# Vertical

## The City from Satellites to Bunkers

Stephen Graham

# Preface: Dubai, January 2010

> What would happen if you took geographic thinking and instead of putting it on a horizontal axis, you added a vertical axis?
>
> Trevor Paglen

My brain simply could not process what I saw. That tiny grey smudge, just visible far below to my right through the ice-specked Perspex, was *Baghdad*! As 200 travellers and holidaymakers around me sipped gin and tonics, delved into familiar episodes of *Friends* and *The Simpsons*, or played classic 1980s arcade games like *Missile Command* or *Battlezone* on in-flight entertainment systems, we were flying high above a full-on war zone.[1]

Between us and the ground, complex military air operations were under way, coordinated from a bunker in our destination country linked, since the previous August, to newly established air traffic controllers in their own fortified complexes in Baghdad itself. Each day, around sixty commercial flights were being routed either over or around combat operations; these command centres were simultaneously organizing war and tourism within the same airspace.

The circuits of global capitalism and tourism – and in the case of my colleague and myself, travel for academic research – were not to be interrupted by a mere full-scale counterinsurgency war. Such violence could, since the airspace was 'liberalised' in 2008, simply be bypassed, the aircraft icon hovering on a digital map on a small screen, a banal signifier for passage over contested territory riven by violence.[2]

And so to our stopover: Dubai. By chance, we were in town during the ultimate stage-managed urban spectacle: the opening of the world's tallest building, the 830-metre Burj Khalifa. Here, rather unexpectedly, was a place that, like few others, hammered home the growing need to appreciate the vertical aspects of geography and urbanism: a centre of extraordinary vertical politics and vertical geographies.

Jet-lagged and dazed, we walked among excited crowds. We also enjoyed the vast fireworks display and lightshows emanating from the tower itself and the 30-metre, $225 million 'dancing' fountains (the world's tallest, needless to say). The fountains seemed especially lavish in a desert country with no real rivers, a collapsing or totally nonexistent ground water supply and the highest per-capita water consumption on Earth. As the towers and fountains have risen, so Dubai's ground water level has plummeted by over a metre in the last twenty years. It would take centuries for this drop to be reversed, even with a complete cessation of usage.

We looked in awe at the most verticalised of cityscapes, ratcheted into the sky in a mere decade, rearing up from hundreds of miles of pancake-flat desert.[3] It felt as though we'd arrived on some vast stage set for a highly sanitised sequel to *Blade Runner* made by Disney. Everywhere we looked there were exalted proclamations that the Burj Khalifa, which snaked ever upward like a sci-fi icon, heralded, along with the many other new skyscrapers in the city, Dubai's arrival as a 'world-class' or 'global' city.

No longer, it seemed, are the world's tallest skyscrapers erected merely to house the headquarters of corporations competing for prestigious space in the centres of tightly packed financial districts. Nor are they the products of utopian and visionary thinking about housing future urban populations. Now they emerge, isolated in deserts, as visual symbols constructed to demonstrate a location's global clout. 'Not since 1311, when the spire of Lincoln Cathedral first topped the Great Pyramid of Giza', novelist Geraldine Bedell reminds us, 'has the tallest structure in the world been located in the Arab world'.[4]

Such towers are ultra-vain – and some would say suspiciously phallic – embodiments of the hubris of the super-rich. Despite the claim that high-rise construction is necessary to accommodate a burgeoning humanity, between 15 per cent and 30 per cent of their height – the highest part, the so-called vanity height – is so slim as to be capable of housing only lift shafts and services.

Such super-tall towers are catalysts designed to add value to vast malls and real-estate projects. And they are stage sets for media stunts designed to lubricate the worlds of tourism or hyperconsumption. 'Burj Khalifa is more the spike of luxury, than anything accessible … the condominium level [rents] for $2,000 per square foot.'[5] Startlingly, the top 244 metres of the tower fall into the vanity height category – the sole purpose of this part of the tower is to get the place into the record books.

Meanwhile, the sculpted, *Thunderbirds*-style helipad atop Dubai's other famous new structure, the super-expensive, sail-shaped Burj Al Arab Hotel – count those seven stars! – is as much a global stage of bling as a place for the super-rich to land and take off. It has been used to stage-manage launches of Aston Martins and Formula 1 racing car teams, to play host to superstar tennis matches, and to accommodate Tiger Woods's golf demonstrations and product launches.

Also central to the spectacular vertical rise of places like Dubai are global flows of speculative investment as the cash-rich super-elite who profit most from global neoliberalism seek iconic vertical buildings in low-tax, unregulated enclaves as investment vehicles. In Dubai, as elsewhere, this process raises towers that are often not even fully occupied by people: while projecting their symbolic value to the world, they often house capital rather than humans. 'Brand Dubai' is thus all about linking the rising forest of steel, concrete, aluminium and glass to a collective architectural fantasy, a phantasmagoria of 'supreme lifestyles',[6] for consumers, tourists, speculators and elites orchestrated through the complex machinations of global finance, global airline systems and global geopolitics (as well as, less visibly, organized crime, money laundering, financing of terrorism and sex and people trafficking). Vertical metaphors saturate – indeed *constitute* – these narratives.

