very far off the mark. Rather, they are 'by-places' which depend on the by-products of the journeys of people and things for their existence.

Then how we experience urban space begins to be mediated by infrastructure in ways that strike at the heart of our experience, as we began to argue in the preceding chapter. Take the case of sound. In the past, the soundscapes of cities left room for sounds emanating from natural sources. Church bells might produce a periodic cacophony, especially in larger towns and cities, the noise of horse-drawn traffic might create a low roar

at certain times of the day, and various shouts and bursts of music interspersed the daily round. But there were also periods of quiet and many acoustic spaces in which sound still consisted of the wind and birdsong (Glennie and Thrift, 2009). Now, things are very different. Places where the only sound is natural sound are few and far between – in Britain, you have to go far into a remote Northumbrian bog to find the quietest place. Cities are chockful of noises which form their own acoustic ecology, noises which become their own associative landscapes intensifying and fading as we move around – from the distant sound of aircraft overhead through the hum and honking of traffic to snatches of music and conversation, each with their own arcs (Gandy and Nilsen, 2014). Meanwhile, the world has become so beset by noise that great tits are forced to sing faster and higher in



Communication

the urban din, and robins have taken to singing at night when it is quieter. Shipping noise disturbs the breeding of whales and dolphins: whales are having to sing louder and louder – and in some cases have given up entirely. (But there are also radio quiet zones around a few large radio telescopes to prevent interference from radio waves.) And the main reason why we can't get away from all this noise is – infrastructure.

Streams of (Un)consciousness

Cities are, of course, the places where infrastructure is thickest, and its experience most pressing, as the example of sound demonstrates. But they are also the places where new kinds of infrastructure have been invented and applied most fully – from roads and wheels (Bulliet, 2016) to wireless masts and phones. Most particularly, physical infrastructure has been supplemented by a new wave of infrastructure arising out of microcomputational sensing and data-gathering capabilities and sponsored by the so-called security-entertainment complex which acts both at a remove from conventional physical infrastructure and as one of the main items carried on that infrastructure. If physical infrastructure was second nature, this new wave of infrastructure is best thought of as a *third nature* based on the mass transportation of culture around the world at speeds which would once have been thought impossible. This is the history of the rise of a different kind of flow infrastructure.

This third nature has its origins in cities in the rise of a print culture of indexical mediation, which, in turn, led to the rise of counting and coveting and reporting, and transcribing in bureaucracies. In turn, this bureaucratic imperative led to further infrastructural innovations and, most notably, the documentary tradition of files, indexes and the various paraphernalia surrounding them, all brought together in specialized spaces intended to

focus and routinize (Vismann, 2008). Equally, it led to all manner of means of identification, from spatial locations like addresses (Tantner, 2015) to passes allowing access to particular spaces like passports. It also led to planning using maps, diagrams and, latterly, equations. In other words, it became increasingly easy to produce an exterior memory that could then be reworked.

Working alongside this semiotic infrastructure set up to manipulate signs of life in a classic disciplinary manner was, of course, money in its various forms, another kind of abstraction which relied on both bureaucratic infrastructure and the rise, especially, of bookkeeping. And, finally, since the eighteenth century in particular, large corporations grew in scale and displayed an increasing bias to diagrammatic/algorithmic thinking based in procedures, plans and quantitative indicators, all set down on paper, and, latterly, liberal amounts of management thinking intended to slot human beings into the right place in a corporation.

However, in the past fifty years another level of abstraction which can itself be legitimately counted as a form of infrastructure has become recognizable as a result of large-scale changes in information and communications infrastructures pushed by developments in security and entertainment which have allowed the machinism of infrastructure to be extended into many other aspects of life which were formerly passed by. All manner of new semiotic motors have come into existence which bypass representation and consciousness but can be counted as real presences in the world with important and sometimes devastating effects (Lazzarato, 2014). They operate outside of our direct perception but in ways that can significantly affect our activity in all manner of ways. In other words, as Hansen (2015, p. 23) and others have argued, they denote a new kind of experience: 'experience simply is not what it used to be'.

