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Urban Pedogeneses

The Making of City Soils from Hard Surfacing to the Urban Soil Sciences

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Abstract This article examines the rise of urban soils as a topic of scientific inquiry and ecological engineering in France, and questions how new framings of soil as a material that can be *designed* reconfigure relationships between urban life and soils in a context of fast-growing cities. As a counterpoint to the current situation, the article first examines how the hard-surfacing of Paris, in the nineteenth century, sought to background the vital qualities of soils in urban areas, making their absence seem perfectly stable and natural. It then shows how the new urban soil science moved away from classical descriptive approaches to soils, and set out to fabricate soils as a research experiment on anthropo-pedogenesis. In the French context, urban soil scientists soon formed new bonds with the worlds of urbanism, administration, and waste management, reframing their approach as a technical response to issues brought by sprawling cities, backgrounding soils again under a trope centered on the management of soil services. These stories allow to critically inhabit soil scientists' claim that humans participate in pedogenesis by examining the specific conditions in which modern modes of being in the world and urban soils become entangled or disentangled in modern metropolis.

Keywords anthropology, urban soils, surfaces, pedogenesis, ecological engineering

Urban soils are typical of the things that have been neglected in modern approaches to both soils and cities, to the point that most people find it hard to think of the city as a repository of soils, to the exception of those lying in a few parks and gardens. How can it make sense to think of roads, roofs, walls, and squares as soil, while nothing seems to grow in them? When modern-day Westerners hear about soils, they tend to think about topsoil—soil in which food can be grown. In the mind of most of them, soils are associated with rural culture: they are the top layer of fields, the horizontal foundation of environments that must be nurtured so as to produce quality food and sustain the livelihoods of those who grow it.

Until recently, this disinterest was most noticeable in the soil sciences community itself, where urban soils were often regarded as off-topic. In France, throughout the

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twentieth century, soil maps displayed urban soils in the same category as glaciers and lakes: all of them are considered to be “nonsoils.”¹ They were seen, at best, as a soil ersatz, the heavily disturbed remnants of a once-natural soil. Such maps and categorizations made it seem as if there was nothing interesting to learn from urban soils. Neutral and absent they were to the minds of urbanites, mayors and city planners too. If they got any attention, it was merely as polluted environments, as a public health issue.² They were then treated as a problem for confinement and remediation techniques that aimed at creating a city of abiotic surfaces. They were at best an embarrassment. It seemed nothing was to be learned from them.

In the past twenty years, in parallel to the rapid development of urban ecology, urban soils have met a revival in the soil sciences. Since the 1990s, many soil scientists have argued that the soil sciences needed to widen their scope to include the volumes and surfaces made by the growth of urban and industrial areas within their understanding of soils. In 2006, the new soil group Technosol made its appearance in the World Reference Base for Soil Resources (WRB), the soil classification system of the FAO and the International Union of Soil Sciences (IUSS). This group refers specifically to soils and ground types that have been strongly modified by human activities, and contain a large proportion of technogenic objects or materials, such as concrete, bricks, or plastic.³ This opened the way for a growing catalog of proposed or recognized urban soil types within the WRB classification system.⁴ Hence, an abandoned garbage dump might give birth to a Garbic Technosol or perhaps an Ekranic one if it becomes sealed under concrete, whereas green roofs or the organic matter that accumulates in a gutter can now be described as Isolatic Technosols.⁵

By putting these new soil categories forward, urban soil scientists prompt their colleagues to address the issue of soils in the Anthropocene.⁶ They argue that pedology should redefine itself as “anthropedology,”⁷ a proposed disciplinary development that understands human activities as integral to soil genesis. To them, such a reframing of the soil sciences is a possible response to the current worldwide development of Technosols as a consequence of the generalized expansion of urban areas. The urbanization

1. See for example Gis Sol, “Rapport Sur l'état Des Sols de France,” 39.

2. Cheverry and Gascuel, *Sous les pavés la terre*.

3. According to the FAO international soil classification, a “Technosol” is any soil that contains “20 percent or more (by volume, by weighted average) artifacts in the upper 100 cm from the soil surface or to continuous rock or a cemented or indurated layer, whichever is shallower.” The category also encompasses soils that are covered by an artificial impermeable layer—usually made of concrete or tarmac—or that contain such a layer within its first meter of depth. See IUSS, *World Reference Base for Soil Resources 2014*, 87.

4. See Burghardt, Morel, and Zhang “Soil Research about Urban, Industrial, Traffic, Mining, and Military Areas.”

5. IUSS, *World Reference Base for Soil Resources 2014*.

6. Lehmann and Stahr, “Nature and Significance of Anthropogenic Urban Soils.”

7. Richter et al., “Human-Soil Relations Are Changing Rapidly.”

of soils is described as an ignored challenge⁸ that threatens food and soil ecologies, destroying soils as surely as agricultural soil exhaustion.

