Graham S.

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LIFE-SUPPORT:THE POLITICAL ECOLOGY OF URBAN AIR

Stephen Graham

Newcastle University

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'Life Support': Anthropogenic Atmospheres and the "Defencelessness of Breathing"

"At first we feel nothing, we are insensitive, we are naturalized. And then suddenly we feel not something, but the absence of something we did not know before could possibly be lacking. Think of the poor soldiers on the front line, deep in their trenches, the 22nd of April 1915 near Ypres. They knew everything about bullets, shells, rats, death, mud, and fear—but air, they did not feel air, they just breathed it.

And then, from this ugly, slow-moving, greenish cloud lingering over them, air is being removed. They begin to suffocate. Air has entered the list of what could be withdrawn from us. In the terms of the great German thinker Peter Sloterdijk, air has been made explicit; air has been reconfigured; it is now part of an air-conditioning system that makes our life possible." Bruno Latour (2005; 104)

Humans, increasingly, manufacture their own air. For a species which expires without air in two or three minutes – what Elias Canetti (1987; 930) has called "defenselessness of breathing" -- this anthropogenic manufacture of air is of incalculable importance. Inescapably, "air constitutes as implicit condition of existence" (Sloterdijk, 2009).

The process of manufacture happens in a variety of related ways. On a planetary scale, the earth's atmospheric temperature and composition is now so radically different from what it was a few centuries ago that geologists are now pushing for the contemporary period to carry an appropriately anthropomorphic moniker – the 'Anthropocene' – rather than the previous 'Holocene' (the period since the retreat of the ice sheets around 12,000 years ago -- see Boschman, 2014). Global climate change is a product of

three centuries of rampant urban-industrial growth: between 70% and 80% of all greenhouse gasses emanate from the world's urban areas (Hodson and Marvin, 2010).

In and around the three-dimensional aerial environments within and above large urban regions, this manufacture of air reaches even greater levels of intensity. Here, giant, warmed-up domes or 'heat islands', heated by the city's release of energy, the extra-high concentration of greenhouse gases (and other pollutants) that linger above cities, and the tendency of concrete and asphalt to heavily absorb the sun's heat, are systematically filled with complex 'cocktails' of pollutants from all the energy-intensive activities that concentrate in and around cities: power generation; industry; transportation, building use and so on. As urbanisation intensifies and spreads, so a wide range of global health organisations are asserting that these domes filled with warmed-up cocktails of gases are becoming one of humanity's greatest killers (see World Health Organization, 2014; OECD, 2014).

Startlingly, however, the politics and geographies of bad or lethal air in cities remain peripheral to the huge growth of political-ecological work on the social and technological productions of nature in urban environments that has in other ways been so productive in human geography and critical urbanism over the past decade (see Heynen et al, 2006a). This body of work, linked closely to wider post-humanist and materialist shifts in social theory and philosophy (Bennett, 2010), has successfully challenged conventional conceptions of the urban by positing urban processes as complex multi-scaled metabolisms fundamentally integrating social, organic and technological agents into string-out, 'cyborgian' assemblages (Swyngedouw, 2006).

Resulting studies of the urban metabolisations of nature have successfully addressed water and sanitation (Kaika, 2005), the politics of food (Heynen, 2006), the production of

green space (Heynen, et al, 2006b), amongst other analyses, (for a recent review, see Heynen, 2013).

Beyond a few initial analyses, however, the political ecology of bad urban air remains startlingly underdeveloped. 'Technical', depoliticised, medicalised, physical-geographic and public health policy discourses dominate the field. "Urban political ecology research has so far been focused on natural resources for consumption, production, and recreation, rather than on environmental pollution" (Véron, 2006; 2094). Raymond Bryant's diagnoses over fifteen years ago that "the existing literature [on changing air quality] is largely devoid of political analysis", a problem which inevitably works to obfuscate the ways in which "unequal power relations are 'inscribed' in the air" retain power today (1998; 89). (Although it must be noted that some progress has been made on the environmental injustices and epidemiologies of air pollution-related ill-health in cities -- see Corburn et al, 2004; Morello-Frosch et al, 2001; Pearce et al, 2006).

A few innovative papers, motivated by this wider neglect, have made useful starts. Michael Buzzelli (2008) developed a political-ecological discussion of challenges of multi-scaled nature of air pollution for air pollution monitoring in Vancouver. Janice Harper (2010) blended political ecological theory with medical anthropological ideas to presented a searing ethnography of the stark air pollution and asthma crises in Houston. And Réne Véron's (2006) built an innovative analysis exploring the growing power of bourgeois-environmentalist ideas emphasising the beautification of Delhi as a 'world city' in shaping pollution monitoring in the city. Ostensible efforts by governmental elites to 'clean-up' urban air in Delhi, Véron shows, thus amount to a deeply revanchist programme to remove the poor, along with their vehicles and informal communities, which they deem not to befit to 'purified' environments of this urban vision.

Such analyses, however, remain sporadic and occasional; the contrast with the literatures on the political-ecologies of urban water is sharp. Erik Swyngedouw' and Nik Heynen's emphasis over a decade ago on major metropolitan regions as socio-natural and technonatural complexes within multiscaled political ecologies through which dangerous and bad air is produced and shifted has yet to shift such processes to the centre of critical-geographic analysis:

"The cars burning fuels from distant oil- deposits and pumping CO₂ into the air, affecting people, forests, climates, and geopolitical conditions around the globe, further complete the global geographic mappings and traces that flow through the urban and "produce" London as a palimpsest of densely layered bodily, local, national and global—but depressingly uneven geographically—socioecological processes." (2003; 899)

More broadly, whilst the innovative work of German Philosopher Peter Sloterdijk (2005; 2009) on the histories of deadly air in warfare, climate change and geoengineering is having major influence, environmental anthropologist Tim Choy asserts that air remains peripheral to social theorisation. "Air matters too little in social theory," he writes. "Aside from signifying a loss of grounding, air is as taken for granted in theory as it is in most of our daily breaths. □ Air is left to drift [...] neither theorized nor examined, taken simply as solidity's lack. There seems at first to be no reason not to let it" (Choy, 2010, 9-11)

Such a neglect seems especially paradoxical given wider recent shifts in the social theorisation of urbanism and urbanisation towards an emphasis on a Lefebvrian process of planetary urbanisation (Brenner, 2013); a preoccupation with the urban dimensions of global climate change and the unsurprisingly huge contribution of urban-industrial centres to greenhouse gas emissions (Hodgson and Marvin, 2010); a growing recognition of the

volumetric and vertical aspects of politics and geopolitics (Elden, 2013); and the wider cultural geographies, affective atmospheres and histories of urban air (Anderson and Holden, 2008; Martin, 2011; Adey, 2013).

