

Reciprocity and design for an era of compressed temporal and spatial scale

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Abstract

*Haraway and others have suggested reciprocity with the non-human world is a pathway to understanding our humanness. Two urgent trends accelerate our need for this reciprocity: the first is the COVID-19 pandemic as a harbinger of future pandemics, and the second is our changing planetary climate. Our present time is increasingly becoming a “present-future,” linked irreversibly by scientific models to specific future states of our planet and local regions. At the same time our bodies are co-evolving with a virus in a global reciprocal process with no end in sight, collapsing our sense of scale and separation among bodies. A long view of time in the past could act as a counterbalance to this experience. Bringing the *longue durée* model of time into our present requires reestablishing our knowledge of a long-term past in which humans adapted to major changes in climate earlier in the Holocene. Forms of future urban adaptation can embody reciprocity by emphasizing strategies that anticipate change rather than seeking to prevent it, leaping forward in time to embrace global changes we are no longer able to prevent.*

Keywords

Humanness, climate adaptation, reciprocity, human-animal hybrids

The argument: what does it mean to be human in our time?

This essay explores three arguments that emerge from the concept of reciprocity as the human condition. First, that reciprocity is inherent in the human biological condition, and that our relationships with other forms of life inside and around our bodies has always been reciprocal. I will extend this argument that reciprocity is the human condition to argue that we humans are increasingly aware of an unprecedented compression of temporal and spatial scales, as the human population expands, as more infectious diseases become pandemics, and as our planet changes as a result of increasing greenhouse gases in the atmosphere and oceans. Second, I will argue that humans have responded to our condition of reciprocity in the past by articulating fantastical human-animal hybrids. Re-exploration of these hybrid constructions can counterbalance our disorienting present, expanding the compression of time by evoking the *longue durée*, in which human self-awareness is a very old and complex phenomenon. Finally, I will use an urban design proposal as an example of how proposals for physical space can embody reciprocity, and provide at least a local, multi-decadal expansion of compressed spatial scales as we adapt to rising seas.

Many contemporary people's perception of future possibilities has been fundamentally altered by pre-

dictive numerical climate models. These models link human actions that have occurred in the past and present to specific future climate outcomes. Periodic reports from the Intergovernmental Panel on Climate Change (IPCC) appear in news media and are repeated and amplified in social media, shaping a narrative that the range of possible futures is restricted by both the past and the present. Instead of imagining that many future conditions are possible, the use of these models increasingly links a specific present (defined in terms of gigatons of greenhouse gas emissions) to a relatively narrow range of possible futures (defined in meters of sea level rise, weeks of drought, days of excessive heat, frequency of pandemics, etc.). This creates an experience of a *present-future*, which we could define as a compressed linkage of hundreds of billions of unique actions taken each day with a set of resulting global conditions that could persist for millennia. The intensity of this compression represents an unprecedented density in both temporal scale (moments determining thousands of years) and spatial scale (billions of local actions resulting in global alterations of rainfall patterns, for example). Like the aesthetic concept of the sublime, these scales and the complexity of relationships that occur across them are difficult to comprehend; and yet this disorienting experience of time and space is the current human condition.

The experience of a drastically compressed present-future can produce significant personal anxiety. For many people, this anxiety has become amplified by the experience of a life-and-death global pandemic over the past several years. A pandemic that may have resulted in whole or in part from the expansion of human territories into the territory of bats, which in the overlap of territories is also a form of spatial compression. Interspecies intrusions are not new in themselves, but the speed and spatial scale with which a virus that spills over from bats to human can spread to billions of people connected by airports all over the planet is new in human experience. The speed and complexity of interactions among entities at different ends of the biological size spectrum (humans and viruses) blurs spatial and temporal dimensions in dizzying ways. It's now perfectly reasonable to wonder how our own bodies might be transformed within months by real-time reciprocity with viruses and bacteria that live on the other side of the world. The human relationship with the non-human world has changed in fundamental ways because space and time are compressed into a terrifying, uncontrollable immediacy. Given this altered context that exists across scales, what is the role of design? One answer is that designers can become radically anticipatory actors. Designed environments can reveal these compressions of space and time, and designers can anticipate future states and advocate moving to embrace them as a way of slowing the rate of change for managed phases of time, perhaps several decades long. For example, Dutch designers now promote the phrase "living with water" as a maxim for adaptation to higher sea levels. The designs proposed to embody this ideal combine engineering models with aesthetic experiences that generate a sense of wonder. Like the best Dutch projects, designers and decision-makers can reject the paralyzing anxiety of a 'present-future' in favor of innovation. It won't

prevent change, but it will allow us to live well with some major changes, while recognizing that no act of design will ever make a more extreme climate a good thing.

