12 Against the Driverless City

Steven Fleming

It's the first rule of marketing: don't start with the product, start with the customer's need. The customer seeking a drill bit, we are reminded, is really just seeking a hole.

We could likewise say the person who we think wants a driverless car, doesn't want that, or even a helicopter or teleporter for that matter. They want to be somewhere else.

If that somewhere else is a place of retreat—a house in the country or isolated beach—then maybe, just maybe, an autonomous car is the answer. But how many trips are to get away from other people? Most trips are not to places per se. Most trips are to meet people or join groups. We move for the sake of new unions.

None of us wants a driverless car, any more than we want a new drill bit. What we really want is to regroup. From the group we're a part of at breakfast—our family, let's say—we might want to join a work team, crew, gang, committee, cohort, jury, class, board, panel, etcetera, in time for the start of the workday. Before returning to the group we began with, we might have joined audiences, choirs, class reunions, sports teams, or any of hundreds of possible groupings.

Many groupings, of course, involve only two people: a server and a diner, a doctor and a patient, a customer and a shop assistant, or simply two friends. Whatever their size, the possibility of many such groupings in a day is the *raison d'être* for cities. The form of any city, along with its mobility system, is a result of the inhabitants' wish to group and regroup. It's why central land in a city costs more: times taken to get there are shorter.

Artists' impressions of future cities, if cities were reshaped to suit driverless cars, appeal to our emotions—they are sublime. They hypnotize us with technological possibilities, the way a new drill can. If we fall under the spell of those visions, we risk treating our cities like Masonite sheets in the hands of weekend handymen with new drill bits, turning them into pegboard for no reason except that their drill bits allowed.

We've seen how our ancestors got carried away with the car. They went crazy remodeling human settlements to suit the new tool, forgetting what settlements are built for, and that is to help people group and regroup. We repeat their mistake if we get too excited about the new kind of cars, the ones we don't steer. We start thinking these shiny new tools will let us build places of meeting even further apart, never mind what intuition would tell us, that the regrouping function is served by compactness. Since we won't have to drive them, we start thinking of cars as buildings of sorts, in which families might sleep or staff might sit in face-to-face meetings. Since we're not concerning ourselves with life-cycle analyses, public health, or

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the poor, we might as well go all the way and imagine our bodies as playing cards, and every grouping as a dealt hand, and every building as a card dealer, in a world operating as a giant machine, built to shuffle people around.

There are cities like Dubai that function as symbols of wealth. In cities like those, the re-sorting of people into teams, boards, crews, and the like, could cease altogether and the economy would barely be touched. The meeting rooms, classrooms, and shops aren't the engines of Dubai's wealth. The oil fields and gulf are, and those don't depend on people coming together. If any city could sink its surplus into a gigantic experiment that involves driverless cars, and all the infrastructure they require, it would be Dubai.

Most cities aren't like that. They depend on mobility, even more than the basics, like food and water. There's the countryside for those who are hungry or thirsty. What brings people to cities, is the opportunity of connecting with people. You only have to look at what social distancing did to most economies during the COVID-19 pandemic, to know cities' fortunes depend on face-to-face groupings, and regroupings, of people. Most cities don't have the luxury of experimenting with city forms that proceed, teleologically, from a new gadget. The gadget's success could be the city's demise. Thinking must proceed from the problem of regrouping itself.

Accepting that regrouping is the city's paramount function, leads us to take a step back for a moment and look at the city in such terms alone. As best as we can, we need to look past the pegboard mistake of our immediate ancestors who got carried away building settlements dependent on cars. We should also look beyond whatever form our cities took as a result of the invention of streetcars and trains. At a time when some are rushing to imagine how driverless cars might reshape the city, we should pause to think in the opposite manner and not even assume that historic town centers, shaped over centuries by the most basic mode, walking, are necessarily more than historical blunders.

It would be nice to suggest that we think about building a city from scratch, to be the most fluid city ever, when it comes to sorting people into new groups. However, we know from the arguments caused by Thomas More's *Utopia* or Plato's projection of an ideal polis in the *Laws* that discussions that aren't grounded in tangible models can throw up more stumbling blocks than they provide answers.