Take money again with all of its algorithms and protocols and equations and second-order derivatives. It has

sprouted all manner of second-order instruments which can only exist because of this infrastructure: stock market indices, options and derivatives and the like, based on an infrastructure that depends not only on physical infrastructure like millions of miles of cable or server farms but also on software algorithms, datasets and statistics, equations and accountancy conventions (Esposito, 2012). And, recently, money has become an even more pervasive infrastructure because of the rise of new kinds of financial technology and especially payment systems that are, in effect, enormous automated ledgers. These systems are often called 'rails' in obeisance to their infrastructural qualities.

Or take science that can only exist nowadays because of computation and equations that link the atomic and the chemical, the biological and the cosmic. Or take mass consumption that is reliant on a series of innovations that have allowed the mass personalization of consumers, most especially based around the integration of big data, advertising and the crafting of relationships. Or take mass media stratagems where computation and instantaneous communication allow an impersonal and preconscious rendition of the personal to take hold through temporary operative stabilities, listings which do not originate in the individual subject – but are designed to act as though they do (Fuller and Goffey, 2012). Or take government, which increasingly relies on the differential management of plural publics as part of a security state held together by data.

These machines do not act on consciousness as such but rather impact directly on the affective level as 'the continuous variation and force of existing and potential action' (Guattari, 2014), made concrete by asignifying elements pulsing directly through the body like rhythm, temporal cues, spatial formats, the variation and intensity of luminosity and colour, and sexuality. T'was always thus, one might say. But access to this realm is now much more easily brokered and worked upon, presentified and intensified if you like (Thrift, 2007). In each case, signs and

things engage each other outside representation: monetary signs act directly on production, computer languages make machines run and communicate with each other directly, and so on. And they do this before the event, before they show up as the concerns of consciousness (Thrift, 2007). The result is, as Hansen (2015, p. 25) points out:

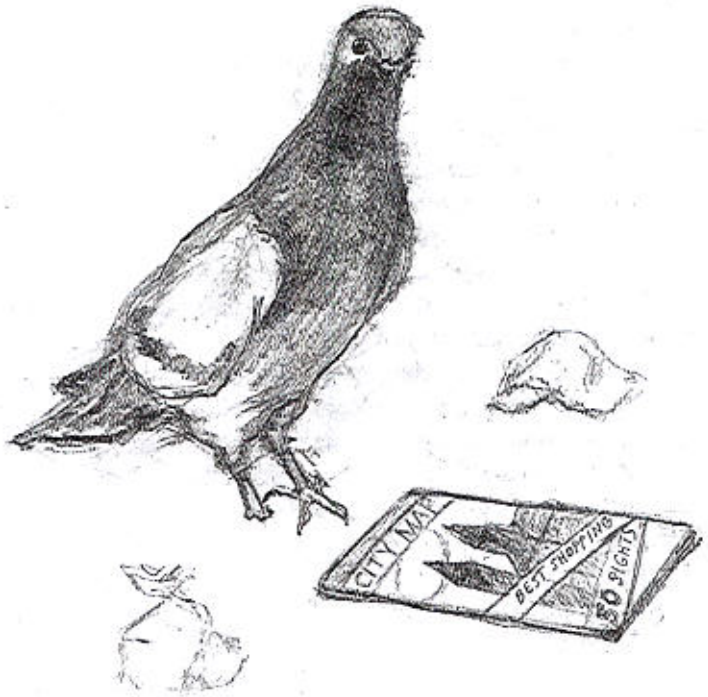
> Consciousness takes on what, contrasted with its near-absolute privilege in the history of Western philosophy, cannot but appear to be a more humble role as a modulator of a sensory presencing that takes place outside its experiential purview.