Much work thus remains to be done to explicate the political ecologies and politics of the materiality of urban air in the context of rapid urbanization and global climate change. Such a project needs to work to make explicit the systematic anthropogenic manufacture and material conditioning of both 'good' and 'bad' air, through design, technoscience, capitalist industrialism, militarism, warfare, commodification, consumerism, and so forth. In a context of planetary urbanisation, unprecedented pollution and public health crises, rising social inequalities and rapid anthropogenic climate change, air, in other words, needs to be wrenched fully finally and fully from any lingering post-Enlightenment categories of its givenness within a 'Nature' that is external to the socio-technical worlds and processes of urban life. As Bruno Latour has emphasised, so elegantly Sloterdijk's work hammers home the enormous stakes which surround the essential technopolitics of a species inhabiting environments of increasingly manufactured and 'conditioned' air. "This is Sloterdijk's explicitness," he writes:

"You are on life support, it's fragile, it's technical, it's public, it's political, it could break down—it is breaking down—it's being fixed, you are not too confident of those who fix it. Our current condition merely relies on our more explicit understanding that this tentative technological system, this "life support," entails the whole planet—even its atmosphere." (2005; 104).

With such an apparent gap between global public health crises, and analytical neglect, this review paper seeks to help shift the politics and political-ecological materialities of urban

air; from the margins to the centre of critical urban social science. To achieve this, it mobilises Javier Arbona's concept of 'the manufacturing and 'design' of urban airs, atmospheres and 'airsapes' (2010) as a way of developing an unusually broad, international and multi-scaled review of the multiple dimensions of the politics of contemporary urban air which conventionally are separated within the highly 'soloed' discourses of separated academic and policy communities. Through an interdisciplinary synthesis, the paper's aim is to blend insights from recent research in human geography, urban studies, urban design, architecture, environmental sociology, climatology, social policy, public health, epidemiology, political theory, international relations and philosophy around a series of key, cross-cutting thematic vignettes. The aim here, then, is to use such a synthesis to add momentum to an already discernible 'turn' towards the critical social scientific and architectural analysis of air (see Adey, 2013, 2014; Gissen, 2013) and to further the incorporation of urban air (and its politics) into urban social theory.

Accordingly, what follows is structured around a manifesto of nine suggested themes, each exploring one set of an interlocking range of urban airsapes, to which, I feel, a political ecology of urban air should be directed. These address, in turn, the links between global warming, urban heat-island effects and killer urban heat-waves; urban pollution crises; the paradoxes of urban pollution; horizontal movements of polluted air; the vertical politics of urban air; the construction of vertical condominium structures for elites; the vicious circles that characterised air-conditioned urbanism; heat-related deaths of workers in increasingly hot climates building air-conditioned structures; and, finally, the growth of large-scale air-conditioned environments.

Heat Islands and Killer Heat Waves

“The U.S. Environmental Protection Agency estimates that, between 1979 and 2003, heat exposure has caused more than the number of mortalities resulting from hurricanes, lightning, tornadoes, floods, and earthquakes combined.” (NASA, 2010).

Turning to our first vignette, the well-known “urban heat island” effect already mentioned (see Lee, 1984; Gartland, 2010) means that the raised ambient air temperature at the core of large urban areas is usually at their highest during clear, still nights, reaching temperatures which are between 3 and 10°C higher than that in the surrounding area (Figure 1). Such effects are important contributors to global warming as a whole. Although their precise contribution remains controversial amongst Climatologists, the best recent evidence suggests that the extra heat given off by urban areas has contributed something between 15% and 21% of global warming as a whole over the past 150 years (as opposed to greenhouse gas emissions and other changes) (Zeke Hausfather and Menne, 2013).

Figure 1: Typical urban heat-island effects in a US city by day and night (Source: NASA, 2010): http://www.nasa.gov/topics/earth/features/heat-island-sprawl_prt.htm

Recent research using remote sensing shows that urban heat islands can have even greater effects than even recent thought suggests: one major study in the United States in 2010 showed that summer temperature in the main cities on the North east – Boston, New York, Philadelphia and Washington DC -- were an average of 7 °C to 9 °C (13°F to 16 °F) warmer than surrounding rural areas over a three year period. (NASA, 2010).

As well as ameliorating cold winters, urban heat islands can dramatically accentuate the lethal effects of hot summers within a context of warming planetary climate.

Emergencies such as the Chicago heatwave in 1995 and the European heat wave of 2003 (which killed 70,000 largely elderly people) have dramatically revealed the ways in which systematic inequality, housing policies, poor urban design and hopelessly

inadequate emergency response policies can combine together allow urban heat-waves to become mass killers of the poor, the lonely, the old, the weak and the vulnerable.

Epidemiological studies have shown that there is a “significantly increased risk of hospitalization for multiple diseases, including cardiovascular disease, ischemic heart disease, ischemic stroke, respiratory disease, pneumonia, dehydration, heat stroke, diabetes, and acute renal failure, with a 10°F increase in same-day apparent temperature” due to urban heat waves (Ostro et al, 2010; 1053).