What we need are examples of actual places, specifically designed to group and regroup large numbers of people, that are sufficiently like cities for us to see how their lessons might be transferred. High schools and Olympic parks would both qualify. However, for their sophistication and comparability to cities, airports do the most for our thinking.

The biggest airports (Hartsfield–Jackson Atlanta, Beijing, Dubai, O'Hare, etc.) regroup more people per day than cities of a million inhabitants. At holiday time they manage more than three hundred thousand connections per day. If we disregard security checkpoints, which cities don't have, and luggage, which city commuters don't carry and which in airports is transported underground, then we can see the airport as a place that lets Bob and Mary leave the group of passengers they arrived with on a plane from Bogota, and a few minutes later—fifteen at the most—become members of a group who will be departing on the next plane to New York. That's the time it will take Bob and Mary to walk to the Skytrain, take a short ride, then walk from the train to their gate for departure.

On the way, Bob and Mary will have crossed paths with more people than cross their path when they commute in their city. However, those strangers will not have turned traffic lights red on their way. Those strangers will not have caused crowds to thicken so much that Bob and Mary were unable to pass. If Bob and Mary noticed any of those strangers at all, it would

have been because they thought they were attractive or strange. None would have been a hindrance, like traffic.

It's just as well elected governments don't operate airports. Imagine if the mayor of your city was given the reigns. Come hell or high water, she would find some way of opening the concourse to all the car addicts who gave her their vote, and wouldn't they love her for that! Instead of a concourse where people must walk, they will have one that allows them to drive. They could drive right the way through and collect their loved ones at the gate. They could drive around looking for parking spots right outside any restaurant or shop. They will have a concourse in which there are taxis hustling to drive Bob and Mary from the gate they arrived at, to the gate they must get to before the plane they must catch, goes to New York without them on board.

It would be madness, but don't laugh: this very thing happened to the city you live in.

I'm from Australia where streets use to have porticos extending halfway out to the middle, but traffic engineers, using words borrowed from the field of hydraulics, wanted streets that had frictionless edges. There's a sad story in Charles Montgomery's book *Happy City* about the pioneer of traffic engineering, Miller McClintock. He completed a PhD on the topic in 1924, filled with arguments for the removal of cars from the city, but with a family to feed, he took a position financed by Studebaker right after university to champion an antithetical line. The new line involved the abolition of porticos. Regardless of how they protected pedestrians, the way pedestrians in airports have roofs to walk under, the columns of porticos were vulnerable in the event of a car crash. Studebaker wanted their customers to have the freedom to crash.

To different degrees, it's a similar story all over the world. Right when walking was getting hard enough anyway because cities were growing, traffic engineers exposed walking to the weather and stopped it with red lights in the shape of stationary men. Now, every few minutes a green walking man flashes for a few seconds, then it's back to vroom vroom.

Movement got put into cars, which in the city don't move. It was as though the city was viewed as a parade ground for the worship of rich peoples' automobiles, crawling at a snail's pace for something to do.

In cities where prosperity derives from the length of a river, the depth of a harbor, a natural fortification, or access to natural resources, you might argue that mobility doesn't matter much, anyway. What does it matter if cars cause congestion, if they are useful as symbols of status!

But cities, these days, don't function that way. Their fortunes ride on their capacity to assemble and reassemble groups sourced from potentially millions of people, all in the course of a single workday. Families relocate to cities for the opportunity of sending one member to a specialized school, another to a specialized job, and of putting another's specialized service or product in reach of millions of potential customers—and all of this during a single workday. Some come from rural areas, where there are no jobs, markets, or schools. Others come from cities where commute times from most neighborhoods (the poor outer districts, which the bourgeoisie tend to ignore) are so slow the city's millions lack access to opportunities all of them would naturally seek.

The main objection to this definition of cities, as places where millions struggle daily for the chance to connect, comes from the modern-day patrician class. Occupying central neighborhoods, a short stroll from the best schools, shops, and jobs, they bemoan the plebeians and their movement. They define cities as places in which to be still. They say the masses don't need all their movement. They need better cafés, or, as Marie Antoinette might say, instead of mobility, they can eat cake.