Echoing the Anthropocenic arguments of some of their geology colleagues, they assert that humans have become among the Earth's biggest earth-moving forces, and that they ought to be considered "the sixth factor of soil formation."⁹ To them, the pressing matters of soil degradation and urban sprawl mean that "in the Anthropocene, pedology is fundamentally challenged to bring humanity entirely within the soil continuum."¹⁰ As with other approaches to the Anthropocene in the natural sciences, these narratives tend to refer to abstract humans rather than victims and perpetrators of the problem, and generally elude questioning the social and political dynamics at the root of urban sprawl and soil degradation.¹¹

In this paper, I want to critically inhabit the hopes of reconfiguring relations between humans, cities, and soils by considering how they might reveal the dependencies and the performative effects of hiding the latter away. My aim is to take seriously the idea according to which modern city making participates in pedogenesis. Rather than seeing city making as inherently antagonistic to soils, I question how it performs specific kinds of soils—or better, how dominant processes of making urban soils and urban life intertwine and constitute one-another.¹² Drawing on French examples, I examine two steps in the history of soil-city relations by concentrating first on the nineteenth-century figure of the enlightened city dweller, and then on the twenty-first-century figure of the reflexive ecological designer. As we shall see, the ways in which these characters have known or ignored urban soils, the way they let themselves be affected by them, directly related to the way they engaged in the making of soils. "Urban pedogeneses" is my expression to call the multiple ways in which these entanglements unfold.

Between January 2014 and November 2015 I conducted interviews and ethnographic fieldwork with soil scientists, ecological engineers, and building companies in the Paris area and Lorraine region, in Eastern France, with the aim to trace the development of a field of urban soil research in France. French research teams such as that of Soil and Environment Laboratory (SEL) of the University of Lorraine are recognized internationally as pioneers in research on urban soils. Since the 1990s, its members have

8. EEA, "Urban Sprawl in Europe."

9. Since its inception with Dokuchaev, pedology has recognized five factors of soil formation: climate, parent material, topography, time and organisms. There is still debate among pedologists on whether humans should be recognized as a sixth factor, or should be treated like any organism. It seems that the first option has become widely accepted under the influence of Raoul Dudal, one of the founders of the *FAO Reference Base for Soil Resources*. This framing of human agency tends to continue a tradition of human exceptionalism within soil theory. See Dokuchaev, *Tchernozyém (Terre Noire) de La Russie d'Europe*; and Dudal, Nachtergaele, and Purcell, "The Human Factor of Soil Formation."

10. Richter and Tugel, "Soil Change in the Anthropocene."

11. Blaikie, *The Political Economy of Soil Erosion*; Engel-Di Mauro, *Ecology, Soils, and the Left*.

12. For a study of urban soil-making practices by non-hegemonic groups of urban gardeners, see Meulemans, "Reclaiming Freak Soils."

published many influential papers on the topic, and have been key actors in the SUITMA group of the International Union of Soil Sciences—which takes the soils of urban, industrial, traffic, and mining areas as its focus. Since 2010, new players have emerged on the French Technosol scene. These are scientific departments, such as the Parisian Institute for Ecology and the Environmental Sciences (IEES), but also a range of public and private actors, such as city authorities, or engineering consultancy groups.

At the beginning of fieldwork, I discovered that these scientists' understanding of cities as places full of soils questioned common conceptual differences between soil and ground, or between living and nonliving compounds. When these scientists looked at them, they didn't see inert surfaces, but plants pioneering every crack, dust and organic matter forming accumulated layers in every street corner, and processes of sedimentation, decomposition, and erosion taking place everywhere. They regarded urban surfaces—sidewalks, gutters, parking lots, what have you—as soil in becoming. The idea of *becoming* links to an understanding of the world as made of processes rather than finished objects.¹³ For these soil scientists, this came through the notion of pedogenesis—the continuous growth or making of soils.¹⁴

Pedogenesis is a better term than pedology because it lures us toward a processual approach rather than a classifying one. If the study of urban soils contributes to a renewal of what is understood as soil, it also renews what is understood by pedogenesis, as human activities are now seen as participants in the soil's processes of making. These new foci on urban soils therefore hint at an understanding of soil not as something that lies out there in the landscape but as a living process of becoming, making, or *poiesis*. The work of these scientists participated in revealing that urban soils, like other soil types, were part of what Maria Puig de la Bellacasa¹⁵ calls “the dismissed infrastructure of bios”—the web of relations that sustain life, human and other, and to which modernity turned a blind eye.

The scientists of SEL and IEES have drawn an important conclusion from their examination of the place of past and present human activities in pedogenesis: since they participate in the making of soils, they argue, scientists should also attempt to make soils to better understand urban soil pedogenesis, to bring soil making at the center of their inquiry. To them, soil ecological engineering—or the making and growing of new soil from scratch—thereby becomes a way of doing anthropedology.