David Coulthard's Formula One car on the helipad of the Burj Al Arab, where it had been lifted in a 2013 media stunt

Critics also invoke vertical metaphors to come to grips with Dubai. Mike Davis lambasts the city as a surreal world apparently drawn from the imaginations of Margaret Atwood or Phillip K. Dick: a world where fantasy itself is 'levitated'.[7]

The opening of the extreme verticality of the Burj Khalifa was loaded with multiple myths, symbols and messages of progress, arrival, success, centrality and future prosperity. For one, the tower's height and strength were over-coded with ubiquitous images of Dubai's apparently benevolent and patriarchal ruler, the tall bearded figure of Mohammed bin Rashid Al Maktoum. Combining the roles of monarch, prime minister and president, Al Maktoum and his family rule Dubai as a quasi-medieval fiefdom: he must always be called 'His Highness' (HH). With absolute power, Al Maktoum and his family 'own every lucrative grain of sand in the sheikhdom';[8] he is even able to personally dictate criminal sentences.

Dripping with endless bling and cordoned-off, hyper-luxury enclaves, Dubai and its architectural rise have been matched, crucially, by its location at the heart of the most aggressive airline and airport expansion project of the early twenty-first century. By June 2014, Dubai's 'ascendency', following the economic collapse of 2007–8, meant that it had become the world's largest hub for international air travel. Within two short decades a humble refuelling and duty-free stop for airliners travelling between Europe, Asia and Australia was re-engineered to replace London Heathrow as the largest international hub airport on the planet – the aerial 'crossroads of the world'.[9] By 2020, the Dubai government estimates that the airport and its related industries and services will generate fully 22 per cent of Dubai's employment and 32 per cent of its GDP.

The United Arab Emirates (UAE) – itself the world's fifth largest gas and oil producer – also houses one of the greatest concentrations of US military power on the planet, with more US Navy ship dockings than any other nation outside the United States. (Jebel Ali is the only Gulf port capable of taking US aircraft carriers.) Meanwhile, Al Dhafra Air Base in Abu Dhabi, the next emirate to the west of Dubai, which the US Air Force took over during the First Gulf War in 1990, is one of the US Air Force's most important drone and spy plane bases. Al Dhafra is only a hundred miles as the drone flies from Iran.

A short distance along the coast to the west, the tiny Gulf state of Qatar – the controversial site of the murderous construction of air-conditioned stadia for the 2022 World Cup – has provided bases for many of the warplanes involved in the Iraq and Afghan wars. Its Al Udeid Air Base also houses a huge

'Airspace Control' centre for the US military's Central Command (the strategic command focusing on the pivotal Middle East region).[10] The Al Udeid control centre had been responsible for organizing the unreal juxtaposition of our tourist flight above the war zone surrounding Baghdad.

Tellingly, Qatar's 'Airspace Control' centre was relabelled the 'Combined Air and Space Operations Center' – CAOC, pronounced 'KAY-ock' – in 2008. Such a shift reflects a strategic effort across the US military to deepen their control and use of extra-atmospheric space. Indeed, the Iraq War was deliberately used as an exercise in pushing such a shift.

The huge CAOC complex seeks minute control of the airspace and inner space above the twenty countries in the Centcom area in and around the Middle East, stretching from Sudan to Kazakhstan and from Pakistan to Egypt. The centre was thus the pivotal hub through which the wars in Iraq and Afghanistan were organized. CAOC is a crucial command centre for the prosecution of lethal drones strikes by the US military throughout the Middle East and the main complex organizing the fourteen-nation coalition air war against Islamic State in Iraq and the Levant (ISIS) since 2014.

Although bombing missions over Iraq and Afghanistan are now relatively rare, the extraordinary rise of ISIS in Syria and northern Iraq, as well as continued instability in Pakistan and Afghanistan, means that the vertical scrutiny of these regions is, if anything, intensifying: 'The center gathers more than 800 hours of surveillance video over the war zone every day'.[11]

Such is the UAE's strategic importance that plans are in place for an invisible 'dome' of strategic space above and around the city to be protected by one of the world's most sophisticated missile defence systems – the Terminal High Altitude Area Defense (THAAD) system – as a deterrent to missile attack from Iran, just across the Gulf. These air defence missiles are designed to destroy attacking missiles in the upper atmosphere and even beyond the atmosphere's limits.