Enough cities in this world are burgeoning despite their terrible coffee, and in some cases, barely a park or museum, for us to be certain that niceties like these are not the reason that cities exist. Cities exist for the possibility of getting from district to district for education or trade. Cities without the finer things—fine public space, for example—may see the disappearance of a handful from the upper echelons of society, seeking cities with culture or sun, but cities with gridlock lose the struggling masses, who by their sheer weight of numbers, matter far more. The cities that win them, and the companies keen to employ them, are the cities with decent commute times. The airport analogy helps us understand why.

The world's biggest airport would be in New York, if hot destinations were what made certain airports turn into international hubs. However, scanning the field of international airports, we see the really large ones—Dubai, Atlanta, O'Hare—had something else going for them. There was efficiency in the way they helped people regroup that wasn't lost as new terminals kept being added. Whichever airport in a region of the world can keep on providing quick transfers as more and more airlines choose it as a base, will become a honeypot for even more airlines, which will keep coming as long as the concourse and Skytrain can shuffle the volumes of people effectively.

The honeypot lures all sorts of airlines, from those flying small planes to obscure destinations to those filling Airbuses headed to capital cities. The bigger the airport, the easier it is to fully book flights. The bigger the airport, the bigger the market to which an airline will have access.

But the airport must be efficient. If one airport can't guarantee swift passenger connections, there are others that airlines can choose.

The busiest airport in the world is in Atlanta. That's not because Atlanta is unrivaled in terms of its central location to receive international and domestic air traffic, and it's certainly not because millions are clamoring to visit Atlanta itself. It's because the terminal design was efficient and remained efficient as its efficiency led to more growth.

The same mobility system underpins airports as underpins transit-oriented cities. A mass rapid transit system—a Skytrain—moves between terminals, leaving people to walk the last quarter mile. To save them cluttering the concourse while schlepping their luggage, suitcases get handled by others downstairs. Meanwhile, to speed up their walking, moving walkways are often provided.

But stop for a moment and think about the ways many staff move around in these places. Because they are familiar with the environment, they can be trusted on bikes, or in some countries Segways or scooters. Whatever the choice of personal mobility device, it will be faster than walking, yet equally agile. If passengers were familiar with the environment, they might all be trusted to cycle as well.

For staff with duties covering a whole airport, having fast wheels is essential. In some airports it can be as far to walk from one extremity to the other as it is to walk from midtown to downtown in Manhattan. Walking would consume their whole day. But agility is important as well. If staff made these trips in the golf carts used to help the disabled move around airports, they would be slowed down the way carts are slowed down, by pedestrians in their paths. What staff need are nimble wheels that allow them to slip between gaps.

We've imagined what would happen to airports if shrinking, populist, groveling mayors were in charge, but what would happen if the CEOs of airports became the mayors of our cities? Could they ban cars, remove traffic signals and curbs, reinstate weather protection, and allow as many people as could be trusted to speed up their walking with bikes? The first of many questions this raises, is whether or not this would be a recipe for crashes.

There is a live experiment in the central borough of Amsterdam—a district where 68% of all trips are by bike—that absolutely dispels fears that lots of bikes in an airport-like city would cause injuries due to bike crashes. In the middle of the craziest crossroads, where north/south and east/west bike and pedestrian traffic gets funneled, the city of Amsterdam has created a “shared space,” the *gedeelde ruimte* between Amsterdam Centraal and the city’s free ferries to Amsterdam Noord. The nearest thing you could liken it to are those figure-8 sessions they used to run at skate rinks, the ones that always seemed to end with some poor kid breaking their arm. The shared space behind Amsterdam Centraal is a pure cluster of madness that no planner would want for their city (especially if they cared about the vision-impaired), but it does prove one thing without doubt: pedestrians and cyclists mix without hitting.

That’s not to say no cyclist anywhere in the world has ever crashed into somebody walking; those incidents get so much attention from people who think bikes aren’t legitimate transport but toys, that no one could be unaware that such accidents happen. What is being argued is simply that, where both pedestrians and cyclists are prevalent and known to each other, like in the shared space behind Amsterdam Centraal, they miss each other with surprising aplomb. They are doing, naturally, what engineers are striving to achieve with autonomous cars. They’re automatically engaging in lane formation by following the rider ahead, and they are making subtle adjustments to their speeds in order to anticipate, and just miss, all the others crossing their paths.

