

KATHERINE RICHARDSON

A climate oracle on the importance of realising the interconnectivity of the problems we face.

PHILIP BALL

A look into the biotechnologies that will allow us to grow humans in new ways in the future.

LUCIA PIETROIUSTI

Curator of General Ecology at the Serpentine Galleries on four artists who can show us how to do art ecologically.

MAYDAY

Issue Five

Future Culture and Society

A detailed oil painting of a bird, possibly a crow or raven, perched on a light-colored branch. The bird's head is turned towards the viewer, and its face is rendered with human-like features, including a prominent nose and a mouth. The feathers are dark and textured, with some highlights. The background is a mix of dark and light colors, suggesting a natural setting. The overall style is expressive and somewhat somber.

IT'S ALL
CHANGING
NOW



**THE WORLD AS
WE KNOW IT**

Tomorrow Isn't the Question

IN A WEIRD WAY, we have never been as certain of the future as we are right now. Still, we are feeling a bit stuck because the future laid out for us is unfortunately not the best. But amidst predictions and projections, we must remember that our future is anything but set. It's in our hands, and the next move is ours.

Formulating the next move means taking stock of the present from different vantage points so that we can observe connections that exist between unlikely things. That's the kind of thinking that a magazine is good for. The resulting interconnectedness might seem like enough to halt the advancement of any change, but Katherine Richardson (p. 18) explains that the acknowledgement of complexity is a good place to start. And looking closer at the network and seeing it as an ecosystem can even encourage new ways of working (p. 38). If we are at least aware of the connections that construct our society today, it's not so hard to imagine that small changes can have radical impact.

Having the future in our hands requires us to use our imagination. So we start to look more closely, but we can do that in a lot of different ways. The biologist and researcher Thomas Lovejoy (p. 70), opens our eyes for a scientific but emotional look at the diverse life of the Amazon rainforest. The artist group SUPERFLEX presents dystopian scenarios to get us to switch our perspective (p. 50), while others choose to look more closely at the mundane (p. 62), and others still look to the dynamism of colour (p. 57). Such diverse views help us draw new conclusions about the world around us; like maybe between a discussion of how contemporary nature is being shaped by human-made environments (p. 68) and the story of an eccentric Prussian polymath who obsessively recorded and maybe even invented our concept of nature around the turn of the 19th century (p. 108).

Given all the connections we could make, imagining and then creating the future involves a careful thought process when you really think about it (p. 36). Sometimes the process manifests in fictional stories that can open up our minds to new possibilities (p. 112). Other times the field of science can lend stories as mind-bending as growing humans from any cell in the human body, and history can instill introspection as we partake in the fluctuating relationship between nature and humanity (p. 124).

So, it's true. We know a lot about our future, but that does not discount our ability to imagine and take action for a different one. Regardless of whether we choose to believe the predictions, or to mobilise ourselves towards mitigating the effects, one thing is for sure: we need a discovery, a new connection, a revolution.

This is Mayday. ▣

B&O



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AW19 COLLECTION

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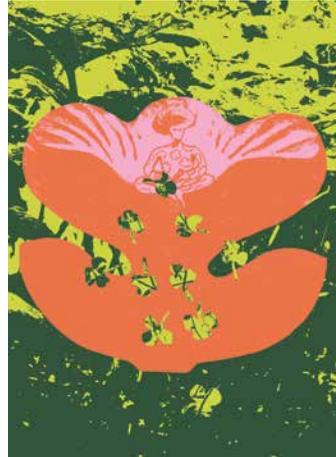
BANG & OLUFSEN

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Katherine Richardson calls for a more holistic view of and approach to the climate crisis. There is no singular adjustment; we must first understand the network to move forward.



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Despite the ubiquity of the colour green in the Earth's natural landscapes, we humans have been remiss to synthesise the hue artificially. So much so that the first attempts came with a body count.



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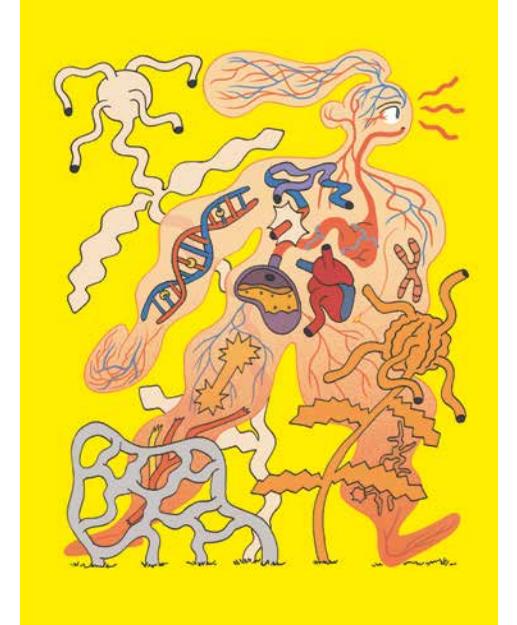
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The grandfather of biodiversity, Thomas Lovejoy, leads expeditions into the Amazon Basin to back up his years of research and findings with experience and a little bit of magic.

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The sea is a compelling phenomena, and for centuries we have been physically and mentally drawn to it. But now, the waters are rising and we are forced to retreat.



86 New Ways to Grow Humans

Look into the future of human life and you may be surprised at what it takes to grow a human being. Or, rather, you may be surprised at what it doesn't take.

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TL;DR

Recap of your favourite magazine 😊

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Sara-Vide Ericson

I Wanna Be Your Dog, 2017

Oil on panel. 100 × 68 cm.

V1 Gallery



From the Editor

Fraternité or Death

LIBERTÉ, ÉGALITÉ, FRATERNITÉ. The rallying cry for a disjointed French society takes its power from the delicate balance inherent within it. The adage — a holy trinity upon which we've built much of modern society — is credited to the powerful politician Robespierre. The first two words guarantee rights for the individual, while the latter — fraternity, brotherhood or community — places a moral obligation on the individual to act relative to the interest of the group; to put the common good over one's desires.

It's now clear that we are no longer part of a just society as Robespierre envisioned. These days, millions of young people across the globe are turning out in protest against the state of the planet as it will be left to them. Who else could represent the needs supposedly protected by the ideal of fraternité more fully than those who have been abandoned by it? That need to *do something* is the moral obligation that fraternité lays upon us in action. There's nothing wrong with wanting freedom and opportunities, but the third imperative of a just society ensures a sustainable culture in which we can freely and equally pursue those opportunities. From the environment and the economy to emerging technologies and social justice, we owe the next generation a society balanced enough to navigate these issues.

To do so, we have to curb the excessive freedom we've been chasing in the light of a new, global fraternité. Recognising limitations to one's freedom and the duty one has to their global society does not necessarily enslave — in fact, it ensures the exact opposite. Yes, we will have to make sacrifices, but the sacrifices we will make won't be acts of servitude; they'll be acts of communal love, carried out for the greater benefit of humanity as a whole. We'd be rebalancing our values in order to once again reveal the beautiful image of a rational, good humanity as conceived by the Enlightenment that produced these ideals. We are mere custodians of the future, safeguarding society and the Earth for the forgotten fraternité: those who cannot act now, and who sit on the sidelines as they watch the adults do nothing.

These days we have forgotten the conclusion of Robespierre's thoughts: “...ou la Mort” — “or death.” The meaning strikes quite clear. If we don't simultaneously strive for all three — liberty, equality *and* community — our society will unravel. Robespierre forgot that his role was to serve the greater community and, as a result, he was executed five years before Napoleon's ascent ended the First French Republic. Now the community we serve is a global, interconnected one and we are heading towards equally dramatic challenges on behalf of our entire civilisation. Now it's up to us to temper the motto in its entirety lest we forget what's at stake.

Liberty, equality, community, or death. The choice is clear, isn't it? ▣

EDITOR-IN-CHIEF
ANDERS EMIL MØLLER



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hi@trouble.cotrouble.co**Mayday** Issue Five

November 2019

Made in Copenhagen, Denmark

Mayday gives space to people, ideas and stories that present new perspectives for humanity. Always striving to communicate the complexity in a way that activates all of our senses as we seek out what it means to be human.

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#MaydayMagazine

Mathias Svold and Ulrik Hasemann

Photographers



Mathias Svold and Ulrik Hasemann work together on in-depth photo projects that have garnered them several national and international awards. Through their work, they investigate how climate, people and culture affect nature, and their photographs depict small stories within larger themes. Their use of analogue, medium-format cameras allows them to obtain a slow working process and a symbolic visual language. In this issue, the team offers a photo series from their recent work *KYSTLAND*, which investigates the relationship between humans and nature along the Danish coast.

Troubled Waters
p. 100

Sara-Vide Ericson

Artist



Recently, Swedish artist Sara-Vide Ericson got the words "Hunter Gatherer Painter" tattooed on her upper arm. The words conjure an image of the artist existing within and among natural elements and phenomena — fitting for Ericson as she returned to the countryside near where she grew up to live out her artistic practice. Through both landscape and figure painting, she explores these notions of wild, unchecked nature and human sensibility, and the fluctuating relationship between these elements. Her work graces our cover, lending a visceral representation of the human-nature dynamic to our fifth issue.

Cover

Johanne Bille

Author and Editor



Danish author and editor Johanne Bille's life centres around literature. She believes in working together with talented people to get to the best version of a work. And sometimes that person is actually herself; at a certain point, her novels take on a life and will of their own, even though she is the one writing the story. At her publishing house Harpyie, she enjoys working alongside her co-editor whose different vantage point often presents her with new ideas in just the right time. In this issue, she imagines a near future scenario to help us get our minds around what the climate crisis could mean to humanity.

Hera's Column
p. 114

Pernille Matzen

Writer



For Pernille Matzen, writing is one of the best ways to reflect and feed her curiosity about the world. And for better or worse, that also happens to be her job. She sees each text as an opportunity to think about things, meet people and see places you otherwise wouldn't see, hear or think about. She's always looked to collaborators for inspiration and like any other writer, she enjoys reading. But lately, she's taken up new hobbies like fishing. In this issue, Pernille interviews the curator of General Ecology at the Serpentine Galleries, Lucia Pietroiusti.

Doing Art Ecologically
p. 28

Kristine Bethge

Photographer



A German photographer who lives between Berlin and Rio de Janeiro, Kristin Bethge activates her artform to capture and portray people. And after just a few shots, she's sure she knows her subjects better than most. Indeed, her affinity for face-to-face storytelling is evident in her palpable and emotional photographs. When she isn't photographing or telling stories, Bethge enjoys the authenticity of short Brazilian fiction, especially on her flights back to Germany. In this issue, her photographs capture one of Dr. Thomas Lovejoy's expeditions deep into the Amazon rainforest.

Lovejoy
p. 70

Blake Butler

Author and Editor



American author and editor Blake Butler enjoys how imagining fictional worlds enables him to tamper with space time. This way, he's the only one responsible for the world he creates and doesn't have to answer to anyone or any laws of everyday life. His stories present an often demented and out-of-the-ordinary reality that make them surprising and even droll. But back here in reality, he finds inspiration alongside his wife and fellow author Molly Brodak. In this issue, Blake contributes an original fiction short that invites us into the mind of a person living, if we can call it that, in a future shaped by climate change.

Pray
p. 116

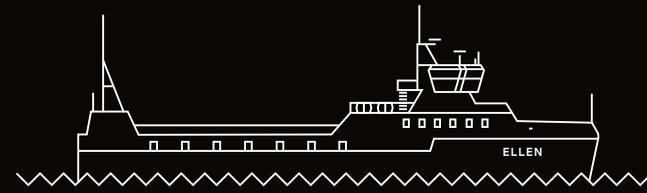


DON'T FALL FOR JUST ANYTHING

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ON THE RADAR



1. Electricity on the High Seas

The Ellen, the world's largest all-electric ferry, sailed from Fynshav in southern Denmark to Søby Havn on the island Aerø, an hour's journey away. In a statement made about the voyage, Anil Srivastava, CEO of Leclanché, the Swiss battery company behind The Ellen's electrics, declared: "This project demonstrates that today we can replace fossil fuel thermal drives with clean energy, and thus contribute to the fight against global warming and pollution for the well-being of our communities." No small task, but one made easier with The Ellen's efforts.