Design in this compressed era is increasingly deontological; it expresses an ethical position, rather than a utopian ideal. We are no longer able to design an ideal future, knowing what we know about the consequences of past and present actions and territorial circumstances. The replacement for utopian visions could be understanding design as a radical form of care and reciprocity. Haraway describes our condition as entanglement, and advocates staying with the trouble as the only ethical action. But no matter how innovative we are, trouble cannot now be avoided. Acting out of a sense of care, despite this unavoidable change, is a radical act.

Instead of pursuing ideals, design can be a meaningful and ethical form of activism that expresses care as a mix of witness, compassion, and radical anticipation. The socio-biological world in which designers construct intentional changes can act as a sort of mirror, revealing the consequences of our decisions. The act of design is simultaneously activism and critique, the taking of a position and acknowledging the consequences of that position. Hannah Arendt described action in terms of power, memory, and the space of appearance, but she also highlighted the unpredictability of action – and pointed out that if the effects of action are irreversible, the possibility of forgiveness is a necessary context for action (Arendt, 1958).. The actions of designers can generate a reciprocal form of care through actions, new awareness, and reactions. That cycle can relieve some of the pressure of living in a 'present-future' by becoming radically anticipatory, and by exploring the hybrids of human and non-human that are the cultural legacy of an anxious, pre-literate human past.

The reciprocity of co-evolution: what is human, and how is humanness altered by spatial networks?

The question of who and what a human is has always been problematic. If there is a useful way of defining humanness for our time, given the trend of increasing pandemic disease, that definition would need to recognize our relationships with viruses and bacteria.

The playwright and politician Vaclav Havel wrote that humans are fundamentally just a particularly busy intersection of molecules, within a field of interacting molecules. Biologists tend to be more specific. Current estimates place the number of non-human cells in the human body at about the same number as the number of human cells contained in our blood, tissue, organs and bone structure (sender, 2016). If we consider only human cells with a nucleus, which includes all cells that contain DNA but excludes blood cells and platelets, human cells would be outnumbered by viral, bacterial and fungal cells by a ratio of about 10:1. This split in human to non-human cells implies that our bodies are only at best half human. We and all other animals live in a state of constant and evolving biological reciprocity with viruses and bacteria; our ecological context and actions influence them, and in return, they influence our biological health, our ability to nourish ourselves and have healthy children, and even our psychological and emotional health.

These multitudes of viruses and bacteria also have relationships with each other that affect us. For instance, since viruses are made up of only a strand of RNA¹ coated in a protein, they have no DNA-containing nucleus of their own. Viruses must enter human or bacterial cells in order to reproduce. This can be bad for our health when we are their host, but it can also be beneficial. Human DNA has always co-evolved with snippets of viral RNA. The human ability to give birth to a healthy baby is just one example researchers have identified of the benefits of

co-evolved viruses, in this case within the placenta (Kämmerer, Germeyer, Stengel, Kapp, Denner, 2011). Co-evolution occurs through a process geneticists call 'domestication', because the relationship creates long term beneficial relationships.