Current estimates suggesting that average planetary temperatures rose between 0.5°C to 1.3 °C between 1951 and 2000 due to human pollution. These temperatures, moreover, will inevitably rise further by the end of the century by between 1.70C and 4.80C (depending on the degree to which greenhouse gas emissions can be reduced) (Johnson, 2013). Given that, by 2100, the UN estimates that the world's population will be between 11 billion and 15 billion, and that fully 65%-85% of that population will inhabit heat-island cities, primarily in tropical or semitropical locations, the future threat if major urban heat emergencies seems an especially daunting one.

Worrying precedents already exist. In the 1995 heat wave in Chicago, after a forty-eight hours period of daytime temperatures between 41-43oC, those without air conditioning, living near the black, bitumined roofs of the city's notorious public housing 'projects' on the South Side quite literally baked. Many were too worried about the possibilities of crime to open their windows. Many who did have air con could not afford to turn it on (power outages were also a major problem). By Friday, July 14, as Eric Klinenberg (2002a) recounts:

“thousands of Chicagoans had developed severe heat-related illnesses. Paramedics couldn't keep up with emergency calls, and city

hospitals were overwhelmed. Twenty-three hospitals—most on the South and Southwest Sides—went on bypass status, closing the doors of their emergency rooms to new patients. Some ambulance crews drove around the city for miles looking for an open bed. Hundreds of victims never made it to a hospital. The most overcrowded place in the city was the Cook County Medical Examiners Office, where police transported hundreds of bodies for autopsies.” (see Klinenberg, 2002b).

By the end of the week 739 people had died because of the extreme heat (especially the lack of cooling at night). The pattern mapped perfectly on to the geography of poverty: most victims were old, poor, isolated and male— they died alone. Elderly African American men were statistically the most likely to die (Klinenberg, 2002a).

The heat catastrophe across Europe in 2300, which prematurely killed around 70,000 people, similarly overly affected the old, the ill and the lonely living isolated lives in major cities like Paris (where 4,800 such people, labeled the ‘forgotten’ in French media, lost their lives)(NASA, 2010). As in Chicago, the most lethal spaces were marginal, poor quality apartments high up in the tenements beneath the dark, baking slate and bitumen of roofs. “Many of these forgotten victims lived in *chamber de bonne*,” Richard Keller (2013; 302) writes, “the former domestic servants’ quarters under the roofs of many of Paris’s buildings that are a legacy of Prefect Georges-Eugène Haussmann’s reconstruction of the city in the nineteenth century”.

Indeed, the deaths of the isolated, poor and old helped to expose the Janus-faced vertical architectures and geographies of Paris: a sumptuous and burnished street-level face for the bourgeoisie hiding an invisible, decrepit (and dangerous) world of attic-living for the

poor. Richard Keller (2013; 302) explored the personal residences of the isolated and old people who died in the heat wave (many of which were buried, like victims of the Chicago heatwave, in unattended funerals). Entering the street-level front door of the apparently wealthy East side Haussmannian block where one of the heat-wave's victims lived, he discovered that "it is actually two buildings in one. A marble-lined entryway gives access to the building concierge's apartment, the elevator, a wide staircase leading to the main building's apartments, and the courtyard."

The rear-side of the block, Keller (2013; 307) found, was, by contrast, "accessible only by a serpentine and decrepit service staircase. This side of the building houses the *chambres de bonne* [the tiny attic apartments of students and the poor where] seven or eight such apartments with a common toilet and sink at one end of the hall." These apartments, hidden away high up from view, are raised up to the sun, were the killing zones in Paris' 2003 heatwave. They illustrated profoundly how heightening social inequalities, embodied through the complexities of physical urban form, can dramatically effect the vulnerabilities of marginalised populations during urban heat emergencies.

Toxic Domes

"Air...from Johannesburg to Tehran, to Delhi to Jakarta, isn't about aesthetics, or even possible climate change at some point in the future: it's about life and death now (Doyle and Risely, 2008; 246).

As well as unlivable heat, processes of urban-industrialisation systematically manufacturing whole environments where the ambient air is a basically toxic environments which kill millions of people a year. Le Corbusier (1967) called the air of industrial cities, "devil's air" – and for good reason. The statistics here are even more

startling than those surrounding urban heart emergencies: urban air is killing urbanites at alarming rates.

Iconic episodes show that this is not new, of course. Indeed, deadly air pollution, rather than some simple 'externality,' has long been constitutive of modern urban-industrialism, and its machinic landscapes (Véron, 2006; 2096). In 1952, in one iconic example, 13,000 people died in a three-month smog episode in London. Recent studies, however, estimate that global death rates from air pollution are rising exponentially: Toxic air now provides the world's biggest public health crisis.

In 2014, following new evidence that the stresses of polluted air are responsible for many deaths through strokes and heart diseases amongst physiologically-stressed urbanites, the World Health Organization estimated that fully 7 million people were killed by air pollution globally in 2012. "The risks from air pollution are now far greater than previously thought or understood, particularly for heart disease and strokes," argues Dr Maria Neira, Director of WHO's Department for Public Health, Environmental and Social Determinants of Health. "Few risks have a greater impact on global health today than air pollution; the evidence signals the need for concerted action to clean up the air we all breathe." (WHO, 2014). 4.3 million of estimated deaths these were due to indoor air pollution (mainly from lit stoves). 3.7 million were die to bad external air. When analysis takes into account the secondary deaths through cardio-vascular and pulmonary mortalities (especially emphysema and chronic bronchitis), fully one in eight of all human deaths was caused by bad air inside and outside (WHO, 2014): Children, the elderly, the poor and those with respiratory and heart problems are dramatically over-represented in this annual figure.

In China alone, air pollution, largely from the cars and industries within cities, is estimated to kill over 1.2 million people prematurely per year. (The combination of mass automobilisation, extreme reliance on coal and rapid industrialization make Chinese City's the most polluted in the world)(Environmental Technology, 2013).