2. Hybrids Meet Ethics

A few months after the CRISPR scandal involving He Jiankui and his now infamous genetically edited twins, China and CRISPR have met in the headlines again. According to a Spanish newspaper, Juan Carlos Izpisua Belmonte of the Salk Institute led a team of researchers in China to create a human-monkey chimera. The point doesn't seem to be a desire to play Dr. Frankenstein, but to continue Izpisua Belmonte's research into the possibilities of organ transplantation from animals, though primates would be a poor choice for this. The team refrained from commenting.

3. World-Wide Polluter

The World Wide Web is now 28 years-old and in that time, it's managed to hook its wires into almost every aspect of society. As omnipresent as it is, though, the internet is strangely invisible. It's everywhere and nowhere. Fortunately, Internet Live Stats keeps track. So far this year, over 750 million tons of CO₂ have been emitted to power the 1,7 billion websites that form the digital world for the internet's 4,3 billion users. While its functions disappear into the cloud, we must remember the internet is a physical thing that interacts with our atmosphere as well.

4. The Aging Population

By 2100, the UN expects the world population to increase from our current level — 7,7 billion — to 10,9 billion. But the demographics of Earth will not remain at a constant: 83 percent of people in 2100 will live in either Africa or Asia. They will live longer, but fertility rates will remain more-or-less constant, creating a world in which those older than 65 will number equally with those under 15. The policies and innovations of the future will have to deal with the expected extreme poverty in Africa and care for an increasingly ageing society.

5. Our Galaxy Is Warped

In Issue Three, we interviewed Jean-Pierre Luminet, who hypothesised that the universe takes the shape of a dodecahedron. We still don't know about that, but a paper first authored by Dr. Dorota Skowron at the University of Warsaw claims that our galaxy looks like a warped LP record. In *The Guardian*, she reported that "stars 60,000 light years away from the Milky Way's centre are as far as 4,500 [light years] above or below the galactic plane." The team relied on measuring the varying levels of brightness displayed by *Cepheids*, bodies whose brightness goes through cycles.

6. Top Ten Emerging Technologies in 2019

The future is now, so what does it look like? In July, the World Economic Forum released a report following this question entitled *Top 10 Emerging Technologies 2019*. Some continue pushing for sci-fi futures, as in the cases of social robots, or robots programmed to better interact with people, and collaborative telepresence, which search for ways to integrate AR and VR into meetings now conducted on Skype. The other theme is a greater concern for sustainability, including bioplastics, safer nuclear reactors and smarter fertilisers that can reduce environmental contamination. Looks like we're well on our way to a smarter, greener future.

7. Nuclear Investments

"Every investment represents a choice," writes Susi Snyder of the Utrecht-based international peace group PAX. By investing in a company or an idea, investors help shape the future. PAX's annual report, which identifies companies investing in nuclear weapons companies, found that investment in nuclear weapons has increased by 42 percent overall. Even though many companies have stopped or scaled back investment, Boeing and Thales's increased spending overshadowed these changes by raising their investments by 192 percent and 300 percent respectively. It seems that a choice has been made.

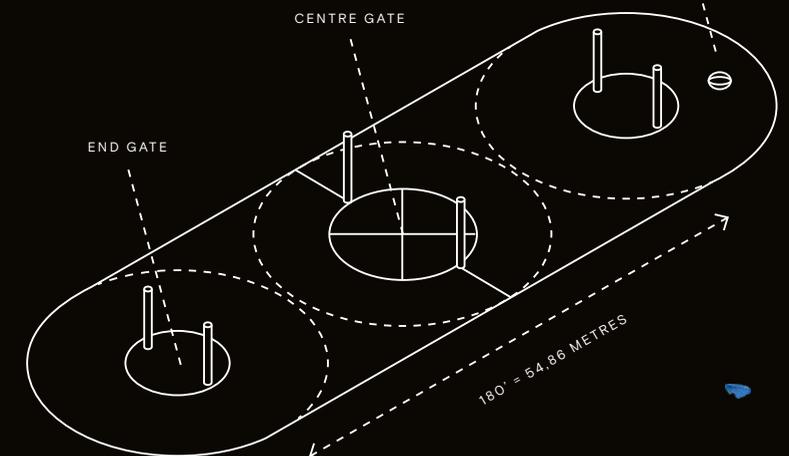
8. AI MVP

"Face the ball to be the ball to be above the ball." No, sporting goods advertisements have not reached such banality yet. The incomprehensible imperative is the motto for Speedgate, a sport created by an AI for Design Week, a festival held by a group of designers in Portland, Oregon. The team fed the algorithms data from 400 sports and saw what came out. The rules of the game set two teams of three against each other, vying for possession of a rugby ball, attempting to ferry it to the end posts without letting the ball remain motionless for more than three seconds. Game on.



1 MILLIMETRE
SOME OF THE
SMALLEST
MICROPLASTIC
PARTICLES VISIBLE
TO THE NAKED
HUMAN EYE

SIZE 4 RUGBY
TRAINING BALL





5 MILLIMETRES
THE LARGEST
SIZE OF A PIECE
OF PLASTIC
CONSIDERED A
"MICROPLASTIC"



9. Plastic Is Everywhere

A plastic bag beat humanity to the bottom of the Mariana Trench in the Pacific Ocean. While dispiriting, the fact isn't necessarily surprising. Experts from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research have discovered that microplastics, plastics fragments as small as pollen grains, have settled in both Svalbard and Bavaria, mingling with the snow as it descends after being carried long distances in the atmosphere. So far no extensive work exists that examines exactly how humans interact with microplastics. But time will certainly tell.



1 NANOMETRE
UNDETECTABLE
BY THE NAKED
HUMAN EYE

Microplastics in the Ocean

Ah, plastic. The wonder of 20th century ingenuity that has been favoured as a result of its low cost, easy manufacturing, versatility and resistance to water. Ironically, plastic's durability is also its downfall in contemporary society. Because it cannot be quickly broken down in nature, it becomes a pervasive pollutant in marine environments especially.



THERE ARE TWO TYPES OF MICROPLASTICS: PRIMARY AND SECONDARY. PRIMARY MICROPLASTICS ARE PRODUCED AS SUCH FOR INDUSTRIAL APPLICATIONS. SECONDARY MICROPLASTICS ARE THE RESULT OF THE BREAKDOWN OF LARGER PLASTIC OBJECTS.



THE TERM MICROPLASTIC DIDN'T EVEN EXIST BEFORE THE LAST DECADE, AND IT WAS INVENTED TO DESCRIBE SMALL PIECES OF PLASTIC IN THE OCEAN — AND WE MEAN SMALL: THEY'RE COMMONLY DEFINED AS ANY FRAGMENT LESS THAN FIVE MILLIMETRES IN DIAMETER.



MICROPLASTICS HAVE BEEN FOUND IN THE BODIES OF VARIOUS CREATURES THAT LIVE IN OR INTERACT WITH THE OCEANS; FROM INVERTEBRATES AND FISH TO BIRDS AND MAMMALS



THE SMALLEST MICROPLASTICS HAVE BEEN SHOWN TO CROSS CELL MEMBRANES, CAUSING TISSUE DAMAGE THAT MAY WELL AFFECT A CREATURE'S FITNESS.

Source: The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection

Photographer: Wolfram Burner

3/4

OF LAND-BASED ENVIRONMENTS AND

66%

OF THE MARINE ENVIRONMENT HAVE BEEN SIGNIFICANTLY ALTERED BY HUMAN ACTIONS.

1/3

OF THE WORLD'S LAND SURFACE AND NEARLY

75%

OF FRESHWATER RESOURCES ARE NOW DEVOTED TO CROP OR LIVESTOCK PRODUCTION.

10. Nature's Dangerous Decline

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services has released a report detailing the increased rate of species extinctions, the deterioration of ecosystems and the impact it will have on humans. 75 percent of land environments and 66 percent of marine ones have been significantly altered by humans, resulting in mass extinctions. The two major causes cited in the report are changes in land- and sea-use and direct exploitation of organisms, with climate change coming in third. We need to coexist with nature in a sustainable way, not exploit it even further than we have.

11. Operation Night Watch

Have you ever wanted to sit down and watch restorers and researchers work on a masterpiece from the Dutch Golden Age? Well, whether you have or haven't, you now can. Operation Night Watch, the Rijksmuseum's restoration and research project on Rembrandt's *The Night Watch*, is currently underway with the occasional live stream uploaded to YouTube. The cultural significance of the piece has now expanded beyond being the exclusive concern of museum goers to that of the global community with the use of technology. Art — and technology — can bring people together, after all.

12. Is Innovation Only for Humans?

First, they automated us out of our jobs. Now, they're claiming our ideas as well. According to the *BBC*, an AI called Darbus that's programmed to imagine new ideas has invented food containers for robots to grasp as well as a hard-to-ignore warning light. Patent offices have refused Darbus copyright protection on the grounds that innovations can only be attributed to humans. Two professors from the University of Surrey have joined Darbus's cause in what promises to be a case that will have implications on AI's place in society.

13. Breaking News: Physics Is Still Confusing

There are actually two distinct fields that make up the study of physics: classical physics, which governs objects larger than an atom, and quantum mechanics, which operates within the realms of atomic uncertainty until it snaps into a shape that classical physics can work with. After decades of trying to connect the two, one theory that would alleviate some of the issues has garnered some experimental support to its claims. Quantum Darwinism, proposed by the Polish theoretical physicist Wojciech Zurek, suggests the environment gets

rid of the more unstable possibilities and then proliferates copies of that data. The best outcomes are then adapted as those that inform our lives.

14. VR In-Flight Entertainment

British Airways performed a trial run of bringing VR entertainment to First Class flyers from London to New York. The VR selection includes films, documentaries and travel programmes in 2D, 3D and 360° formats. For those scared of flying, guided mediation and therapeutic programmes will also be on offer. It's too early to say if this is the future, but if it is the future, how British Airways incorporates VR into the economy sections of their aircrafts could be a gamechanger for long-haul flights. Still, it seems unlikely that this would make sitting on a flight from the UK to the US any more comfortable.