Viruses can also enter the body and re-activate other viruses that have been dormant, as has happened in cases of SARS-CoV-2 where Epstein-Barr virus or cytomegalovirus become reactivated and contribute to severe cases (Kämmerer, Germeyer, Stengel, Kapp, Denner 2011). In this sense, a kind of reciprocity can occur in relationships among viruses in the body, as well as between human cells and viruses. These virus-to-virus and virus-to-bacteria relationships can also be beneficial. Immunologists and others are studying methods of using viruses to 'train' a harmful kind of virus or bacteria to evolve along a different trajectory. Introducing carefully selected RNA strands into cellular DNA is becoming an important vehicle for gene therapies that can cure genetic abnormalities or slow the reproduction of bacteria that are resistant to chemical antibiotics. As Charlotte Brives wrote in reference to Donna Haraway's book, *When Species Meet* (Haraway, 2008), viruses are one of the companion species people share with each other and often with other animals (Brives, 2017). She argues that it is a form of ignorance that causes medical science to focus on fighting *against* viruses and bacteria, instead of understanding the need for 'becoming with' them through the process of active co-evolution. Instead of going immediately to an outbreak narrative for new virus epidemics, the emergence of viruses or bacteria in human systems could be treated with the knowledge of how complex reciprocal relationships co-evolve.

Although scientists are still largely unable to describe these complex relationships, it is a fact that humans are literally hybrids of many animals. We have always existed in a hidden ecosystem that extends within and beyond our skin. As David Pride 39

writes, “Our bodies are really superorganisms of co-habiting cells,” (Pride, 2020) many of which we are entangled with at birth. Mothers share this microbiome with their babies, and even people who simply live together as roommates come to share about 25% of the viruses in their systems. Where and how we live also matters at regional and global scales, since Western cultures tend to have less diverse microbiomes than non-Western cultures. Humans are hybrids of many living things, and that hybrid mix varies from person to person, creating many different kinds of hybrids within our species – the functional implications of which we don’t really understand.

When human communities expand into larger territories by trade or travel, move to new regions, create colonies, or enslave or displace other peoples, these actions alter the ecosystems within and outside our bodies. The origins of HIV may be in human patterns of living, where African villages were disrupted by colonial market economics. Market-based labor caused people to move back and forth from villages to cities. Without this new connectivity, the HIV virus could have entered a relatively isolated group of humans and then several years later died out. Connectivity with a wider world of urban sex workers, traders, soldiers and tourists was what allowed it to become a pandemic. The so-called Spanish Flu of 1918 is now thought to have originated in Kansas, USA, and spread to Europe via American troops in the late stage of World War I. Historians at the American World War I Museum in Kansas suggest that soldiers burned horse manure at the military base, releasing the pandemic virus either by handling animal waste or breathing airborne particles. In the same way, the viral star of our current pandemic (SARS-CoV-2) moved from individuals who had contact with animals in China through airports, conferences, cruise ships and ski resorts and into local communities many thousands of miles away, all over the world. Each contagious variant

does the same, creating new waves of infection and co-evolution. Now we all know that our reciprocal, co-evolving relationships with viruses and bacteria can collapse our sense of planetary scale down to the scale of our city, a local shop or sports event, a workplace, a circle of friends, a family, and a single body as if they were not separated by geographical distances at all. A planetary scale becomes the scale of one person’s (or one bat’s) lungs in a matter of weeks or months as airborne viruses spread in airports and other transportation networks.

Spatial and social networks that extend across thousands of miles, allowing rapid movements by military, recreational and business travelers collapse the distances between regions, make faraway places effectively adjacent to each other. This accelerates the biological reciprocity of humans with other species to unprecedented rates. A virus that emerges from a bat cave in China can evolve on a mink farm in Denmark and spread back to people living in the megacities of Asia or a remote village in Africa within months. Now that these rates are present, every new virus that emerges from a dense cattle feedlot in California, or from the migration of Arctic bird species that are exposed to new viruses from melting ice, can literally alter the human biome at the species level, re-emerge as a mutation and cycle back through all the forms of life that can host the virus. In that sense, the human transformation of travel has turned all forms of life on the planet into a rapidly co-evolving mega-biome, which is probably not what the designers of airports ever anticipated as an outcome.

