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Water, Sanitation and the Modern City: Colonial and Post-colonial Experiences in Lagos and Mumbai

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Executive summary

- The technological and political arrangements for the provision of water and sanitation that emerged out of the chaos of the nineteenth-century industrial city can be characterized as the "bacteriological city". This ideal type, which reflected the design principles of leading engineers, involved the development of centralized, universal and public water supply and sanitation systems in preference to chaotic, expensive and unaccountable private sector provision.

- Although this universal model became the norm throughout the developed world in much of what is now referred to as the global South the bacteriological city was never fully implemented for a mix of political and fiscal reasons. Most colonial cities only provided adequate water supplies to elite enclaves or to predominantly middle class districts. With respect to sewerage and drainage infrastructure these disparities in service provision were even worse leading in many cases to severe and repeated outbreaks of infectious disease. With rapid urban growth in the post-colonial era many of these inequalities in access to water and sanitation infrastructure have substantially deteriorated, a situation exacerbated by poor public finances, economic instability and deficiencies in metropolitan government.

- By the 1970s and 1980s the state dominated model of the bacteriological city found itself under sustained political and economic pressure in developed economies leading to an enhanced role for the private sector in the funding and provision of basic services. Since the mid-1990s there has been an attempt to export this "privatization" model to many cities in the global South but this has had a marginal and in some cases deleterious impact on the water and sanitation crisis. The current policy debate is shifting towards a recognition that large-scale divestment programmes cherry picked by global water companies will not benefit the poor and that a combination of local solution such as municipal bonds combined with a detailed exploration of best practice rather than externally imposed solutions may provide the best way forward. The state, whether as coordinator or direct provider, will continue to play a central role not least through its connection to the democratic arena and wider processes of rebuilding the public realm and extending citizenship rights for the urban poor.

- The two case studies presented here — Lagos and Mumbai — share important features: a majority of the urban population in both cities lack direct access to municipal water supplies; the urban poor are largely reliant on exorbitantly priced private sources such as tankers and street vendors; and the municipal sector faces formidable fiscal, organizational and political challenges. In both cities there is intense debate over how to improve services and widespread scepticism towards externally imposed privatization programmes. There is a high level commitment in both cities to improve the efficiency, transparency and equity of service provision but this rests on securing sufficient capital for investment, employing high calibre dedicated staff and re-building public confidence in municipal government.

Introduction

The development of water and sanitation infrastructure is now the focus of a vibrant debate that combines the established insights of urban history with emerging perspectives drawn from other fields such as architecture, critical theory and urban studies. Emphasis on the administrative, technical and political dimensions to urbanization since the nineteenth century has been supplemented by a greater emphasis on the micro-spaces of the modern city — in particular the body and the domestic interior — along with an expanded theoretical discussion of themes such as the ideological rationale for urban governance, the role of public works projects in the construction of a functional public realm and the social, cultural and economic implications of technological networks in urban space (see, for example, Gandy, 2004; Graham and Marvin, 2001; Heidenreich, 2004; Kaïka and Swyngedouw, 2000).

Implicit within this current debate is a sense that a relatively stable period extending from the mid-nineteenth century until the last quarter of the twentieth century has been partially supplanted by a new set of socio-technological developments. This report begins with an exploration of the movement towards of a distinctive constellation of space, society and technology that is referred to here as the "bacteriological city" in order to differentiate this historical phase from the early industrial era and also from a range of developments over the last thirty years associated with the emergence of neo-liberal approaches to public policy. Placing an extended period of urban history under one conceptual frame risks a degree of elision between different developments but it does help to identify some of the commonalities and anomalies that have characterized processes of capitalist urbanization since the middle decades of the nineteenth century. This urban epoch has been variously referred to in the literature as the "hydraulic city", the "sanitary city", or the "modern infrastructural ideal" but the term "bacteriological city" is deployed here to denote a distinctive set of interrelated developments ranging from science and technology to new forms of municipal administration.

In exploring the development of water infrastructure the first part of this report examines the transformation of the modern city as part of an interrelated set of developments that transcend the interventions of individual engineers, planners or medical advocates. The relatively stable urban form that emerged out of the chaos of the nineteenth century is presented as a historical compromise that emerged in order to enable the modern city to function more effectively. Yet in circumstances where the modernization process was never fully completed — most notably in a colonial context — the underlying weaknesses of the bacteriological city as a universal ideal are sharply revealed. The colonial experience is explored in the report using the examples of two megacities in the global South — Lagos and Mumbai — and deploys findings from two international research projects entitled *Cyborg urbanization* and *Rethinking urban metabolism* funded by the UK Economic and Social Research Council. We find that the current crisis in the provision of water and sanitation in these cities cannot be understood without reference to the historical development of inadequate infrastructure systems and the current political and economic constraints on investment in the physical environment. A core argument articulated is the need to combine an understanding of water infrastructure with the development of citizenship rights and the construction of the public realm as a tangible expression of collective social and political goals.

1. The emergence of the bacteriological city

The nineteenth-century city, as the political and economic fulcrum for industrialization, posed a complicated set of dilemmas for the scope and effectiveness of modern government. A particular challenge during the first half of the nineteenth century was the marked deterioration in urban living conditions punctuated by devastating outbreaks of infectious disease. Though the public health crisis affecting rapidly growing cities was readily ascribed to atrocious physical conditions this masked competing interpretations of the problem and the degree to which public health was conceived as part of a wider set of social and political reforms. The more narrow technical view of the British sanitary reformer Edwin Chadwick, for example, can be contrasted with the more radical agenda advanced by the German bacteriologist and political advocate Robert Koch (see Evans, 1987; Hamlin, 1998).

The relationship between poverty, disease and the physical environment remained a confused arena in the pre-bacteriological era in part because few professional discourses engaged with urban problems in any systematic way that might enable the political, economic and technical spheres to be considered in relation to one another. In any case, diseases such as cholera and typhoid threatened not just the poor but entire populations and problems with water supply were generally conceived in terms of taste or convenience rather than outright threat.

1.1 The development of new forms of scientific analysis for urban problems

With the development of the empirical sciences in the early decades of the nineteenth century, however, the pattern of mortality and morbidity could be conveyed far more accurately than in the past. The surveys and writings of figures such as Friedrich Engels, Henry Mayhew, Thomas Southwood Smith and others placed the living conditions of the modern industrial city under unprecedented critical scrutiny. The issue of public health became an increasingly significant concern for the modern state so that the health of the population acquired a strategic importance that had previously been neglected.

The gradual acceptance of contagionist conceptions of disease epidemiology also undermined the last vestiges of an organic conception of the modern metropolis and rendered human faeces not only a focus of abjection but also a source of danger to public health. In Paris, for example, new legislation in 1894 made the connection of individual dwellings to the main drainage system mandatory as the introduction of *tout-à-l'égout* replaced the complicated and increasingly unworkable sanitary arrangements of the Haussmann era (Gandy, 1999; Jacquemet, 1979).