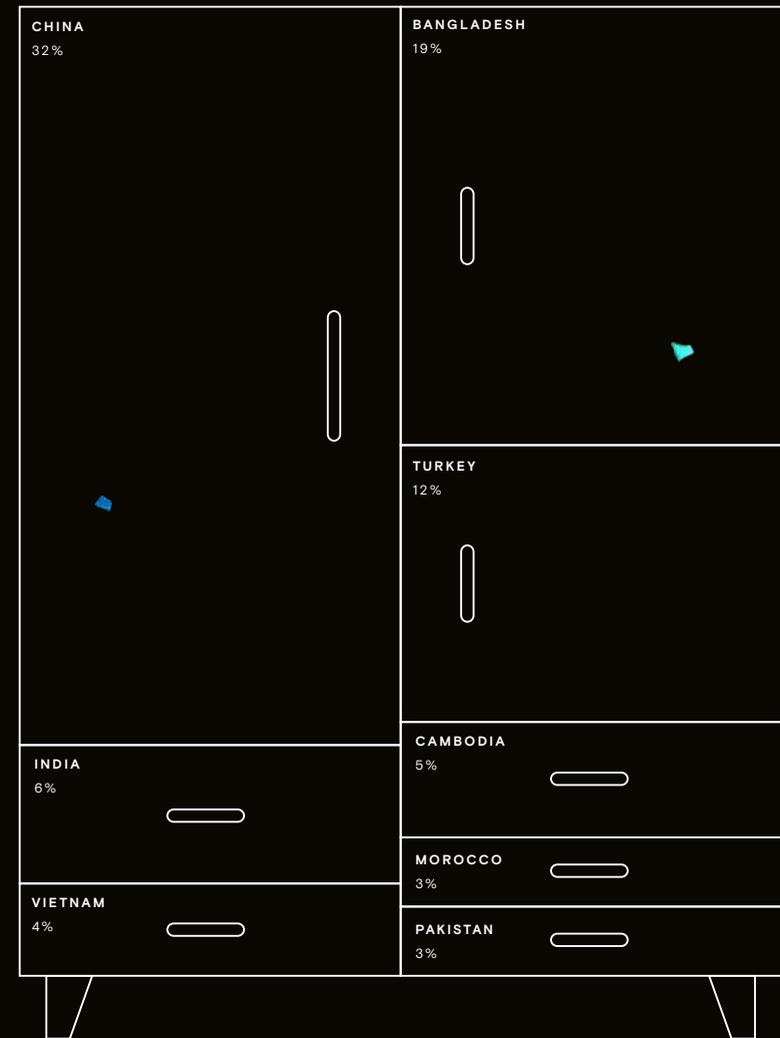
15. Another Hottest Month

July was hot. It was really very hot. In fact, the Copernicus Climate Change Service (C3S) announced that they found this July to be the hottest month on record, squeaking ahead of July 2016 by 0.04°C. Seven of the other hottest Julys, which are usually the hottest month of the year, have occurred since 2005. The record, though, merely continued 2019's trend as June was the hottest June ever and every other month ranked amongst the top four hottest for their month. "With continued greenhouse gas emissions and the resulting impact on global temperatures," Jean-Noël Thépaut, Head of C3S, commented, "records will continue to be broken in the future."

ONCE SUBMERGED, COOLER TEMPERATURES AND REDUCED UV LEVELS MEANS FRAGMENTATION BECOMES EXTREMELY SLOW.

16. Who's Dressing the EU?

Supply chains tend to slip in when people have serious conversations about the fashion industry. The increased concern may be reflected by the data provided in *Where Do Our Clothes Come From?* In this piece, Eurostat, the Directorate-General of the European Commission that provides statistical information about the EU to the EU, shows that between 2013 and 2018, the amount of clothes EU countries imported from non-EU member states dropped from 75 percent to 51 percent. Still, more than half of these non-EU imports come from China and Bangladesh.





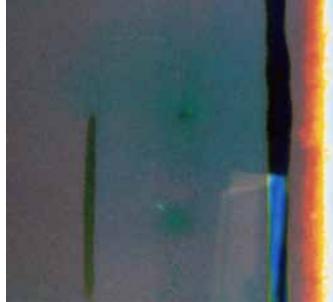
Global network

The Future Is Ecosystem Literacy

WRITER
ANDERS EMIL MØLLER

PHOTOGRAPHER
SARA GALBIATI

The reach and complexity of the climate crisis makes it hard to see how small actions can make a difference, but if we can just get a decent idea of which connections need adjustments, the potential results can reverberate across the biosphere. *Katherine Richardson* is a biological oceanographer and the leader of the Sustainability Science Centre at the University of Copenhagen. She is a developer of the Planetary Boundaries Framework and a member of the UN expert panel on Global Sustainable Development Goal Report. **Mayday** editor-in-chief Anders Emil Møller meets with the professor to talk about the current state of the climate, biodiversity, humankind and what it takes to effectively move forward.



oxygen in our atmosphere, for the ozone layer protecting us from UV radiation and even for things like coal.

So, it's not solely our emissions that affect future climate conditions; we need to take the interaction with biology into account. And the models used by the IPCC today don't do that very well. We need better research to understand this.

■ **What aspect of the crises do you think has been under emphasised in the surrounding discussion?**

■ They ways our local conduct affects the whole world needs to be impressed upon the general public. Society has always been difficult about accepting new knowledge, even going back to Darwin and Galileo. The fact that our species can affect the whole world is a similarly difficult thing to swallow. Such an idea challenges our cultural and economic paradigms. We cannot achieve economic growth or stability without access to fossil fuels. That, along with actually understanding how our resources are limited, is perhaps one of the most important messages.

■ **You've said that focusing solely on predictions when we talk about climate change is problematic, but from your professional experience, could you tell us what you expect the situation will look like in 2030?**

■ Based on countries' current actions, it is almost certain that we will fail the Paris Agreement's goal to limit global temperature increase to two degrees. Such an increase will have enormous consequences for our society. Exactly what kind is difficult to predict since we are at a crossroads and the people are the ones who must decide where we will be at that point. As of right now, though, I am unsure what the people want. Politicians have set some impressive goals, and many companies have declared that they intend to change. It looks promising, but we need to say: now the rubber meets the road.

■ **Have you found a medium that conveys this message best?**

■ To my great surprise, it's a 16-year-old Swedish girl who decided she didn't want to go to school anymore. Now that's interesting.

In a more systematic way, there has been some talk about climate literacy. While it's a good idea, we perhaps ought to talk more about systems instead. In the name of economic optimisation, we've gotten rid of the idea that things are connected. Companies, even universities, are being governed by the economically-oriented who don't see the bigger picture. We hire and reward people who are experts in the details, giving no credit to seeing the bigger picture. But if we want change, we need an understanding of the entire system.

■ **So, we need Earth system literacy, not climate literacy?**

■ Yes, or perhaps just ecosystem literacy. We need to learn to view Earth as an ecosystem, because for every action there's an equal and opposite reaction. We can't continue to pump greenhouse gasses or reactive nitrogen and phosphorous into nature and expect no reaction.

■ **Anders Emil Møller: Could you begin by describing the situation we're facing right now?**

■ *Katherine Richardson:* People have framed the crisis of climate change as a prediction problem. While the scientific community has considered man-made climate change as a fact for a long time now, the more public debate is still about the validity of individual predictions, not the overall issue itself.

Similarly, we're still talking about getting people on board and how their support is needed to do something. But this is the wrong approach. Climate change is a risk problem, and risk problems are usually handled far more promptly. Look at how rapidly and efficiently security checks were established in airports after 9/11. No one asked the public for consent. They didn't wait for support. Even though we aren't entirely sure how significant the level of threat terror poses, we invest heavily in security against it. Climate change endangers society to a far greater extent, and in reality, the danger is much worse than what science has reported. The ice melting in the Arctic and in Greenland has happened much faster than the scenario imagined in IPCC estimates. People are unable to wrap their heads around how wild such a phenomenon really is. It's frightening. And the climate crisis is only one risk. The biodiversity crisis is just as terrifying.

■ **How do the biodiversity crisis and the climate crisis differ?**

■ Simply put, the climate will recover if we start conducting ourselves in better ways. It will take a long time, but it will happen. We will never be able to recover the loss of biodiversity. Once a species goes extinct, it's gone. It can't return. It's impossible to return to a level of biodiversity that goes along with a biosphere unaffected by humanity. Even though we cannot prove how all living organisms affect the planet today, we know for certain that once the damage is done, it will be irreparable. Thus, the biodiversity crisis is fatal, and the consequences may turn out to be much more severe than we could ever imagine.

■ **What facts do you wish people better understood about the crises with climate and biodiversity?**

■ That what makes this planet special isn't that it has a climate. Instead, biology and the effects of that biology are what's wholly unique. The conditions on Earth are a product of interactions between the climate system and the biosphere. It takes care of all living organisms. We can thank biology for the

■ **How can we start thinking in terms of ecosystems, then?**

■ In both the US and Asia, there have been efforts to support the "convergence" of disciplines when it comes to research. We haven't been so good at this in Europe, but I see enormous potential, especially in smaller countries like Denmark where distances between most things and most people are shorter. We shouldn't beat ourselves up for not being able to play ball with the bigger countries, though. In an age of transition, it's actually an advantage to be a small country and a country with a very flat hierarchy. We have to capitalise on that.

I also wonder if our failure to focus on interactions in the Earth system has hindered more breakthroughs. The areas in which we see breakthroughs tend to be cross-disciplinary fields. For instance, I'm a biological oceanographer. That means I'm a lousy biologist as defined by the Danish educational system. But my training in physics is much deeper than a Danish biologist. But that doesn't make me a physicist either — just ask a physicist. From a European educational standpoint, I'm neither fish nor fowl, but this has led to a wildly successful field of research. A lot happens within these disciplinary intersections for both research and society.

“Once a species goes extinct, it’s gone. It can’t return. It’s impossible to return to a level of biodiversity that goes along with a biosphere unaffected by humanity.”





■ **Meaning that we have to start thinking about these challenges in a more holistic way?**

■ Yes. And a more systematic understanding of the issues around climate change is emerging. The new IPCC report on land use states that the way we evolve as a society, from social and economic inequality to education and health, will impact the way we counteract climate change and adapt to life after the effects manifest themselves even more.

We cannot simply control climate change with a single “climate lever.” It’s the sum of our activities that generates the problems, and as such, the sum of our joint efforts will make a difference. If everyone on Earth used as many resources as you and I or even just the average Dane, we would need over four Earth-like planets to sustain that. And this is before we add a further two or three billion people to the planet.

■ **What could world leaders do to accelerate the necessary changes?**

■ While I fully agree that world leaders have a role to play, I am a bit unsure what that role will be. They have been elected to ensure their people’s prosperity, not to preserve Earth’s resources. That’s what makes this affair so wicked.

Consider the UN’s Sustainable Development Goals. Goals One through Six deal with poverty, hunger, health, education, gender equality and access to clean water and sanitation. Succeeding here would place a greater strain on climate and biodiversity. Environmental concerns like these are referenced in goals 13, 14 and 15, but they have no direct regard for people. No one knows how we ought to balance the tension between these two imperatives.

It’s easy to imagine that leaning too far towards the preservation of the global environment would hamper our ability to provide people with their needs. On the other hand, if you lean too far towards the human side, you risk undermining the environment by depleting the finite global environmental commons that, ultimately, are the source of human prosperity. Everything we know about climate change and the state of biodiversity indicates we are leaning too far towards the human-centric goals at the moment.

■ **Can we reduce the tension between these two extremes?**

■ As I said, there isn’t a single “climate lever” that could balance this for us. Instead, we have a variety of levers at our disposal, which are identified in a recent UN report of which I am a co-author. These levers include the economy and finance, governance, individual and collective behaviour and technology. Any solution would have to pull all these levers simultaneously. We can’t rely on technology alone, as it can’t create more resources, nor can it create biodiversity. The individual elements can help us move towards a more efficient use of Earth’s resources, but, by definition, isolated elements won’t engender holistic change. And what we really need right now is that holistic change.

In this sense, world leaders have a role to play. Our politicians have to initiate incentives that minimise destructive

behaviour. We have a global market and trade deals that operate on a global scale. These deals are purely monetary, but if we managed to incorporate some environmental currency to the activities regulated by these deals, we might make serious progress. Preserving the global environmental commons so that future generations will also be able to use them requires global governance of some sort. Remember, however, that governance is not necessarily the same as government. We simply need some global rules — such as those we have for trade.

■ **Do any ideas or events point in the right direction?**

■ 2015 was incredible. It saw two major agreements amongst nations: the UN Sustainable Development Goals and the Paris Agreement. The enormity of these agreements was that they were the first multilateral deals that acknowledge the fact that our resources are limited.

The challenges identified in the individual goals laid out by the UN are nothing new, so it is their grouping within one framework that’s interesting. The individual goals are not really what is in focus. Instead, it is the interactions between these goals that are. With that in mind, we might be able to take a more systematic approach while moving forward.

