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Urban environmental history: what lessons are there to be learnt?

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The paper traces the emergence of urban environmental history first in the United States and since the 1990s increasingly also in Europe. It identifies the development of large technical networks which provide cities with water and energy and which serve to take problematic substances and waste out of urban areas as a central theme of this new subfield where scholars from urban history, environmental history and history of technology converge. The concepts of 'path dependence' and 'urban metabolism' are introduced as useful heuristic devices to assess long-term effects of these infrastructures in a holistic manner. The paper shows that the implementation of networks and related household technologies was accompanied by comprehensive processes of social and cultural adaptation which fundamentally altered the attitudes and behavioural patterns towards resource use. Lessons of urban environmental history are seen in providing long-term horizons to current debates over urban technologies and their environmental consequences.

Introduction

Recently urban environmental scholars have become increasingly pessimistic about the future of large cities and their ability to reach levels of sustainability if current trends of resource use and economic development continue (Ravetz 2000: pp. 30–33, McNeill 2000: pp. 269–295, Radkau 2000: pp. 328–240, Hughes 2001: pp. 238–241). As a historian I am in no position to provide models and technical solutions for these problems. History, however, can offer perspectives and analyses that provide scholars of the current environment and policy makers with a deeper understanding of the evolution of the urban predicament. By so doing, historians can also help to clarify choices and options in the formulation of current policy. In this paper, therefore, I will discuss the emergence of a new academic field, urban environmental history, where scholars from different disciplines collaborate and which might give current environmental policy a greater temporal depth and wider scope in its problem analysis. The paper will show how urban environmental history emerged, will then introduce some of the major themes of this research and in the final section I will reflect if, and in what respect, current policy, today's urban and environmental planning might 'learn' from urban environmental history.

What is urban environmental history? How did it emerge?

Urban environmental history emerged in the USA in the early 1990s as a "major subfield of both urban and environmental history" (Tarr 2001: p. 39). Three major influences can be seen as crucial for this process. First and foremost the research into urban technical infrastructures, especially systems of water provision and sewage, waste collection and disposal, as it had been developed by Joel Tarr, Martin Melosi and other scholars since the 1970s, was fundamental. This research greatly expanded our knowledge how and why these systems had been implemented in the first place (Tarr 1996: pp. XXIX–XLVII). The second influence can be seen in the seminal work of William Cronon on Chicago, "Nature's Metropolis". In this book Cronon develops an environmental perspective for the making of Chicago and its hinterland. He shows how crucial Chicago had been for the environmental transformation of the Mid-West from grassland to farmland and how Chicago — in turn — also transformed itself and its immediate environment, the river and the lake. Cronon's work questioned the traditional city–country division and focused the attention on the web of functional relationships binding city to country (Cronon 1991). As a third factor current political influences, especially the debate in the wake of the Rio conference of 1992 on climate change and the UN target to achieve 'sustainable development' provided a strong motivation for urban historians to ask to what extent cities had been 'sustainable' in the past, when and why there had been qualitative changes and ruptures in the ways cities managed their environment and used their resources.

It was Martin Melosi who claimed in 1993 that the city should have a prominent place within environmental history (Melosi 1993). He challenged the exclusion of the city from environmental history which Donald Worster, one of the pioneers in the field in the USA, had postulated in his 1990 article "Transformations of the Earth. Towards an Agro-ecological Perspective in History" (Worster 1990). Melosi criticized that Worster would include farmed landscapes, obviously product of human intervention, as an integral part of environmental history, but not the intervention of building cities. Insisting that cities are derived from the natural world, that they interact and sometimes blend with the natural world, Melosi envisaged that urban environmental history would combine 'the study of the natural history of the city with the history of the city building process and the possible intersections between the two'(Melosi 2001: p. 126). Melosi's intervention was backed by several other historians such as Joel Tarr, Christine Meisner Rosen, Jeffrey Stine and Samuel Hays, who took their stand against such a reduction of environmental history to 'natural spaces' (Rosen and Tarr 1994, Tarr and Stine 1994, Hays 1998, Platt 1999).