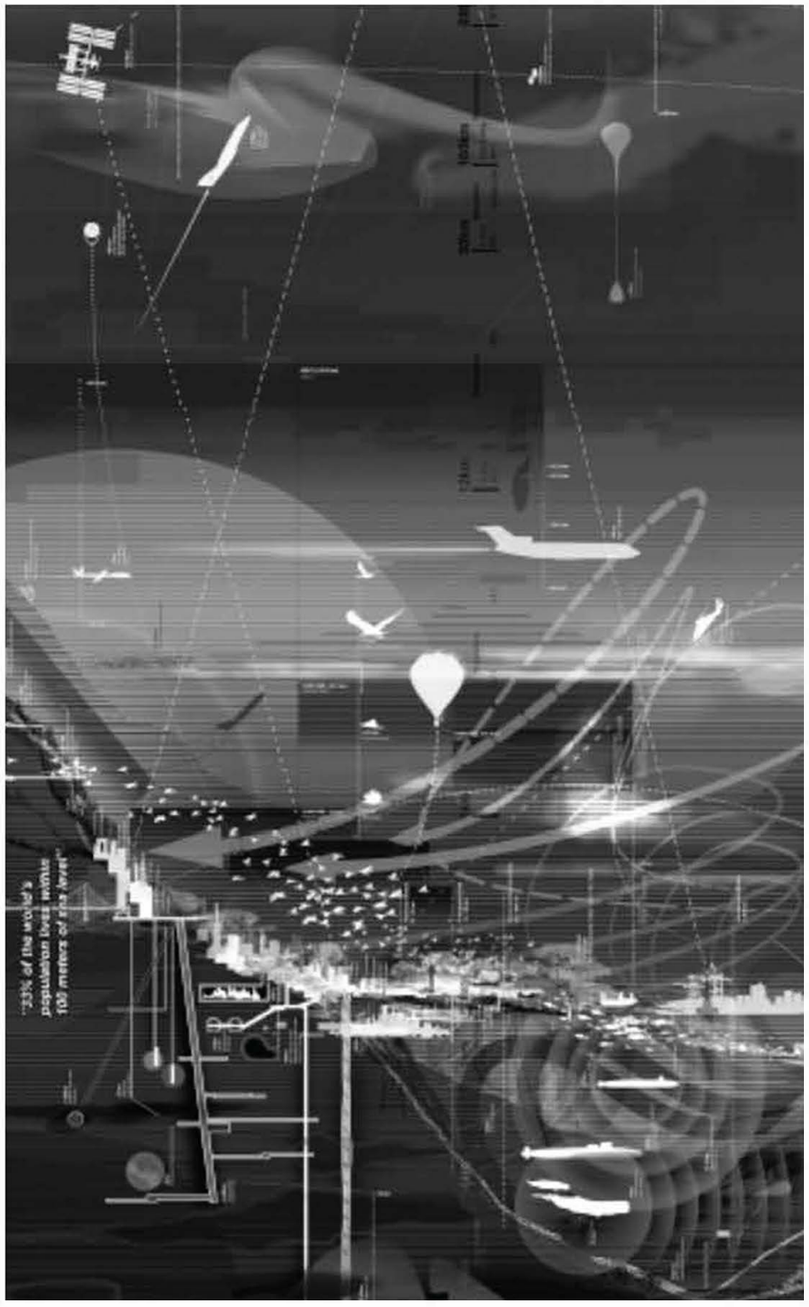
And so, after a mere twenty-six hours in Dubai, we moved on to our post-stopover flight to Mumbai to carry on a long-standing research project. This time our Emirates plane was equipped with the latest version of in-flight entertainment systems where video cameras on the underside and tail of the aircraft allow passengers a perfect view down on all they fly over. Travellers can now peruse the details of the topographies far below – their very own Google Earth.

For us, such a view was apposite, as our flight took off over the alter-ego to Dubai's vertical megalomania – a vast archipelago of artificial islands horizontally engineered up from the seabed, again with near-slave labour, to look good from Google Earth. For a final element of the 'Dubai model' has been the widescale manufacture of lucrative waterfront land through the literal sucking up of sensitive seabed ecosystems in a process mistakenly labelled 'reclamation'. With waterfront land generating real-estate premiums, this economic model involves the almost complete neglect of Dubai's horizontal desert hinterland in favour of the vast horizontal manufacture of artificial islands shaped with their appearance in mind to arrays of satellites, which in turn transmit the images to laptops, TVs and smartphones.

As we took off, our camera looked down on Dubai World's half-built archipelago of diminishing dune-islands. The rumour circulating at the time was that Rod Stewart had bought the 'United Kingdom' island (a rumour which sadly emerged as

untrue; the actual owner, Safi Qurashi, was in jail for seven years for using false cheques).

As the dune-islands receded we readied ourselves, now even more dazed than we had been on landing, to confront a very different world of vertical politics: Mumbai. Another vertically stratified urban world awaited. This was full, as we shall see later in this book, of more elite towers rising to the skies (some marketed for the way they herald status as well as provide cooler air); of twenty-seven-storey single-family skyscrapers; and of growing networks of flyovers and walkways on stilts which raise up the city for the rich and mobile who can thus bypass the teeming streets below.




City of Volume: Harvard landscape architect Pierre Bélanger's cross-section showing verticalising cities tightly enmeshed in a world of drones, helicopters, aircraft and satellites above and subterranean infrastructures, mines and submarines below. He writes, 'This schematic cross-section view of the world opens a lens on the planet as an urban projection, pattern and process of overlapping change across different layers and level of space.' See Pierre Bélanger, 'Altitudes of Urbanization', *Tunnelling and Underground Space Technology* (2016).

## Apartheid Atmospheres

Importantly, air conditioning is increasingly being applied to much bigger environments than single office, housing or mall buildings. Upscaled use of air-conditioned interiors has been central, for example, to Dubai's spectacular emergence as the ultimate dreamworld of neoliberalism, with an archipelago of air-conditioned interior 'experiences', each of which enjoys a wholly manufactured climate. This trend, which is even leading to the air conditioning of whole beaches, perhaps reaches its extreme with Ski-Dubai, the conceit of a complete indoor skiing environment with real snow in the middle of one of the world's hottest deserts, one that regularly reaches 50°C beyond the walls. In 2015, Dubai planners announced the construction of an entire indoor ski resort, complete with a 1.2 km slope.