■ **Does this make you optimistic?**

■ Yes, you can view the Sustainable Development Goals as a vision for how to distribute the Earth’s limited resources to a population of nine to ten billion. That’s a huge challenge. The problem is, the moment you acknowledge that resources are limited, you are forced into a situation where you have to consider how these resources will be used or shared. This, of course, is a hugely difficult task.

■ **And are there aspects of the discourse around climate change that irritate you?**

■ When people say they don’t “believe” in climate change, that’s of course a source of irritation. What irritates me the most, however, are people who say that since Denmark is such a little country, what we do here makes no difference and we, therefore, are better off going in and helping developing countries lessen their impact, rather than doing something ourselves. That’s ethically irresponsible. We Danes cannot say to people in other countries that they need to change while arguing that we do not have to because we are lucky enough to live in a country with only five and a half million people. Denmark is a global actor and just like all the other countries, it has to do its part in this major transition.

Another irritating trend is the finger pointing: if you fly, you’re a bad person; if you eat meat, you’re a bad person. In reality, it’s about how we all have a limited amount of resources. We can treat our resources like a budget, allowing each individual to choose the shape of their impact but keeping their resource consumption equal. For someone like me, who lives in Denmark but has most of my family in the US, it’s actually important to fly once in a while. On the other hand, though, I rarely ever eat beef.

■ **But surely flying and eating are examples that will have to be affected by a systemic or holistic change?**

■ I completely agree. But rather than dictating how people should live, we have to instill in people the importance of using our resources as we would our money, i.e. using no more than absolutely necessary to maintain our lifestyles. Over time, we may well discover that it won't be enough to merely make the process more efficient and that we might have to make compromises in terms of our lifestyle.

For instance, you can't convince me that people won't be flying in 2050. Of course they'll be flying. And there will also still be a market for meat. But I can guarantee you that the market will be controlled by meat producers to ensure a minimal amount of environmental impact or even none at all. That's what we need to bet on — and work for.

But all of this isn't to say that our own individual impacts won't have to be reduced as well. This is something we all need to focus on, including the farmer and you and me.

■ **Even though technology, as you say, can't simply fix everything, does it still have an important role in the fight against climate change?**

■ It does. Since the industrial revolution, society's development has piggy-backed on technological development. This has left us so accustomed to the idea that only technology can bring about change or progress. But back then, we were nowhere near the biophysical boundaries of our planet. We've known for a long time that when we harness Earth's resources to create wealth, they will not regenerate. The major limitation of technology is that it cannot compensate for overall resource limitations.

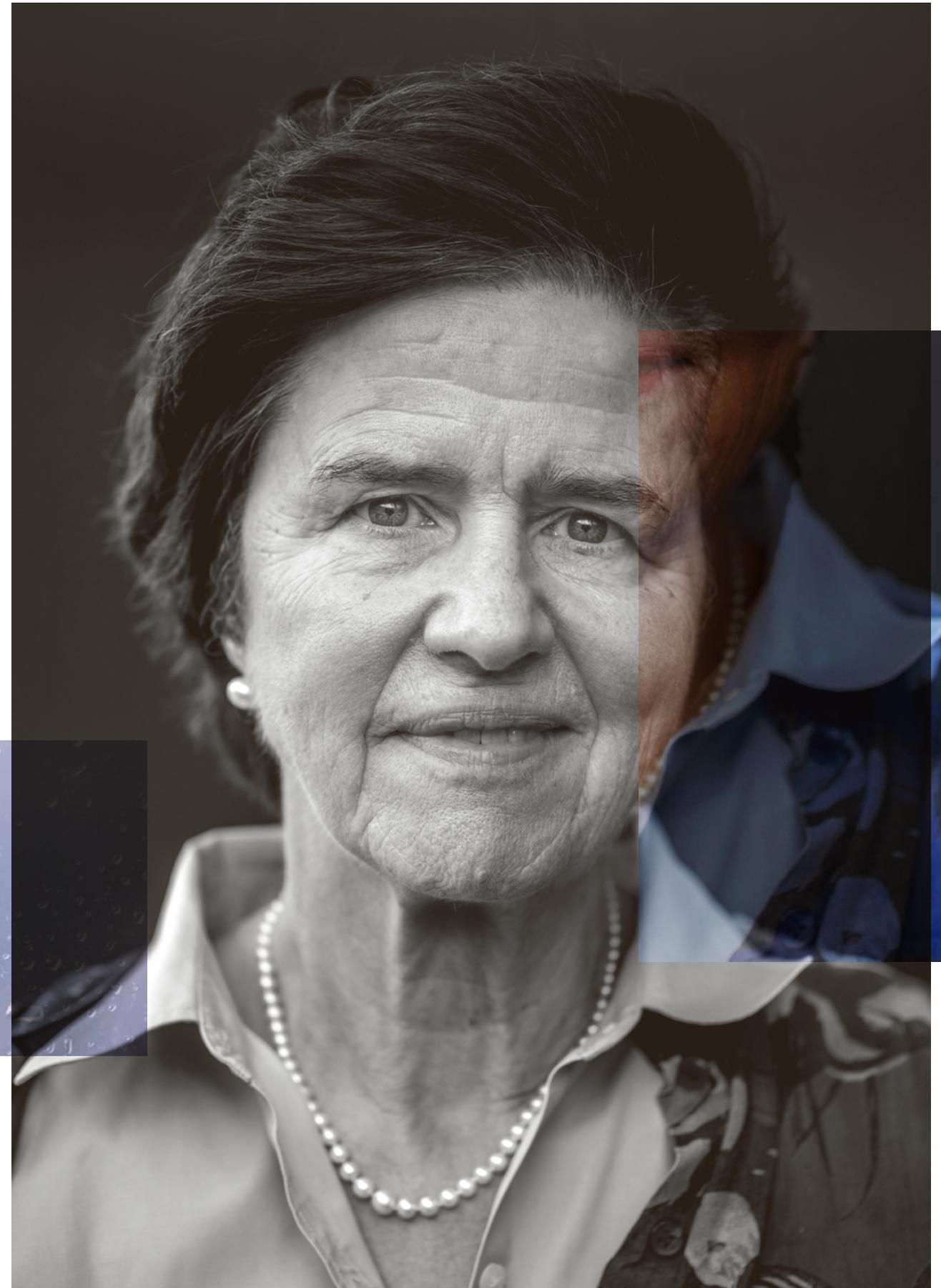
Technology is an important tool, but we have to approach the technology we're betting on in a context we are not used to. Think about how extensive our plastic use is even though we've known since the 1950s that it's practically non-degradable. But, at the same time, there are some extremely interesting things happening with the push to make electricity our primary source of power. Who knows, perhaps the car market will suddenly become entirely electric. Some even say that it might happen in just a year or two.

■ **So we might expect a sudden explosion of renewable technology in the near future?**

■ Yes. But good grief. We're standing against the wall and with a knife to our throats. It's definitely time to act. ■

“But good grief. We're standing against the wall and with a knife to our throats. It's definitely time to act.”

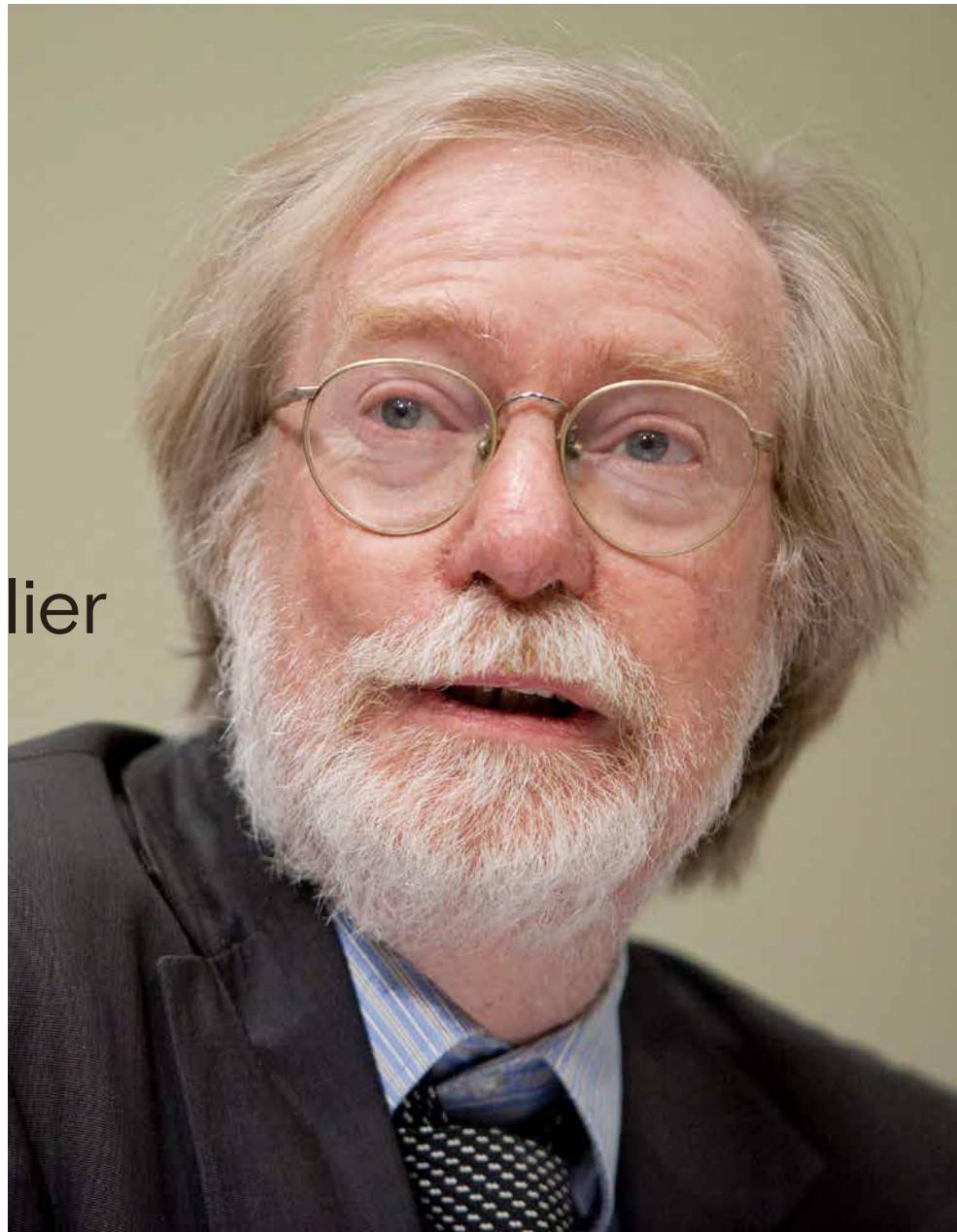
Katherine Richardson is a biological oceanographer at the University of Copenhagen. Her research focuses on biological processes in the ocean and the uptake of CO₂ from the atmosphere and how ocean biology contributes to the overall function of the ocean in terms of the Earth system. Her governance involvement gives her a wide view and she is also a core researcher in the international research team focusing on identifying Planetary Boundaries. She has published over 100 scientific papers and book chapters.



Healing the Rifts

Q&A Paul Collier

WRITER
ANDERS EMIL MØLLER



Photographer: Andrew Harrer/Bloomberg

The last four decades have overseen the development of a profoundly unequal society, argues the British development economist *Paul Collier* in his latest book “The Future of Capitalism.” Only recently have politicians started to pay attention to these social and spatial rifts. As society progresses into a future of climate change and automation, we must consider those on both sides to be successful.

Q Anders Emil Møller: You’ve titled your book *The Future of Capitalism* and you have structured it around what you describe as “deep rifts” in society that must be addressed. How do you see that squaring with a future shaped by the climate crisis?