1.2 Political and economic demands for improved water supplies

The place of water within the nineteenth-century city reflects an ambiguity between the strategic needs of the modern state and the development of reformist dimensions to urban political discourse. The demonstration of linkages between contaminated water and ill health played a pivotal role in fostering the political demands of the burgeoning public health movement for the physical reconstruction of cities even if the rationale for improving water infrastructure rested on a wider set of factors at best only tangentially related to human health. Many industries in the nineteenth-century city such as chemical works, breweries, tanneries and distilleries all relied on pure and reliable water supplies and demanded action from municipal authorities to tackle the deteriorating situation. In addition to industrial needs for water, the constant threat of fire provided a further spur to action not least because of the growing political power of the insurance industry (see Gandy, 2002).

1.3 The creation of new forms of public finance

The rapid growth of nineteenth-century cities quickly overwhelmed the historic reliance on wells, water vendors and other sources and led to the introduction of centralized water supply systems in, for example, Paris in 1802, London in 1808 and Berlin in 1856. Yet this shift towards more elaborate systems of water supply introduced new tensions over how the costs of these infrastructure projects would be borne. The transformation of the modern city would have been impossible without the innovative use of financial instruments such as municipal bonds to enable the completion of ambitious engineering projects without imposing substantial additional tax burdens. In the 1830s, for example, New York City issued bonds to enable the completion of the Croton Aqueduct to solve the city's chronic water shortages and in the 1850s Berlin drew not just on British engineering expertise to develop its water supply but also on the financial resources of the London capital markets (Bärthel, 1997; Tepasse, 2001). Municipal bond markets weathered the economic turbulence of the 1870s and played a pivotal role in enabling the development of infrastructure networks: by 1905, for example, water works constituted the largest component of municipal debt for US cities (Cutler and Miller, 2005). These and other financial mechanisms enabled the flow of capital to be channelled into the built environment and also underpinned the growing interconnections between urbanization and international finance.

1.4 The rise of modern individualism and changes in the domestic sphere

In one sense the urban population was increasingly regarded as a collective statistical entity but in another sense the more communal sensory experience of the past was increasingly challenged by new attitudes towards privacy and social distinction. Changing attitudes towards health, hygiene and cleanliness, for example, involved an emphasis on increasingly individualized forms of identity and a growing cultural emphasis on the redefinition of the domestic arena (see Corbin, 1986; Frank, 2003; Lupton and Miller, 1992). The emergence of new social formations also coincided with intensified forms of spatial differentiation so that the vertical segregation of the congested pre-industrial city was increasingly superseded by the horizontal segregation of the expanding industrial metropolis and the emergence of distinctive working class districts within the city.

Yet the spread of these technological networks and new plumbing innovations within the home remained highly uneven in different national and cultural contexts and was largely restricted to middle-class households until the wider diffusion of prosperity during the twentieth century: the general introduction of water closets, for example, was limited before the 1880s and bathrooms only became a standard domestic fixture after 1914 (see, for example, Glassberg, 1979; Goubert, 2000).

1.5 The development of urban and regional planning

In addition to new methods of financing public works the reconstruction of cities also required the establishment of new policy instruments such as the power of eminent domain and other planning mechanisms that enabled a strategic urban vision to override multifarious private interests. Wealthy residents with their own wells, for example, had frequently sought to organize petitions against the development of municipal water systems that they regarded as expensive and unnecessary (see Gandy, 2002). Furthermore, the construction of large-scale hydraulic engineering projects required the acquisition of private lands both for the completion of new infrastructure and also to protect public water systems from possible contamination with agricultural wastes or other possible sources of pollution.

1.6 The shift from private to public water supply systems

A critical trend from the middle decades of the nineteenth century onwards was the replacement of inadequate private water companies by public ownership. Private companies routinely exploited their monopoly of individual supply networks by refusing to extend services to outlying districts or by making excessive charges for poor quality services. In cities such as Los Angeles and New Orleans, for example, the charters of private water companies were revoked under public pressure to allow the development of municipal water services. In the USA some 43 per cent of water works were publicly owned in 1890 compared with over 70 per cent by the 1920s as networks expanded to include poorer or more distant neighbourhoods (Cutler and Miller, 2005; Kahrl, 1982; Melosi, 2000; Troesken, 1999; Troesken and Geddes, 2003; Walton, 1992). The trend towards the municipalization of water supply involved bringing diverse private operators under the control of the local state to produce more unified, centralized and democratically accountable forms of service provision (Daunton, 1983; Evans, 1987; Penzo, 1994; Pickstone, 1992).

1.7 The development of new forms of technical and managerial expertise

The development of the "bacteriological city" required the introduction of new forms of technical and managerial expertise in urban government. The replacement of miscellaneous administrative bodies such as parishes and vestries with more centralized approaches to urban management necessitated the expansion of state bureaucracies so that the development of cities became an interrelated facet of the growing political power of the nation state. Yet the relationship between technical knowledge and municipal reform remained a complex arena where rival technological solutions to the problems of urban sanitation became repeatedly entwined in political conflicts over the autonomy of professional expertise in urban policy: engineers, for instance, frequently expressed their frustration at the fiscal and political barriers to the completion of their work — a sentiment which finds its clearest expression in the ambivalence of colonial urban administrations towards the latest advances in engineering science.

1.8 The limits to the bacteriological city

In a colonial context advocates for urban improvement operated within a political arena where the nascent forms of citizenship and political reform enjoyed in Europe or North American had only limited significance. The emerging bacteriological city was a technical adjunct to capitalist urbanization yet its full realization was in conflict with the marginal status of the colonial city so that dualistic, moralistic and "neo-miasmic" discourses persisted in preference to any universalist response to the modernization of urban infrastructure. Throughout much of the global South neither comprehensive sewer systems nor waste water treatment works were ever introduced and even in Europe and North America the deficiencies of existing water treatment systems have been the focus of new waves of legislation and political contestation since the 1980s.

Until recently the lagging levels of connection to modern water supply and sanitation systems in the cities of the global South were widely perceived as a temporary phenomenon to be overcome through ambitious efforts at urban planning and reconstruction. The UN Mar de L'Plata declaration of 1977, for example, which initiated the International Drinking Water Supply and Sanitation Decade, envisaged that the centralized "bacteriological city" model would ultimately be extended worldwide. In reality, of course, the technocratic ideal that drove the development of the bacteriological city conflicted with the political and economic dynamics behind capitalist urbanization: a tension that was largely masked within the metropolitan core

of Europe and North America but which was clearly manifest within colonial cities from the outset.