European urban environmental history

European environmental history had overall never been dominated by an 'agro-ecological perspective'. A broad range of studies on pollution, especially of air and water, and a growing interest in environmental problems within urban history prepared the ground (for surveys *see* Brüggemeier 1998, Luckin 2000, Radkau 2000, Delort and Walter 2001). By the late 1990s the impetus from US scholars such as Melosi and Tarr to develop 'urban environmental history' as a comprehensive and interdisciplinary field found fertile ground among European scholars. Over the last few years a European discourse on urban environmental history and an international network of scholars active in this field has grown through workshops and publications.

A major session on 'urban environmental problems' at the 4th International Conference on Urban History in 1998, organised by Christoph Bernhardt, provided the start. From this initiative a series of Round-Table workshops in Clermont-Ferrand (2000) and Leicester (2002) had been organised, where urban and environmental historians met to exchange their research findings. In June 2004, the third round-table in Siena dealt with 'The Making of European Contemporary Cities: an Environmental History'. Publications from these meetings take the study of the historical European urban environment to a more comparative and conceptual dimension (Bernhardt 2001, Bernhardt and Massard-Guilbaud 2002, Schott *et al*. 2005).

Apart from these more focused round-tables, European environmental history has also improved its general standing through setting up a 'European Society for Environmental History' in 1999 and holding two well-attended conferences in St. Andrews and Prague (Jeleček 2003, and http://www.eseh.org/home.html).

What are themes of urban environmental history?

In a state-of-the-art survey Joel Tarr (Tarr 2001: p. 38) recently identified the following five primary themes in urban environmental history:

— the impact of the built environment and human activities in cities on the natural environment,
— societal responses to these impacts and efforts to alleviate environmental problems,
— exploration of the effect of the natural environment on city life,
— the relationship between cities and an ever widening hinterland,
— the role of gender, class and race in regard to environmental issues.

The impact of the built on the natural environment, Tarr's theme number one, and societal responses to these impacts, number two, have been most thoroughly studied in relation to one of the central research fields, the 'networking of the city'. Urban environmental historians as well as historians of technology have investigated how since the middle of the 19th century a multi-layered complex of infrastructures for the provision with and disposal of basic resources and services has developed in European and American cities, a second or 'invisible' city underground. This complex of water and sewage pipes, of gas pipes, electricity, telegraph and telephone cables, and public transport lines has proven of fundamental significance for the maintenance of urban civilization (Hietala 1987, Tarr and Dupuy 1988, Tarr 1996, Schott 1999, Melosi 2000, 2001). Special characteristics of these networks are their capital intensity, their longevity and the path dependence they imply.

'Path dependence', a concept which has found increasing acceptance in economic history and history of technology, means that choices for certain key technologies and systems — for instance in early electrification the option for direct current rather than alternating current — can limit the future room of manoeuvre for municipal policy and urban development. The chosen 'path' can only be revised at great expense, and this clearly inhibits a change of direction in how cities manage their resources (Hughes 1983, Schott 1999). When in the wake of war destruction cities considered radical changes in their grid, the restrictive character of these infrastructures became strongly apparent: Most plans to radically redraw the basic lay-out of cities, such as the Scharoun plan for Berlin after 1945, were scrapped after the huge costs of relaying the infrastructure, often not destroyed, had been calculated (Diefendorf 1993).

Urban environmental historians like Tarr and Melosi argue that these networks should be understood as historical responses to specific constructions of problems. The networks offer solutions to certain problems as they were being perceived at the time of their implementation; they document which problems had then been given priority. Studying the making of these networks also drives home the insight that they did not result from a quasi-natural evolution towards technological progress. Rather, they were products of a decision-making process, which comprised scientific concepts, technical expertise, alternative technical options as well as cultural values and financial restrictions (Melosi 2001: pp. 143–157).