In India, meanwhile, a conservative estimate suggest that 620,000 people die prematurely each year through the effects of urban air pollution (Economic Times, 2013). This figure is growing rapidly as the country urbanizes fast. Of 180 Indian cities monitored for Sulphur Dioxide, Nitrogen Dioxide and suspended particle matter only two—Malappuram and Pattanamthitta in Kerala—met the World health Organization's rather generous criteria of 'acceptable' pollution.

Atmospheric dust thrown up by diesel engines, coal-burning power stations and industry --- 'particulate matter' — is the single biggest killer within the toxic domes above cities: this literally asphyxiates urbanites through cancers, lung disease and asthma. "By 2050, there could be 3.6 million premature deaths a year from exposure to particulate matter; most of them in China and India," a recent report by the OECD (2014) estimates. Chilling epidemiological records and surprises are continually recorded in such situations: in November 2013 an eight year old girl living adjacent to one of Beijing's massive flyovers became the the youngest person ever to be diagnosed with lung cancer (Duggan, 2013; for wider research on air pollution and asthma crises in urban neighbourhoods, see Corburn, et al, 2006).

Toxic urban atmospheres are especially lethal in cities that are hemmed in by mountains or other natural features; where concentrations of particularly dirty pollutants are most intense; and during stable climatic episodes where air fails to rise or get blown away and lingers for days and even weeks. It is now common for health authorities in major cities —

Beijing, Lagos, Santiago, Mexico City, Kathmandu, São Paulo, Cairo, Jakarta, Athens are only some of the most notorious examples – to declare states of emergency during such situations. Millions of vehicles are forced off the roads; the most-polluting industries are shut down; populations, especially the most vulnerable, are urged to stay indoors until the smog clears.

Architect Albert Pope, invoking Peter Sloterdijk's (2009) work on the weaponising of air through lethal gas attacks in war and terrorism, wonders if such crises, in effect, work as what Sloterdijk calls 'airquakes'. "Can a set of ontological rights — such as breathing — actually challenge or even displace economic hegemony?" he asks. To him, the unbearable urban air within many Chinese cities works to "bring the elements of our life-world out of a background of neglect and foregrounds them as the ontological preconditions of human existence."

Pollution Paradoxes

"Smouldering away, the megacity's atmospheres lend a definite aura" (Adey, 2003; 2).

Toxic urban air works to interrupt the efforts of city agencies to entrepreneurially brand and market their cities as blue-skied and fragrant-aired destinations for tourists, conferences, film locations, investment flows and, above all, sporting mega-events.

The authoritarian regime in Beijing – a city that pumps out more particulate matter than Portugal (Adey, 2003; 7) and adds 400,000 cars to its roads every year -- worked especially hard to artificially re-engineer the city's air for the 2008 Olympics by forcing traffic off the road and closing factories. The population's health dramatically improved. The reversion to normal levels of transport, energy generation and industrial production

immediately after the Games reintroduced the downward spiral. Indeed, by the end of 2013, the murderous pollution in Beijing and other big Chinese cities meant that airline pilots were being instructed on how to land in smog. The crisis was so bad that the country's official media was reduced to releasing bizarre platitudes that the pollution had meant that the people's "knowledge of meteorology, geography, physics, chemistry and history [had] progressed." Stranger still, blankets of killer smog were invoked as a defensive shield against the prying weapons of unknown enemies. "Smog may affect people's health and daily lives," the announcer admitted. "But on the battlefield it can serve as a defensive advantage in military operations." (Kalman, 2013).

Pollution paradoxes can sometimes interrupt apparently inexorable logics of urban warming. In a particularly prolonged smog event in February 2014, Chinese scientists warned that the smog blanketing the Beijing region was becoming so bad that its effects were starting to resemble those of a nuclear winters, creating a city almost "uninhabitable for human beings". Densities of suspended particles hit concentrations over 20 times maximum limits recommended by the World Health Organization. And photosynthesis in agricultural crops was even being reduced in the greenhouse-based systems within Beijing's hinterland by around 50%. Architectures to boost food production for teeming cities at the local, ground-level scale will always prove to be no match for the human manufacture of toxic, and increasingly opaque, urban atmospheres (Kalman, 2014).

In Hong Kong, meanwhile, in the year 2000, a priority of economic development authorities was to tempt the Walt Disney Corporation to build a theme park there. They were nearly unsuccessful because the Corporation felt that the city's notoriously bad Winter air pollution "did not mesh particularly well with the family image that Disney so prided itself on cultivating." (Choy, 2010; 6). (Deep ironies lurk here of course: Los

Angeles, the location of Disney's headquarters, has suffered episodes of catastrophic smog for decades).

Echoing the complex simulations of pollution-free urbanism choreographed 2000 miles further North in Beijing, tourist managers in Kong Kong now routinely erect blue-skied panoramas next to the iconic city view points when pollution episodes obscure the skyline and harbour with what the *International Business Times* called a “steamy sauna of

humidity and noxious air” (FlorCruz, 2013)(see Figure 2).

Urban tourism economies are indeed especially vulnerable to toxic urban air.

The FIGURE 2: The fake skyline erected for tourist use in Hong Kong in 2013. Source:

<http://www.ibtimes.com/hong-kong-tourists-use-fake-skyline-backdrop-during-high-pollution-days-photos-1396217>

urban pollution crises in China in late 2013 saw domestic and international visitor numbers to iconic sites such as Beijing's Forbidden City drop by 75%. Chinese insurance companies have introduced travel insurance packages covering smog events to try and bolster bookings (Coldwell, 2014).

But immersion in megacity air leads to more than health hazards, environmental injustice and problems for place marketers and tourists. As in the smoke-filled industrial cities of nineteenth century Europe, these airs also inevitably shape the atmospheric, aesthetics and experiences of place. These relationships are often paradoxical: as Turner found when painting the startling sunsets generated by major global volcanic events in the 1880s, toxic air can generate its own sublime urban beauty.