Bringing narratives from the long past into the present to expand our awareness of time

One of the ways we can expand the collapsed sense of time that characterizes our era is to recover an awareness of the *longue durée*, which includes patterns of culture, behavior and environmental change that link us to the lives of our an-

cestors from previous millennia. One of the first examples of tentacular entanglement and reciprocity that collapsed scales of space is the expansion of Rome's empire from Europe to Seleucia in Mesopotamia around 165 CE. Authors at that time believed this territorial overlap was the origin of the Antonine Plague (Sticker, 2000). Territorial expansion of an urban empire into a smaller neighbor's city may have introduced a new virus into the human ecosystem, spread by armies and traders. At the peak of this 15-year outbreak its peak, historical sources indicate that 2,000 people a day may have been dying in Rome. The deaths and illnesses disrupted both record-keeping and supply chains, some of which appear to have never recovered (Duncan-Jones, 2018)

Marcus Aurelius was the co-emperor at the time of this devastating plague. Aurelius was unusual in his commitment to writing and philosophy, developing the ideas of the Greek Stoics in his *Meditations*, written from about 170 to 180 CE. (David, 2002) Aurelius described the universe as possessing a nature. He also described each person or thing as having a nature. A good life, in his view, is one lived both in accordance with and as a part of this concept of nested and reciprocal scales of nature. While Aurelius' writing was more an effort to encourage himself and record his own insights than a rhetorical treatise, he drew on the Greek Stoics' concept of *kata phusin*, which referred to living in alignment with universal nature or one's own nature, or perhaps both, as a way to understand what was valuable in one's life. Unlike earlier Greek philosophers who treated *phusis* (nature) as a dichotomy in relation to *nomos* (law, or culture), Aurelius and the Greek Stoics saw "nature" as both universal (applying to everything) and also unique to everything and everyone.

Since Aurelius wrote his *Meditations* during a dramatic 15-year plague, it's not hard to imagine that he developed his sense of the nature of the uni-

verse in relation to the human impact of a long-lasting, often fatal pandemic. His adoptive brother and co-emperor, Lucius Verus, may have died of it (Duncan-Jones, 2018). Adopting a Stoic philosophical frame made sense when some of those who became ill died, but many didn't. Believing that the universe had its nature would also have allowed Aurelius to focus on what he could control, including his military campaigns, rather than worry about a pandemic that he could not control. In a long-running disaster of that kind, the Sophists' alternative view that nature was superior to laws may have made sense; laws would have seemed weak in comparison to the dramatic restrictions on the military, everyday life, and trade that were brought into being by the Plague. *Kata phusin*, living according to the universe's nature, may have made sense as a way to cope with an overwhelming, disorienting external disruption that extended from the farthest parts of the empire to the residents of Rome.

City of lions: human-animal hybrids, disease, and rapid environmental changes

The question of what nature is and how we are co-evolving with it (within ourselves), is very old. To ask that question is to collapse time like an accordion, linking us in the present to specific people and moments when that same question was asked before. Human ideas about culture, landscape and disease have often conjured animal-human hybrids. For example, the Greek winged horse (Pegasus) and the griffin (a combination of lion and eagle parts) was represented in both Greek and Roman urban culture, along with horned lions and other hybrids. Those cultures drew on pre-existing imagery from a pandemonium that developed in Mesopotamia and the Nile Valley, starting at least 6,000-8,000 years ago. The people and animals of that period lived through an overwhelming set of changes in climate, ecology and health that were not so different from what we are beginning to experience and anticipate

today. One of their responses to aridification in the landscapes that surrounded both river valleys was to urbanize, but also to develop a complex culture that used hybrids combining human and animal forms as symbols for forces that affect human life but are beyond human control. Perhaps density and tight spatial networks promote both pandemics and the need for representations of co-evolution.

The ancient Egyptian goddess Sekhmet, who was believed to command fearsome plagues, had the head of a lioness and the body of a woman. Her breath created *Deshret*, the red desert that represented chaos and surrounded the black soil of the Nile Valley. Female lions are ruthless, creative hunters who track their prey and overpower them – particularly the young and the weak. Lions are not a bad metaphor for the way that contagious diseases like influenza (or our contemporary coronavirus) that overpower people who have other vulnerabilities. People also believed they could pray and sacrifice to Sekhmet to avoid sickness. In that sense, people saw the hybrid woman-lion also as a defender against the chaos of contagious diseases, spreading quickly in dense urban settlements.