Let me illustrate this with an example. When sewage systems were being planned in the European capitals and major cities of the mid-nineteenth century, public health thinking was dominated by the miasma theory identifying dirt and the filthy stench emanating from it as prime causes of diseases. Consequently the first priority was given to cleaning city streets and installing piped water and WCs in residences in order to flush away all decaying organic matter from the urban environment (Hamlin 1998). The city was conceived as a quasi organism; water pipes and sewage systems would act like the body's blood circulation to keep the city functioning and prevent it from being poisoned through its own waste products. Although the miasma theory was disproved by bacteriology in the 1880s, the general approach towards cleaning the urban environment continued to take material shape in the form of sewage systems and water works all over Europe and North America (von Simson 1983, Melosi 2000). This was also due to the sheer scale of waste disposal problems in rapidly growing cities, which led to a collapse of traditional systems of recycling domestic waste on gardens and farmland close to cities. This concept of water works and sewage systems, eventually merging into an integrated system of water provision and waste-water disposal, proved rather successful in reducing water-borne diseases and improving urban cleanliness; it was, however, blind to its effects on the natural environment. At the input side of the system the effects of abstraction of water were hardly considered, and neither were — at least for some time — the effects at the output side through the disposing of waste waters and liquid effluents (Kluge and Schramm 1986, Luckin 1986, Büschenfeld 1997). With the combined sewer as a universal carrier for liquid wastes, it became impossible to separate out more dangerous contaminants before they entered the system (Tarr 1996: pp. 131–158). As long as almost all rubbish and waste on the streets were of organic nature and could be decomposed biologically this was not a major problem, but with motor cars replacing horses, toxic substances such as oil, lead, rubber wear-off and asbestos, produced by motorised traffic were all washed down the drains.

Networking the city was not just a technical task however. The implementation of these networks also generated a social and cultural process of adaptation, leading to fundamentally changed behavioural patterns of urban residents in their use of resources and disposal of waste. Let us take the example of water. Before the introduction of piped drinking water systems in European cities the average water consumption per head was 10–20 l per day. All water had to be carried by hand from the well to wherever it was to be consumed, little wonder that people used it economically. The Finnish expert on water engineering Tapio Katko cites a study from the 1950s, that all Finnish women together daily walked the distance from earth to moon and back carrying water from the well to the cowshed and house (Katko 1997, 2000).

In the 20th century, with flush toilets, bathrooms and electrical household appliances such as washing machines and dishwashers, domestic water consumption rose roughly tenfold to 150–200 l per head per day, in US households even 300 l. (Weizsäcker 1995: p. 117, Ipsen *et al*. 1998, European Environment Agency 2001). The physical networking of the city by pipes and sewers was furthermore shadowed and duplicated by an evolving complex of institutional and legal regulations, which came to govern the relations between suppliers and consumers of these services. Since these services had — at least as compared with most industrial activities — rather high fixed costs, invested in the networks, in reservoirs, power stations and gasometers, and relatively low variable costs, their economic logic drove their managers to stimulate consumption by degressive tariffs; the more you consume, the less you pay per unit, thus favouring higher rates of consumption and consequently growth of resource use (Hughes 1983). With an agenda of sustainable development, this complex of material infrastructures, mental consumption patterns and economic and legal regulations today proves a major impediment to short-term changes.

I have taken the water cycle here as an example, because it makes up the bulk of material flow through cities — for Greater Manchester Ravetz estimates it at 90% (Ravetz 2000: p. 133). Today's civil engineers and environmental planners still have to cope with the basic structures of this legacy, set in place about 150 years ago.

How far is this now urban environmental history and not simply history of technology? Historians studying these networks, while originating from history of technology, have in recent years embraced a wider research agenda by conceptualising the city as an urban metabolism. This concept, derived from human ecology, has been developed in many variations. For urban environmental history I find particularly productive the concept of 'social metabolism' linked with 'colonization of nature', as it has been suggested by a research project directed by Marina Fischer-Kowalski at the University of Vienna (Fischer-Kowalski 1997). This provides a useful framework for a differentiated understanding of all kinds of environmental interventions and