Figure 3: Air pollution in Shanghai, 2013. Photograph by Fung Leo. Source: <http://www.everystockphoto.com/photo.php?imageId=12866901&searchId=3aab0a4b8063f9a9a1d8039a05475e22&npos=27>

In cities like Shanghai (Figure 3), the combination of rising vertical towers and the worsening state of city air creates its own aesthetic connection: the view of the smog-filled lower atmospheres from tower residents, above. Giuditta Vendrame, an Italian designer who lived for 11 months on the 17th floor of a gleaming new tower in central

Shanghai, recalls that the thickening haze of the city's polluted air "often imbue[d] the city with a particular sense of lightness, suspension and fragility." The foggy air, in turn, softened her view of the city's burgeoning forest of concrete, skyscraping towers. "The city gains visual and architectural qualities," she writes. "The light of the sunbeams penetrates this foggy layer, giving the city a magic and fairytale color. However, this 'magical haze' is harmful. It is smog, air pollution." (Vendrame, 2012).

Downwind

But the uneven distribution of bad air works horizontally, too. Less urbanised areas downwind of major metropolitan formations breathe the filth of the city they may never visit. Such downwind vulnerabilities are especially lethal after chemical spills (as at Bhopal in 1984 which has killed up to 16,000 people) or when they become radioactive due to atmospheric nuclear testing or nuclear catastrophies like those at Chernobyl and Fukushima. Less often, it is cities that are downwind from bad air generated by rural conflagrations: "Singapore frequently complains of the extreme haze caused by Sumatran forest fires in Indonesia." (Adey, 2003; 10).

The geography of dangerous air is also complicated by the lacing together of the world's major cities through the atmospheric transmissions produced by the world's airline system: thousands of densely-packed aluminum tubes flying at 10,000 meters and 1000 kilometers an hour accommodating roughly half a million humans and countless other species at any one time. As was discovered during the 2002-3 SARS epidemic, this aerial system, which is more or less unstoppable during times of crisis, works superbly and delivering aerial pathogens direct to the major airports on the fringes of the world's great cities within a period of hours. (Medieval transmissions of diseases such as the bubonic

plague often took several years just to cross Europe). Due to our global system of tightly-coupled and connected cities, we live, as S. Harris Ali and Roger Kiel (2008) have so memorably argued, in an age of networked disease – a period where pathogens become ultra mobile by hitching a ride on the aerial movements of mundane and banal air travel. Epidemiologists now work with urban geographers of air travel to model the future spread of pandemics.

At a planetary scale, the relative (although sometimes chimerical) cleaning-up of the airscapes above European, Japanese or North American cities has been achieved through a massive geoeconomic shift across the horizontal terrain of the Earth's surface: the huge and filthy extractive and manufacturing complexes that sustain these cities is now strung out across China, East and Southeast Asia, Africa, Latin America and even Australia.

A major report of the Intergovernmental Panel on Climate Change in 2013 concluded that such wholesale offshoring between the West and East Asia was the key reason that global emissions of carbon dioxide and the other greenhouse gases increased twice as fast between 2000 and 2010 as they did during the previous three decades. This was because of the huge growth of manufacturing capacity powered by electricity generated from dirty coal-burning power stations. "A growing share of CO₂ emissions from fossil fuel combustion in developing countries," the report concluded, "is released in the production of goods and services exported, notably from upper-middle-income countries to high-income countries." (cited in Goldenberg, 2014).

The circulations of the global atmosphere, however, means that even horizontal outsourcing and offspring of bad air across horizontal scales fails to offer a complete insulation from bad-air: a recent study finds that between 12 and 24% of the sulphur

pollutants in the Western United States had been blown there from industrial and urban sites on China by atmospheric wind systems (Walker, 2014).

Airy Refuges, Human Sinks

“One can [...] discern a political-economic geography of air” (Choy, 2010; 26)

In all cities, the impacts of these toxic and warmed-up aerial domes is distributed extremely unevenly and unjustly: whilst atmospheric pollution can be a great leveler in terms of wealth and class, generally, wealthy and elite groups are able to insulate themselves from its effects more effectively than are poor or marginalised ones. Here a three-dimensional cat and mouse game of environmental injustice is wrought out as systems of linked, ‘capsular’ spaces such as condominiums and penthouses, malls, office complexes and upmarket cars are constructed which offer air-conditioning (whilst pumping their heat straight to hose immediately outside)(see De Cauter, 2005). Cars, often flitting across the cityscape on raised flyovers, dump their heat, noise and carcinogens straight onto the relatively impoverished communities that such structures bisect. Adjacent communities have been shown to have dramatically higher death-rates due to asthma and other pollution-related diseases than those further away from the highways. “Residential proximity to freeway is associated with uncontrolled asthma.” (Huynh et al, 2012).¹

The damaging impacts of auto exhaust emissions were one of the motivations of modernist architects like Le Corbusier to advocate the destruction of traditional streets and the mass housing of urban populations into raised towers (see Gissen, 2013; 3).

¹ See, for example, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2948442/>

Cars, meanwhile, would traverse the city on freeways surrounded by buffer zones of pollution-absorbing greenery. These days, however, mass modernist housing programmes are mostly in abeyance – with some exceptions such as Singapore. The colonization of (air-conditioned) vertical space is now largely an elite program – a three-dimensional rising up of the powerful and wealthy bound up with the neoliberal and revanchist reengineering of entire cityscapes largely for their needs. As elites in many cities literally rise up into gated, air-conditioned, vertical communities and tall, climate-controlled workplace towers, so they work to escape both the din of urban life and the pressing heat and pollution of the hotter urban surface.