Like some bad sci-fi movie, air pollution crises are also driving urban elites to engineer a wide range of domes and capsules which benefit from filtered, good-quality air and temperature control and which are removed from the wider urban environment. In one of the most powerful examples so far, governors of Beijing's International School for elite, expat children have spent $5 million housing their previously outdoor playgrounds and sports spaces within a giant plastic dome. This allows the air breathed by the school's children to be filtered to very high standard by powerful US-made industrial air filters that control the interior's relationship to the urban outside.[68] 'It's a bit of a change having to go through an airlock on the way to class', Travis Washko, director of sports at the school, admits. 'But the kids love it, and parents can now rest assured their children are playing in a safe environment.'[69]

As well as being a staple of urban comics and science fiction, much larger urban domes have also been proposed as ways to create climate-controlled urban air spaces within Dubai's huge, 4.5 million square metre 'mall of the world' project. In Houston, a group of local engineers proposed in 2010 a mile-wide dome to cover the entire business district – a means of confronting increasingly frequent and intensifying hurricanes and worsening heat and pollution crises. The only way to save Houston, an apocalyptic *Discovery Channel* documentary intoned, 'is to move it indoors'.[70] Although only a speculative project, the idea sparked fierce debate in Houston's media. Residents in the zones just outside the city's business district wondered if they could benefit from an extended project or even of a second dome was possible.[71]

Designers in Beijing are meanwhile looking to upscale the International School's ideas to a much larger dome enclosing a major new privatised urban park in the city.[72] Architects have also suggested burying copper coils under parks to create electrostatic fields which attract smog particles from the immediate atmosphere.[73]

These examples of the growing interiorisation of 'nature' powerfully echo 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, in 1960 Fuller suggested a giant, 400-tonne glass geodesic dome encompassing Midtown Manhattan which would permanently sustain what he called a 'Garden of Eden' climate'.[74] Fuller claimed that 'the cost of snow removal in New York City would pay for the dome in 10 years.'[75]

Today's 'bubbles' for the precise manipulation of urban air contrast sharply, however, with Fuller's urban planning ideas in one crucial respect. His projects were rooted in an ethos of the democratic manipulation of urban air for cities and urban districts as public goods and public spaces to be experienced by all. Examples like Dubai's giant malls and ski resorts, Beijing's expat school and a myriad of privatised corporate plazas and überwealthy residence towers, by contrast, are organised carefully to allow powerful elites to cordon themselves off from the worst effects of a deteriorating urban life outside. They are exemplars of a widening range of efforts, at a variety of scales, to try and make good air privately available to those who can afford it, amid an increasingly lethal exterior.[76]

Crucial questions surround such an incremental and haphazard privatisation of urban air through the spread of air-conditioned spaces and enclaves designed against a deteriorating exterior. Clearly, such projects inevitably become self-defeating at the urban and planetary scales. Beyond their sometimes negative impacts on those inside – who can succumb to poor health through problems such as 'sick-building syndrome' – these interiorised capsules of privatised air contribute disproportionately to the deterioration of the planetary climate outside their engineered bubbles. The sheer contradiction between the mass and density of the inevitably public city and dreams of controlled, hermetic microclimates shaping the inherently mobile air around mobile individuals inevitable breaks down.[77]

'People feel very strongly that their private constructions of immunity are endangered by the presence of too many constructions of immune spheres', Sloterdijk writes.[78] Such bubble-like worlds are 'pressed against each other and destroy each other.'[79] Thus, city-dwellers increasingly feel compressed and crowded within and between archipelagos of privatised interiors and deteriorating exteriors organised based on principles of extreme inequality. Italian design scholar Giudetta Vendrame, reflecting on living in Shanghai, does indeed get the sense that the city's residents seem to 'feel suffocated' by the proliferation of air-conned interiors separated off from the deteriorating exterior city of ground-level toxic air. It's 'as if there isn't enough space', she continues. '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].'[80]

Beyond the private and elitist nature of contemporary domes of relatively good or cool air, their construction is often sustained by sacrificing the bodies of unknowable labourers who expire through heat exhaustion while working to construct the spectacular façade. If the increasingly hot urban world can be

starkly divided between those who are inside air-con environments and those who are outside, the 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°C temperatures of the UAE, Saudi Arabia and Qatar is the lethal apogee of such injustice.

In Qatar, 2 million indentured labourers from Nepal, Pakistan, India and the rest of South and South-East Asia are constructing these edifices in a $140 billion programme to ready the 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 the migrant work force – died in 2013 alone.[81] Over 500 Indian workers – between 20 and 30 a month – died between 2012 and 2014.[82] 'As things stand', the Play Fair Qatar campaign calculates, 'more than 62 workers will die for each game played during the 2022 tournament.'[83] That's one for every 90 seconds of football that will be played in the tournament. Most death certificates of workers in Qatar are marked with the catch-all attribution 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 bubble-like visitor spaces – including, the Qatari government claim, the World Cup stadiums – will be air-conditioned.

Just down the coast in the UAE, bonded South Asian labourers are also dying in great numbers to construct air-con megacities for locals, expats and tourists. 'During the summer, temperatures soar above 45°C (113°F), and visitors are advised to walk outdoors only in the evening, and drink water continually', writes Richard Abernethy. 'Heat stroke is a killer for workers doing heavy physical labour for shifts of 12 hours or longer.'[84]

Human Rights Watch cite a report from the journal *Construction Week* which found that 880 migrant construction workers died in the UAE in 2004 alone.[85] The Indian consulate registered the deaths of 971 Indian citizens in 2005; 61 of these were registered as site accidents, many from heat stroke and heat exhaustion. 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.' The Indian government say that at least 60 Indian citizens died building the Burj Khalifa alone, but Emirati employers of bonded labourers on the site have regularly been exonerated for brutal violence against workers in UAE courts.[86]

Extreme racism, isolation, brutal working conditions, alienation and failure to be paid have also created an epidemic of worker suicides. Indeed, some workers leap to their deaths from the very skyscrapers they have helped construct. In May 2010, journalist Nesrine Malik heard about the first worker suicide off the Burj Khalifa. 'Gossip about the suicide was horrifyingly callous', she noted. '"It only took 10 months" [after the opening of the hotel], one person said. "He's inaugurated the building", another almost laughed. "Why did he jump?" I asked. People shrugged. He's probably an expatriate worker, I was told – it's usually them.'[87]

With even darker irony, the very construction of Dubai that these workers sacrifice so much for is actually worsening the heat crises and urban heat-island effects that are so dangerous to their lives. 'What could be hotter than the desert?' Emirates journalist Nick Leech asks. 'The answer is a city in the desert.'[88] Dubai's huge growth produces ever more hectares of asphalt and concrete,

which absorb more of the sun's heat and become even hotter, creating a dome of super-hot, polluted air that lingers above the city.