1.9 Conclusions

The bacteriological city that emerged our of the chaos of the nineteenth century comprises a series of identifiable elements:

- new advances in the science of disease epidemiology and later microbiology that gradually dispelled miasmic conceptions of disease;
- the emergence of new forms of technical and managerial expertise in urban governance;
- the innovative use of financial instruments such as municipal bonds to enable the completion of ambitious engineering projects;
- the establishment of new policy instruments such as the power of eminent domain and other planning mechanisms which enabled the imposition of a strategic urban vision in the face of multifarious private interests;
- and the political marginalization of agrarian and landed elites so that an industrial bourgeoisie, public health advocates and other voices could exert greater influence on urban affairs.

In broad terms we can conceive of the modernization of industrial cities as a shift from the "private city" to the "public city" whereby fragmentary, piece meal and highly localized solutions to the problems of water and sanitation were superseded by the promotion of more complex kinds of coordination between political and economic interests. This transition was in fact a double movement so that public activities such as washing were increasingly restricted to the private sphere whereas privately organized access to potable water or sanitation was gradually incorporated into a centralized, networked and municipally controlled metropolitan form. The bacteriological city was, above all, a new socio-spatial arrangement that could simultaneously ensure a degree of social cohesion at the same time as protecting the political and economic functions of the modern city.

In the last thirty years the municipal dominance in urban water provision has come under pressure from a number of different quarters:

- the anomalies within the universalist ideal, where it has been only partially implemented, have been exposed through the so-called "brown agenda" and demands to extend global access to water and sanitation;
- the integrated model of service provision has been extensively fractured through the splintering and disaggregation of technical networks to produce new inequalities;
- expert led approaches to civil engineering and urban planning have been extensively challenged by an emphasis on expanded public participation and a widening array of different interest groups;
- and the resurgence of private provision, in conjunction with new patterns of capital investment, is generating a different kind of urban landscape to the more ostensibly homogeneous technological landscapes of the past.

2. Lagos

Lagos — the largest metropolis in West Africa — is now one of a number of rapidly growing cities in the global South which appear to challenge many previously held assumptions about the relationship between economic prosperity and demographic change: unlike the experience of nineteenth-century Europe and North America, for example, we observe a form of urban "involution" marked by vast expansion in combination with economic decline (see Davis, 2004; UN, 2003a). The UN has recently predicted that by the year 2015, the population of Lagos — currently estimated at over 10 million — will reach 17 million, making it one of the largest cities in the world (UN, 2003b). The sprawling city now extends far beyond its original lagoon setting to encompass a vast expanse of mostly low-rise developments including as many as 200 different slums ranging in size from clusters of shacks underneath highways to entire districts such as Ajegunle and Mushin.

The recent history of Lagos has been marked by a stark deterioration in quality of life. Over the last twenty years the city has lost much of its street lighting, its dilapidated road system has become extremely congested, there are no longer regular refuse collections, violent crime has become a determining feature of everyday life and many symbols of civic culture such as libraries and cinemas have largely disappeared. The city's sewerage network is practically non-existent and at least two thirds of childhood disease is attributable to inadequate access to safe drinking water. In heavy rains over half of the city's dwellings suffer from routine flooding and a third of households must contend with knee deep water within their homes. Average incomes of under one dollar a day are now lower in real terms than in the 1960s and export earnings from manufactured goods have fallen dramatically since the de-industrialization and economic instability of the 1980s. A combination of external debt, currency collapse and capital flight has contributed towards an investment crisis across virtually every sector of the Nigerian economy complicated by centrifugal tendencies that threaten to tear the country apart along lines of ethnic, religious and tribal difference.

2.1 Colonial Lagos and the emergence of dual governmentality

From its early development as one of the leading centres for trade and commerce in West Africa, Lagos was imprinted with a persistent and striking disjuncture in living standards between European elites and the African majority. Successive colonial administrations from the middle decades of the nineteenth century onwards failed to tackle the problems of overcrowding, disease and inadequate urban infrastructure. The so-called Manchester doctrine of minimal financial support for overseas colonies ensured that Lagos would be perceived as "little more than an entrepôt of trade" (Aderibigbe, 1959: 8). The British colonial administrators sought to transform the port into the "Liverpool of West Africa" yet attempts to improve urban conditions were hampered by lack of financial support from the British Treasury, regional political instability and wider economic perturbations affecting the price of commodities such as cotton and palm oil. Lagos became renowned as one of the most insalubrious cities in West Africa on account of its swampy setting and virtually non-existent sewer system (Brown, 1992; Echeruo, 1977; Gale, 1979). Earlier efforts to tackle malaria, foster public health education and improve the sanitary conditions of poorer districts were gradually abandoned in favour of new strategies of segregation between wealthy enclaves and the supposedly indifferent general population (Home, 1983; Peil, 1991). The "hygienist" discourse which developed in tandem with new scientific approaches to public health policy in the cities of Europe and North America was re-fashioned in a colonial context to produce a cultural dualism between "modernity" and "tradition" so that investment in urban infrastructure was

disproportionately concentrated in wealthy enclaves. In order to manage the growing city colonial administrators incorporated the existing power structures of chieftaincy into the apparatus of government to produce a highly iniquitous and unstable legacy of authoritarian and undemocratic control over the African majority (see Mamdani, 1996). This "incomplete modernity" was to have catastrophic consequences for Lagos as the partial completion of water supply systems in the absence of any systematic modernization of sewerage and drainage infrastructure led to a series of devastating public health crises culminating in the bubonic plague outbreaks of the 1920s (see also colonial Bombay below).

After the public health crisis of the 1920s a comprehensive plan for the modernization of the Lagos sewers was prepared by the colonial authorities but after the economic downturn of the 1930s the scheme was "indefinitely postponed". A further post-plague initiative was the creation of the Lagos Executive Development Board in 1928 but the remit of this body was geared towards large-scale slum clearance. The demolition rather than improvement of African parts of the city provoked increasing anger and hostility and underlined the degree to which planning activities ignored African opinion. By the 1950s local newspapers were describing sanitation conditions in impoverished districts as "poor and disgraceful" and the Nigerian National Democratic Party was making increasingly vociferous attacks on the mendacity and incompetence of colonial administrators. The structure of local government increasingly resembled that of a nineteenth-century English town with a "confusing maze of interim committees appointed to deal with specific needs" (Baker, 1974: 168). The official response to African demands for municipal reform in the 1940s and 1950s was to either play on the perceived differences in "traditional" sanitary practices or to highlight the nefarious effects of urban life on indigenous power structures. The urban question was thus repeatedly framed in terms of a problem of public order rather than the outcome of inadequate investment or unaccountable policy initiatives. An ideological distinction between "modernity" and "tradition" was drawn on in order to obfuscate the fiscal and administrative limitations of the colonial state. A pervasive sentiment on the part of colonial administrators was that poor environmental conditions facing the majority of the city's population were essentially an outcome of unregulated or ill-advised settlement patterns and hence largely the fault of the people themselves.