Making is also a powerful concept for anthropology. It implies more than just building a representation of the world, and it can be taken in a very material sense. The point, as Bruno Latour explains,¹⁶ is to be constructivist without referring to social construction, which would imply that different social views apply to one soil that in itself

13. Ingold, *Being Alive*.

14. See Gobat, Aragno, and Matthey, *The Living Soil*.

15. Puig de la Bellacasa, “Encountering Bioinfrastructure.”

16. Latour, *Science in Action*.

is always the same. “Making” directly addresses what it means to act in the world, to participate in a world that is itself taken up in multiple processes of making.¹⁷ This also relates to a pragmatist ontology in which, according to William James, “what really exists is not things made but things in the making. Once made, they are dead.”¹⁸

In this article, I consider two steps of urban pedogenesis in France, which illustrate ways in which the becomings of socialities, bodies, cosmologies and urban soils entangle and participate in the making of one another. The first part of the article draws on the work of historians of urbanism and engineering, and connects it to the recent anthropological interest in surfaces. It relates the rise of the hard-surfaced city in nineteenth-century Europe, and more particularly France, where doctors, engineers and urbanists sought to neutralize the vital qualities of soils in urban areas, making their absence seem perfectly stable and natural. This initiated a radical, large-scale separation between soils, the city and the daily life of its inhabitants.

The second part unfolds from the development of the new urban soil science in the early twenty-first century, and the ambition to fabricate soils as a research experiment on pedogenesis that allows scientists to open up fundamental questions about what soils are. I address how these soil scientists also soon formed new bonds with the worlds of urbanism, administration, and public works, and how this changed the way they do science. As fertile soils are growingly referred to as a scarce and fast disappearing resource, scientists and engineers start regarding constructed soil as a fertile material that can be grown, transported and sold.

The Hard-Surfaced City and the Groundlessness of Urban Life

Up until the nineteenth century, city grounds were far more diverse and blurred entities, and the separation between soils and cities was not as clear as it later became. The historian of technology Lewis Mumford¹⁹ points to how many premodern cities had been careful to keep vegetable gardens and even fields within their walls—a precaution that he regretted was later forgotten by the builders of modern cities. In Paris, from the Romans to Napoleon, many of the materials that were used to build the city—from limestone to mud or gypsum plaster—were extracted directly from its subsoil. Most other substances produced by life in the city—“night soil,” or “town manure”—were collected manually and reused to fertilize nearby fields. In her historical studies of the involvement of doctors and engineers in Paris development at the turn of the nineteenth century, Sabine Barles²⁰ shows that Paris soils were considered a source of wealth for many, because the many substances that could be collected or extracted

17. Ingold, *Making*.

18. James, *A Pluralistic Universe*, 263. See also post-ANT approaches to practical ontologies: see Gad, Jensen, and Winthereik, “Practical Ontology”; and Mol, “Ontological Politics.”

19. Mumford, “The Natural History of Urbanization.”

20. Barles, *La ville délétaire*.

from them played a role in the artisanal or agricultural activities of the time. What comes through in Barles's account is a sense of profuse urban soil vitality. This is a story of continuous soil making that indexes processes of sedimentation and extraction of materials by city dwellers, but also cycles of material transformation such as rotting, dissolution, leaking and infiltration. The surface of the city, far from being a smooth space, can be regarded as a meshwork woven from the active mingling of human and animal excreta, artisanal and food refuse, bacteria, minerals, liquids, and other things that would later come to be regarded as urban waste.

Towards the end of that time, however, doctors, chemists, philosophers, and other scholars started to abundantly debate about the soils of European large cities, which they considered a den of iniquity and perdition. At the time, many doctors paid more attention to the environment than to the organism in their efforts to understand diseases. Urban soils were frequently referred to as a putrid carcass, and their smell as deleterious miasma that corrupted bodies and minds.²¹ This early hygienism initiated a fight against the stench, dirt, and rot that they linked to urban soils. This was the start of a movement that would revolutionize cities and the way they are built. Paul Rabinow²² argues that the urbanism that took form at the turn of the nineteenth century can be regarded as ecological in that it sought to adapt human beings and their milieu. The result, however, was to background one aspect of the environment after the other. At the same time as the marshland that persisted in the countryside was being drained, cities were turned into a waterproof, inorganic, abiotic space. Any organic material found on the pavement would be considered dirt—"matter out of place," as anthropologist Mary Douglas²³ would put it.