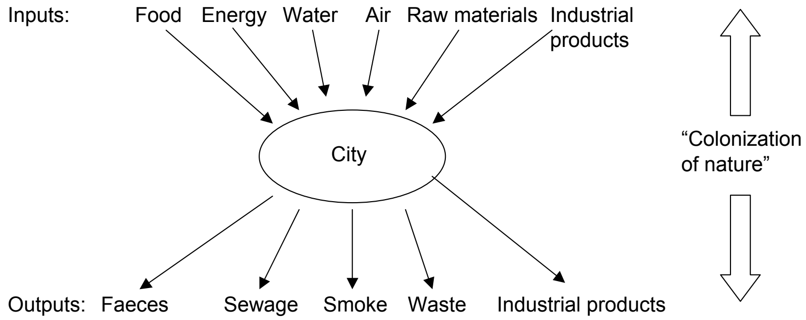

Fig. 1. The urban metabolism. The diagram applies the concepts of 'social metabolism' and 'colonization of nature' as developed by Fischer-Kowalski (1997) and her group for the urban metabolism. The aspects listed under inputs and outputs are only meant as examples and do not include the totality of urban inputs and outputs.

appears particularly suited on the level of cities (Fig. 1).

'Metabolism' of a society is defined — according to Verena Winiwarter — as, 'the sum of all input and output between the biosphere/geosphere and society.' Colonizing interventions are defined 'as the sum of all purposive changes made in natural systems that aim to render nature more useful for society' (Winiwarter 2001).

Such a concept redirects the focus away from the technical networks per se and towards the environmental changes their implementation has effected through 'colonization of nature' on both the input and output side. In historical long-term perspective we can identify a pattern of effects, which are common to all these systems:

— incorporation of resources from an ever-widening hinterland to supply the urban metabolism (e.g. water reservoirs, dams),
— externalisation of critical substances away from the human sphere,
— displacement of pollutants to media where they are considered less harmful,
— dilution of pollutants to render them harmless,
— redefinition of potential resources as waste.

In relation to air pollution, for instance from power stations, these effects can be shown by the construction of higher and higher smoke stacks, a typical approach to air pollution (Clapp 1994, Brüggemeier 1998, Mosley 2001). While the immediate environment around a power station or a major industrial polluter benefited from these measures, this externalization affected a much wider natural environment. The acidification of Canadian and Scandinavian lakes and rivers, far removed from any industrial emissions, but polluted by long-distance air transport of SO^x emissions from US and British industrial regions, is a classic case here.

Joel Tarr has called this universal tendency of externalisation and displacement the "search for the ultimate sink", the place where polluting materials could — as it was assumed — be stored safely without affecting human health (Tarr 1996). He has shown how, in dealing with sewage and solid wastes, a series of disposal methods such as recycling for fertilizer, incineration, and sanitary landfill succeeded each other. Whenever regulation set in to prevent or restrict a certain kind of pollution, because the negative effects had become too obvious and protest had stirred, disposal strategies shifted to a different medium such as compacted landfill. It certainly is one of the major lessons of environmental history in general, that there is no such thing as a 'safe ultimate sink'. Approaches to solve problems with noxious substances by disposing of them 'on the cheap' have proven far too shortsighted, not sufficiently taking into consideration the natural cycles of material transport through water, wind, precipitation, erosion etc. Even the dumping of sludge from sewage treatment on the high sea, customary practice in many cities close to the sea over substantial periods of time, might come back on us through decimated, deformed and degenerate fish resources. And although the smoke emitted from stacks of power stations or the water discharged from sewage treatment plants into rivers is now being filtered and dangerous and polluting substances have come to be extracted by sophisticated modern technology to an astonishing degree, the problems remain how to dispose of those highly toxic substances which have been filtered out.

For Pittsburgh, probably the most heavily polluted U.S. city in the first half of the 20th century, Joel Tarr has recently applied the concept of 'urban metabolism' to examine in a long-term study the above mentioned processes of incorporation, externalization and displacement for water, air and land (Tarr 2002).

Let me give you two examples of what urban environmental history is about from a book — which I am currently editing — about the 2002 Roundtable on urban environmental history in Leicester: Sabine Barles, by training a civil engineer, is engaged in an ambitious and comprehensive project on the urban metabolism of Paris. The group traces and quantifies the flow of water and basic minerals through Paris in the 19th and 20th centuries. Barles could show, how highly integrated these flows still were throughout the 19th century. Most substances arising in the course of urban metabolism through eating and defecation were not in the modern sense 'waste' but were being recycled and reused in a wide range of production processes. These material cycles were not simply residuals from a pre-industrial economy of scarcity but developed anew in response to new market requirements and new technological options. Barles highlights the keen awareness of natural scientists, and economists as to the material value of waste products and their intensive commitment to reconstitute material cycles. Only in the 20th century most of these material cycles seem to have broken up and 'waste' ceased to be a resource (Barles 2002, 2005).