Such vertical geographies of environmental injustice tend to be exaggerated where cities are built on mountainous terrain. Ascending up the proliferating skyscrapers in the world's most vertical city – Hong Kong -- Anthropologist, Tim Choy (2010; 29), is struck that that “the rich have access to good air while the poor are relegated to the dregs, to the smog and dust under flyovers or on the streets”.

Elite expatriates, for example, can seek refuge from bad air, noise, heat and humidity by colonising Hong Kong's “airy refuges” -- in skyscraper penthouses located in the topographic heights of the Peak or Mid-Levels. Just above the teeming street, meanwhile, covered, extending, air conditioned escalator systems snake to connect archipelagoes of elite spaces of consumption, work and leisure. “Much of Hong Kong seems designed to get off the ground—into the air, and out of it” (ibid.) These dynamics add to and layer over the long-standing traditions of elites to inhabit exurban or mountainous locations to escape the worst of the environmental toxins and pollutions within the toxic domes above cities. (Classic urban geography dictates that often such processes of elite exurbanisation were orchestrated upwind of the main metropolitan centre).

Hong Kong offers a startling system of vertically-raised walkways snaking between the huge, raised podium structures at the bases of upmarket hotels, residential blocks and malls and corporate enclaves (Figure 4). Such systems can literally allow those who have access to inhabit the kind of raised-up, premium accommodation and mobility systems so beloved of science fiction writers.

Figure 4: The raised walkway systems, central, Hong Kong (Photograph: Stephen Graham).

Continuing his discussions of working in Hong Kong, Choy talks of a day spent in the company of an executive from the Tsing Tao beer company as he “wends his way expertly through Wenchai, a government and nightlife district on Hong Kong island, without ever touching the ground” (ibid.) .Because the city’s deep, canyon-like streets and long podium structures act to channels and contain relatively-heavy polluted air, this has crucial impacts on relative health of the vertically-stratified population. “In the typical street canyons of Hong Kong, air pollutants tend to be trapped in the bottom 15 m.” (Wong et al, 2012). Moreover, the massive podium blocks between the streets and the raised walkways in Honk Kong “not only block most of the wind to pedestrians (affecting comfort and air quality), but also minimize the “air volume” near the pedestrian level (affecting air quality).” (Ng, 2009).

Splintering Air: Vertical Architectures as “Spatialized Immune Systems”

“An analysis of air reveals who belongs and who does not, who is deserving and who is not in a constellation of megacity inequality” (Adey, 213; 4).

“One could [...] lament the splintering of the atmosphere.” (Canetti, 1987; 10).

Figure 5: Placards around the IndiaBulls 'Sky' residential tower in downtown Mumbai, 2011. Photograph by Adam Cooper, reproduced with permission.

Political-ecologies of urban air thus urgently need to address the conditioning of airs within interior spaces (for recent progress here, see Biehler and Simon, 2011). The layered politics of urban atmosphere is not lost on real estate agents and developers who build, design and market the world's vertical gated communities. "The Higher You Go, the Cooler You Get!" screams the advertising hoarding at the elite Indiabulls Sky complex in Mumbai's central business district (Figure 5). Perhaps the ultimate capsular living environment, the building – marketed under the banner "way, way above the rest" -- offers a litany of elite, luxury services, a suite of pools, spas and restaurants (all above the 12th floor), a private helipad, and a complex system of air-conditioning and pollution filtering. In effect, the Sky Complex, like other elite towers, works to offer what

Philosopher Peter Sloterdijk's (2009) has termed as a "spatialized immune system" lifting elites above the bad air and heat of the grounded city below.

Exploiting the deep etymological and cosmographic connections between height, status and power, the developer of India Bulls urges its customers to "soar higher" to embrace "a lifestyle unprecedented and elevated up to the sky". On the placard around the corner, startlingly, vertical height is equated not just with premium atmosphere but with a direct invocation of theological supremacy for the elites lucky enough to ascend the tower. "Consider it a blessing", it shouts, "to share the same address as God". "Where the heavens extend an invitation" is the strapline of the development's brochure.

Such secessionary verticalities reach their apogee with personalized air and helicopter travel. During the sweltering Atlanta summer of 2009, one private pilot recounts her decision to fly simply to escape the ground-level heat of the city. "I don't understand this crazy weather, She admits:

"We have been having incredible heat and humidity for two weeks straight now. □ I couldn't wait any longer to fly□. If the heat isn't going to leave then I just have to fly in the heat. The good thing about flying is the higher you go the cooler you get. Even at 1000 feet this evening it was a nice break from the heat." ('CristalClear', 2009).

Fragmenting Atmospheres: Vicious Circles of the Air-Con City

"But where is Utopia, where the weather is 64.4°F...?" (Le Corbusier, 1967; 42).

An urban politics of air must address the widening and increasingly ambitious processes through which air is deliberately manufacturing and conditioned. Expected to almost double between 2012 and 2018 – from USD 98.2 billion to 178.4 billion in 2018 -- the global airconditioning industry is in bonanza mode (Transparency Market Research, 2013). Urbanisation, urban heat-island effects and the very warming of the planet, combined with the ubiquity of consumer capitalism, provide a perfect market environment for an industry which offers the promise of manufacturing what Peter Sloterdijk (2010; 94) has called “thematized” or “designed air”. “The breaking up of the social world into spaces of moral interdependence inaccessible to one another,” he suggests, “is analogous to the micro-climatic fragmenting of the atmosphere” (Sloterdijk, 2009; 99).

The widespread normalisation of expectations amongst middle class and wealthy urbanites in warmer cities that of urban life must consist of a continuous experience of chilled air manufactured to cover every building or transport choice, adds further to the 10% per annum market global growth rate (Transparency Market Research, 2013). The growing normalisation of air-con urbanism in hot climates like the Southern US has been paralleled by major architectural, social and geographic shifts. “By 1960, 20 per cent of homes in the South owned an air conditioner,” writes Pete Adey:

“ by 1973 80 per cent of [US] cars had air conditioning, as it became felt as an almost legal right. However, this also contributed to a massive shift in population density [in the southern states] which almost doubled from between 1930 to 1980 due to declining mortality, and, interestingly, new routines of travel and migration to the ‘sun belt’. The 1970 census was dubbed the ‘air conditioned census’ by the New York Times because it captured the evolving effect of the technology in creating

attractive and comfortable climates in the South, even in the summer.” (2014; 156).