To anyone with an interest in two and two, and in putting them together with a mind to reaching new and amazing conclusions, a few possibilities arise from this observation. We start to imagine cities that don’t have any cars, but that do have weather protection, like super-sized airports. If we like, we can imagine what might have happened to the world’s prototypical city, Rome, if the ancient world had had bikes.

The previously walled center of Rome was 13.7 square kilometers and was traversed at walking speed only. Linearly, cycling is five times faster than walking (15 to 20 kph, as opposed to 3 to 4 kph) and therefore capable of encompassing areas twenty-five times greater in the same time. Had the Romans all cycled, their city could have been 68.5 square kilometers in area and still have had the same average trip times. Instead of housing just 450,000 people, the ancient city of Rome could have housed more than ten million.

Let’s not quibble about densities, streets widths, or how ancient Roman cyclists would have made it up the Palatine Hill with no gears. Let’s just acknowledge that if we were starting from scratch, with a new city, we could achieve a hell of a lot if we planned it around cycling and banished the cars.

What would a city made from scratch, around bicycle transport, be like? Our imaginations wouldn’t be too far off target if we pictured eighteenth and nineteenth-century cities built around the speed and dynamics of horses. What is Amsterdam, if not a city designed around horses, where the horses got swapped for bikes?

We have license, though, to imagine something tailor-made for bicycle transport. We are well within our rights, for example, to imagine a city where the streets are protected from rain. Why not! We no longer need rain to wash away horse poo. These days, we have sanitary bicycles that we can use—not to mention a plethora of tiny, electric-powered, personal mobility devices. It’s about time we thought about streets that provide pedestrians and cyclists with weather protection.

It’s time too that we thought about spiraling buildings, buildings that would allow us to cycle all the way up and through them. The time is right to think about undulating ground surfaces,

where places of stopping and slowing are raised, and traveling paths are all lowered. That way, we would not have to brake to slow down or pedal any harder when getting our bikes back to speed.

What gives us license to think in such fanciful terms, about some imaginary, future, bike city? We are granted this license by all those who have been imagining the city of the future if it had driverless cars. If it is OK for some to speculate about cities being even more sprawling, or to picture the street as a virtual train track, filled with cars electronically coupled so they speed along bumper-to-bumper, it is fair that we be allowed to imagine a city planned around bicycle transport.

It may just be the case, too, that a city designed around cycling will have even faster connections, and provide even more comfort, than a city shaped by driverless cars.

In a moment (on the next pages) we'll look at three images imagining the city of the future. Though they haven't been published before, the thinking behind them is from my 2017 book *Velotopia*. It was promoted as the book Ebenezer Howard might have written had he cared more about cycling than trains, or the book Le Corbusier may have written had he not been besotted by cars.

In *Velotopia* I express my bemusement that neither of those authors ever mentioned bicycles as part of their mobility plans. There was actually a bike boom in full swing when Howard was writing about garden cities. As for Le Corbusier, he was a cycling enthusiast himself; you would think the bicycle would figure in some measure in his vision for future cities, but like Howard, his mind went to enclosed and powered machines.

In *Velotopia* I said the problem they must have seen with bikes was all of the horse shit. Streets used to be caked in the stuff, meaning people whose jobs were indoors preferred to travel indoors, in trains, omnibuses, and cars. However, I have come to see an even larger, if less visible, factor at play: the factor of money and power.

It was industrialists who lured millions to cities in the late nineteenth century, so it was industrialists, not politicians or planners, who decided how they would commute. Industry in Victorian London took off thanks to steam engines and railways, so as planning proceeded for the population to grow to six million by the year 1900, it was done hand-in-hand with the train. Producers of oil and cars were behind the postwar prosperity of American cities like Dallas and Detroit, so those cities grew according to a car-dependent model of urban growth.

Bicycling doesn't have a small cartel of rail or oil magnates who stand to get rich from more cycling. The only ones standing to gain are ... everyone else!