Startlingly, official discussions of how to deal with Dubai's heat crises fail even to mention its effects on the vulnerable construction workers who are exposed to it all day long. Instead, the concern is for the small parts of the Emiratis,' expats' or tourists' urban experience that is not already absorbed within chains of linked and mobile air-con bubbles. 'We've all felt that unbearable blast from the asphalt while walking the final few metres to our cars', one article in the UAE *National* relates. 'But few realise how damaging the effect of this can be'.[89]

Qatar and the UAE represent stark examples of the wider construction what Mike Davis and Dan Monk termed the 'dreamworlds of neoliberalism'[90] – cities sustaining fantasy lifestyles for the wealthy built at the expense of unknowable numbers of heat-related deaths among near-slave migrant workers. After the UK's then shadow sports minister Clive Efford expressed revulsion at the latest revelations of worker deaths in Qatar in 2013, Australian journalist 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.[91]

### Skyscrapers as 'Inverted Minescapes'

One effect of the flatness of prevailing discussions about exploration, colonialism and empire is the assumption that the transport, infrastructure and mobilities that sustain them rest entirely on or above the earth's surface. And yet, just as shipping, railways, roads, telecommunications and aircraft have been the basis for extending empires horizontally and aerially beyond current 'frontiers', so colonial penetrations deep below the earth's surface have relied on their own transport system. This technological key to extending mining vertically downwards has been the shadow of that already discussed which makes tall buildings possible: the lift or elevator. One reason the two systems are rarely discussed together, however, is that it is conventional to label mining elevators with a different moniker: the 'cage'.

While even more rarely discussed than the politics of above-surface elevators, the politics of subterranean elevator travel – subsumed within the crucial but usually invisible worlds of mining – are even more startling than those above ground. It is also rarely realised that the technologies of building massive vertical mining structures deeper and deeper into the ground have fundamentally co-evolved with those for building the growing forests of taller and taller skyscrapers into the sky.



Belgian coalminers reemerging at the surface in a miners' cage after their shift, 1920s

Corporate skyscrapers, located at the cores of the world's 'global' and wannabe global cities, house the corporate executives, stock markets and super-rich financiers who draw portions of their vast wealth from neocolonial deep excavation of scarce and valuable metals and ores in the world's peripheries. We have already explored the extraordinary global obsession with the race to build ever-higher skyscrapers – and ever-longer elevator tracks – over the past 150 years or so. The parallel excavation of ultra-deep mines deeper and deeper into the earth, by contrast, is scarcely noticed at all.

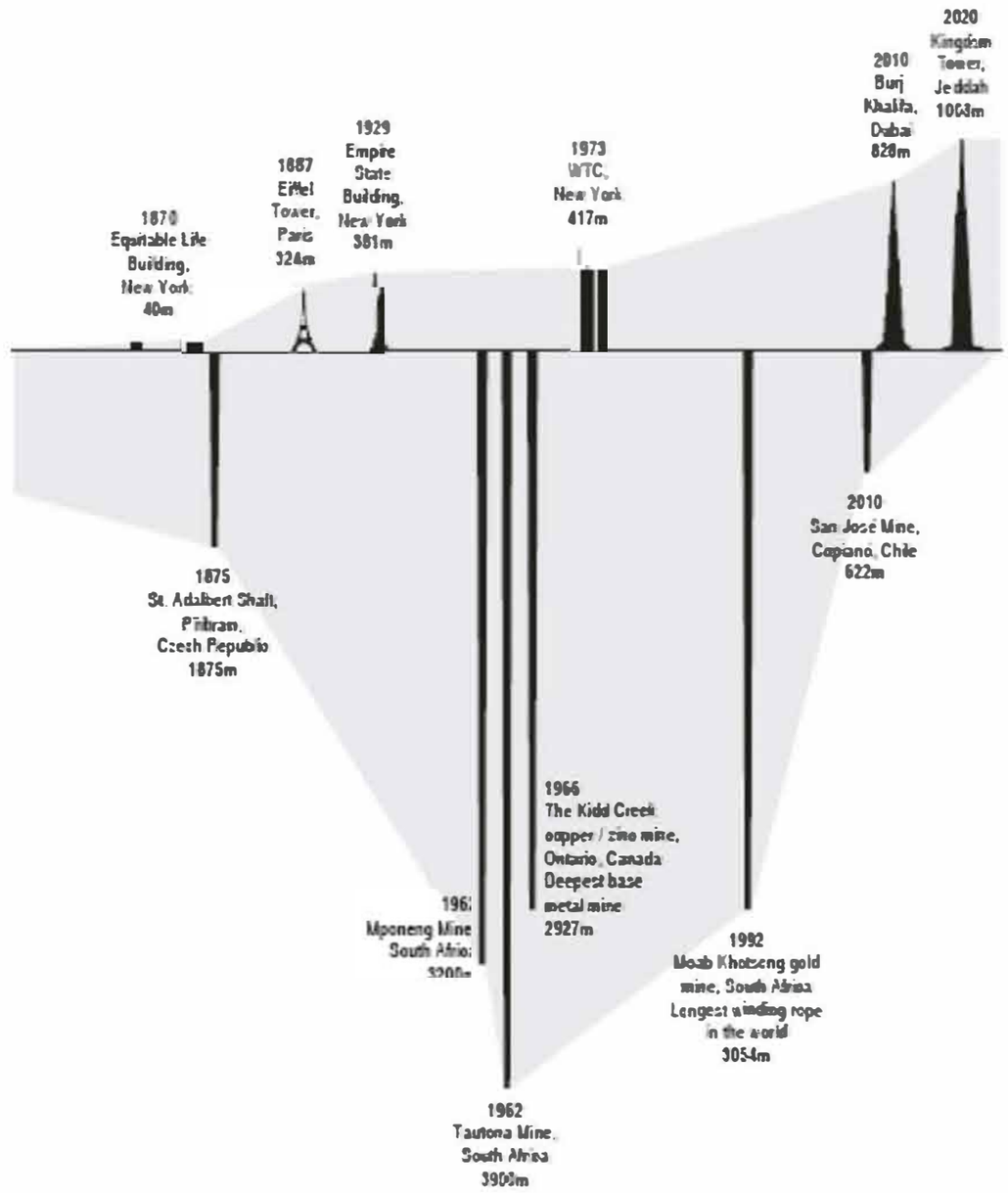
It remains rare indeed for popular graphs showing the rising heights of skyscrapers and elevators over the last 150 years to also show the parallel, but actually far more extraordinary and dangerous, excavations downwards in mines. The only example of such a diagram known to this author accompanied architect Rem