Simone Neri Serneri, professor of contemporary history at the University of Siena and organiser of the 2004 'round-table' on urban environmental history, shows, for the case of Milan, how a sophisticated system of canals and natural watercourses permeated the city and fulfilled a range of functions from transport, energy through to waste disposal and the irrigation of surrounding agricultural land. When the sanitary situation deteriorated massively due to population growth, this system was superseded in the late 19th century by a modern water provision and sewage system. However, this superimposition, not taking into account the capacity of the watercourses to absorb organic pollutant substances, eventually led to the near-collapse of the regional hydrological regimes and the widespread pollution of agricultural land near Milan. This example clearly illustrates that pre-industrial cities did have — sometimes quite elaborate — systems in place to cater for the urban metabolism. The intervention of modern technical networks, while solving public health problems within cities, could easily create a range of collateral problems in their wider natural environment (Neri Serneri 2002, 2005, Bernhardt 2003).

What lessons are there now to be learnt from urban environmental history?

These remarks do not embrace the full breadth of urban environmental history; valuable research is also progressing in other fields such as urban green spaces, the history of soil pollution, regulation of industrial pollution or urban noise (http://www.helsinki.fi/ml/maant/UrbanGeo/openspaces/index.html, Bernhardt and Massard-Guilbaud 2002). However, urban networks and their effects on urban metabolism are clearly central to any discussion on the role of the city in environmental terms.

As a first general point I would claim that urban environmental history brings to current environmental debates a long-term dimension and a higher degree of reflection. Studying the genesis of modern water and sewage systems, of energy and transport systems will help to demonstrate their historical, i.e. to a certain extent contingent, character. Not necessarily the 'best' or most advanced technology won the contest but the technology which in view of the criteria selected, the expectations of relevant actors, the technical expertise available and the financial funds at disposal promised to bring the largest benefit at least costs. Such planning discourses usually were made without any consideration of environmental effects, either because they were not anticipated at that time or because contemporary scientific paradigms such as the capacity of running waters to purify themselves and absorb large quantities of polluted water legitimised the implementation of such technology (Büschenfeld 1997, Radkau 2000). With knowledge of the environmental effects, the criteria might have been different, but since the impact of these systems on the natural environment did not enter such calculations as costs, as these costs were 'externalised', they could be disregarded over substantial periods of time.

Urban environmental history, my second point, can also demonstrate that engineering setting up these networks was dominated by centralizing paradigms. Trained by river improvement and railway construction to plan in larger regional dimensions, 19th century civil engineers conceived water works, sewage, power and transport systems as networks, which were designed to concentrate the management and distribution of resources in large controlling and coordinating premises (Hughes 1983, Gilson 1994, Kaijser and Hedin 1995, Cioc 2002). Their structure and mode of operation was meant to exclude the ordinary citizen from the day-to-day running of the networks. In pre-modern German cities it had been customary for residents using a certain well to assume and exercise shared financial and practical responsibility for the maintenance of this well (Kluge and Schramm 1986). Modern water and sewage networks should in contrast be self-acting systems where no active intervention of a citizen beyond the normal use of his household appliances would be expected. To be sure, this 'normal use' only evolved after a lengthy process of cultural adaptation, which has vanished from the collective consciousness of modern contemporaries, leaving us with the illusion that our current patterns of use of these appliances are somehow 'natural'. This comfortable exclusion of urban dwellers from the functioning of the networks favoured consumerist attitudes but also implied a practical disempowerment. Its backside is a complete dematerialization of resource use. Finnish farm women who as a national collective daily walked 'to the moon' while carrying water, will have physically sensed the quantity of water they had transported by the end of the day. Heating with coal or wood involved physical labour, chopping wood or carrying coal upstairs, and thus made the use of energy resources tangible and material. With oil and gas heating such a connection has vanished, the only sensitive issue remaining is the price. Experiences with environmental innovations over the last years, such as the overwhelmingly positive response of the German population to waste recycling schemes involving extra activity, have motivated environmentalists to challenge this disempowerment of the common citizen, to encourage technological designs which involve and require a higher degree of active citizen participation (Weizsäcker *et al*. 1995, Ravetz 2000).