A Paul Collier: While we can trust businesses that put purpose over profit to behave responsibly, we mustn’t let climate change become an elite metropolitan issue by which those in power choose to ignore the pressing realities of the poor. The way society has formed in recent history has set opposing sides squarely against each other — such as highly skilled elites against less educated workers, developed nations against less developed nations and the metropolis against the provinces. It would be easy for us to address climate change in a way that overlooks these dynamics, but we would do so at our peril.

Q What would happen if the elite metropolitan centres were to continue along the track they’ve already laid out?

A Well, the results are everywhere. While the *Gilets Jaunes* began their protests over a tax on diesel and petrol — even though it would help with the transition to green energy — they were clearly mutinies against Paris, not the environment. The tax effected them much more than the Parisians. We saw similar outbursts with the rise of the Five Star Movement and Lega Nord in Italy, the Brexit party in Britain and the AfD in Germany. In Britain, though, the Brexit vote wasn’t a mutiny against Brussels. Rather, every region in England which voted for Brexit were provincial regions and had generally been considered as such by Londoners. London, not Brussels, was the target of the mutiny.

These outbursts might find their triggers in the migrant crisis, Brexit and taxation. But these triggers weren’t the causes. Rather, the causes for these outbursts — globalisation, the rise of complexity, the reduced value of manual skills and especially the economic activity and gravity redirected from the provinces to the metropolis — they were the real forces

behind the rifts. They were what caused the outbursts as they had been building up for 40 years, like an undetected gas leak. The struck match didn’t cause the explosion, per se, it was the leak of gas. Though, of course, like the triggers, the match ignited the gas.

Q Are we seeing politicians responding to these causes?

A They’re starting to. When Mette Frederiksen invited me to Denmark to address the Social Democrat Party, for example, I realised that she really understood these unseen rifts in a way other politicians hadn’t managed yet. She told me her message to the voters: “You didn’t leave us. We left you. And now we’re back.” That’s exactly right. What she’s doing is basically recognising that people belong to a place and their social solidarity has to be place-based.

Outside of Denmark as well, there’s a new emphasis placed outside of the metropolis. In Germany, East Germany is taken much more seriously. In Britain, both Labour and the Conservatives are refocusing on the provinces. And Macron even visited provincial French towns in response to the *Gilets Jaunes* protests. It’s necessary to help the less developed regions.

Q How do you think we could proceed to become simultaneously more sustainable and more equitable?

A To address the rifts, I have a broad idea that I call the “Social Maternal Chain.” Essentially, it’s a series of policies that collectively try to raise a baby into an adult that would make a productive contribution to society. And really we could learn about what’s working from the best around Europe to realise such a system. The French *Ecole Maternelle*, the Finnish schooling system, the Swiss vocational training — each are brilliant.

Even so, I’m a pragmatist. I don’t believe in permanent utopias that remain unchanged forever. Periodically, society will derail. And, given the mess we’ve gotten ourselves into, it will take a good ten years to get back on track. Today is for getting it back on the rails. ■

Sir Paul Collier is a British development economist who serves as the Professor of Economics and Public Policy at Oxford University and as the director of the International Growth Centre at the London School of Economics. He is a specialist in the political, economic and developmental predicaments of low-income countries. His book *The Future of Capitalism*, was published in 2019 by Penguin.

“THE MORE WE
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GENERATIONS.”

— Philip Ball

Read about New Ways To Grow Humans on page 86

NATURAL BY DESIGN

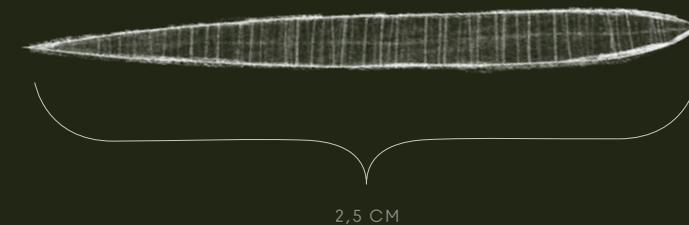
WRITER
FELIX BEHR

In nature, plants and animals evolve to take advantage of naturally occurring phenomena. Within that context, humans have developed an unmatched adaptability that allows us to mimic and replicate the advantages these ecosystems have naturally developed. As Leonardo da Vinci designed flying machines based off of the anatomy of birds, he was, in fact, pioneering what would later be known as “biomimicry,” or the imitation of nature as a solution for a problem. Until relatively recently though, the explicit copying of nature was left unsaid. While da Vinci’s attempts at imitation failed, biomimicry has now blossomed in its own contemporary renaissance. From industrial design to product design, designers today take inspiration from nature’s genius to get things done.

EMBRACING NATURE’S IMPACT

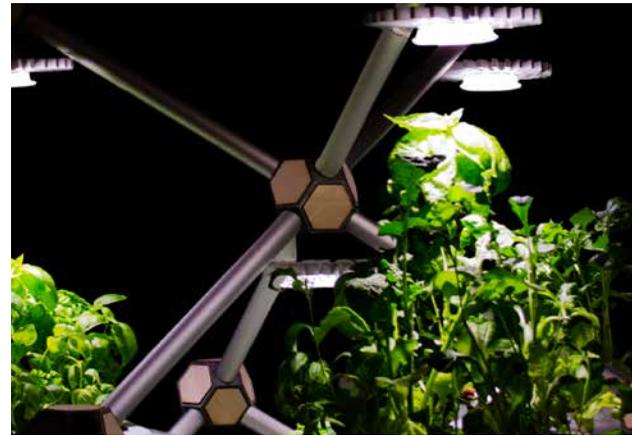
"This was a case of problem-driven biomimicry," Emily Kennedy, the CEO of the Ohio-based startup Hedgemon, explains. The problem was that in American football, concussions and other head injuries are commonplace, giving rise to the need for a helmet that would lessen the force of the impacts that the players experience during a game. So the researchers at the University of Akron, where the designers were based, turned to nature to see how animals mitigate impact in the wild. After going through many examples — including bighorn sheep, diatoms and woodpeckers — they found the most viable inspiration in the small but resilient hedgehog.

FIG. 1
HEDGEHOG QUILL



Hedgehogs, like players in American football, crash — a lot. According to Kennedy, **"they are active climbers and regularly fall from significant heights. Their quills dissipate the shock, though, and prevent fall-related injuries."** Essentially, each quill deflects a portion of the impact of the fall onto another quill, lessening the impact's power with each deflection.

After they had identified the problems they faced and the solutions offered by the hedgehog, they began designing. The conceptual work had been completed in the wild, and by utilising biomimicry principles, they could focus more so on the application instead. Hedgemon's application manifests in a helmet in which they created a space between the hard outer layer of the helmet and the part that rests on the players head. The space in between is filled with polymer elements that mimic the impact-absorbing qualities of the hedgehog's coat.



HIVE OF INNOVATION

HEXAGRO URBAN FARMING, a Milan-based start up, works within the realm of biophilia, a concept that claims people have a need to connect with nature. Most of us spend our workdays crammed inside an office without any connection to nature, only for us to go home and also find ourselves cut off from nature. Such an environment affects us adversely, hurting us in some ways even more than our dietary choices or lack of physical activity. In response to our deprivation of nature and of healthy foods, Hexagro developed the Living Farming Tree, an automated indoor farming system for workplaces.

“We didn’t start with biomimicry in mind,” Alessandro Grampa, the CMO of Hexagro Urban Farming, admits. **“But we understood that biomimicry was the way to implement our vision when we participated with Biomimicry Launchpad — an accelerator program that encourages participants to look to nature for inspiration.”**

The concept proved useful as the team was looking for a way to fit the system into workplaces. Encouraged to examine answers nature had already provided, Hexagro turned to honeybees. **“Honeybee hives combine the most compact volume with the largest amount of surface area,”** Grampa clarifies. **“They also lend themselves to a completely modular design that’s beautiful to see, especially since it builds upon the concepts of biophilic design we began with.”** Regardless of whether biomimicry is an explicit ideological background or not, as we reorientate ourselves with respect to nature, we will naturally end up learning from it, and mimicking what it does best.

FIG. II
HONEYCOMB STRUCTURE

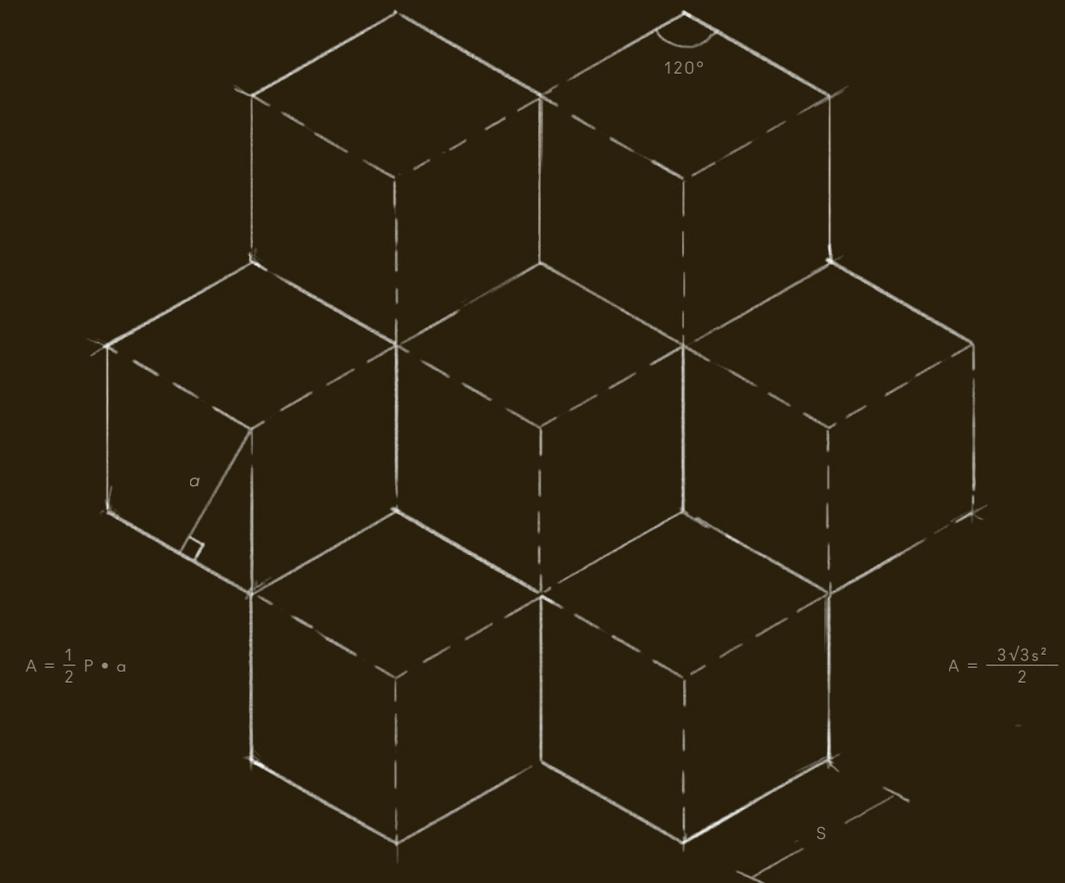
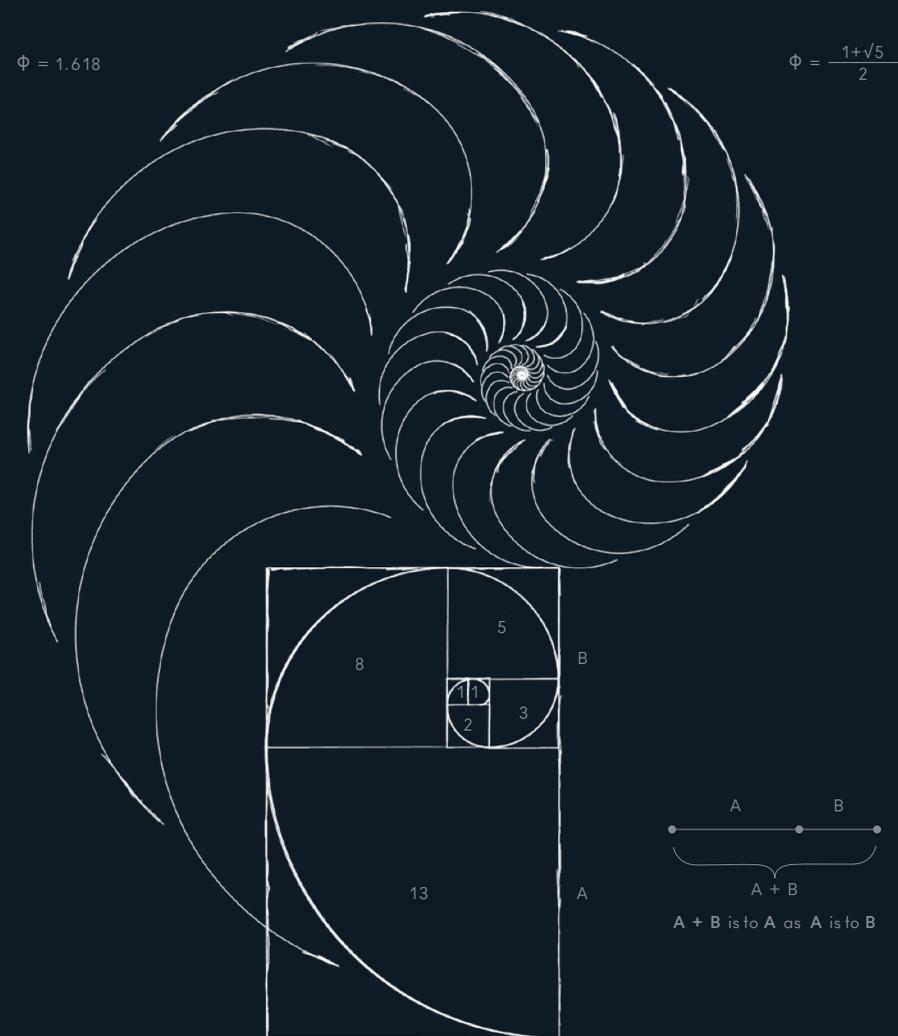