Koolhaas's exploration of architectural fundamentals at the 2014 Architecture Biennale in Venice.[13] Such a perspective reveals that mining cages have been plummeting miners over a kilometre vertically down into the earth for nearly a 150 years (since 1875). It also shows that the world's deepest mines currently are around 4 km deep – at least four times deeper than that other, much more familiar icon of modernity, the super-tall skyscraper.

In his pioneering work on the imperial resource grabs that sustained the explosive growth of San Francisco in the nineteenth century, Berkeley geographer Gray Brechin has explored the deep but neglected historic connections between mining and skyscrapers in unprecedented detail.[14] He shows how many of the technologies that were key to the building of corporate skyscrapers in North American downtowns from the late nineteenth century onwards emerged first in deep mines.

The deepening gold mines of the Californian Gold Rush in the 1850s, in particular, provided the sites where the ventilators, multilevel telephones, early electric lighting and high-speed safety elevators that would later be pivotal to construction of the first downtown skyscrapers were first used systematically. 'All were demanded and paid for by the prodigious output and prospects of the gold mines of California', he writes.[15] In addition, the use of square supports, initially made of wood, to build large, multi-storey structures within mines to provide support as mined material was removed, later provided the basis for the famous steel girder structures of the first corporate towers.






The parallel growth upwards and downwards of the world's highest skyscrapers and deepest mines between 1850 and the contemporary period (redrawn from Koolhass, 'Elevator')

The parallels between the processes of using these suites of technologies to dig down to provide the raw materials to construct skyscrapers were not lost on contemporary commentators. 'Imagine [the mine] hoisted out of the ground and left standing on the surface', reporter Dan De Quille wrote in 1877. The viewer 'would then see before him an immense

structure, four or five times as large as the greatest hotels in America, about twice or three times as wide, and over 2000 feet high … In a grand hotel communication between these floors would be by means of an elevator; in the mine would be in use the same contrivances, but instead of an "elevator" it would be called a "cage".'[16]

Brechin draws here on legendary American urban critic Lewis Mumford (1895–1990). Using Mumford's ideas of the capitalist 'mega machine' – where financial industries constitute an economic apex based ultimately on the exploitative and dangerous processes of mining, especially of gold and silver[17] – he stresses that De Quille's vision is even more evident in the contemporary context of super-tall 1 km towers, 3 to 4 km ultra-deep mines, and super-deep pits and quarries. Indeed, Brechin even suggests that the clusters of finance towers that have commonly signified the centres of 'global' cities for a century and a half should actually be seen economically and geographically as little more than 'inverted minescapes'.[18]

Such an idea forces us to consider how skyscrapers reach upwards from the staked territorial claims of real estate at the hearts of global cities or the cores of huge real estate projects: the tiny pieces of land at the heart of a tiny sample of metropolises from which global capitalism is directed.[19] Brechin addresses the unusual question of how such towers rely on both a wide range of mined materials for their construction and on speculative and commodified wealth that – ultimately – also heavily depends on mining.

It is worth looking in detail at contemporary but neglected examples of the profound connections between deep mining and tall buildings. Doing so helps illustrate the enormous contemporary power of Brechin's critical but often overlooked



insights. It seems especially appropriate, as we approach the end of *Vertical*, that we do this by returning to the ultra-thin pinnacle with which we started our narrative – a tower that has appeared since in various guises: Dubai's Burj Khalifa.