At approximately the same time, Mesopotamian cultures also represented more-than-human forces using hybrid animals. The horned lion was an agent of a god who sent plagues. The winged bull was associated with flooding and the control of floods. Hybrid animals were used to represent either the powers of gods themselves or to represent forces (sometimes referred to by translators as demons) who acted according to the instructions of gods. Mesopotamian heads of state used images of vanquished lions to show that they, the rulers, were able to control a chaotic more-than-human world. At the same time, rulers associated themselves with the lion as a symbol of ferocity towards their human enemies. These hybrid human-animal codes provided a symbolic language in which people gained fluency through listening to and repeat-

ing epic narratives² and religious rituals, and probably also through storytelling, jokes and small rituals in their day-to-day culture at home.

Chaos and order seem to have been the dialectic that preoccupied the ancient peoples of the Nile Valley and Mesopotamia, rather than the Greek philosophers' dichotomies of nature and culture, or our contemporary dichotomy of a nature that is the opposite of human creation. In Mesopotamia and in many later cultures, hybrids of animals and stories of deadly clashes between animals (or between high-status people and animals) were represented as ways of establishing the definition of order and chaos (Mastrocinque, 2007).

If we consider ancient Mesopotamia and the Nile Valley through the lens of their shifting climate,³ we can understand how much was changing around them. An increase in aridity about 8,000 years ago converted the Saharan landscape from a grassy savanna to an increasingly inhospitable desert, a word derived from the ancient Egyptian term *Deshret*. Archaeologists and paleohydrologists have recently concluded that people probably moved from the savanna to the Nile Valley in greater numbers as that extensive grassland dried and became less fertile, forming urban populations as a matter of necessity. The complex urban societies that developed in the Nile Valley took on specialized roles to build irrigation canals and other structures that allowed them to increase food production in a context of regular flooding. Their relationships to each other and within the Nile Valley states became more complex as dry periods occurred that were less productive, sometimes resulting in conflicts over resources or territory. If humans were constrained by the aridification of the Sahara, animals like antelope and deer that grazed the grasslands would also have been constrained. It's not hard to imagine herd animals becoming concentrated in the floodplains and being pursued there by lions and other predators. Human-lion conflicts could have increased as

the grasslands became restricted to the river valleys. A sense of chaotic natural forces could have emerged from the desertification of the grasslands, in contrast to the regularity of wet and dry seasons shaped by flooding on the Nile.

Almost exactly a thousand miles from the Nile in the Mesopotamian delta, recent studies suggest that the drying of the Sahara's ancient grasslands would have been associated with cooler, drier conditions in the middle and lower sections of the Tigris and Euphrates valleys. Cities in those flat, broad river valleys invested enormous amounts of labor and materials to maintain their complex systems of movable dams and levees along their canals and rivers. Without those structures, river flows in a flat, gravelly floodplain could change their paths in the wet season and disappear underground in the dry season. Cities sometimes became disastrously isolated from transportation routes when a river or tributary changed its course and were abandoned. Food could have become scarcer at the same time people were relocating from cities that no longer had water access, creating territorial conflicts and shortages. Diversifying food supplies could have led to a greater reliance on herding goats, creating increased conflicts with lions and other predators, at the same time leaders may have gained power by promising protection and tighter organization of resources. Droughts, floods, famines, plagues and refugees would have been understood as forces of chaos, along with lions.

While imagining those conditions 6-8,000 years ago requires some speculation, there are also meticulous records of Mesopotamian investments in river engineering⁴ as well as some of their temple rituals and practices.⁵ The people who settled the first cities of Ur, Eridu and Uruk may have been some of the last to experience rapid sea level rise at the shore of the Persian Gulf. If we wanted to ask other human beings what rapid sea level rise will be like, we would ask the earliest Mesopotami-

an city-builders. Although sea level has risen much more slowly since then, the associated environmental trend of aridification has continued in Mesopotamia to the point that most of today's farmers are leaving that region.

Here in the present, we and our children will be the last human generations to live during the Holocene era with its relatively slow rates of sea level rise and aridification. Contemporary humans and the ancient Mesopotamians are like bookends of a relatively stable climate period: they experienced the beginning of the Holocene, and we are experiencing the end. Their narratives may offer new meaning for us, as in the epic of Gilgamesh - where a man who lived in a time after a great flood sought to receive immortality as a reward from the gods. We could interpret Gilgamesh's desire for immortality as a desire for his way of life and the environment that allowed his city to flourish to persist forever. Perhaps in our own way, we expect our way of life to last without fundamental change. In a kind of reciprocity with the long past and the future, today's humans must adapt to the changes we can no longer prevent in our own time.⁶ Understanding the role of hybrids and adaptation in the last great era of rapid climate change could open us up to a clearer understanding of who we are in our own time.