Many other nations have followed the US path towards mass air-con use.

Overwhelmingly, such processes are organised, through individualized market forces. Such transformations are reflected strikingly in urban landscapes in many megacities where large buildings which gradually become strewn with walls of individual air conditioners (Figure 6).

Figure 6: The new Great Wall of China? Individual air-con units cover this tower in Fuzhou, China, so densely that it has become one of the most famous structures in the

city

<http://www.chinasmack.com/2011/pictures/most-awesome-wall-of-air-conditioners-in-fuzhou.html>

The laws of physics, of course, mean that heat removed from the cooled, bubble-like enclosures of urban life for the more privileged cannot disappear. It must, instead, be dumped elsewhere. The proliferation of air-conditioned environments thus leads to greater amounts of heat dumping via the heat exchangers on the frontages of the buildings. (Anyone who has stood next to the extracted air next to the aircon outlet of a major mall, hotel or office complex in a hot city can testify to the fan oven-like experience). This external heat dumping further exacerbates both urban heat-island effects (Figure) and the intolerable temperatures of the wider street environment. This, in turn, adds to the increasingly desperate urge by those who can afford it to find refuge within an air conditioned environment. And so the cycle goes on: more air-con, more heat dumping on streets, and ever-greater temperature disjunctures between the street and building interiors...

Research on the 2003 heat emergency in Paris by Cecile de Munck, of the French Centre for Meteorological Research, suggests that ramped up air-con use in the city may have even exacerbated the problem. Here "modeling experiments that show excess heat expelled onto the streets because of increased air conditioner usage during heat waves can elevate outside street temperatures significantly" (see Figure 6)(quoted in NASA, 2010).

Figure 6: Calculations of the effect of heat dumping from air-conditioning on the killer heat wave and heat-island during the 2003 emergency in Paris. **Credit: Météo France/ Cécile de Munck, source NASA (2010).**

A second feedback loop involves the pressure of the peaks of electricity demand created by urban air-con systems leading to major power blackouts as on August 14th, 2003. Behind this unprecedented blackout, “lay a power system overloaded by summer energy use, and in particular, dragged down by the burden of air conditioning” (Grabar, 2013).

In 2013, Aircon accounted for 10% of global power demand -- a figure that, with 38 of the world's 50 biggest cities being in the tropics, is rising fast (Grabar, 2013). Such growth rates force the use of extra fossil fuels for electricity generation, related threats to energy security, the release of more particulate matter and greenhouse gasses, and the increased risk of power outages.

Again, the vicious circle here seems inexorable: more air-conditioning, exaggerated climate-change-related temperature rises, increasingly intolerable urban heat-islands, further demands for air-con environments, and so on. “Turning buildings into refrigerators

burns fossil fuels, which emits greenhouse gases, which raises global temperatures, which creates a need for -- you guessed it -- more air-conditioning" (Hutchinson, 2010).

Such feedback loops add further to the vulnerabilities that marginalised urban groups, who have no choice but to endure urban heat-islands without air-conditioning, face.

Detailed research of heat emergencies demonstrates clearly that "ownership and usage of air-conditioners significantly reduce[s] the effects of temperature" on the wide range of conditions, diseases and ailments that can become killers during urban heat waves (Ostro et al, 2010; 1053).

The lessons of the killer heat emergencies in Chicago in 1995 and across Europe in 2005 discussed above are again deeply relevant here. There remains a startling absence of public policies to systematically organise the delivery of adequately cool environments for the city's poor within rapidly warming cities faced by dramatic rises in consumer electricity costs (on the Australian case, see Farbotko, and Waitt, 2011).

In such a situation, market-based distribution of life-saving bubbles of coolness can only work to kill increasing numbers of the old, the poor, the weak and the ill. Many are now arguing that the failure of markets for cooling mirror the failure of markets for many other public goods. Learning from cities like Hartford, Connecticut, for example, Henry Grabar (2013) argues that public, municipal infrastructures for cooling air are essential to tackle both urban heat crises and the contribution of individualised air con markets to toxic air (after all, many North American cities have long traditions of organising collective heat, steam and electricity infrastructures). Many designers are also calling for a rediscovery of design-based solutions to cooling buildings and for a return to altering the

choreographies of everyday and business lives to deal with hot weather (see, for example, Gandy, 2010).

Citadels of Death: Hot Bodies, Cooled Bodies

“As many people are killed on construction sites throughout the world each year as die as a result of armed conflict” (National Examination Board in Occupational Safety and Health, n.d).

If the increasingly hot, urban world can be starkly divided between those who are inside air-con environments and those who are outside, the massive construction of a whole suite of vast air-conditioned hotels, malls, leisure attractions and even football stadia by armies of near-slave labourers within the 50- degree temperatures of Qatar is the apogee of such increasingly lethal geographies of injustice. Four hundred thousand indentured labourers from Nepal, Pakistan and the rest of South Asia, are constructing these edifices in a \$140 billion program to ready to enclave for the 2022 World Cup. The International Trade Union Confederation has warned that 4,000 construction workers are likely to die before the start of the tournament; at least 185 nepalis – who make up a sixth of Qatar’s 2 million strong migrant work force -- died in 2013 alone (Gibson and Pattison, 2014). Over 500 Indian workers -- between 20 and 30 a month -- died between 2012 and 2014 (Gibson, 2014).