In other words, another kind of impersonal personal infrastructure now exists in the world, a third nature made up of a set of machineries of individuation which is both plural and singular in character (Esposito, 2012): 'the higher-order, complexly embodied human operations have been fundamentally displaced in a world of microtemporal computational media' (Hansen, 2015, p. 26). This imperfect but still potent machinery bears many resemblances to physical infrastructure but the machinery consists of algorithmic systems of systems, circulating machinisms that accompany our daily lives. These machinisms both assist and undergird our ways of speaking, hearing, seeing, writing, feeling and thinking by providing an infrastructure of constant sociability, an infrastructure which creates a predictable set of bubbles of time and space through the assignment of all manner of structured recurrences. These recurrences are etched on our bodies and brains as expected nonrepresentational behaviours that are deterministic even as they grant what seems like a high degree of elasticity of choice. Such machinisms are not separate from or implanted into human life, but coextensive with it, not least because, like much of human life, they operate at the preverbal level as a built equivalent of punctuation rather like a comma which is both a stop and a tie.[7] These machinisms may assign subjective roles but they also

include us in infrastructural assemblages which no longer distinguish between living and dead, human and nonhuman, subject and object, or words and things: 'there are as many living beings in the machine as there are machines in the living' (Deleuze and Guattari, 1983, p. 286). Individuals are literally cogs in a larger 'dividual' machine (Lazzarato, 2014). They are catchphrases in machines consisting of various hybrid animations/automatisms that add up to a process of flow in which intelligence and cognition, sensations and affects, and memory and desire are all lumped together in a diagrammatic, nonrepresentational way and manipulated through modelling and modulation such that nonperceptual potentiality becomes actuality. The essential public good is now a privatized hybridized 'us' which is being written into the world through screens of all kinds and, latterly, sensors and new computational 'metamaterials' which act as ecologies rather than simple technologies and produce an 'environmental subjectivity (Meek, 2014; Thrift, 2007, 2014). The result is that 'human experience is currently undergoing a fundamental transformation caused by the complex entanglement of humans within networks of media technologies that operate, predominantly, if not almost entirely, outside the scope of human modes of awareness' (Hansen, 2015, p. 5).

Such 'asignifying' signs are machinisms that function whether they necessarily mean something for a constituency or not in that they prescribe themselves as they describe themselves (Johnston, 2014). They are diagrams 'whose functions are operational, rather than representational' (Lazzarato, 2014, p. 86). Think punctuation marks again. Their main goal, in other words, is to reproduce a set number of operations by acting as partially discursive and partially nondiscursive entities but operating to the side of the language we ordinarily use, instead using cues which consist of sets of machinic instructions – like computer code. They produce multiple realities. Thus, as Lazzarato (2014, p. 92) argues in the case of financial trading, there is 'the reality of the "real" economy, the reality of

forecasts about the economy, as well as the reality of share prices and the reality of expectations about these prices rising or falling'. Each of these multiple realities has its own indexes and data and diagnostics, its own evaluative software, and its own diagrams. Much of what counts as each form of reality is either outside explicit human control, consisting of machines communicating with machines, or nudges human thoughts and actions into certain well-defined tramlines through institutionalized forms of technical imitation like measures of various kinds. Multiple decisions are being made, then, but they are often outside a conventionally human purview of consequential alternatives (Amoore, 2013).



Orientation

Back to the City

But what has all this to do with the city? Machinic ways of working like these might be thought of as a part of the creation of urban 'hyperobjects' (Morton, 2013), a term we will return to in due course. Cities are human presences but they are more than that, not least because not all of their activity can be made present to thought and because they consist of many intersecting modes of existence. We have created in cities something that has its own kind of causality but one that does not just coincide or correlate with us. In making this point, we obviously run squarely across the correlationist conceit that the world only exists within a narrow bandwidth – the human and what the human counts as the world. 'Meaning is only possible', according to this conceit, 'between a human mind and what it thinks, its "objects", flimsy and tenuous as they are' (Morton, 2013, p. 9). 'There is no thinking of reality without thinking of it' (Gratton, 2014, p. 6), in other words. But that conceit omits much of what exists – the world beyond how it appears to us – a 'what' that, in any case, continually impinges on the human, come what may, and which we can certainly speculate about. In other words, a part of the philosophical conversation has turned from *how* we know reality to *what* the stuff of reality might be (Gratton, 2014), given that it cannot be reduced to one set of primordial entities.

Whatever that 'what' is – and there are many arguments about this – it is not simply a human domain but nor is it simply 'other' and therefore able to be swept under the carpet. To put it another way, things can belong to the social without being socially constructed. Equally, there can be nonhuman social assemblages (like coral reefs). There is no rigid argument to be had in these circumstances: matter can shift about, can become something else, according to how it is aligned, and infrastructure is one of the chief ways of achieving this.