The benefactors of a bicycling city are those of us who are not oil or car companies. We are all the small and large businesses, and all the consumers, carers, students, and workers. Our interests don't include trains, cars, or even bikes for that matter. All we want is a city where everyone gets around quickly, preferably cheaply. Can we squeeze into the cigar room of a businessmen's club and conspire about highways or railways? Hardly! We number in the millions. We are the masses at large. All we have are representative bodies: the governments that we elect.

The time has come for governments to open their eyes to something no industrialist is likely to tell them: that fast machines are obstructions to a fast city. To think fast machines could make cities faster, is to misunderstand what cities are. Cities are sorting devices, built to sort, and re-sort, people into all manner of temporary groups.

The city can be likened to a giant bowl full of cornstarch and water into which each of us can lower a spoon. All of us, simultaneously, can slowly move our spoons to any point in the bowl we may wish, and will get to that point in good time. All it takes though, is for one fool to try and stir quickly, and the entire bowl of cornstarch will freeze.

That fool is the person who brings a car into a city. A hundred years ago, their presence created the need for traffic signals, turning movement in the city into a stop-and-start matter. In the future that fool will be in a driverless car, thinking each car should be coupled to cars fore and aft, all speeding around bumper-to-bumper. It will not occur to this fool that he has turned the street into a chainsaw. Lest they be minced, pedestrians will need to be stopped from ever crossing the road, with fencing like you see around train tracks. Will the fool care? Of course not! He is an heir to the Filippo Tommaso Marinetti spirit, not seeing the city as a delicate re-sorting device to make ever-changing groupings of people, but as a stage for rocketing bodies between removed points on the map. He will never understand that rocketing bodies is a business for NASA and SpaceX. He would rather get frozen in oobleck.

The three large plates in this chapter provide an alternative vision of the city of the future to those offered by believers in driverless cars. The first is of an apartment block, designed around a bike-friendly access gallery.

Plate 1: An apartment building designed to make use of things that have wheels.

Image: Steven Fleming

The idea here is to eliminate a portion of time in each trip that the automotive industry has chosen to discount: the time it takes to get on the road after walking out your front door. Average car trip times for cities are collated from data recorded in logbooks that study subjects keep in the glove compartments of their cars. They don't capture the time that can be spent schlepping children and groceries between cars, homes, and destinations. In the building we're about to imagine, that schlepping all disappears. If you wanted to, you could take your children in your cargo bike and use the cargo bike as a trolley when doing your shopping.

Figure 1: An apartment designed to make use of the bike.

Designer: Matt Sansom

It would not be essential to include an elevator in a building like this. If there was one, it would only be for taking you up. Coming down would be faster by bike—the bike you would keep inside your apartment if you lived in a building like this. You wouldn't leave home without it, at least not if you were concerned about time. That is because there would be no faster way out of this building than on a bike. With the whole building designed around a spiraling escape ramp of sorts, leaving would be as simple as riding out your front door and letting go of your brakes. The only faster way out of a building would be via a fireman's pole!

Figure 2: Most shops could make use of the bike as a trolley.

Photo: Matt Sansom

Similarities can be drawn between this proposed new kind of building and: a building called the 8 House in Copenhagen that has maisonette apartments accessed via a ramped aerial street; Park Hill in Sheffield that has horizontal aerial streets extending to meet the hillside where the building is sited; and the West Village Basis Yard in Chengdu, a perimeter block with scissored bike ramps connecting the access galleries back to the ground.

Bike access eventually had to be banned in the 8 House due to inadequacies in the detailed design, but Park Hill and the West Village Basis Yard remain popular with people wanting to ride from high-level apartments directly down onto the ground. The building we're imagining would be even more popular among cyclists, given it provides them the most direct path to the street.

Note how it spirals clockwise from bottom to top. That is because the example we're looking at has been designed for countries like England and Australia, where we drive on the left. The idea is to put cyclists who are on their way down, and thus going faster, on the side furthest away from the apartments' front doors.

However, finessing of that sort doesn't completely negate the need to make those ramps wider. If they're to handle people walking, people in wheelchairs, and people on bikes, the regular width of an access corridor would at least need to be doubled.