Radically anticipatory design: adaptation as reciprocity

Another way of expanding compressed time is to embrace a trend and leap forward within this certain but gradual process of change, using a design that anticipates and is predicated on a future condition. Although the term 'hypernature' was originally used by Matthew Urbanski (Amidon, 2006) at Michael Van Valkenburgh's landscape architectural design firm to describe intensified juxtapositions of conditions in space, perhaps we might use the same term to describe an intensified juxtaposition of temporal conditions within a trend that is cer-

tain but gradual. In this example, I'll start with the *longue duree* and then describe an example of design that uses radical anticipation to adapt an urban district to a new condition. It seems likely that combining these two strategies (ie, the *longue durée* and radical anticipation of a future condition) may be a more effective narrative than incrementalist anticipation alone.

During the past 5-7,000 years, the global average sea level has been exceptionally stable. This allowed the great deltas of the world to form, as major rivers dropped their sediment loads in approximately the same location over such a long time period. Cities were built on those deltas in part because they provided natural seasonal irrigation of grain crops. More recent cities may have been located on deltas because they were important locations for trade, or because they provided flat land for industrial expansion and/or military bases during the last two centuries. Now that the era of slow increases in sea level is ending, cities located next to the open ocean or in bays and along tidal rivers are at risk of flooding by seawater as well as groundwater rising from below. In coastal cities where pollution has been buried in soils on former industrial and military sites, rising groundwater, river and ocean flooding create new risks that dangerous chemicals may be mobilized and affect human health as well as nearshore or riverine ecosystems. Along with pollution, major highways and rail lines, buried pipes, tunnels and conduits have also been introduced in coastal cities that will be difficult and sometimes impossible to remove and relocate. In some countries, including small island nations as well as Bangladesh and the Netherlands, the choice is either migration or adaptation. What forms of reciprocity might characterize our time as adaptation and migration occur in phases, affecting communities of people, animals and plants?

44 The difficulty, expense and risks of relocating large urban populations and infrastructure point to the

need for physical designs and behavioral changes that would allow coastal populations to adapt in place wherever possible, rather than move inland. This requires people to develop a form of reciprocity with the sea itself, accepting and adapting to its cycles and extreme events rather than seeking to wall them out. The biodiversity of coastal ecosystems would be severely reduced by walls, dikes and tide-gates, at a time when seafood will be an increasingly important component of the diet for a growing global population of human beings. Designs are needed that would allow people to live with higher water, as the Dutch say, without sacrificing the health of the environment or their quality of life. These strategies need to be applicable in low-income countries as well as high-income countries if they are going to safeguard human health and safety, as well as animal and ecosystem health.

One spatial strategy is to create an intentional mixing zone in which reciprocity is defined as an area of overlap between dry land and the ocean. Instead of hardening the edge and creating a destructive zone of erosion, pulling apart edges to create a new space between the saltwater shoreline and the city creates a new set of opportunities. Local cut and fill tactics for earthwork could help open-up new landforms as options when regional material supplies fall short.⁷

Excavation also makes sense where contaminated soils have been left in place near the ocean, or on bays and tidal marshes. Along many urban coasts, soils have been capped in place that are polluted with petroleum hydrocarbons or industrial chemicals. As sea level pushes shallow groundwater up near the shore, these contaminants may be mobilized, contaminating the Bay or nearby buildings. There are few solutions other than excavation that could be completed in time for rising groundwater, which will be one of the first impacts of a rising sea level. Cutting contaminated soil away would leave artificial ponds behind and provide some per-

centage of the cut material for reuse. A mosaic band of ponds filled with groundwater, separated by low dikes, would provide a whole new structure that can be programmed with dense urban functions, as well as managed bird habitat. Once water levels are controlled in the ponds with armatures of dikes and tide gates, it's possible to introduce floating residential or mixed-use districts into the ponds. Unlike houseboats, newer approaches can create higher density in a floating condition by using prefabricated units that are stacked on shared decking, with pontoons organized under the decking instead of under each unit.