Cities are social assemblages but equally they exist as a nonhuman domain. How might we think about them as entities when they are seen in this light, to add to the account already begun in the preceding chapter? One way is through Morton's (2013) fruitful notion of cities as hyperobjects, a status they gain by dint of the properties they display, many of which are both in and outside human awareness, exerting a gravitational pull that we can't help but feel but cannot necessarily put into words. (Intuition, suggestion and fantasy are just three of the ways we attach meaning to these foreign objects (Berlant, 2011; Harman, 2012).) According to Morton, a number of properties are particularly germane in sketching the urban hyperobject. To begin with, cities are *viscous*; that is, it is impossible to get away from the field of concurrences they generate. Cities stick to us: like it or not, we are a part of them. Then they are *nonlocal* in the sense that everything existing in them has ties to other locations; they are the embodiment of action at a distance and, at the same time, hyperconnected so that they cannot easily be separated into distinct but interacting parts or into the general and the particular – everything overflows, everything is wrapped in something else, everything that exists always coexists. Again, they are *temporally discontinuous* with human lives. They consist not only of human-scale thoughts and practices but also of all manner of modes of sentience with their own timelines and modes of intervention in the world. None of them is necessarily consistent with the others but each of them is able to interfere with each other because their parts do not have to become a single whole: city never becomes City. Yet, at the same time, everyone is affected in some way by city: cities are also forms of regularity which impose a kind of order on this surging, vibrant crowd of becomings, as infrastructural meshes both emitting and capturing spacetimes. Finally, cities are configurational. The different combinations of integration and connectivity of the various links that go to make up cities produce

differential effects which act as sublunary compasses, as 'space syntax' (Hillier, 1999).

We can think of a number of ways of invoking these knots of teeming activity. For example, cities can be thought of as *ontographs*, interobjective piles of beings brought into alignment via locative infrastructures like streets and pipes, an alignment on which causality has been inscribed but only very loosely: don't forget that cities also have cul-de-sacs, abandoned and derelict plots, roads to nowhere (Bogost, 2012). Or cities can be thought of as a spatially configured *multiverse* in which each universe bears the imprint of the others, is ontologically bound to its siblings, in other words, as a mix of mixes (Rubenstein, 2014). Or cities can be thought of as a meta-form like grids, which manifest both variety and evolution and are able to encompass both building and unbuilding (Higgins, 2009; Hommels, 2005). Whatever the case, in a city there is no simple presence or absence or foreground and background or natural and unnatural or withdrawn and sensual to be found: these concepts have evaporated as infrastructure moves things around and between cities. But there is a sense of nearness and intimacy, even if not a sense of belonging, which is brought about by alignments that may be regular and predictable but may equally flicker like an early silent movie, reach a standoff like two dogs fighting to a standstill or even come to rest like an exhausted migratory bird.

> Think of a city. A city contains all kinds of paths and streets that one might have no idea of on a day-to-day basis. Yet even more so, you could live in a city such as London for fifty years and never fully grasp it in its scintillating, oppressive, joyful London-ness. The streets and parks of London, the people who live there, the trucks that drive through its streets, constitute London but are not reducible to it. London is not a whole greater than the sum of its parts. Nor is London reducible to those parts. London can't be 'undermined' downward or upward. Likewise,

> London isn't just an effect of my mind, a human construct – think of the pigeons in Trafalgar Square. Nor is London something that only exists when I walk through the Victoria Line tunnel to the Tate Gallery at Pimlico Underground Station, or when I think about London. London can't be 'overmined' into an after-effect of some (human) process such as thinking or driving or essay writing. (Morton, 2013, p. 91)

But let's not get too romantic about these things. Cities may leave all kinds of gaps and generate all manner of unexpected revelations. But none of this is to suggest that the systems of systems of third nature cannot provide extraordinary levels of panoptic surveillance that seem to act as a shroud around each and every event, tying the possibility of possibilities into duelling knots. Take the example of the way in which American cities corral young male African Americans. As Goffman (2014) shows in her controversial book on one of the poorer areas of Philadelphia, they can be caught up in a system of law enforcement so punitive and panoptic that it is difficult to forge anything except a life as a criminal. Multiple databases, a squad car filled with information technology, blanket policing and a blizzard of warrants produce outcomes that are both implacable and almost always malign. It can often seem as if these parts of cities are simply extensions of prisons, part of a new Jim Crow (Alexander, 2012).