As a third point I would like to emphasize that the spatial context of these networks has changed considerably: for the fairly compact and densely populated cities of Europe in the 19th and early 20th centuries centralizing network technologies displayed major economies of scale. In the much more dispersed and suburbanised urban agglomeration of the 21st century costs for installation and maintenance of networks increase over-proportionally with decreasing population density towards the periphery of urban areas. And in shrinking towns and cities, a not unlikely prospect for quite a few in the 21st century given current demographic trends in Europe, the existing water and sewage networks may soon be grossly oversized, posing operational and financial problems. On economic as well as environmental grounds it might therefore make sense to rethink the general approach, to install local, decentralised systems of sewage treatment, close to new estates, rather than linking them up to distant centralised systems involving extensive network construction as well as energy for the transportation of the sewage. I have read that Finland with its many second homes in the remote countryside has a rich tradition of well-functioning technologies to offer here. Thus the 'economies of scale' of centralised networks should no longer be simply taken for granted.

The same principle, a reconsideration of basic philosophies of system building in the light of new environmental parameters can be applied to the structure of the electric energy system. In view of the relatively low energy efficiency of large thermal powerstations, urban small and medium size co-generation power stations, supplying power and heat to their neighbourhood have recently been promoted as means of reducing waste of fossil fuel (Hewett 2001). In historical terms this retraces an approach already suggested by some electrical engineers and managers of municipal utilities in Germany in the 1920s and 1930s. At that time this approach as a general principle to structure the energy system was defeated by the hegemony of centralizing paradigms and state interests in rearmament (Hellige 1986, Gilson 1994). Only where cities had control of the power generation and had pursued housing policies — enabling the use of distant heating systems — could such approaches capture a niche market. This example shows how urban environmental history can uncover points of bifurcation in the development of systems where technological alternatives, which from today's perspective might have been more sensible, were excluded and no longer pursued (Schott 1997, Kaijser 2001).

One might argue, what is the use of urban environmental history in the age of globalization? Despite the undeniably global scale of major environmental problems, the slogan "think global, act local" does make sense. The city and the city region have been rediscovered as functional and appropriate levels of environmental action, due to the fact, that the use of resources and the disposal of waste products are *in nuce* and fundamentally a phenomenon occurring at a specific locality, although with potentially global ramifications. The technologies which manage our resource use and waste disposal today, were, as I have demonstrated, developed in cities and as answers to urban problems. And as the local Agenda 21 processes in many European cities have shown, it is within an urban environment that discourses on how to progress towards sustainable development can be and are being organised, that practical steps can be outlined, that changes for the better or worse can be felt. Studies like that of Joe Ravetz "City Region 2020" on planning for a sustainable Greater Manchester underline the feasibility of such a strategy (Ravetz 2000).

To conclude, analysing the historical genesis of urban material flows and urban metabolism can show how in the current systems which manage urban metabolism there are structures incorporated which are residuals from past problem constructions no longer adequate for the problems as we see them today, but nevertheless real and having an impact as integral parts of functioning networks. Urban environmental history thus can raise awareness for the fact that these systems in their historical genesis have environmental, social and cultural effects far beyond their period of primary implementation. This, in turn, should sensibilize for possible restrictions and path dependencies implied in today's choices on urban technologies. Such awareness might inspire a range of questions to put to current decision makers such as:

— What will the half-life of the structures created today be?
— How difficult, how financially demanding will it be to revise today's decision, if this were to be deemed necessary, to find new, different solutions?
— What kind of materials and emissions will be released, how can they be recycled or neutralised?

Urban environmental history also draws attention to the 'software' dimensions of environmental problems, to the fact that certain patterns of wasteful and inefficient resource use and pollution have developed as the result of social and cultural adaptations to historical new technologies. Therefore they may only be altered by a combined approach, reviewing both the material infrastructure as well as their manifestations in law, administration and urban culture.

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