A crucial starting point for such a task is to realise, as sociologist Mimi Sheller has put it, that 'the … skyscrapers that serve today as the cathedrals of late modernity are grounded in the heavy (and dirty) industries of power generation, mining, refining, and smelting.'[20] To explore the Burj Khalifa's connections with extraction and mining, four related and overlapping processes need to be understood in parallel. First, we need to look at the huge effort needed to provide the material for the tower. To construct the Burj Khalifa, 55,000 tonnes of steel, 250,000 tonnes (or 330,000 cubic metres) of high-performance concrete, 700 tonnes of aluminium and 85,000 square metres of glass were necessary. Such headline figures translate into a remarkable 79 tonnes of steel, 357 tonnes of concrete, a tonne of aluminium, and 121 square metres of glass for each of the 700 apartments in the building.[21]

Many other materials – Egyptian marble and Indian granite for flooring and upscale worktops and tables – were also necessary in smaller quantities to fit out the interior of the Burj with the required 'luxury' aesthetic.[22] Deeply mined gold, platinum, diamonds and other precious stones and metals were also required to fill the shelves of the large indoor souk specialising in gold sales constructed in the enormous Dubai Mall at the base of the tower.

Even when such figures are considered, it is rarely emphasised that producing such extraordinary volumes of construction materials must, in turn, involve the mining, extraction and processing of countless tonnes of limestone, gypsum, bauxite

(from India and Guinea), iron ore (from Australia and Brazil),[23] coal (to produce the steel and aluminium) and a wide range of other minerals, ores, aggregates and fuels across many locations. Crucially, the mining, manufacture and transport of most of these materials are very energy-intensive, require large amounts of scarce water resources, and produce large quantities of greenhouse gas emissions. 'In most projects in the UAE, however, materials are evaluated and selected based on aesthetics and cost and not on their energy and environmental performance.'[24]

Dubai, moreover, has so exhausted its own marine sand deposits through the vast dredging necessary to construct its various artificial island projects that – bizarrely for a desert nation – it had to import the sand necessary to produce the concrete for the Burj from Australia.[25]

Added to dependencies on coal, iron, aluminium and sand and aggregates are the vital roles both of other 'base' metals such as copper, nickel, zinc,[26] and of the rarer earth metals such as tantalum, tin, tungsten and gold (collectively, '3TG'), in skyscraper construction and operation. This group– often labelled 'conflict minerals' – are crucial in furnishing buildings like the Burj, and global cities like Dubai, with functioning electrical and IT systems. They gain this name because they are the focus of resource wars that surround their extraction in some key conflict zones, notably Rwanda and the Democratic Republic of Congo.[27]

In the pivotal iron and steel sector, meanwhile, global growth in demand for iron ore, partly caused by the global proliferation of vertical and other massive architectural projects, has forced prices to rise dramatically. In 2008, alone, iron ore prices rose 50 to 60 per cent. Even with more recent price reductions due to the global economic slump, the three dominant iron ore companies – Brazil's Vale, Rio Tinto and BHP Billiton – are making huge investments to expand production, particularly in Brazil and Australia. (Qatar is rapidly building up an iron ore business in Brazil to provide for its own meteoric urban growth.)

David Robertson, business correspondent for the London *Times*, points out that the spectacular growth of steel-hungry skyscrapers, as well as the construction of huge factory landscapes in China, is so dependent on huge supplies of iron ore (as well as other metallic ores) that 'it seems inevitable that we will soon be talking about the strategic importance of these metals in the same way that we talk about oil.' As a consequence, Robertson argues – ironically, in an article read at 40,000 feet by passengers of the Emirates airline – that the epicentre of the global economy may no longer be the financial cores of London and Wall Street or even upstart global cities like Dubai. Instead, 'it is a vast expanse of red earth in the middle of nowhere': the iron-ore producing peripheries of rural China, Western Australia, northern Brazil and other mining areas.[28]

Architects Liam Young and Kate Davies further emphasise this point in their report about explorations of the pit and shaft mines that sustain the world's cities. 'Here lies the shadow of those cities', they write as they venture to the bottom of deep iron ore pits in the desert interiors of Western Australia, 'the silent twin: the void where a land-form once was. These are the dislocated resource sites that support the world that we know'.[29]

The environmental and social impacts of each stage of the mining, transportation, processing and construction processes associated with all of these sectors need to be considered. All are controlled by a few giant and often esoteric multinationals; use vast amounts of scarce water and energy; are huge polluters; and are run and owned by tiny cabals of super-rich elites of financiers and predatory speculators, in often-corrupt alliances with states

at various scales, and frequently backed by local security forces or their own violent militias.

Evidence of violations of human rights, labour rights and ideas of environmental justice by transnational mining companies is abundant.[30] Such companies often leave a wake of catastrophic social and environmental devastation in their wake. Indigenous and local people in the Global South are often displaced using violent mercenary and 'security' forces controlled by the mining companies themselves.[31] Trade unionists and community activists working against mining corporations are often targeted and killed. Toxic and polluted air, water and landscapes can leave a legacy of poverty and ill health for generations after the mining corporations have moved on. With crucial soil removed, dumped and heavily polluted, agriculture and foraging remain impossible long after the mining corporations have left (for this reason, activists call mining areas 'sacrifice zones').[32] The US Environmental Protection Agency ranks metal mining as the most toxic of all industries even when operating in the relatively well-regulated United States.[33]

In such a context, Cambridge criminologist Laura Gutiérrez Gómez has used her expertise to study abuses by gold mining corporations in Colombia. She characterises the criminal behaviour of many mining corporations as a form of accumulation by dispossession organised through systematic 'state-corporate' harm against the health, welfare and prosperity of local communities.[34]

A second process linking the Burj with mining involves the growing effort by UAE elites to diversify away from oil to mining and other forms of resource extraction. The wider engineering of skyscrapers, infrastructure projects and huge islands has pushed Dubai and the UAE to the centre of global industries for mining,



metal refining, quarrying and aggregate extraction. Increasing efforts are being made to control, through ownership or joint ventures, the geographically spread minerals, mining and extraction industries 'upstream' of the construction process in the UAE and Gulf.