Heatstroke and dehydration are the main killers, especially during the summer months (although fatal ‘accidents’ and suicides are also routine). Most death certificates are marked with the catchall of ‘natural’ “cardiac arrest” by Qatari Doctors. This deflects

attention from the lethal working environment that is the real cause of such huge death rates. The dark irony is that, when opened, the entire archipelago of visitor spaces – including, the Qatari government claim, five new and one extended stadia -- will be air-conditioned.

The Qatar example, however, is only the most visible of many: the wider construction of a series of what Mike David and Dan Monk (2009) termed “dreamworld of neoliberalism” – in Dubai and Bahrain, most notably -- have been achieved at the expense of unknowable numbers of heat-related deaths amongst near-slave migrant workers. After the UK’s shadow sports minister, Clive Efford, expressed revulsion at the latest revelations of worker deaths in Qatar, Maher Mughrabi wondered:

“Where exactly has this man been?” Dubai, Qatar and Bahrain have been hosting the stars of golf, tennis, snooker, formula one and, of course, horse racing for decades now. And all those holidaymakers in Dubai who have sampled the shopping festival, the mall with the indoor ski slope or zooming up in the lift of the world's tallest building should also know that all this was built through the same system of labour that is suddenly so appalling” (2013).

“During the summer, temperatures soar above 45 Celsius (113 Fahrenheit), and visitors are advised to walk outdoors only in the evening, and drink water continually,” writes Richard Abernethy (2010). “Heat stroke is a killer for workers doing heavy physical labour for shifts of 12 hours or longer.” Human Rights Watch (2006) cite a report from the journal *Construction Week* which found that 880 migrant construction workers died in

the UAE in 2004 alone. The Indian consulate, moreover, registered the deaths of 971 Indian citizens in 2005. 61 of these were registered as site accidents; many were of heat stroke and heat exhaustion; suicides made up the remainder. The report found that “as many as 5,000 construction workers per month were brought into the accident and emergency department of Rashid Hospital in Dubai during July and August 2004” (Human Rights Watch, 2006).

Journalist, Nesrine Malik (2011), visiting Dubai to research the deaths of migrant workers, found that conditions for Indian workers building Dubai’s air-conditioned skyscrapers and megaprojects were so appalling that two committed suicide each week. (The first suicide from the world’s tallest tower, the Burj Khalifa, another Indian migrant worker, happened when she was there. Locals joked callously that the death had “inaugurated the building” as a suicide platform, such is the frequency of suicide leaps) (ibid.).

Echoes of Buckminster Fuller: Climate Capsules

“The air starts to become private” (Vendrame, 2012)

“Let us not forget that today’s so-called consumer society was invented in a greenhouse – in the very same glass-canopied, nineteenth century arcades in which the first generation of ‘experience customers’ learned to breathe the intoxicating scent of an enclosed, interior-world full of commodities” (Dorrian, 2012).

Increasingly megalomaniacal use of air-conditioned interiors has been central to Dubai's spectacular emergence as the ultimate dreamworld of neoliberalism. Reaching its extreme with the conceit of a complete, indoor, skiing environment, with real snow (the smaller, existing, 'ski mall') in the middle of one of the world's hottest deserts (Figure 7), Dubai's archipelago of air-conditioned interior "experiences" each enjoys a wholly manufactured climate: and the much larger, so far unbuilt, 'arctic experience' (which was to include live Polar Bears)(Dorian, 2012).

Figure 7; Oil and Ice: The world's largest freezer. SkiDubai's 400 meter slopes are maintained at a constant -2oC even when summer temperatures beyond the walls soar past 50oC

<http://www.everystockphoto.com/photo.php?>

imageId=10559969&searchId=cd5bce6e1eebc4a6502d9334b77d79c7&npos=22

Dubai's interior ski spaces – the ultimate interiorisation of 'nature' -- echoes architect, Buckminster Fuller's, influential ruminations between the 1940s and 1960s on the possibilities of dome-like constructions at various scales within which urban air could be precisely controlled. (Famously, Fuller even suggested a giant dome encompassing mid-Town Manhattan which would permanently sustain what he called a "Garden of eden" climate"- see Krausse and Kichtenstein, 2001). To Mark Dorian (2012), Dubai's capsular, air-conditioned interiors echo Fuller's domes, with their "complex connotations of autonomy, encapsulation, and world imagery." Here, though, the techno-utopia of bubble for the precise manipulation of urban air – what Mark Dorian (2012) calls a 'renovated atmosphere' -- rests, deep paradox, of the bodies of unknowable labourers who expired through heat exhaustion in their efforts to project the façade.

The juxtaposition of interiorised simulacra of 'nature' unleashes less lethal paradoxes. The interior condition within 'bubble' environments like Dubai ski-dome emerges "more pure, less polluted, and hence more 'itself' than in the world beyond, albeit now as commodity." (Dorian, 2012).

More broadly, of course, as we saw in the case of the Paris killer heat wave in 2003, the incremental privatisation of urban air through the spread of air-conditioning spaces and enclaves becomes entirely self-defeating at the urban scale. Beyond their impacts on workers or those inside, the interiorized capsules or privatised air exert their own damage (most notoriously, of course, with the problems of 'sick building syndrome' amongst those who work within capsular environments) and contribute

disproportionately to the deterioration of the planetary climate outside the engineered bubble. The sheer contradiction between the mass and density of the inevitably public city and dreams of controlled microclimates shaping the inherently mobile air around mobile individuals inevitable breaks down: "people feel very strongly that their private constructions of immunity are endangered by the presence of too many constructions of immune spheres which are pressed against each other and destroy each other." Thus, urbanites "feel compressed within these overcrowded spaces," writes Giuditta Vendrame (2012):

"We feel suffocated. As if there isn't enough space. As if there isn't enough air for us. On one side the fear of suffocation, of no-breath. On the other (out)side the fear of the unknown, the invisible [hazards of urban air pollution]."

"Which is and which will be our relationship. to the air? ", she asks. "What sort of air do we breath on the inside and outside of our spaces?" (ibid.),

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