To save a doubling of the width, causing a halving of the plan's efficiency (in other words, an inordinate ratio of public circulation space to the private floor area of the apartments), it would make sense if bike-access apartment blocks had twin-level, maisonette, units. That way, access would only need to occur on alternate levels. To really boost efficiency, access could be stretched out to every third level. The architect would just need to configure the apartments in a manner pioneered by architects Peter and Alison Smithson in a building called Robin Hood Gardens. The following drawing shows how two-story apartments can sit over and under floor levels largely given over to ramp space. The only private space on the access level would be entry vestibules and single offices or bedrooms connected by private stairs to apartments, one stretching over, its neighbor stretching under, the level of entry and access.

Figure 3: Access galleries can be widened without reducing floor plan efficiency.

Image: Steven Fleming

Velotopia works through the thinking and planning of various types of ramped bike-access apartment blocks, with apartments as small as one bedroom ranging to large ones that interlock like bayonets. There are also slab blocks organized around aerial streets that switch back on themselves, the way roads switch back when they're leading up mountains.

Lest any scenario be forgotten, there are sections on all kinds of buildings, from office blocks to retail and even country retreats. Has there been uptake? As an author, you don't always know. I can say that as a consultant, I have slipped these ideas into masterplans I've worked on in Norway and China. Also, the City of Bogota had me work there to deliver a competition brief for a school and bicycle industry incubator. Initial plans are to give the poor district of Bosa a building derived from "Velotopian" thinking.

The real-world dimension to the work gives it a practical edge, missing from city-of-the-future visions with driverless cars. Ramp gradients are not randomly chosen but conform to guidelines developed for wheelchairs. Similarly, hard lessons learned in the 1960s, when there was no passive surveillance of access galleries, have put limits on what can be imagined as real.

If there is one contemporary orthodoxy that can't be acquiesced to, it is New Urbanism's moratorium on big buildings. An atrium needs at least a sixty-meter circumference for a ramp to fit in it, and double that if the ramp is to skip alternate stories. There is no way, in old cities, for buildings of that size to be squeezed onto small lots, at least not without the amalgamation of sites or some inelegant planning.

Really though, this represents a fairly insignificant point. Old city centers aren't where humanity is struggling to provide housing. Urbanization is playing out on former industrial land, or, in poor countries where urbanization is happening at the greatest pace, new buildings are being constructed on cleared forests and farmland. Either way, new buildings are big enough to be designed around ramps, instead of high-maintenance lifts. The second of our large plates shows what could await a person on a bike as they ride out of their building.

Plate 2: A street that is easy to cycle on, yet hard to drive on, meaning it is easy to walk there and use wheelchairs too.

Image: Steven Fleming

The first thing to note is that the street isn't flat but something more analogous to a skate park. Only this skate park is for adults and on the scale of a city.

The concept derives from a desire to prevent fast-moving, heavy machines from ever dominating the city. A car or a motorbike would be shaken to bits if it went faster than bike pace on a ground surface that goes up and down.

With fast machines out of the picture, we can imagine the perfect environment for cycling, while not forgetting the needs of pedestrians or people in wheelchairs. The inspiration comes partly from skate parks, where children stop on elevated plateaus. The elevated plateaus of *Velotopia* are where cyclists slow down before dismounting or riding into the buildings.

One meter below those plateaus are elevated mounds, positioned at all of the crossroads. The idea is to slow cyclists a little where their paths intersect.

The lowest plane of this undulating terrain is where cyclists would be moving the fastest. Test-riding has taught us that a two-meter elevation, from the lowest/fastest point of the road to the top of the mounds, is just the right height to bring a loaded cargo bike to a standstill without braking, and to get it back to full speed when it heads down.

Figure 4: A stop-motion photo showing ideal elevations for slowing and starting without having to pedal or brake.

Photo: Charlotte Morton

The book *Velotopia* has ideas about grade separation between cyclists, pedestrians, and the disabled, for the busiest parts of our cities—around central train stations, for instance. But in a city without transit nodes (subway stations, for example) and where cyclists aren't funneled onto the few streets remaining after driving has taken the others, movement would be diffused. Few streets would have so many cyclists that they couldn't operate as shared spaces, with pedestrians, the disabled, and bicycle riders all crossing paths without hitting.

Based on that assumption, the vision of the future city shown in plate 2 has paths on diagonals, between the plateaus, at a gradient to suit people in wheelchairs or using mobility scooters.