The experience of colonial rule in Lagos involved a medley of different power structures in which successive European attempts to manage the settlement revealed both the internal contradictions and outer limits of their governmental strategies. Whilst European educated engineers and sanitary inspectors sought to influence colonial administrators the unfolding dynamic of largely unregulated capitalist urbanization served to instil an ideological coalescence between fragmentary forms of urban governance and a weak public sphere marked by intense and deepening forms of social inequality. Indeed, it is arguable that the "splintering urbanism" thesis, recently elaborated by Stephen Graham and Simon Marvin (2001) in relation to the post-Fordist restructuring of urban technological networks, is in fact a closer approximation to the existing structure of Lagos than the never implemented "modern infrastructural ideal" which preceded it in the cities of Europe and North America.

2.2 The post-colonial metropolis

The city of Lagos at Nigerian independence in 1960 was fast becoming not only the commercial but also the pre-eminent cultural centre in West Africa. Yet the fast growing city of just under a million people was wrought by organizational complexities and political tensions including continuing jurisdictional disputes

between city and regional government. The municipal authorities lacked both the institutional mechanisms and administrative capacity to cope with the needs of the city: a survey of Lagos by a United Nations research team shortly after independence identified a range of serious problems including extreme congestion, extensive housing shortages, exorbitant rents, scarcity of housing finance, rapid growth of slums and inadequate sanitation (UN, 1964). High land values in combination with weak municipal government ensured that the best sites were consistently allocated to elite low density housing in a continuation of colonial land use patterns. Yet even if enlightened planning policies had been adopted there would have been major difficulties in implementing them since the Nigerian state had very little technical and administrative expertise available for the management of cities: in the mid-1960s, for example, there were only thirty professional planners working in the whole of Nigeria; and in the immediate post-independence era there was reportedly only one skilled engineer in charge of the city's entire water distribution system (Muench and Muench, 1968; Williams and Walsh, 1968).

The limited investment in water and sanitation infrastructure had left a situation in which only ten per cent of dwellings in the Lagos metropolitan area were directly connected to the municipal water supply system whilst the rest of the city relied on shared taps, standpipes, wells and polluted creeks. As for the city's sewer system the situation was even worse with the complete absence of any functional system at all. The creation of a comprehensive underground sewage system had been proposed at various times since 1902 but with little impact. The most recent attempt in 1956 had been abandoned because of lack of capital combined with political chicanery on the part of an "anti-sewage" clique on the Lagos Town Council who had business connections with night-soil collectors (Williams and Walsh, 1968). The continuing absence of a functional sewer system in Lagos provides perhaps the most striking indication of an emerging disjuncture between a "showcase modernity" reflected in the construction of prestige projects such as the National Theatre in 1977 and the city's continuing inability to provide basic infrastructure (Gandy, 2005).

The problems of adequate infrastructure provision and the implementation of regulatory frameworks for the development and establishment of more responsive and accountable forms of municipal government simply overwhelmed what limited resources that were available. The inherited governmental structures of "decentralized despotism" from the colonial era militated against the development of more inclusive or responsive forms of democratic government (see Mamdani, 1996). In 1966, following Nigeria's first military coup, the Lagos Town Council was dissolved to be replaced a year later by a new administrative structure called Lagos State under military control. In the wake of the two and a half year Nigerian civil war which broke out in 1967 the city's difficulties were further exacerbated by huge waves of migration from eastern parts of the country. The civil war, fostered in part by secessionist attempts to control newly discovered oil resources, resulted in an intensified militarization of Nigerian politics and a shift from the colonial legacy of "indirect rule" towards a new form of "authoritarian governmentality" stemming in part from a political compromise between the Muslim north — where the army drew its main sources of support — and the concentration of commerce and natural resources in the mainly Christian south.

At independence Lagos was the leading industrial centre of Nigeria. The city accounted for at least 30 per cent of national production with more than 200 factories producing products such as soap, beer, building materials, textiles, steel, aluminium, motor cars and some 30 per cent of the male workforce was engaged in skilled

manual work (Mabogunje, 1968; Marris, 1961; Williams and Walsh, 1968). From the mid-1970s onwards, however, the city suffered from acute and accelerating industrial decline marked by declining real incomes and huge increases in poverty and unemployment. The provision of infrastructure for the city's industrial base remained so poor that most firms had to spend over 20 per cent of their capital on providing their own sources of water, electricity and other basic services (see Anas and Lee, 1989). Companies such as Lever Brothers and Guinness, for example, were having to pump water from half a mile below the surface to continue production and many of the city's 14 "industrial estates" — established in the 1960s and 1970s to attract inward investment — were in a state of total disarray (Ayida, 1981). The city's ill-fated industrial estates also fostered the development of vast slum settlements for their workers characterized by hastily constructed two or three storey dwellings with as many as 10-15 occupants per room and often no water or electricity (Aina, 1989; Aina *et al*. 1994; Fapohunda and Lubell, 1978). The origins of some of the most extensive slums in Lagos such as Ajegunle, Mushin and Somolu represent the remnants of the city's failed industrialization strategy: they are in effect intense concentrations of human labour for which the promise of work and prosperity has never materialized.

The conversion of the Nigerian economy into a "petro economy" after the discovery of oil in the Niger Delta just before independence was to have far reaching consequences. During the 1970s, for example, government oil revenues multiplied almost sixty fold yet the "rentier" nature of oil wealth in comparison with other forms of productive activity fostered the emergence of powerfully fetishistic conceptions of money and wealth that served to destabilize Nigerian society. The Nigerian economy, like other oil rich states such as Angola and Venezuela, became increasingly characterized by a paradoxical combination of extreme wealth in the hands of a few accompanied by a generalized deterioration in living standards due to a combination of currency collapse, hyperinflation, income polarization, political instability and rising poverty and unemployment (see Karl, 1997; Watts, 1994). The global recession of 1981 led to a collapse in oil prices that immediately plunged the Nigerian economy into debt and led to the abandonment of many of the city's infrastructure programmes (Obi, 2003; Okunlola, 2003). Even those few capital investment projects that garnered political support during the 1980s were often abandoned for economic reasons: countless contracts became untenable because of the collapse of the naira (the Nigerian currency unit) and the impact of spiralling foreign debt which rose from 13 billion dollars in 1981 to in excess of 30 billion dollars by 1989 (now equivalent to some 75 per cent of Nigerian GDP) (see Elliot, 2005; Isichei, 2002; Owusu, 2001).