FIG. III
THE GOLDEN RATIO



NATURE IN THE MIX

THE SPIRAL SHAPE creates a poetic rhyming throughout nature. It's shared by the Milky Way, snail shells and the pattern in which our hair grows at the crown of our heads, to name just a few instances. From a young age, this ubiquity of spirals in nature fascinated Jay Harman, the President and CEO of Pax Scientific. After a childhood spent on the Australian beaches, something eventually clicked in his mind. **“One day when I picked up a seashell on the beach,”** he recalls, **“I realised that the animal’s shape was tracing the path of least resistance.”**

A few years later, Harman put this epiphany to use by becoming an early proponent for the application of biomimicry in engineering and design. The spiral motion he saw in the shell can also be found in natural equivalents that inspired the PAX Mixer, an industrial mixer produced by PAX Scientific. **“PAX’s impellers are inspired by natural vortices or whirlpools,”** Harman explains. **“The impellers generate whirlpool-like ring vortices, which are like innertubes or doughnuts made of liquid in the tank. Since nature always prefers rolling over sliding, creating these ring vortices moves and mixes liquid molecules more efficiently.”** The increased efficiency enables the PAX Mixer to blend more effectively and more energy-efficiently than traditional designs. Harman describes biomimicry as a practice that, **“learns strategies from nature which perform just as well or better.”** By working with these principles, biomimicry further reverberates the rhymes around us.

Nature has spent millions upon millions of years testing evolved designs in “real world” situations with the least effective designs simply dying off. Biomimicry focuses on reapplying these natural principles to human problems. By engaging in biomimicry, designers help rebuild the connection between the nature of the wild and the nature of our daily lives. ■

Lost in thought

IMAGINATION IN FLUX

WRITER CATHRINE RASCH
ILLUSTRATOR STUDIO KLEINER



Thinking of the future happens in a distinct mental space where we imagine things to come. But our imagination is based on always-biased views of the present. The future really is happening now.

I GREW UP IN DENMARK in the 1980s, less than 20 kilometres from the Swedish nuclear power plant Barsebäck. As both of my parents were radiologists, I suspect there's no reason to guess how much they feared the two reactors, which to this day form part of my view of Sweden. Suffice it to say that my mother would anxiously instruct me on how to close all the windows in my childhood home in case the sirens went off. The sirens either signified A) a nuclear accident B) a Russian invasion or C) a more indeterminate end to the world. The Danish authorities tested them every Wednesday at noon from 1951 to 1993, and on numerous occasions over the course of my childhood, I'd have to remember that it was just another Wednesday, that it was 12 o'clock and that the world was not on the verge of collapse. Fortunately, the world never ended. But my mother still cried in 1986 when she heard the confirmed news about the Chernobyl disaster.

When instructing her three daughters in practical conduct in the case of a nuclear meltdown at Barsebäck, my mother and the authorities had to resort to linguistic formulations to convey a future that they couldn't exactly be sure of. Future tense is a relatively advanced concept in every language. Linguistically, we humans operate with constructions that necessitate a certain overview of the future, which we assume we're able to say something about, based on various hypothetical and realistic strata. This is quite the cognitive feat when you think about it.

Essentially, thinking in terms of the future is a purely imaginative process that is, in most reasonable cases, derived from experience, hypotheses and a belief in causality. In a way, it's almost endearing that every minute, the human brain entertains scenarios that have nothing to do with the current now — regardless of how "now" is defined. It's dizzying to think of the amount of energy spent on something that's yet to transpire, resulting from the release of zillions of nerve cells in an endless flux.

To help us cope with all this cognitive activity, we have notions of *dystopia* and *utopia* in the arts and popular culture, just as we have economic models, prophecies, weather forecasts, fortune tellers, probability calculus, horoscopes and futurologists. Empirical methods vary in substance, but the reason I even dare mention them together is because the German philosopher, Georg Wilhelm Friedrich Hegel, whose concept of *Zeitgeist* usually seems to instil a level of comfort. Put simply, we're bound by the matters that occupy our contemporaries.

This is completely understandable, but our perspectives also include a lot of blind spots, and Hegel believed that this was something worthy of attention — to be critical of the place where our own criticisms come from.

This dynamic tendency manifests in architecture, for instance, since architects' designs are both visionary and bound by their time. For a long time, visions of the future from the beginning of the 20th century revolved around skyscrapers — a combination of steel, glass and height that continually appeared in our utopian and dystopian depictions. Other examples are more functional. My former workplace, a school built in the 1980s, was fitted with a nuclear fallout shelter. In my current workplace, a school built in 1956, the corridors were designed to be so wide that two hospital beds could pass by one another, as the school would serve as a military hospital in the event of an act of war.

Disaster films are also caught in the crossfire of *Zeitgeist* as they mirror our fears about the future. *The Day After Tomorrow*, *Twister* and *Dante's Peak* are just a few examples of blockbusters in which nature goes on a rampage, targeting us because of us. It's a common characteristic of most disaster films: when nature has a soul, it's quite angry

with us. In the 2009 disaster movie *2012*, the climate is practically waging a personal vendetta against mankind. Usually evil capitalists are to blame, but nature punishes everyone, and in that respect, the genre is not entirely unrealistic.

While we're intrigued by these dystopian futures, we are not indifferent to whether we and our children and their children will survive. But our planet has no particular interest in this. And the fight against climate change has now overtaken our visions of the future. It is a long and protracted battle against ourselves and not against nature — even though nature *will* continue to come after us for playing fast and loose with resources and defying its laws.

Today, Barsebäck has been shut down and while we don't have imagined future technologies like flying cars — "Because that's a really bad idea," my 14-year-old son assures me — we do have technologies that can save us all from a great number of things. Implicit in our anxieties, hopes, thoughts and dreams are criticisms and visions of the future; that's exciting and crucial, as we are co-creators of the future. The dystopian fear of our doom and the utopian belief in progress impel us all to reflect, rethink, alter, improve and create. ■

"The human
brain entertains
scenarios that have
nothing to do with
the current now."



DOING ART ECOLOGICALLY

WRITER
PERNILLE LYSTLUND MATZEN

Lucia Pietroiusti is the founder and curator of the General Ecology department at the Serpentine Galleries in London. She also curated *Sun & Sea (Marina)*, by Rugilė Barzdžiukaitė, Vaiva Grainytė and Lina Lapelytė, the Lithuanian Pavilion at the 58th Venice Biennale and was awarded the Golden Lion for Best National Participation. Her research spans topics from more-than-humanism, ecology, interspecies consciousness and species extinction to plant intelligence, botany and myth.

Questions around climate change and the environment have developed from being niche issues to appearing front and centre in newspaper headlines, global demonstrations and political agendas all over the world. But how do we face such a pressing matter, and how can museums and art institutions respond? Lucia Pietroiusti is the founder and curator of General Ecology at the Serpentine Galleries in London, an ambitious new programme committed to exploring questions of ecology on institutional, methodological and curatorial levels. The programme is the first of its kind in a major art institution.

“I developed the General Ecology project at the Serpentine to more-or-less infect everything we did with ecological principles or questions: How can we do ecology across all levels of an organisation through ideas and methodologies that are themselves derived from ecology? For example, how can we work like a mushroom? How can we reuse materials in the way that a forest does?” asks Lucia Pietroiusti. **“On a more practical level, the first step was to create an Ecology department, because you aren’t committed to a topic unless you restructure yourself in order for that topic to become a part of the lifeblood of the institution itself.”**

The program is particularly committed to being interdisciplinary. In the face of an issue as incredibly complex and wide-reaching as climate change, one cannot have the illusion that one discipline alone will ever result in a sufficient response. Furthermore, questions around climate change and the environment are closely entangled with issues such as poverty, conflict, commodification and interspecies relationships that make it necessary to relate across different fields and disciplines.

“The space of art is really interesting because artists have an almost amateurish approach to things, which means they have an easier time seeing, feeling and sensing connections between different phenomena and systems. Art is able to bridge knowledge between different disciplines and to point to the fact that we are all in some way hovering around the same set of principles and thoughts. And whilst you need an enormous amount of scientific research, you definitely also need the capacity to translate across disciplines. Art can present these findings in a way that is both compelling and alluring. It seduces you into thinking more in depth about these questions through the senses rather than just the intellect.”

Photographer: © Andrej Vasilenko

← *Sun & Sea (Marina)*, 2019

Opera-performance by Rugilė Barzdžiukaitė, Vaiva Grainytė, Lina Lapelytė at Biennale Arte 2019, Venice

RUGILĖ BARZDŽIUKAITĖ, VAIVA GRAINYTĖ *and* LINA LAPELYTĖ

In their collaborative practice, Lithuanian filmmaker and director Rugilė Barzdžiukaitė, writer Vaiva Grainytė and artist and composer Lina Lapelytė work in the field between documentary and fiction, bringing together a cross-disciplinary mix of theatre, music and visual arts. Their opera-performance *Sun & Sea (Marina)*, which won the Golden Lion Award at this year's Venice Art Biennale, is a poignant commentary on the artificiality of modern-day tourism and daily life in the age of climate change; and it's presented right in the centre of Venice, a city practically drowning in middle- and upper-class Western tourism every year. Here, in a building situated along one of Venice's narrow streets, the performance installation gathers 20 performers and singers on an artificially constructed beach. The only break in the slice-of-life scenario is that the beachgoers sing – individually and collectively – about everyday life.

“The installation puts you face to face with a situation that is almost unbearably mundane: The performers, the kids and the dogs do what they would normally do on the beach. The installation hovers between life itself and not-life. It's a radical way of putting the audience face to face with themselves and the banal simplicity and fragility of human life and humans' relationship to the planet,” says Pietroiusti.