By designing the mosaic band of ponds to serve as a mixing zone, the dikes around the ponds can be designed for overtopping by waves in extreme events. This makes all the difference in reciprocity. Lower dikes that allow waves over them a few times each year act as a threshold instead of a barrier. The ponds would already be brackish, so having saltwater flow in from the sea would not be damaging. In fact, it would create a hybrid of ocean and freshwater ecosystems. Each body of water in this mosaic could be understood as a pond that breathes in the ocean, or perhaps as a tiny puddle of ocean that is diluted by the rain.

These mosaics of ponds, excavated in bands along the shore, could allow for the removal of contaminated soil before it spreads like an ink stain in a higher ocean. Buildings floating on shared decking in an artificial pond would be prepared for the disruptive shock of earthquakes, isolated from the shaking of the ground. The mosaic of ponds for housing, recreation and habitat could create new economic and environmental value for coastal land that would otherwise be ruined by rising groundwater and/or saltwater tides. Constructed ponds and their floating urban districts would create a precedent for orderly, phased periods of investment and migration that could occur over longer periods of time as our ability to live this way improves. Dense

communities can be built floating on the groundwater, in areas where there is dry land today. The network of dikes that would protect them would eventually become too saturated to be structurally stable as sea levels rise two meters or more. The potential for failures of the dikes would drive the need to move the entire band of ponds inland, starting a new phase of adaptation in place where conventional buildings and underground infrastructure would begin to fail from rising groundwater.

Adaptation like this is radically anticipatory of future conditions that are certain in their eventuality, if not their timing. It opens up and expands compressed time and space, establishing new forms of reciprocity between humans, animals, plants and water. It would establish a give-and-take with extreme tides and flooding rivers, allowing them to spill over into the ponds and be drained out again through tide gates without destroying either the armature of dikes and gates or the buildings within the ponds. By radically anticipating a future condition that is certain to come, this type of adaptive design allows human communities to thrive safely for a limited period of time. Tidal urban districts would serve as a bridge between the present and the future that expands our sense of time, jumping ahead to accept a future condition and live with it. They would expand our sense of compressed space by building a liminal zone between the vastness of the ocean and the small spaces of human neighborhoods, thickening the "line" of the shore and widening it so that it contains a greater diversity of nested spaces – from tidal marshes to indoor living rooms.

In closing

The condition of being human has always been reciprocal with other forms of life; but the speed of mutual transformations has accelerated as a result of the use of fossil fuels that have supported mass travel. While humans have always lived in reciprocal relationships with other animals, the breadth

of our almost instantaneous interconnections has changed. Instead of having fast-moving local reciprocal relationships and slow-moving regional and planetary relationships, all of the scales of interconnections that drive transformation are fast. As a result of accelerated temporal processes, spatial distances have collapsed as a regulating influence on the reciprocity among living things.

Coal, oil and gas are made from the bodies of species that lived before humans emerged. Human use of these fuels has brought a new set of organisms into relationship with us: phytoplankton, plants and algae that floated in seas that no longer exist. Burning the organic carbon from their cells introduced 400-million-year-old carbon into today's atmosphere and oceans, compressing time so that the pre-human past overlaps with the human present. Predictive models based on how many gigatons of carbon are emitted each year pair today's actions with specific future conditions tens, hundreds and thousands of years in the future. Burning ancient fuels has produced a change in the temporal scale of human reciprocity by linking our lives with organisms that lived 400 million years ago, and with future conditions that will be unavoidable for hundreds and thousands of years.

In this essay, I've argued for two different strategies that could inform design. One is to reach into the human cultural past to draw upon our long, continuous use of human-animal hybrids to represent reciprocity – a vocabulary that may have emerged during previous eras of rapid environmental change. This symbolism of chimaeras could change popular understanding of our interconnectedness, both spatially and among species, perhaps adapting and evolving some of the positions of the Stoics about human nature.