2.3 The search for a new governmental paradigm

Deficiencies in water and sanitation provision continue to provide some of the most striking manifestations of the city's worsening infrastructure crisis. We now find that less than five per cent of households in Lagos have piped water connections (a fall from around ten per cent in the 1960s) and that less than one per cent are linked to a closed sewer system (principally hotels and high-income compounds). Even those with piped connections must contend with interruptions due to power supply failures affecting the city's water works. The rest of the city depends on wells, boreholes, water tankers, various illegal connections, street vendors, and in desperation, the "scooping" of water from open drains by the side of the road (Expunobi, 2001). Inhabitants of slum settlements often face a stark choice between either polluted wells or expensive tanker water distributed by various intermediaries at high and fluctuating prices making the management of household budgets even more precarious. When municipal authorities do attempt to extend water supply to poorer neighbourhoods they are often met with violence and intimidation from water tanker lobbies, "area

boys" and other groups who benefit from the unequal distribution of water and the "micro-circuits" of exploitation which characterize slum life. People's daily survival is based on careful distinctions between different kinds of water suitable for drinking, cooking and washing, with much time and expense devoted to securing household water needs. Regulatory authorities also struggle to cope with the proliferation of "pure water" manufacturers producing small plastic sachets of drinking water sold throughout the city which have been associated with the spread of water-borne disease (Aina, 1994; Ikoro, 2001; Osumah, 2001). The sellers of these "pure water" sachets — thousands of mostly young Lagosians — weave their way between lines of slowly moving or stationery traffic as the need for potable water has become part of the city's burgeoning informal economy.

The politics of infrastructure provision after the return to civilian rule in 1999 is currently undergoing a subtle yet profound transition in Lagos marked by an extended influence for NGOs and a plethora of interest groups which could not function under military rule. Organizations such as the housing activist network Shelter Rights Initiative, the critical architectural forum Central Intelligence Agency and the urban environmental group Metamorphosis Nigeria have made demands for an improvement in urban conditions and have become an integral element in new forms of civic mobilization facilitated by the rapid spread of wireless communications, new press freedoms and the wider dissemination of information (see, for example, Ahonsi, 2002). And patriarchal structures, underpinned by political clientelism and military rule, are now being increasingly challenged by a new generation of women activists and public servants committed to improving social and environmental conditions within the city (see Järvelä and Rinne-Koistinen, 2005; Tostensen *et al*. 2001). Yet as the Lagos-based planning consultant Ako Amadi relates, the pervasive problems of corruption, however we choose to define this term, in combination with widespread public indifference have produced a scenario that is peculiarly antithetical to more socially responsive forms of urban policy making (Amadi, 2003). Despite these formidable barriers, however, some limited changes are discernable in the electoral arena: in the regional elections of 2003, for example, the governor for Lagos State, Bola Ahmed Tinubu, a US-trained accountant, was re-elected on a political programme which specifically sought to address the city's crisis in the provision of basic services. The issue of water, for instance, featured prominently within Tinubu's re-election campaign as part of a more technocratic approach to Nigerian politics reflected in the appointment of public administrators with extensive international or private sector experience. Yet the current emphasis on more technocratic forms of urban politics threatens to widen disparities in service provision between different parts of the city: rather than a renewed dynamic between the state and civil society the underlying impetus is towards a business led model for urban regeneration. In 2003, for example, the city transformed the administrative structure of water provision to create 28 water zones and 13 sewerage districts geared towards "strategies specific for the demographics in those areas" (Coker, 2003). Yet the creation of these "governable entities" based on the demographic characteristics of different areas raises important questions: in prosperous parts of the city, for example, water charges will be made directly to individual households whereas in slum areas "community-based markets" will be established utilizing the traditional authority of chiefs as a revenue raising strategy (see Page, 2004). This emerging dichotomy in modernization strategies for water provision raises the spectre of new forms of "authoritarian governmentality" which combine neo-liberal concerns with "full cost recovery" with a dependence on non-democratic sources of power in civil society. There is a danger, for example, of perpetuating a dual discourse of governmentality between wealthy enclaves which emulate the commercial zones of other global cities and the mass of

the urban poor trapped under the arbitrary largesse of powerful local networks or held in abeyance by chiefs, elders and other unelected dignitaries.

International agencies such as the World Bank have emphasized the privatization of public services as a panacea for the city's infrastructure crisis but the broader implications of legal and institutional reform that might underpin tentative moves towards improved and more accountable modes of public administration have been scarcely addressed. These tensions were exposed in 2003 with the break down of negotiations between the Lagos State Water Corporation and the International Finance Corporation when it became clear that the proposed privatization proposals prepared by external consultants were unworkable and bore little relation to the "social and economic realities on the ground" (Coker, 2003). This represents a significant change from the late 1990s when a number of Lagos newspapers openly embraced the prospect of privatization as an alternative to the municipal control of basic services. We can discern a shift in policy discourse underway in Lagos which is marked by less reliance on external expertise and a greater commitment to developing local solutions which learn from best practice elsewhere: the impact of failed large-scale divestment programmes in cities such as Buenos Aires, Manila, and most recently in Dar-es-Salaam, has had a profound impact on policy discourse in the city. The newly emerging African technocrats running public services in Lagos and elsewhere are much better informed about international policy developments than their predecessors and are far more sceptical towards the advice of the World Bank and other international agencies.

2.4 Conclusions and reflections

Given the young demographic profile of Lagos and the high proportion of migrants from elsewhere in West Africa most people have never experienced functional public services so that any political mobilization for change cannot simply be predicated on the memory of Lagos before its rapid deterioration during the 1980s and 1990s. In these circumstances the construction of a viable public realm is doubly difficult because of the fiscal and administrative weaknesses of municipal government in combination with the lack of political salience for any appeal to better urban conditions experienced in the past.

Lagos faces a paradoxical situation within which any tentative steps towards improvement may engender new waves of migration from more precarious locations elsewhere (Coker, 2003). Yet this is not a city undergoing an economic transformation comparable with Mumbai, Shanghai or other dramatic examples of a globalized urbanism. Lagos is a city on an uncertain trajectory which differs from recognized patterns of capitalist urbanization because the city is growing rapidly in a context of economic stagnation to produce what one might term a "post-productive" metropolis on account of its degree of dislocation from the global economy. This dilemma is illustrated by the evolving relationship between capital flows and the built space of the city: under the classic model of Western urbanization flows of capital were fixed in space through a combination of financial and institutional mechanisms ranging from municipal bonds to legislative interventions in the urban land market. In Lagos, by contrast, the colonial state apparatus and its post-colonial successors never succeeded in building a fully functional metropolis through investment in the built environment or the construction of integrated technological networks. Vast quantities of capital that might have been invested in health care, housing or physical infrastructure were either consumed by political and military elites or transferred to overseas bank accounts with the connivance of Western financial institutions (Owusu, 2001).

The continued poverty and international indebtedness of Nigeria also poses immense obstacles for the containment of HIV, malaria and other public health threats that may yet engender a further spiral of social and economic decline. The extreme poverty and ethnic polarization within Lagos present a continuing threat to rebuilding the social and physical fabric of the city. Though informal networks and settlements have made an enormous contribution to alleviating the most pressing social and economic needs of the poor these grassroots responses cannot in themselves coordinate the structural dimensions to urban development for which the state must continue to play a pivotal role through its potential to articulate a public interest above either sectional interests or the impetus towards a purely market-driven approach to urban development. The severe and increased flooding experienced throughout the metropolitan area, for example, is one clear outcome of the absence of any strategic vision to manage the urban environment in the public interest as uncontrolled developments encroach across all available land and comprehensive drainage schemes under discussion for decades remain at the most rudimentary planning stage. "Infrastructure is government's responsibility," notes the Lagos based architect, Koku Konu, "— if not to put it in place then to plan" (Konu, 2003). Critical to any improvement in urban conditions is the need for a panoply of institutional reforms ranging across specific areas of law, tax and regulatory intervention which encompass new codes of professional conduct, transparency and accountability.