Their very complexity, however, also makes it hard to keep these systems of systems functioning like this in logistical lockstep for concerted periods of time. Not that it hasn't been tried. Think only of some of the ways in which socialist planning manifested itself in cities by locating representatives of the state on every city block or the various means of contemporary urban surveillance from urban passports through ubiquitous cameras to drones. Think only of the way in which halting attempts to build systems that could cope with emergency produced a patchwork of systems that could manage states of emergency, systems that have gradually migrated into government as

usual (Collier and Lakoff, 2015). Or think only of China's attempts to construct a new Great Wall, a Golden Shield or Great Firewall, within which information can be strictly controlled. But each of these systems, however tightly they are drawn, has cracks, moments of breakdown or confusion, bypasses, interpretative overloads, jagged edges, missing pieces and simple errors which can add up to a new and enticing opportunity for someone. In other words, even systems of systems find it difficult to dry out the world, much as they might try to do so. There will always be room for politics – but what kinds of politics will continue to be an open question. After all, that question is itself political.

Furthermore, it is now overlaid by an Anthropocene whose effects are far-reaching. The term has been described as primarily 'a politically savvy way of presenting to nonscientists the sheer magnitude of biophysical change' (Castree, 2014, p. 233). But this is to miss the point. The Anthropocene does far more than this. It 'questions the seeming self-evidence or coherence of... basic conceptions' (Clark, 2015, p. 20) like the human, the social and the cultural. It puts so much stress on the standard categories of Western thinking that it shatters them. Instead it ushers in a perspectivist world in which all manner of becomings and relations jostle against each other in no particular order of eminence and prevail over being and substance. A people receptive to any shape and able to believe in everything. In particular, the idea of a system of beliefs with its implications of sovereignty and rule can be replaced with something more malleable, an ontology 'consisting of essential ontological incompleteness – the incompleteness of sociality and in general of humanity' (Viveiros de Castro, 2011, p. 47), not least because humanity radically expands its definition of human so that others are a solution and not, as they have been in so much Western thinking, a problem.

Cities illustrate something else too. They are both an assertion of human dominion and a challenge to it. Many

writers on economic development and growth simply assume that the expansion of a human-dominant world is a fact of life. But the Anthropocene lays down a challenge to this account. It does so in several ways. First, it points to the fact that there must be an end point to this process on a planet with finite resources. Perhaps human dominion is an evolutionary dead end. Second, it challenges us to think of new models of the human. For example, we might think of humanity as a detrivorous species, one that, similarly to earthworms or slugs, digs up dead material and releases it as energy into the environmental system and, as a result, is caught in a 'bloom and crash cycle' because it lacks biogeochemical circularity. Or, we might think of it as a hive species, intent on building a mammalian of insect eusociality by other means than those found among orders like hymenoptera (ants, bees and wasps). Again, we might think of it as a species that is so plastic that the environmental spheres it etches, the self-realizing forms that Sloterdijk (2011) calls 'animated interiorities', are different variants of adulthood. Third, they highlight Isabelle Stengers' issue of inheritance: who and what is it we want to inherit from in a time when agency itself is changing, when who and what have become ever more malleable? Cities are both the object and the subject of this question, not least because they both concentrate space and time through the intricate processual couplings that have become possible through infrastructure (Hamilton, Bonneuil and Gemenne, 2015). And, finally, the obvious but still neglected empirical point: cities are always and everywhere orchestrated by human *and* nonhuman means. They are a series of knots which rely on various kinds of attunement in which infrastructure is a vital thread. They are always and everywhere live mappings, constantly constructing patchy and incomplete but still productive propositions out of often unintentional assemblages and blurring the boundaries between ordinary and extraordinary as they do so (Tsing, 2015).