As a materially performed partition between the ground and the sky, soil sealing implied the joint creation and concealment of new networks that carried away the fluxes of collected rainwater and waste.²⁴ As Stephen Graham²⁵ notes, infrastructures such as the urban seal and the pipes underneath it are a prerequisite to any notion of modern civilization and its associated identities and economies. In this sense, the sealing of urban soils is intimately linked to the performance of a kind of cosmic disregard whereby nature is relegated to the background, to being either a pristine space or a resource and rubbish tip. As long as infrastructure is well maintained by those who are specialized in doing so, it is easy for everyone else to take the material means that support modernity for granted, and rely on the mere impression of their stability and permanence.

We may call here upon the idea of backgrounding, which the Australian philosopher Val Plumwood²⁶ has discussed at length. For Plumwood, this notion refers to

21. Corbin, *The Foul and the Fragrant*.

22. Rabinow, *French Modern*.

23. Douglas, *Purity and Danger*.

24. See for example Kaika and Swyngedouw, "Fetishizing the Modern City."

25. Graham, *Disrupted Cities*.

26. Plumwood, *Feminism and the Mastery of Nature*.

common forms of denial of nature and women that treat them as “providing a background to a dominant, foreground sphere of recognized achievement or causation.”²⁷ Backgrounding is a process whereby a collective comes to underestimate something’s force and pervasiveness as it becomes absorbed into the background and becomes banal, while at the same time foregrounding a hyperbolized sense of human, male, or individual autonomy. Tracking the exact conditions under which urban soils are continually brought into being as nonsoils, and what these imply, leads to questioning the illusion of disembeddedness from soils as well as ideas of a unilinear progression toward ever more healthy and efficient infrastructures and cities.

In many ways, the project of modernization of urban life was not just about hygiene *stricto sensu*: it went hand in hand with the dream of improving the human species by freeing it of environmental constraints.²⁸ Stone pavement, then concrete and asphalt, were enlisted to clean up cities but also contributed to the materialization of a surfacic city that has come to dominate many human-built environments. To Mike Anusas and Tim Ingold²⁹ both Western design and Western architecture have a characteristic obsession with enclosing what they call the “textilic” nature of things—this textility is identified as the “entangled mesh of materials in energetic movement, out of which the forms of things are continually emerging”³⁰—under smooth surfaces. Urban soil, once a permeable membrane, a medium formed through the interweaving lives of bacteria, minerals, water and humans, became a solid, opaque surface. Town manure, mud, stench, miasma, and all the things that formed the vitality of city soils could only be forgotten at the cost of patient material and symbolic stabilization.

The sealing of urban soils was a general project for a new cultural form, which also impacted the way citizens walked in the city. As Tim Ingold has remarked in an essay titled “Culture on the Ground,”³¹ the paving of streets, the technology of footwear, the education of posture, and the detached contemplation of landscapes all underwent important developments at this time. All of these, Ingold explains, “conspired to lend practical and experiential weight to an imagined separation between the activities of a mind at rest and a body in transit, between cognition and locomotion, and between the space of social and cultural life and the ground upon which that life is materially enacted.”³² In engineering the urban soil in order for it to “stop to exert its tyranny on the walker,”³³ historian David Ripoll notes that the politics of hard surfacing also gave

27. Plumwood, *Feminism and the Mastery of Nature*, 22.

28. See Rabinow, *French Modern*; and Picon, *French Architects and Engineers in the Age of Enlightenment*.

29. Anusas and Ingold, “Designing Environmental Relations.”

30. Anusas and Ingold, “Designing Environmental Relations,” 66. Soils are just one example from a vast repertoire of surfaces that have come to partition the modern world, and that goes from the skin, the surface of the body, to the touch screen of a smartphone. For other examples, see Anusas and Simonetti, *Surfaces*.

31. Ingold, *Being Alive*.

32. Ingold, *Being Alive*, 37.

33. Ripoll, “Du caillou roulé au ciment coulé,” 110; my translation.

birth to the Baudelairian *flâneur*, the casual wanderer whom Walter Benjamin upheld as the archetypal figure of Modern urban experience: a pedestrian in the crowd who is “captain of his body,” who can walk unaffected by the ground and thus think only of the higher occupations of trade and politics. One advocate of the hard surfacing of Paris was Alexandre de Laborde, who had a prolific career as an archaeologist, politician, and administrator in the first half of the nineteenth century. To him, providing the city with a smooth hard surfacing would be a definite step in setting the city and its inhabitants on the path of progress and enlightenment: “Busy people, no longer having to focus their attention on which stones they should walk on, shall be able to think freely about their interests and trade, and shall thence uplift their spirits.”³⁴ In trying to transform walking from a negotiation with the land to a more automatic activity, promoters of hard surfacing exemplified the ambition of enlightenment for city dwellers. They could now lift their eyes and mind, literally paving the way for the modern distinction between mind and body, and between thinking and the world.