3. Mumbai

Mumbai (formerly Bombay) presents an interesting set of parallels and contrasts with the experience of Lagos. In the case of water and sanitation the city has never been able to provide the most basic services to all of its population: high infant mortality rates persist through poorer parts of the city and the rudimentary sewer system is easily overwhelmed by monsoon rains that regularly cause severe flooding. In the record monsoon rains of 2005, for example, over 400 people lost their lives in the city as makeshift dwellings were washed away, buried in landslips or simply inundated with rising flood waters that could not disperse through blocked or absent drains. "The shanties of the poor," writes Somini Sengupta (2005: 17), "as well as the refuse of the rich blocked gutters and creeks". The increasing frequency and ferocity of these extreme weather events — probably connected with anthropogenic sources of climate change and certainly exacerbated by the concretization and destruction of the city's natural floodplain — adds another facet to the city's seemingly intractable challenge to modernize its basic infrastructure.

Mumbai is a city of striking contrasts: the glittering towers and opulent hotels of the downtown business district along with elite neighbourhoods such as Juhu, Worli and Malabar Hill are encircled by informal settlements and armies of pavement dwellers who form neat rows along the city streets at night. By some estimates over half of the city's estimated 18 million people live in the *Zopad Patti* or slums which appear in city maps as amorphous grey areas clustered along roads, railways lines and extending into some of the most polluted and insalubrious spaces next to creeks and the remnants of once lush mangrove swamps. During the nineteenth century colonial Bombay became the largest city in the British Empire — playing a pivotal role in a vast transfer of wealth from South Asia to the banking systems of Europe — and it remains the most important "global city" in the Indian sub-continent with property prices in the mid-1990s exceeding those of Manhattan (it is now ranked the eighth most expensive city in the world for property).

The inequalities and injustices that mark everyday life in contemporary Mumbai are exemplified by problems of access to water. The municipal water supply system provides nearly 3,000 million litres a day and is derived from six sources outside the city: Tansa, Modak Sagar, Upper Vaitarna, Bhatsa, Vehar and Tulsi. Yet this vast arrangement for the transfer of water from the jungles, lakes and mountains of what is now Maharashtra state do not meet the city's needs: many businesses and local communities also rely on nearly 4,000 wells and over 2,500 bore holes scattered across the metropolitan region along with hundreds of private tankers and innumerable illegal connections. These modern means of distributing water in the city are juxtaposed with complex patterns of water use originating in the pre-colonial era. A number of so-called "tanks" — elaborate bodies of water surrounded by stone steps — still exist in the city but these are now mainly used for recreation or ceremonial bathing. Water is a dominant symbol in Hindu mythology: intricate distinctions and ritualized washing play a role in purification and social differentiation. In many apartment blocks, for example, taps are separated by caste (Benegal, 2002). Although this "caste-based apartheid" is now weakening in comparison with rural areas it has not yet disappeared and provides an added layer of social inequality to the class based differences associated with the development of the modern city.

3.1 Colonial and post-colonial antecedents

Bombay's first water commission was appointed in June 1845 following political agitation to improve urban conditions in the rapidly growing city. At that time the island city was dependent on shallow wells and tanks with particular problems during the summer months. As in the case of many other nineteenth-century cities a technical consensus emerged around the need to connect the city with more distant sources of water beginning with the construction of the Vehar dam between 1856 and 1860. The city's first modern water system provided 32 million litres a day but this quickly proved insufficient: in 1872 the Vehar system was more than doubled in size and the drought of 1879 forced the rapid completion of the Tulsi scheme. Successive legislative changes in the 1870s and 1880s initiated a major reorganization of urban government with the creation of the Bombay Municipal Corporation: an administrative structure that emulated the grandeur and administrative scope of a Victorian town hall yet never enjoyed the same degree of effectiveness or legitimacy in tackling problems such as inadequate housing or sanitation (see Dossal, 1991).

The publication of the so-called Tulloch report in 1872 involved an extensive exploration of further water sources for the city and in 1885 the much larger Tansa scheme was initiated. The completion of the first stage of the Tansa scheme in 1892 brought a further 77 million litres a day to the city followed by the completion of further stages in 1915, 1925 and 1948, adding a further 331 million litres a day. At first, however, the Tansa scheme contributed towards a public health catastrophe: the improved water supply in the absence of adequate drainage in low-lying parts of the city left whole districts in a filthy waterlogged state. As a result of the deteriorating urban conditions a series of bubonic plague outbreaks in the 1890s occurred with devastating social and economic consequences (see Arnold, 1993; Klein, 1986; Ramanna, 2002).

At independence in 1948 the city's total water supply stood at 494 million litres a day for a population of about 2 million but there were already significant shortages and inequalities in access. The anticipated demographic and commercial development of Bombay necessitated a further expansion of the water supply system so that the problematic existing situation would not deteriorate further. The first major water project for the city after independence, constructed between 1949 and 1957, involved the transfer of water from the more distant Vaitarna River and the construction of a vast reservoir named Modak Sagar after the city engineer Shri N.V. Modak. The so-called "Vaitarna-cum-Tansa" project used the latest advances in engineering science and was the first water project to be completed using only Indian technical expertise, thereby exemplifying Nehru's conception of a science-led Indian modernity within which hydraulic engineering would play a leading role.

Just as drought had forced the construction of the Tulsi project in 1879 ahead of Tansa scheme, the drought of 1965 necessitated completion of the Ulhas River scheme in 1967 to divert additional water into the Tansa distribution network. The use of an integrated treatment system at source was to be the model adopted for the much larger Bombay I-III projects under construction between 1980 and 1997 which included the completion of South Asia's largest water treatment complex — the vast Bhandup works at Vehar Lake in the north of the city. The completion of the Bombay I-III projects marked a significant expansion in the city's reliance on bilateral loans from the World Bank and its ancillary agencies but these projects also faced a range of technical and logistical challenges ranging from disputes over land acquisition to shortages of key materials such as cement, sand and steel. By 1997,

however, these three projects combined had added more than 1,300 litres a day of capacity to the city's water supply system but demographic pressures left the city with a continuing inability to meet demand. Only about half the city's current population have access to piped water either from individual connections or from shared taps whilst slum dwellers are largely reliant on other sources of potable water including wells, tankers and illegal connections. And the rich — partly out of fashion and partly out of fear — have begun to consume increasing quantities of bottled water as part of "a new glamorous world of beauty and wealth" that seeks disengagement from the "disconnected segments" of the city (Bhangar, 2002).