By charting connections between the local and the global perspective, between everyday life and the slow, incremental violences done to planet Earth, the performance installation effectively points to the way that we – as humans – find it incredibly hard to grasp the planetary-scale threats that we face, of which we are, paradoxically, also largely the cause.

“The artists wanted to draw a parallel between the tired body of the Earth and the fatigue of the human. The installation portrays a privileged global North going on holidays at the beach, when in many other parts of the world – or indeed the same ones – there are people that wash up on the beach dead. But it portrays this with a withdrawal of judgment. Instead, I see the installation as a way of relating to those people that are spectators to the piece with an enormous amount of care, knowing that these are also those people there, on the beach.”



Sun & Sea (Marina), 2019

Opera-performance by Rugilė Barzdžiukaitė, Vaiva Grainytė, Lina Lapelytė at Biennale Arte 2019, Venice



Photographer: © Andrej Vasilenko

REVITAL COHEN *and* TUUR VAN BALEN

The London-based artist duo Revital Cohen and Tuur van Balen have a background in design and work with a critical eye for the way products and materials enter into systems of extraction, inequality and conflict.

Often, they focus on a specific object of research which they then disentangle from the clusters of commercial, political and ecological relationships that the particular object holds together — as in a previous project, where they followed the extraction of minerals in the Democratic Republic of Congo through electronics factories in China to end up as smartphones in the hands of global consumers.

Lucia Pietroiusti notes: **“Ecology in relation to the environment is often imagined as very fragile and at risk, whereas we tend to see political systems of money and power as something indestructible and powerful — and we suddenly feel very powerless. But if we start to think of economic and political systems as ecologies, might we be able to disentangle the ungraspable or untouchable appearance they give themselves?”**

Cohen and van Balen’s recent film *The Odds (part 1)* looks at the politics of gambling from the point of view of thoroughbred racehorses in the UK. The film is part of a long-term, research-based project called *Nearly Winning*, which hypothesises that gambling — instead of being an isolated activity or addiction — is an accurate description of our contemporary condition. In the video, the artists freely associate images of racehorses anaesthetised in a horse hospital, casino entertainment dancers from Macau called “sirens” in fluffy, feathery costumes and a bingo hall originally built as a cinema designed to look like a church. The footage is overlaid with hypnotising light formations on large LED screens inspired by techniques of visual seduction taken from Las Vegas.

“When we speak about human and non-human relationships, we often discuss these in abstract terms. But actually, non-human animals do exist within very intense industrial complexes, whether it be in the pharmaceutical, gambling or other industries. Cohen and van Balen’s work complicates the question of interspecies relationships. Their work reflects on interspecies relationships in the context of mechanisms of production in which we are all implicated — and to a certain extent responsible.”

Photographer: Lewis Ronald



Luna Eclipse, Oasis Dream, 2019

The Odds (part 1)
HD video, sound, LED wall
Installation view at Stanley Picker
Gallery



Luna Eclipse, Oasis Dream, 2019

The Fall
High-density foam, Jesmonite
3 x 2.2 x 1.6

DANIEL FERNÁNDEZ PASCUAL *and* ALON SCHWABE

As more and more people are becoming painfully aware, consuming food means participating in a complex web of geopolitical, environmental and economic exchanges. This is exactly what Cooking Sections — a collaboration between Daniel Fernández Pascual & Alon Schwabe — explores in their practice, defining themselves as spatial practitioners rather than artists.

In their ongoing project *CLIMAVORE*, they work with proposing new habits and modes of eating that address the abrupt environmental changes caused by human infrastructure and disruption of ecological systems. The project began with research on the toxic effects of intensive, industrial salmon farming around the Scottish Island, the Isle of Skye, by looking at the amount of chemicals, antibiotics and hormones involved in salmon farming. Cooking Sections started working together with the local community to reverse the damaging ecological effects of intensive salmon farming.

“Cooking Sections works with local stakeholders, farmers, politicians and restaurants to decrease or remove the amount of salmon from the menus of restaurants and help local farmers who work on behalf of the Norwegian salmon co-operations to pivot their activity to oyster farming, since oysters are natural filtrators that purify the water,” says Pietroiusti.

The project was manifested physically as an installation placed in the middle of a tidal zone on the coast of Portree at Bayfield. During low tide, the installation functioned as a dining table accessible to the public, where *CLIMAVORE* dinners and free tastings of recipes featuring seaweed, oysters, clams and mussels were served. At high tide, the structures functioned as tables for the farming of oysters. The installation was activated by Cooking Sections in collaboration with researchers, anthropologists and residents of the island.

“While the installation has an element of poetic materiality — and when you attend a Cooking Section dinner you always have a very pleasurable, sensible and embodied experience — the artist duo is also interested in the ways in which this can then be deployed for very strategic and targeted kinds of change. They do not work in an aggressive way. Instead, you can see in their way of thinking, an idea of embedding yourself within a context rather than the notion of opposition.”

By weaving together the sensible and the methodological through their practice, Cooking Sections envisions alternative systems of food production and consumption that work with, rather than against, local ecosystems.

CLIMAVORE: On Tidal Zones, 2016

Cooking Sections. Site specific.
Commissioned by Atlas Arts. Isle of Skye, Scotland. Image courtesy of the artists.



THE KARRABING FILM COLLECTIVE

The Karrabing Film Collective is an indigenous media group of about 30 individuals based in the northern territories of Australia. The name *Karrabing* is connected to ideas of both landscape and kinship: The word means “low tide” in the Emmiyengal language referring both to a time of coming together, as well as to a collectivity that doesn’t fit within government-determined notions of tribe or land. The group creates films and installations that deal with conditions of precarious existence in the midst of late-settler colonialism in Australia, and have been featured at numerous biennials, film festivals and exhibitions worldwide.

Their films move between speculative fiction, documentary, ancestral narratives and personal history. The most recent work *The Mermaids, or Aiden in Wonderland* takes place in a not-so-distant future, where white settlers are poisoned by a mysterious toxic dust, while indigenous Australians are somehow immune to the toxic material. The story loosely follows the young boy Aiden, who was kidnapped early in his life to be experimented on by scientists conducting a eugenics experiment, and the film creates an almost hallucinatory experience through its overlapping, saturated and free-floating imagery.

“The film was coined ‘aboriginal-futurist,’ even though the collective’s films are about very real, material forms of violence that have been perpetrated. The kidnapping of Aiden obviously refers to real-life events, namely the forced removal of children from Aboriginal communities that happened from the early 1900s and up until the 1970s in Australia.”

Through their visual storytelling, the film collective exposes how the discourses of environmentalism always exist in close entanglements with questions of racism, colonialism and misogyny – in other words, that there is an inherent inequality embedded in the notion of climate change and environmental devastation.

As Pietroiusti explains: **“All other discriminations exist in relation to the environment because indigenous groups, people of color and especially women of color are much more likely to be affected by the effects of climate change as with every other form of violence. If you look at what’s happening in the Amazon rainforest in Brazil now — not only with regards to deforestation, biodiversity being destroyed and indigenous communities being displaced and subjected to unfathomable violence — but also to an extremely repressive government that justifies these actions under extractive capitalism and a certain notion of progress, you can see how it’s all entangled. The environmentalism of today needs to be aware of how all these issues relate to one another.”** ▣

Photographer: Louis Lim



The Mermaids: Mirror Worlds, 2018

Two-channel video, 00:26:29.
Installation view: Institute of Modern
Art, Brisbane.



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SEEING THINGS AS

WE

WRITER HALLE JARVI

ARE

Flooded McDonald's, 2008

Film still. Courtesy of the artists.
Photo by SUPERFLEX.



If we don't employ our cultural tools to try and imagine new futures, we're stuck living in a limited world — and one that might very well go on without us if we don't decide what we want and then act on it. **Mayday** sits down with *Jakob Fenger*, a founding member of the Danish artist group SUPERFLEX to talk about what it takes to make big shifts for a better future and art's role in preparing us for the changes that are surely on humanity's horizon. To them, art is a malleable medium with the potential to produce tangible results by encouraging audiences to consider different perspectives.

FLICKERING FLUORESCENT LIGHTS appear almost out of nowhere, their harsh artifice hurts your eyes. They illuminate a makeshift holding room, a bright oasis in the dark, where you leave your street shoes behind, swapping them for thick rubber boots before heading back out into the darkness. The shock of the light is still with you as you make your way deeper into the abyss. How long will it take for your eyes to adjust? After a few blind steps, the water begins to rise up over your feet, and then the most unnatural thing happens — you see another human being.

So goes the experience of Danish art group SUPERFLEX's exhibition *It Is Not The End of the World*, in the Cisterns of Copenhagen beneath Søndermarken park. The moments of shock inspired by the dystopian scene underground inspire introspection, an all-too-unusual feeling in the increasingly anaesthetised reality that is our everyday lives. But SUPERFLEX, through their recent works, especially, are here to wake us up by helping us imagine the future, starting today.

The group, founded by Jakob Fenger, Rasmus Nielsen and Bjørnstjerne Christiansen in the early nineties, has an extensive and diverse body of work that has evolved across time to speak to larger cultural trends; from the creation of dystopian atmospheres to joyful social experiments to the research of future-proof materials, their perspectives, media and proposals have varied, but their view on art's value as a cultural tool has remained throughout it all. Sitting down in the group's studio, Fenger reflects: **"Art has a functionality within society on different levels. With it, we can address topics as varied as social collaboration and climate action while also inspiring actions. That's why we refer to our works as tools — they call for multiple use."**

To that end, their works strive to deliver more than a single idea and exist in more than one space. By taking a multifaceted approach, the works not only highlight flaws in social, political or economic systems at play in modern society, but they also directly involve people and come forward with new ways of doing things whenever possible. Fenger explains that simple criticism isn't enough, and in its place, the group strives to activate a cycle of social discourse that improves on old ideas by proposing new ones. **"We think it's important to not only criticise a situation, but to also propose things. And the**

proposals are also a way of putting ourselves in a position where we can be criticised, in turn." This cycle of critique and proposal drives their practice forward in a world that seems increasingly stuck in old ways of organising systems.

Fenger concedes that it's difficult to imagine new systems in place of long-standing ones, but he maintains some urgency around the necessity for it. **"There's no system that will last forever — they will all eventually change, we just don't know when. But it can happen at any time."** While realisations like that might stop some in their tracks, that's exactly when Fenger feels confident in the group's artistic practice. He explains that all three founding members have a background in documentary photography, but that the practice of looking at other people and other things eventually wasn't enough for them. **"We got fed up with that idea that we look at things from the outside, in favour of the idea that we are actually a part of it."**

This perspective shift from outside to inside is a primary aspect of SUPERFLEX and is at the forefront of their way of working. By extending the invitation for introspection, their work prompts audiences to become active participants in a situation, rather than simple observers. **"Because SUPERFLEX is the three of us and also the people working in the studio, it constantly brings together many different interests and ways of looking at things,"** he says. Looking inward could inspire the first steps outward towards a better future.