The Paris dreamed of by urbanists is a place where urban soils made people as much as the other way around. In this co-becoming, the strangling of ecosystems participates in the growth of a modern urban subject by establishing what Nathan McClintock³⁵ calls an “individual rift”—the cognitive and experiential understanding of self as external to larger ecosystems. From the effective burying of soils comes the belief that it is possible to exempt ourselves from Earth’s ecological community, allowing for a fixation on subjectivity and rationality in which claims of human exceptionalism are rooted.

As Annemarie Mol reminds us, “objects that are performed do not come alone: they carry modes and modulations of other objects with them.”³⁶ Because of its interweaving with ideas of modernity, soil sealing effected a reconversion of territories, ways of living, economies, and cultures, and participated in the emergence of traits that are now considered constitutive of modernity such as the separation between mind and body, or between active human subjects and a passive environment.

Throughout the twentieth century, technologies of sanitation and rationalization, map-oriented approaches to urbanism, and surface-oriented legislation based on the cadaster and the ground plane continued the backgrounding work started in the nineteenth century. Le Corbusier’s *Athens Charter*,³⁷ one of the twentieth century’s most important urbanistic manifestos, recommended waterproofing soils and burying the water cycle, at the same time creating well-defined green areas—parks and gardens. The only question asked of urban soils was how better to conceal and control them.

34. De Laborde, *De l’esprit d’association*, 442, cited in Ripoll, “Du caillou roulé au ciment coulé,” 110; my translation.

35. McClintock, “Why Farm the City?”

36. Mol, “Ontological Politics,” 81.

37. Le Corbusier, *The Athens Charter*.

From an organic element, they became a mineral element, a backstage area hidden under a well-maintained surface. This would be so until industrial collapse and the exponential development of cities in the late twentieth century led to a reopening of the black box again.

The Intrusion of Urban Soils

Figure 1 shows a 1962 aerial view of the coking plant of Homécourt in Lorraine. In France such a picture already seems like it is from another age. The plant closed in 1980, hit by industrial collapse. Eager to turn their back on a bygone industrial age, the local authorities ordered the demolition of the factory in 1985, wanting to redevelop the site as soon as possible.

Reset. The industrial history of Lorraine was over, and its vestiges had to be forgotten. A clean layer of topsoil scraped off from a nearby field was brought to the site, and a building was erected to attract companies to Homécourt. But on the day the building opened, it was filled by a naphthalene smell, and the developers realized that the site was contaminated with heavy metals poorly contained by the thin topsoil layer. After years of neglect, a partnership was eventually found with scientists from the University of Lorraine in Nancy, which turned the site into a 2.5 hectare experimental area on soil construction, the largest one in France.

The soils that now lie in place of the old factory have been entirely created by scientists of the SEL on the basis of material such as green waste compost, concrete rubble, brick dust, and paper sludge from a local paper factory. These materials, most of which would normally be considered as waste and buried in a landfill, were mixed and laid into separate horizons, as in a naturally formed soil.³⁸ However, unlike soil restoration, soil construction does not aim at recreating a preexisting soil. The soils it creates are entirely original and allow the study of novel configurations that do not occur elsewhere. As one SEL scientist explained to me in a 2014 interview,

I see we have materials with little clay, I think “let’s try to do without clay” and let’s see what happens. . . . Most often I find it interesting to design completely original soils without trying to reproduce what is in nature.

For this soil scientist, soil construction is mostly a way of doing basic research and building a potentially surprising compound. Soil construction experiments make it possible to question soils otherwise, to frame them in ways that allow scientists to know more about them. This comes from an interest in nonlinear ecological dynamics, which

38. This pilot project was called SITERRE. It ran from 2011 to 2016 and was funded by the French Agency for Environment and Energy Management. It brought together researchers, regulatory authorities, environmental consultants, and professional associations. The experiment formed the basis for one of the first books on soil construction issued by soil scientists: Damas and Coulon, *Créer des sols fertiles*.