Dubai companies, diversifying rapidly to deal with the future onset of reduced oil wealth, have become especially powerful as they gain control of new bauxite mines in Guinea in West Africa. This is an important factor given the importance of aluminium in skyscraper and infrastructure construction.[35] But refined aluminium is also Dubai's most important industrial export; the state-owned company Emirates Global Aluminium (EGA) is one of the biggest aluminium producers in the world.

'Dubai is the New York for Africans now', Mohammed Ali Alabbar, CEO of the Dubai real estate giant Emaar – developer of the Burj and a company fast diversifying into global mining – said in 2011. 'I really see that the link between Dubai, UAE and Africa is getting stronger and stronger.'[36] As well as gold, bauxite and iron ore in Guinea- Conakry, his new company, Africa Middle East Resources (AMER), is taking control of major stakes in oil and gas concessions in Uganda, bauxite in Malaysia, oil and gas in Gabon, uranium and hydrocarbon interests in Niger, copper in the Democratic Republic of Congo, gold and coal deposits in Madagascar and phosphate concessions in Mauritania. 'The Burj was over', Alabbar said on another occasion, reflecting on the minerals strategy. 'I was thinking where to go, what to do next?'[37]

The rapid diversification of Gulf global cities like Dubai into extraction industries hints at the broader role a small group of global cities play in the geo-economics and geopolitics of global mining. These are the cities where major mining companies have their headquarters – especially Toronto, New York, Santiago,

London, Los Angeles and Johannesburg[38] – and that gain much of the wealth and power that drives their increasingly vertiginous skylines through the wealth linked to mining.

Few people, for example, realise that the rising towers of Toronto's finance district and stock exchange ('TSX') now constitute by far the most important hub of the global mining industry. Following a period of aggressive recent expansion through acquisitions by Canadian mining capital in Latin and Central America and Africa, fully 75 per cent of global mining companies are now headquartered in Toronto. About 60 per cent are listed on TSX. In 2012, 70 per cent of the equity capital raised globally for mining was raised in Toronto. Canadian mining corporations, supported by recent national and local governments which have been exceptionally generous towards them, are now especially powerful in gold mining and extracting other precious metals.[39]

Moreover, lobbying and donations from Toronto's wealthy mining sector means that everything from hospitals, business schools and university chairs to art centres and museums now receive direct sponsorship from mining. Such 'philanthropy' has even allowed mining companies to influence primary education in the city's schools, so that any social or environmental criticism of their impacts on the extraction zones of the Global South can be removed from books and other teaching content. [40]

To explore the heart of this power, in 2013 local activist Niko Block went to the conference of the Prospectors and Developers Association of Canada (PDAC). The biggest conference in global mining, with 30,000 delegates from 100 countries, it's held annually in Toronto – reflecting the pivotal importance of the city, and Canada more generally, to global mining. Wandering the free bars around the convention centre, Block noted US Geological



Survey stands showing off USGS research work detailing Afghanistan's deposits of gemstones, iron, magnesite, chromite, copper and lithium. He attended dozens of technical discussions on valuing the latest super-deep reserves and the challenges involved in using the latest 3D visualisation and radar systems to help improve prospecting for remaining deeply buried metals and minerals. [41] Late at night, Block saw echelons of chubby mining executives returning from nights on the town arm and arm with local sex workers.

Meanwhile, across town, a startlingly different conference was taking place: a small-scale NGO congress discussing efforts to resist the violent eviction of indigenous communities in remote regions of Guatemala, Congo and Mexico. Here the agenda was rather different. It focused on the burning of villages, environmental and health crises, the murder of activists and trade unionists, and intimidation of women in mining areas by mass rape – sometimes by proxy militia employed by the very same mining corporations whose executives were living it up at PDAC across town.

'We are exploiting people and places that are otherwise made invisible to us', Block wrote. 'Mining is the business that built the skyscrapers at Bay [Street] and King [Street in central Toronto], which absorbs the money as it cascades into the city, as though from out of the clear blue sky, before rippling outward through downtown and toward [the financiers' neighbourhoods of] Ajax, Markham, Brampton, Burlington.'[42]

And, of course, we must attend to the extractive sources of the wealth needed to build the Burj and other Gulf towers, and especially the most important commodity chain underlying vertical construction in the Gulf: the speculative profits from oil extraction that have funded construction of megastructures like

the Burj. 'Today the fantasy skylines of Houston or Dubai achieve a similar inversion' to the 'inverted minescapes' of San Francisco's towers in the late nineteenth century analysed by Gray Brechin, Durham geographer Gavin Bridge writes. 'Their thrusting towers and sprawling infrastructure embody the three-dimensional geographies of oil and gas fields in the Gulf of Mexico and the Middle East from which their wealth and power derives.'[43]

The final key linkage between mining and skyscrapers like the Burj Khalifa involves the flows of surplus capital from the extractive peripheries of the world into the burgeoning forests of elite housing towers in the world's global cities, which we discussed at length in chapter 8.

As often-corrupt extractive oligarchs search for low-tax and high-return safe havens for their bounties of excess capital in volatile economic times, invariably, as we have seen, the booming real estate markets of cities like London, New York, Miami, Vancouver, San Francisco and Singapore are at the tops of their lists. Many of the hard-to-trace shell companies that are buying the most expensive überwealth condos in the prestigious emerging towers we've already explored in New York and London are fronts for mining oligarchs.[44]