In anticipation of the city's inability to meet future needs — the UN predicts that Mumbai will be the largest city in the world by 2010 — a range of new projects are either underway or at the planning stage (Bhatia, 2003; GOM/MCGB, 1994). The so-called Bhatsa (Mumbai IIIa) project is expected to be completed in 2007 yet the much larger Mumbai IV project has not yet started because of uncertainties over its funding in combination with technical complexities (the scheme is dependent on power driven rather than gravity fed distribution) and conflict with the Forestry Ministry over its environmental impact which appears to be more politically contentious than the resettlement of rural villages (Pednekar, 2002). And there are longer term plans to link the city to the more distant parts of the Vaitarna and Ulhas river basins to create one of the largest and most technically complex water supply systems in the world. The city is set to extend its "ecological frontier" ever further into the mountains of Maharashtra state in the context of a sharply polarized post-Narmada dam era of hydrological politics.

3.2 Hydrological dystopias

Contemporary Mumbai faces massive inequalities in access to water: whilst most downtown households have access to water for at least short periods every day there are outlying parts of the city that remain largely unconnected to the city's water distribution network. The situation is most acute at the urban fringe in districts such as Bhayandar and Thane where rapid growth over the last fifteen years has not been accompanied by adequate improvements in basic infrastructure. Unregulated construction activity and the provision of illegal water abstraction licences have created intolerable conditions for poor communities. In March 1999, for example, in the district of Bhayandar on the city's northern edge, some 600,000 people rioted for three days because of interruptions in their municipal water supply. The city's "water mafia" took advantage of the situation by raising their prices ten fold for tanker supplies and railway lines were blocked by hundreds of protesters to prevent commuter trains from entering the city. The problems of water access are exacerbated at the urban fringe by an unregulated scramble for available sources. In fast-growing suburbs such as Andheri, Goregaon, Kandivali, Kurla, Chembur and Ghatkoper there is extensive illegal ground water extraction including new bore holes for bottled water sellers, hotels and the construction industry. Many hotels and wealthy apartment blocks also deploy illegal "booster pumps" to enable them to suck more water out of the system. Speculative real estate companies even advertise lavish condominiums that resemble luxury apartments anywhere in the world except for one thing: they have no water.

The city's urban fringe is also the focus of conflict over regional water diversion whereby marginalized farming and tribal communities in districts such as Thane have found that their water is being increasingly diverted to meet the needs of new urban developments. The city's water engineering strategy has consistently focused on the needs of the city above any emphasis on regional water needs yet the rural water crisis

and escalating rural-urban tensions over access to water resources is a significant spur to new waves of migration to the city. Rural water resources have also been exploited by companies such as Coca Cola who seek to sell bottled water in the city: their water abstraction operations at Wada, undertaken in the face of lax or ineffectual regulation, are diverting ground water reserves from rural communities (Bhangar, 2002). Water politics in India is inextricably linked with the social and economic disintegration of rural communities and widening polarities in wealth between urban and rural areas: a dynamic that reaches its acme in the poisonous sectarian violence of neighbouring Gujarat state where the misappropriation of funds for water projects has been deliberately obscured by the organization of anti-Muslim pogroms by the ruling BJP administration (Bhangar, 2003; see also Appadurai, 1997).

The scramble to access ground water resources because of the inadequacies of the city's water supply network have led to irreversible problems of saline incursion in bore holes and aquifers in coastal areas of the city. The municipal water system also suffers from periodic contamination — not from its rural water sources — but from the corrosion and dilapidation of the water distribution system itself that fosters the spread of bacteria within the pipes and enables dirty water to enter the network through cracks and fissures. The city's poorly maintained network is dominated by old materials such as galvanized iron and parts of the network are over a hundred years old. The intermittent wet and dry conditions in combination with the effects of rising salinity, vibrations from road traffic, stray currents from rail networks and road excavations by other utility companies have accelerated the rusting and disintegration of older pipes so that contaminated ground water can enter the water distribution system during interruptions in supply (Hardas, 2002). The city also cannot undertake large-scale repairs of trunk mains because there are no alternative water distribution tunnels available to temporarily divert water and avoid extensive disruption so that minor problems can easily escalate into catastrophic system failures.

These problems of dilapidated infrastructure are also reflected in the private spaces of the city. Crumbling tenements or *chawls* are characterized by rusting pipes, leaking taps and filthy tanks for the storage of water necessitated by intermittent supplies (in a typical *chawl* at least fifteen families will share one tap for two hours a day). Most rented housing has had extremely limited investment in repairs or improvements: a combination of rent controls and shadowy networks of ownership ensure that what the anthropologist Arjun Appadurai (2000) terms "spectral housing" predominates through much of the city. The extraordinary complexity of the city — both in terms of its morphology and ownership — presents a chaotic array of technical, fiscal and legal obstacles to improvements in water supply that might extend from the large-scale reconstruction of the underground city to the plumbing of individual tenements.

The city's modern water system has been dominated by a supply-oriented engineering ethos since its inception in the middle decades of the nineteenth century. Apart from drought years such as 1992 water conservation efforts have been only a marginal concern. More recently, however, there has been an emphasis on measures such as rain water harvesting as an ecologically driven rediscovery of traditional approaches to water management that contrasts with the "gigantism" of established techno-managerialist paradigms in water engineering (Bhangar, 2002). For the first time in its history the city's municipal corporation and its water engineers have been engaged in educational and outreach programmes to encourage changes in household water use and the introduction of water-saving technologies. At the same time, however, the spread of more profligate uses of water by the city's middle classes reflects changing patterns of consumption that serve to undermine any efforts at water conservation.

Public interest in water is mainly focused on issues of immediate concern such as rising charges and reliability of supply rather than any engagement with the complexities of regional water policy or the economics of infrastructure finance. To some extent, therefore, this shift in governmental attention towards the public is largely chimerical and reflects wider limitations to recent "governance" discourse where the weakness of the state in developing countries has been offset by an emphasis on an expanded role for civil society. Critical within this emerging political dynamic is the role of grassroots campaigns to extend citizenship rights to marginalized communities through the actions of non-governmental organizations such as the Society for the Promotion of Area Resource Centres, the National Slum Dwellers Federation and *Mahila Milan* (see McFarlane, 2004). New forms of political activism have been necessitated by the glaring disjuncture between formal rights — as set out in constitutional and legalistic frameworks — and the material realities of social injustice experienced by the urban poor (see Holston, 1999; see also Kaviraj, 1997). Similarly, the actions of the state as an arbiter of a putative public interest have been consistently in the interests of powerful elites or in order to proliferate its own rent-seeking activities through various forms of "authoritarian governmentality" (see Watts, 2003).