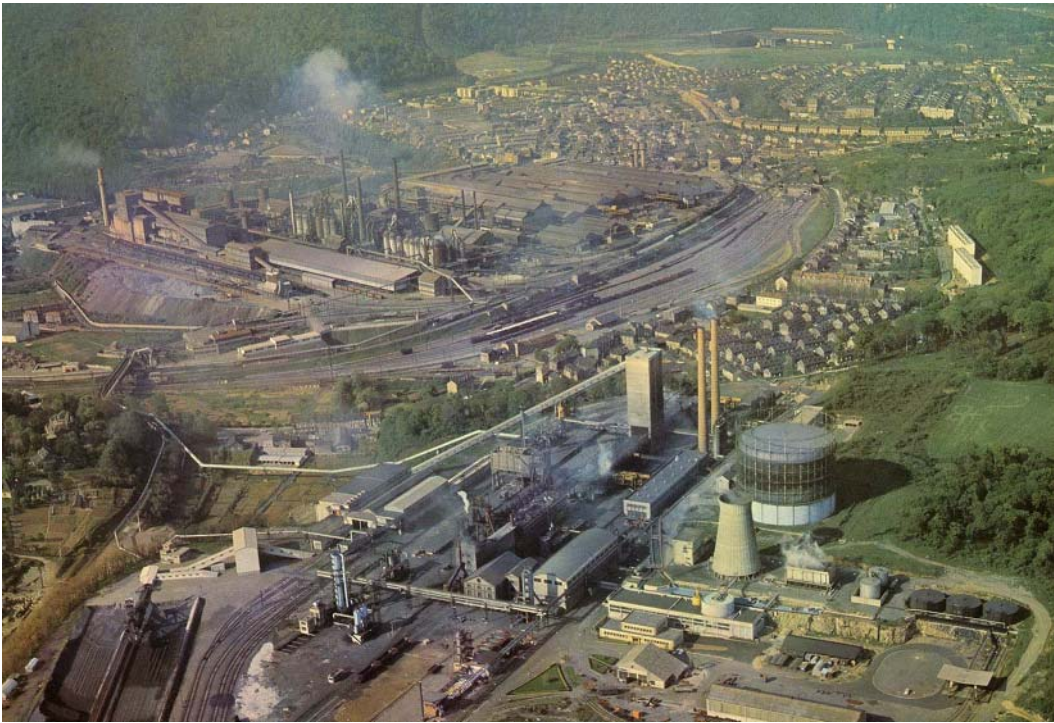


Figure 1. Homécourt, 1962. Courtesy of the Association Mémoire du Pays de l'Orne.

critiques a fixist approach in the ecological sciences, and its focus on natural environments, seen as a fiction from which humans are artificially ousted.³⁹ Whereas restoration or rewilding attempts aim at restoring a past state, Homécourt became a space of experimentation in future relations with soils, which challenges established notions of what soils are, and how to care for them. A place for practical environmental imagining that acts as a lure for a new feel of soil ecologies in landscapes ruined by industry and resource extraction.

The Homécourt experiments also contribute to redefining what soil is by framing soils as compounds that are always *in the making*, rather than treating them as an “out there,” something to be found and compared.⁴⁰ It allows researchers to study pedogenesis by joining into soil making processes, by playing and experimenting with them. They do so in collaboration with other species, such as earthworms, which bind organic and mineral soil particles together, or bacteria, which play important roles in the cycles of nutrients in soils, playing on a form of controlled decontrolling⁴¹ rather than on ambitions of direct mastery.

39. See Botkin, *Discordant Harmonies*; Marris, *Rambunctious Garden*.

40. For a critical approach to the question of classification in pedology, see Engel-Di Mauro, *Ecology, Soils, and the Left*.

41. Keulartz, “The Emergence of Enlightened Anthropocentrism in Ecological Restoration.”

At the same time, concerns arise that the world's soils are quickly degrading under the intensification of soil-related disasters such as erosion, fertility loss, mudslides, and flooding. The suspects are easy to line up, starting with climate change and chemicalized agriculture, but most visibly pointing to the expansion of cities. This is reminiscent to what Isabelle Stengers⁴² calls an intrusion: the event in which the ecological crisis caused by human ignorance or hubris makes itself felt and demands a response. To Stengers, that which intrudes cannot be framed simply as a problem to be solved, but troubles common categories and requires careful experimentation to be dealt with. In Homécourt, the contaminated soils became matters of concern that demanded a response, after the attempt at burying and forgetting them backfired, with the notable effect of attracting attention to life forms that modernity itself had managed to hide away as seemingly irrelevant for urban existence.

The Ambiguities of Ad Hoc Soil Design

In large cities such as Paris, soils have become matters of concern to different groups. In the field of city planning and engineering, the end of the twentieth century has seen a rising engagement with the perceived excesses of nineteenth-century infrastructural modes. Metropolises such as Paris have expanded their waterproofed area to such an extent that water cannot always properly evacuate through sewers, and several areas are increasingly suffering floods. Heat peaks are also becoming more frequent as anthropogenic rock surfaces store heat in the summer. Pollution is still present in various forms, and cannot degrade in the deadened urban soils. Interestingly, as a result the city is starting to be framed as dysfunctionally soil-less, presented as an issue that must be fixed.

Gray infrastructure, hidden down below the well-maintained urban surface, seems to be going out of fashion, as planners started to promote the development of a green urbanism, with its green corridors, green roofs, green belts, and green watersheds staged as alternatives to traditional engineered systems.⁴³ Proponents of the new approach explain that green engineering should not replace, but rely on (and possibly improve) the ecological performances of natural systems to carry out functions traditionally sustained by gray infrastructure. Soil construction becomes increasingly regarded as such a design solution to improve the general quality of the urban environment.