Figure 5: An undulating ground surface would thwart driving, be better for wheelchairs, and unleash the convenience of bicycle transport.

Image: Steven Fleming

The second thing to note, is that bike routes are covered. Some of the artists' impressions in *Velotopia* show giant saw-tooth roofs covering all open space: the whole of the street and all the courtyards within buildings. The idea would be to let people make beelines, oblivious to buildings held aloft on thin columns, and oblivious to rain or snow falling.

The vision shared here is more modest. Only the travel routes are protected, leaving cyclists exposed to a few seconds of rain at the beginning and the ends of their journeys. In this case we're imagining awnings that are parabolic, to capture and harvest rainwater on wet days, and, in sunny weather, to tilt to track the sun and focus all the energy on one point for collection.

Where one might expect the most vociferous critics of covered streets to be drivers, poopooing public expenditure on anything except for more parking, the real hatred for this idea has come from Dutch bicycle advocates. The same people who in one breath say cycling is transport, not recreation, insist that cyclists want the rain on their face to remind them that they are alive. What they are saying is that cyclists are different from patrons of other modes, such as car or rail travel, all of which provide weather protection. Given that country's Calvinist roots, it is tempting to guess that what these tough guy (and gal) cyclists are saying, is that they are God's chosen ones, predestined for heaven, because they ride bikes in the rain. It's an us-and-them attitude with no place in a city that is lacking any drivers to mock.

We end this series of three image plates with a view of a plateau with no buildings. It's a raised space, which means our wheel-borne population naturally slow, or come to a stop, when they get here. While they are on this stopping plateau, they are storing potential energy, by virtue of their slight elevation. When they leave and head down, that potential energy will be converted into the kinetic energy they will use to join their next group.

Plate 3: Their elevation would make cyclists naturally slow down before arriving at building entries and public spaces like this.

Image: Steven Fleming

Like all three of the plates, it is rendered in high enough definition that details in the background ask to be seen. Key among them is the permeability of a city, where buildings can all be passed under.

Figure 6: Cyclists' and pedestrians' inherent ability to cross paths means buildings could be raised and everyone could make near-perfect beelines to their destinations in a bike-centric city.

Image: Steven Fleming

Perhaps the most important chapter in *Velotopia* is the chapter estimating trip times. They come out better for a city of six million cycling than for the six million driving in the Dallas–Fort Worth metroplex—an example often held up in support of car transport. Granted, my trip time calculations are for an “ideal” bicycling city, having no hills, a high population density and nothing to make cyclists slow down. What I would say about my ideal, though, is that it is far easier to achieve in real life than the ideal of a car city. It doesn’t need a lot of things added, like billion-dollar freeways or cross-city tunnels. The main task is taking things away, namely the cars, which since they have wheels, should not cost very much to remove!

All this leads us to the first of two basic questions: Which should we build for, the bike or the driverless car? Where cities are rapidly expanding, or being built out of nothing, the opportunity exists to make cities cheaply, with no elevators or heavily engineered roads, and where the costs to individuals are equally low—bikes retail for US\$50 in poor countries, about as much as motorists spend every time they refuel their cars. Once you factor in the cost to life from having populations sitting, not exercising, when they commute, and the cost to the planet of heavy modes of transport compared to light-weight bicycling, the car city looks like a hideously expensive proposal. When it comes to new urban districts, therefore, or whole new cities constructed from scratch, the case for purpose-building for cycling begins to look strong.

The main objections to cycling—that it is slow and puts people out in the weather—are moot when we construct our cities for cycling from scratch. When we think about bike trips being all under cover, then using the bike to schlep children and loads the whole way, and not obstructing cycling with traffic lights or the detours we subject it to by routing it clear of car traffic, we begin to imagine a city that is just as comfortable, convenient, and time-saving as any we can build around driverless cars, but without the price tag or externalized costs to public health and the planet.

Next comes the more vexed question of adapting existing human settlements so they group and regroup people more quickly. If any role can be imagined for the driverless car, it might be in completing the task of making the countryside a part of that story, in other words, letting people live in the country but still have access to the opportunities that come from fast connections to millions of people.