The second strategy I've argued for is to re-expand compressed space by investing in liminal, temporary zones where humans can build an awareness

of our state of reciprocity in a relatively stable setting. Radically anticipatory design would recognize sea level and groundwater trends and prepare us to live with them, establishing a temporary period in which impacts slow down instead of accelerating. Hybrid physical conditions can be established in which a city district is simultaneously terrestrial (surrounded by earthen dikes), in freshwater (floating on groundwater) and in the ocean (allowing tides to enter the ponds).

Culture, including everything from jokes and stories to landscapes and urban form, is a critical element of humanness that has allowed us to adapt as change occurs in the complex lives within our bodies and on a planet that is so much larger than human comprehension allows us to perceive. The current era of accelerated change makes it essential that designers find ways of initiating cultural adaptation through actions that help humans live with the trouble.

Note

¹ Ribonucleic acid (RNA) carries short, coded messages into or within cells, while deoxyribonucleic acid (DNA) is much larger and acts as the primary genetic code stored in the nucleus and mitochondria of a cell.

² The *Epic of Gilgamesh* is an example of this, and as the oldest written narrative known to archaeologists it's likely that the story was told as an oral narrative for centuries before it was written in clay tablets.

³ See for example: Hennekam, Donders, Zwiep, Lange, 2015, and Sun, Wang, Zhang, Chen, Lu, Liu, 2021.

⁴ See for example: Rost, 2019.

⁵ For example: Wiggemann, 2011.

⁶ Reducing emissions will reduce the magnitude of these changes, but not the fact of them. Sea level, for example, is still very likely to rise by one or two meters based on the

amount of carbon dioxide in the atmosphere today, even if we halted all emission of greenhouse gases immediately. Bringing emissions to zero will help to slow this change, and limit its eventual magnitude, which are also critical to human adaptation.

⁷ I proposed this strategy in 2018 during a competition in the San Francisco region, developing plans for floating urban districts in mosaics or bands of excavated ponds that would move inland in managed phases. It was developed and advanced by me and my colleagues the ABC Team and described here: <http://www.resilientbayarea.org/book> (accessed online October 22, 2022).

Bibliografia

Amidon J. 2006, *Michael van Valkenburgh: Allegheny Riverfront Park*, Princeton Architectural Press.

Arendt H. 1958, *The Human Condition*, University of Chicago Press, 1958.

Aurelius M. and Hicks D. 2002, *The Emperor's Handbook: A New Translation of The Meditations*, Simon and Schuster, 2002.

Duncan-Jones R. 2018, *The Antonine Plague Revisited*, «ARCTOS: Acta Philologica Fennica» (52), pp. 41-72.

Froissart R. and Brives C. 2021, *Evolutionary biology and development model of medicines: A necessary 'pas de deux' for future successful bacteriophage therapy*, «Journal of Evolutionary Biology», 34 (12), pp.1855-1866.

Hennekam R., Donders T.H., Zwiep K. and de Lange G.J. 2015, *Integral view of Holocene precipitation and vegetation changes in the Nile catchment area as inferred from its delta sediments*, «Quaternary Science Reviews», 130, pp. 189-199.

Kämmerer U., Germeyer A., Stengel S., Kapp M., Denner J. 2011, *Human endogenous retrovirus K (HERV-K) is expressed in villous and extravillous cytotrophoblast cells of the human placenta*, «Journal of Reproductive Immunology», (91) pp. 1-8.

Mastrocinque A. 2007, *The Cilician god Sandas and the Greek chimaera: features of Near Eastern and Greek Mythology concerning the plague*, «Journal of Ancient Near Eastern Religions», 7(2), pp.197-217.

Pride D. 2019, *The Viruses Inside You*, «Scientific American» 323 (6), pp. 46-53.

Rost S. 2019, *Navigating the ancient Tigris: Insights into water management in an early State*, «Journal of Anthropological Archaeology», 54, pp. 31-47.

Sicker M. 2000, *The Pre-Islamic Middle East*, Greenwood Publishers.

Sun W., Wang B., Zhang Q., Chen D., Lu G., Liu J. 2021, *Middle East Climate Response to the Saharan Vegetation Collapse during the Mid-Holocene*, «Journal of Climate», 34, pp. 229-242.

Wiggemann F. 2011, *The Mesopotamian pandemonium: A provisional census*, «SMSR» 77/2.