Municipal services such as water supply also suffer from shortages of staff with adequate technical and managerial expertise compounded by generalized problems of low pay, low morale and the difficulties of supervising work over a vast metropolitan area with travel times of often between two and three hours between different locations in the city. Even where the municipal authorities have tried to improve services they have faced problems of collusion between private water vendors such as tanker operators and corrupt public officials in order to limit access of marginal communities to piped water supplies and engage in rent-seeking activities and micro-circuits of exploitation at street level. Over the last fifteen years the city's water supply system has become increasingly linked with criminalized networks as part of a generalized corruption of urban culture in Mumbai (Patel, 2002; Zérah, 2003; see also Davis, 2004).

During the last decade there has been a growing emphasis on attempts to secure greater cost recovery for water services through the introduction of metering, revised tariff structures and higher charges (rising dramatically since the late 1990s). Part of the pretext for these changes is the recognition that current charges amount to less than a quarter of the actual costs of water provision and that at least a quarter of the city's water is unaccounted for through a combination of leakage and illegal connections. The city faces a major dilemma over the financing of its water infrastructure: there are now attempts to disentangle the city from its reliance on bilateral loans from the World Bank and other international lenders but the linking of local capital markets to infrastructure investment would require a range of complex institutional and regulatory reforms (Bhatia, 2003). The scale of institutional change needed for municipal bonds, for example, contrasts with the higher rates of return (and punitive water charges) that would be demanded by a reliance on private equity. Since the mid-1990s there have been external pressures from the World Bank and European water companies to pursue privatization but the municipal corporation is resisting pressures for an outright divestment of the city's water system.

3.3 Delineating a globalizing metropolis

Changes in the Indian economy since the 1980s such as market de-regulation and trade liberalization have contributed towards a growing international role for Mumbai

as part of a globalized urban system (the city accounts for much as 75 per cent of India's stock exchange transactions) and a re-assertion of the city's long standing position as a focus for wealth creation (the metropolitan economy contributes at least a third of national tax revenues). Over the last twenty years the relative importance of established administrative and industrial centres such as Delhi and Kolkatta has declined in comparison with cities such as Bangalore, Hyderabad and Mumbai at the leading edge of expanding economic sectors such as financial services, software and micro-electronics. These changes have underpinned a growing disjuncture between Mumbai as a "global city" and the dilapidated physical state of the sprawling metropolis (see Bannerjee-Guha, 2002; Pendse, 1995). Mumbai has historically been better served than other Indian cities in terms of its basic infrastructure for water, power and transport because of its commercial and political importance: its electricity generation and distribution, for example, has been primarily handled by two private companies since the 1920s without any reliance on the Indian national grid (Zérah, 2005).

The existing municipal government has come under sustained pressure since the 1990s through the growing strength of Maharashtra state and the imposition by the World Bank of a new agency called the Brihan Mumbai Metropolitan Regional Development Authority (MMRDA) to coordinate the planning of large infrastructure projects as an institutional pre-condition for expanding bilateral sources of finance. Certainly, the state, as represented by the Brihan Mumbai Mahanagar Palika (the former Bombay Municipal Corporation), has exhibited many of the features of a "failed state" including widespread corruption, graft and inefficiency.

In recent years there have been attempts to gradually eradicate slum settlements in lucrative development sites by stealth through the denial of basic services and various forms of harassment but in the last year the "politics of spatial elimination" has re-emerged in order to reclaim much larger areas of commercially valuable land such as vast Dharavi settlement near to downtown Mumbai and the international airport. In the wake of the McKinsey report *Vision Mumbai* — which sets out a strategy to boost Mumbai's credentials as a global city — there has been a wave of slum demolition leaving at least 350,000 people homeless (Ramesh, 2005).

3.4 Conclusions and reflections

In the immediate post-independence era we find a new kind of techno-managerialist modernity in which the scale and complexity of water engineering became emblematic of a national self-confidence rooted in a form of authoritarian governmentality. In the 1950s, for example, engineers and planners suggested using road blocks to prevent further rural-urban migration and the bifurcated strategies of colonial governance were reworked to produce a new geography of citizens and mere "inhabitants" who enjoyed no rights to basic services.

This governmental duality has persisted in subsequent decades so that division, inequality and injustice have become a defining feature of urban politics: the cosmopolitan elites who ruled post-independence Bombay have merely been supplanted by a post-secular Hindutva constellation (see de Ballaigue, 2000; Hansen, 1999; 2001). Yet alternative hydrological visions to dominant techno-managerialist or neo-liberal paradigms have struggled to free themselves from either an idealized rurality or various forms of "ecological thrift" rooted in a reworking of pre-colonial forms of water management. In the context of a post-secular urbanism, however, it is difficult to see how an inclusive public realm might be successfully articulated in order to build new forms of urban citizenship.

Conclusions

The complex interactions between disease, water and urban infrastructure reveal that whilst the "bacteriological city" may represent an abstract ideal for the organizational structure of the modern city it has never fully corresponded with urban realities because of the political and economic tensions that underlie the processes of capitalist urbanization.

These anomalies that pervade the technological structure of the modern city become most strikingly represented in the marginal spaces of the city and in those cities that are themselves marginal within the global economy. In the rapidly growing cities of the global South the dilapidated or never completed infrastructure systems of the bacteriological era have been superseded by a proliferation of alternative networks ranging from tankers for the poor to bottled water supplies for the rich.

The bacteriological city emerged out of a synthesis between the scientific and political dimensions to modernity so that the technological characteristics of the networked modern city became characteristic features of a more rationalized urban form. Yet the degree to which these achievements have tended to be associated with individual engineers rather than any more enduring political philosophy underlies the extent to which the sanitarian emphasis of the bacteriological city foreclosed wider political considerations transforming issues such as citizenship rights to basic services into more narrowly technical questions. The persistence of the nineteenth-century "Chadwickian" emphasis on technical solutions to what are essentially political issues must be contrasted with more radical conceptions of water and sanitation provision as a basic feature of citizenship rights in the modern city.

In reality, the bacteriological city has proved to be a transitional phase: even at its acme, in the middle decades of the twentieth century, the techno-managerialist urban paradigm displayed a series of fiscal and ideological weaknesses that would not be fully revealed until the political and economic turbulence of the late 1960s and 1970s. Though most contemporary cities remain dependent on the technological networks built up under the political aegis of the bacteriological era these increasingly dilapidated urban infrastructures serve as a poignant symbol of the fragility and historical specificity of metropolitan urban form.

The economic reality is that the urban poor cannot afford to pay high enough charges to make the necessary extensions and improvements in urban water and sanitation systems viable let alone profitable: an argument which now appears to have been widely accepted by the water multinationals themselves since the scale of the need far outreaches the financial and risk-taking capacities of the private sector. Consequently, municipal authorities must play a pivotal role in finding local solutions for the "fixing of capital" in physical infrastructure that will rest on far-reaching and complex sets of institutional and political reforms.

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