What an absurd proposition! Houses built for tilling the land will not be drawn together—at least not in their millions—until we actually do have personal flying contraptions, or teleporters. The cost of the roads would be greater than the cost of the buildings—that is, if we’re serious about giving people in the countryside equal access to the specialized education and jobs that populations of millions can offer. For the sake of a relatively small percentage of the world’s current dwellings, connecting the countryside using driverless cars would be as wasteful of cities’ resources as it would be wasteful of car manufacturers’ R&D funding.

The fact that R&D into driverless car technology is persisting, is evidence, on its own, that the automotive industry has its eye on more than the country. It expects its products will be welcome in actual cities, on streets that need to accommodate all people’s movement between all the densely packed buildings. The cost of that R&D work is itself proof that the automotive industry isn’t angling to provide driverless car technology on a supplementary scale. It must work at an economically viable scale to the automotive industry. In other words, they are hoping existing urban areas will be retrofitted so that driverless cars become the dominant mode.

Anyone who might be concerned about the slight dangers inherent in a rise in bicycle transport, would have to view the car industry’s plan as an absolute nightmare. The polite visions they’re promoting right now, of cars stopping for kids chasing puppies out onto the street, are to establish a foothold for driverless cars in the city. Once they have that, their profit motive will

compel them to lobby, year after year, for measures that will make driverless cars more prolific. Since capitalism knows no limits to increased profits, the goal must be for driverless cars to take over. By the time car companies have recouped the R&D outlay that they're spending right now, and turned a speculative investment into real profit, they will have convinced us to fence off our streets the way we've fenced off our railways, so cars can be coupled like rail cars. The only opportunities for crossing the street, since intersections will be optimized for cars to sift through without touching, will be via over- and underpasses, paid for by the public and herding us via circuitous routes. The most practical means of just crossing the street, will be to pay for a ride in a driverless car. We'll be slaves to an industry that doesn't sell holes, it sells drill bits.

I would urge anyone being swept down this path by arguments pointing to the short-term benefits of driverless cars, to pause and engage with the *Velotopia* vision. While bicycle-centric, it is pro-walking and pro-public transport in ways the car city cannot be. Also, while it starts with a discussion of a city for six million, built out of nothing on a flat plain, it is ultimately focused on actual cities, with their existing car dependence, rail infrastructure, and hills.

The lofty idea of a perfect bike city for six million people is offered merely to balance the scales. When a highway is planned, we all know the vision we are building toward. It was pushed on the world right through the interwar period in Le Corbusier's Voisin Plan, Frank Lloyd Wright's Broadacre, and, most influentially, Norman Bel Geddes's Futurama exhibition of 1939. When we build a railway with transit-oriented settlements clustered around the new stations, we have Ebenezer Howard's garden city model to tell us what we are setting out to achieve. We similarly know, when we plan a pedestrian-centric new township, that a plethora of ideal models, ranging from those systematized by Kevin Lynch and Jane Jacobs, to actual medieval town centers, are the long-term goal of our efforts. Despite being fast, safe, cheap, healthy, sustainable, nimble, and able to carry things for us, the bicycle never had a city model defined as a goal. *Velotopia* has corrected that error and shown in the process that bicycle-centric built environment planning could lead to faster average commute times than any of the other models just mentioned.

Velotopia's downfall is that no powerful group is ever likely to champion it for their own profit. Selling a bike to each person will not make the bike industry as rich as the car industry became by selling each family one, two, or three cars. Getting everyone cycling won't make a few influential landowners rich the way landowners get rich when train stations are built near their holdings. In a bicycle city, all but the most peripheral land is equally accessible, in terms of average trip times. We also know from the way land prices evened out in cities in China after the arrival of dockless bike sharing systems, that anyone owning land in a central location, who might be expecting it to exponentially appreciate as the city expands, could turn against cycling when they see its levelling effect on land values. None of these traditional profiteers from mobility systems, or the lack of them, will use their power and influence to champion the *Velotopia* model.

The challenge in promoting a bicycle city, is not finding the ears of the rich and influential but of the people at large, because it is they who will reap the fast trip times and comfort. We just have to show that cycling is worth building for, to the exclusion of shiny distractions, like driverless cars.

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