In Paris, local urbanism authorities consider that the main asset of constructed soils is that they can be deliberately manipulated to improve the conditions of a site. This is echoed in publications by soils scientists, who not only argue that knowledge of urban soils should become a key component of green urbanism but also promise that soil construction will be able to follow urbanistic specifications and target specific

42. Stengers, *In Catastrophic Times*.

43. For a comprehensive and critical account of new trends in Green Urbanism, see De Block, "Ecological Infrastructure in a Critical-Historical Perspective."

ecosystem services.⁴⁴ They add that soil qualities could be assessed according to what is wanted for each site—to resist compaction, favor certain kinds of plant life, infiltrate water quickly, or not too quickly, increase carbon sequestration, mitigate urban heat, or provide habitats to plants and animal life. Once optimal indicators for the wanted service have been chosen, made-soil horizons, consisting in mixes of materials chosen for their pedological properties, are assembled so as to construct the ad-hoc soil.⁴⁵

At the same time as they open up new sensitivities toward soils as a crucial, yet endangered condition for terrestrial life to thrive, arguments pointing to the excesses of urban sprawl are tied to a rhetoric of efficiency that frames scientists and engineers as guardians of the situation, insisting that it is their task to design solutions to the problem they have just circumscribed. As sociologists of scientific promises have shown, this is a common mode of problematization of the environment: the joint definition of a problem and a solution “instantiates the promise maker as an obligatory passage point—involves the definition of the problem that has to be fixed.”⁴⁶ The logic consists in stipulating the novelty of the challenge posed as over half of the world’s population now lives in urban areas, and therefore near or with urban soils. Experts insist that this is a situation that humanity has never known before, and that threatens the stability of the system as we know it. The result is a call for tighter links between science and governance, and more or less declared calls for more technocratic management of relations between nature, cities and the economy.

A senior soil scientist explained to me that he wanted city planners to understand that soil scientists can help them imagine the future. As he put it, “We know how urban soils function, how they evolve, so why couldn’t we come up with ways of managing them and construct them so as to deliver this or that service? . . . We can help build the city of tomorrow in terms of ecosystem services.” As another scientist explained to me, “Our hypothesis is that soils function and produce services, so why not mimic nature and try to do even better, construct even more functional soils which correspond to our needs?”

Since 2015, with the beginning of works to build the Grand Paris express train system aiming at transforming Paris into a major European metropolis, prospects for soil construction have met a new turn. The digging of 180 kilometers of tunnels under and around the city is expected to generate 45 million tons of excavated fill.⁴⁷ The lack of outlet sites to store these materials, due to difficulties in opening new landfills sites, is

44. Morel, Chenu, and Lorenz, “Ecosystem Services Provided by Soils of Urban, Industrial, Traffic, Mining, and Military Areas.”

45. Vidal-beaudet and Rossignol, “Urban Soils.”

46. Joly, “On the Economics of Techno-Scientific Promises.”

47. Fill is what gets taken out of the soil when digging to build the foundation of a building, or excavating a tunnel for an underground train line. Along with demolition material, another kind of material that contemporary cities produce in large quantities, fill accounts for a large proportion of “mineral waste”—which amounts to 64 percent of all the waste produced in Europe, according to Eurostat, “Waste Generation, 2016.”

increasingly referred to as an “earth crisis” in the Paris region. This has prompted industry investment into soil construction as a means to recycle fill in large quantities by transforming it into fertile earth. As companies from the waste management sector hope to see the rubble they store become a key material of soil construction, constructed soils become regarded as a commodified good, a fertile material that can be grown, transported, and sold.

As the alliance of urbanism and ecology is increasingly staged as “the design strategy par excellence to address the risk society,”⁴⁸ its self-assigned mission becomes that of guiding the public on the path of sustainable environmental relations. There are striking similarities here with discourses over the Anthropocene, touching on the problem of what Bonneuil and Fressoz have called a “tale of awakening.”⁴⁹ They use this term to critically address a discourse that opposes a blind past to a clear-sighted present. Indeed, scientists working on urban soils, and attempting to manage them, often explain that humans, like all other organisms, have always built and transformed their environments, but that now, they can do it knowingly. As one urban soil scientist once explained to one of his colleagues, “When the Dutch dried up the Polders, they were doing pedological engineering. People have always done it without doing it self-consciously, all we did was to put a name to it. But indeed, what is new is that this time, we really try to mimic nature in the way we design soils.”

Another soil scientist I interviewed thinks about it in a particular way: “All organisms are engineers, and humans are too: every organism is an ecological engineer that continually builds its own niche, and the only difference is set at the level of a *capacity to foresee*, to be aware of the sustainable, or unsustainable character of a project.” Hence, for her, the fault of modernity was to be unreflexive about its relations with the environment, but now scientific progress can put things back on track. For Bonneuil and Fressoz, such a tale of reflexivity reproduces the worldview that it wants to undermine in its unidirectional historicity, and its teleology of ecological becomings: “The new teleology of ecological reflexivity and collective learning replaces the old teleology of progress. Such heralding of the end of modernization is, in fact, a new modernist fable.”⁵⁰

Soil construction is thus a field in which different actors increasingly place their hopes and interests. First explored as a way to reexplore soil-human relations by engaging in urban pedogeneses, it gradually becomes framed as a technical solution to emerging infrastructural problems as it tends to serve the green rhetoric of city planners. At the same time, soil construction speaks to transforming the relationship between modernization and engineering. In the nineteenth century, the engineering consisted of the closing off of soils so that they could become a closet for city infrastructures. In the

48. De Block, “Ecological Infrastructure in a Critical-Historical Perspective,” 367.

49. Bonneuil and Fressoz, *The Shock of the Anthropocene*.

50. Bonneuil and Fressoz, *The Shock of the Anthropocene*, 78.

current period, soils are becoming the very object of infrastructure engineering, rather than something that just underpins it.

The Ongoing Mattering of Urban Soils

Is the present moment of urban soil revival in research and planning that is happening in France and elsewhere foregrounding soils again as a key protagonist in urban ecologies? Now that scientists, planners, and builders speak of re-entangling the humans and soils again, does this challenge modernization paradigms of separation between modern cities and soils more specifically? Deleuze and Guattari,⁵¹ who were always eager to question the agricultural metaphors that shape Western ways of thinking, developed the concept of deterritorialization to describe a process of emancipation or liberation toward ways of doing and established procedures. A deterritorialization is a change of habits in a constituted territory that abolishes the constraints of this territory. Research on “technosols” brings city-soil relations back to the fore by reconsidering how urban life relates to them (rather than being led in a vacuum). By registering what constituted the ecological conditions for urban life, ecologists, urbanists, and policy makers are currently deterritorializing urban soils from the realm of street and foundation engineering and maintenance. From a mute technical being, they become matters of concern that speak to many for discordant reasons. Yet Deleuze and Guattari are careful to note that this liberation is generally only one stage in a process of reterritorialization. It invents and changes the rules of the game, but it can easily fall back into a settled territory with its own new constraints that must, in turn, be resisted.

The intrusion of urban soils has many faces, bringing about several different hopes for the future, some calling for a technocracy, others calling for careful explorations of what soils might be, and how modern urban modes of dwelling interact with them in destructive ways. In France, these new matters of concern have contributed to setting urban soils higher on the agenda, especially around Paris or in the regions affected by industrial abandonment, as many fear that urban sprawl will further loosen the ties between the city and agricultural production areas, and increase the incidence of heat peaks, floods, and threats to biodiversity.⁵² City planners have become interested and worried about urban soils too—and recently also soil construction—for reasons linked to new imaginaries of ecological efficiency, and more particularly to issues of waste management. This resonates with how scientists have begun to value the study of anthropogenic environments and tend to do this with new scientific hypotheses and ways of working, such as soil construction.

At the same time as they try to become careful with urban soils, motivations for attending to urban soils, and the desired outcomes of re-entangling modern cities and their inhabitants more explicitly with them, seem to come down to extending the

51. Deleuze and Guattari, *A Thousand Plateaus*.

52. As was recently reminded in France by a popular exhibition, *Capital agricole. Chantiers pour une ville cultivée*, at the Pavillon de l'Arsenal in Paris.

modernization project underground—whereas before it remained above the sealed surface of the soil. It is exemplary of what Nigel Clark identifies as new “politics of strata,”⁵³ a downward extension of the modernization project whereby territorial management is applied not just to a bi-dimensional space, but to the full depth of the ground. Beneath a discourse of careful experimentation presented, the leopard hasn’t changed its spots. Underlying the trope of making better soils than nature is the age-old hylomorphism that posits human will or agency as the modeler of inert nature or ecologies in need of a better form.

The processes of soil engineering thus come to reproduce the same principles of efficiency and invisibility as the previous sealing of soils. While French cities and their soil seem to become more explicitly entangled again, we first and foremost find scientists and planners asserting themselves on the soils rather than the other way around. Seeing soils in terms of the ecological benefits they bring to humans continues modernist dreams of improving nature to serve urban and economic development. It is a story in which scientists and planners remain the primary achievers⁵⁴ acting upon soils that are soon backgrounded again as green infrastructure. It also easily connects with a capitalistic logic that only equates the intrusion of urban soils with a new field of opportunity. A liberated territory doesn’t remain unoccupied for long, and as we have seen, the new trope of developing and merchandizing ecosystem services is a likely candidate for defining the new model in which urban pedogeneses will exist in the future.

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53. Clark, “Politics of Strata.”

54. Plumwood, *Feminism and the Mastery of Nature*.

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