CULTURAL TOOLS FOR CULTURAL SHIFTS

The artist group's ever-conflicting viewpoints and ideas get to the heart of what SUPERFLEX believes is art's role in the process of changing broader, cultural perspectives. **"It will take a culture change for us to be prepared or to absorb what will happen in the future,"** Fenger states. **"You can implement new rules, guidelines, regulations or this and that. But if we can't affect the culture of how we do, look at or think about things, we won't get anywhere."** So, it follows that such a cultural change calls for art as an integral factor in building our future. Down in the cisterns, that future is painted as bleak and

Photographer: Jan Søndergaard and Torben Eskerod



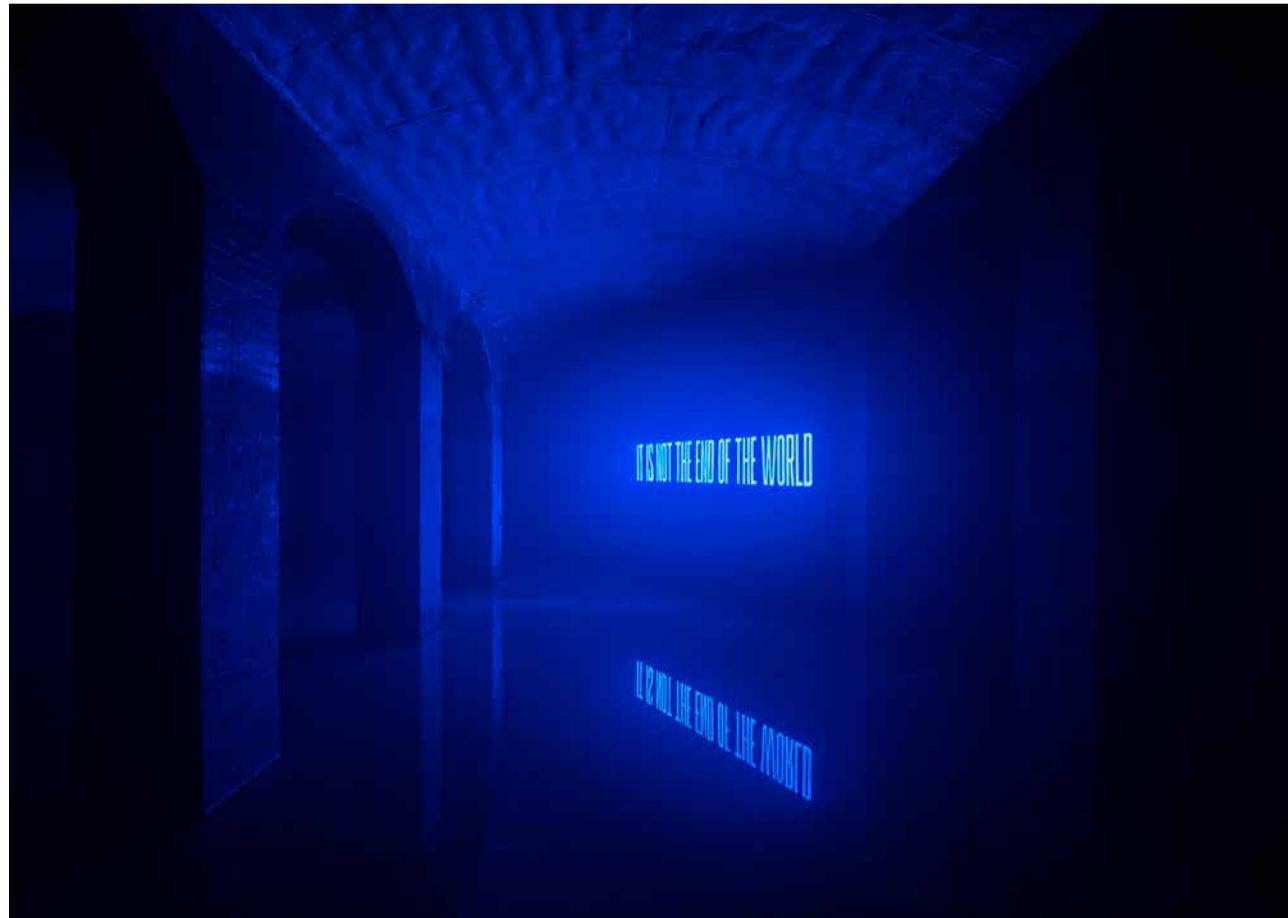
quite possibly devoid of human life. The uncertainty we feel about the future comes forward, out of its usual background omnipresence and undeniably into the light, so to speak. In the darkness, we face the possible consequences of the climate crisis in a space that hauntingly states both how unnecessary human life is to our Mother Earth, and how useless the lacklustre efforts we undertook to save it have turned out. Past the wasteland of failed attempts at change, a glowing sign reveals itself in the darkness, provoking even more so a shift in perspective. IT IS NOT THE END OF THE WORLD. The Earth is fine, we're assured. It does not rely on humanity, humanity relies on it. Behind the sign, shrouded in darkness there is a space. We don't know what lies beyond, but it's increasingly possible that whatever it is, it won't involve us. **"We should remember that the planet is not dependent on our lives, but we are dependent on it,"** says Fenger.

If you think about it that way, the idea of taking a look at things from a new perspective becomes not just an advantage, but a necessity. **"I think it's healthy to take that step back when we can and imagine that we are just another group of animals on this planet."** Enter: SUPERFLEX's latest research project *Deep Sea Minding*. In conjunction with TBA21-Academy

— an Austrian art institution which commissions interdisciplinary research of the oceans through artistic means — the group has set out on a three-year expedition in mental, physical and artistic terms. **"Deep Sea Minding is focused on developing building techniques and materials that can support life for all types of fish or corals, as well as humans,"** explains Fenger. Over the course of their tenure as "expedition leaders," their project explores spaces that will soon see a new kind of migration: **"bringing fish to occupy our homes and humans to mind the deep sea."** The project imagines a future where landscapes may disappear under rising waters, and over the course of the research, the multifunctionality of their proposed material will be tested in terms of both human interaction and fish interaction. Now there's a different perspective.

WE CHOOSE THE FUTURE WE WANT

SUPERFLEX's works invite us into these different perspectives, perhaps towards pondering whether or not we humans will be



a part of the future of life on this planet at all. But really, Fenger explains, this is not a question of whether or not we *will* be there, but rather, whether or not we *want* to be there. We must first and foremost ask ourselves what we want in our future. **"The problem is that at the moment, we won't do what we know we should be doing,"** he says. And he's right — we have the science, we know what it takes to stop the warming of the atmosphere, the melting of the ice, the rising of the sea. And yet, we are paralysed. Science presents us with the truths, but without formulating their importance in terms that people can relate to, it will be hard for us to decide how we should bring about the change necessary to get to the future we really want.

Below ground in the cisterns, we are faced with the remnants of a governmental system responsible for implementing the changes humanity supposedly wants. Represented by exact replicas of the toilets of those in power at the Bonn headquarters of the UNFCCC — the United Nations Framework Convention on Climate Change — our ineffective system is flooded. Sure, there are clear signs of past attempts to tidy up after the mouldy water's rise, but in the end it's proven ultimately pointless. Fenger explains that these are the offices where they set into motion the plan detailed in the Paris Climate Accord; he continues, **"the agreement was a great step forward, but it's just not enough at all."** Wading deeper through the water you might ask yourself: *what could we have done differently?*

In the absence of action, the predominant strategy to "preserve" ourselves seems to be wall-building. This isn't really anything new. **"Humans have always been very busy trying to make walls and keep things out. But it will not be possible to keep everything out. Maybe it's the time to make something different than walls,"** says Fenger. This observation inspired their installation *Dive-In*, as a manifestation of their *Deep Sea Minding* research project. Here, the metaphorical wall becomes more porous. Installed in the prehistoric seabed of the Coachella valley, which very well may be under water again some day soon, *Dive-In* utilises the unique material they're developing. The bright-pink structure stands out in the otherwise barren landscape, but it serves and encourages recreational life for future fish and humans alike, dissolving the notion of polarity associated with a wall today.

If we want to set in motion the cultural changes towards understanding those peoples, ideas and futures that lie beyond our comfort zone, artworks may very well hold the key. Without experience and emotion, you're just reinforcing the walls already set up between people and ideas. And anyways, Fenger muses, **"It's a losing answer to build a wall."** Better to build a bridge. So, the group asks again, what do we *want* as we move into the future? SUPERFLEX's works seem to point to collectivism and coexistence as viable options in an age of hyper-polarisation and -individualisation.

WE MUST COEXIST

Across these works, SUPERFLEX imagines and invites us into possible futures that reconceptualise humanity's place in the world. However unsettling the works are, though, Jakob Fenger admits an air of optimism when he himself looks into that future. **"I'm not pessimistic, but I also think we're in deep shit. And we're going to have to take some radical steps in order to coexist with other people and other species."**

Throughout their work, the call for coexistence runs literally and figuratively through the heart of their practice. It's an ongoing effort, but one that's well worth it. Fenger reflects, **"The other day, I was sitting alone and working, and this big fly came into the room. When I first noticed it, my immediate reaction was to pick something up and smack it. But then I thought, well, it doesn't really do anything to me — it's just hanging out."** He took that inter-species meeting as an opportunity to rethink and change his outlook. Even for the group members, realising a future where humanity is able to not only look *out* at things, but also to see our place *within* the larger Earth community is a process that means fighting against some basic urges. Certainly, SUPERFLEX will be there formulating tools and proposals that pack a punch along the way. ▣

← *It Is Not The End Of The World*, 2019

Installation view. Courtesy of the artists.
Photo by Torben Eskerod.

SUPERFLEX was established in 1993 by Jakob Fenger, Bjørnstjerne Reuter Christiansen and Rasmus Nielsen. Since then, they have been working on a series of projects with a diverse and complex practice that engages art, design, commerce and economic structures of dependency. The Copenhagen-based artist group challenges the role of the artist in contemporary society and explores the nature of globalisation through ongoing collaborative projects.





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THE

G R E E N
E F F E C T

WRITER HALLE JARVI

Green's got a bit of a precarious reputation, stuck between something precious and worth protecting, and something poisonous and troublesome. Today it transcends colour and becomes a verb in itself, where the shade represents an aspirational vision of the future in terms of politics, resources, economies and consumerism. But at its most basic state, green's duality reveals a lot not just about the natural world around us, but about humanity's own nature.

Green inherently conjures mental images of our planet's vegetation. From space, we know the dominant colours that encompass our diverse home: blue and green. Water and land. But the nuances of green extend from the natural to the material world as both a physical thing and an ephemeral phenomena that is simultaneously scientific and emotional.

Perhaps that's why colour itself, and green in particular, has driven some of the world's greatest minds to experimentation, discovery and expression. From Newton's spectrum and Goethe's theories on perception to the artworks of Constable and Kandinsky, green reveals itself to be a dynamic entity in our world worthy of both study and experience.

The physicality of green manifests in light waves and the particles that make up those waves. Vibrating through the air somewhere between 540–580 terahertz, green light waves hit the human eye at — at least — a staggering 540 trillion cycles per second. That's to say that colour is more of an interaction than an independent occurrence. The other side of that interaction takes place as a result of the intricate anatomy of our eyes. Thanks to the millions of photoreceptors at the back of our eye, within the structure called the *retina*, the physical light waves reflected from the objects in our world send a signal to our brain, which recognises the shade. Thanks to this dance between light and perception, colour is just as much physical as it is an abstract medium constructed in our minds. And that's where things get interesting.

EARTHLY PARADISE

Cultural historian and author Kassia St. Clair explains how green prompts visions of the natural world, in part because of its reputation as **“one of the most basic building blocks of life.”** She considers that, especially in light of today's climate crisis, green signals something so fragile and so worth protecting. We owe these vibrant visions of nature to chlorophyll, and because of the way chloroplasts in plant tissues absorb sunlight. By absorbing only the blue and red light waves, green dominates natural landscapes. It stands for sustenance, for abundance and for life itself. In the extreme regions of our planet, green is sometimes a scarce sight, but one of hope when the first blades of life break through snowy earth. Closer to the equator in more temperate climates, the green of lush forests and fields signal a bounty.

Ideas of verdant landscapes have long been associated with cultural and religious conceptions of paradise. Perhaps best exemplified by the positive associations of green in Islamic culture, with just one being green as a symbol of the almost unimaginable beauty of the garden of paradise. St. Clair discusses how this vision holds a lot of currency today in terms of the climate crisis: **“When we're considering what a paradise might look like, and at the same time having fears about what the planet might look like if we continue down our current path, that idea of a wonderful green space becomes even more compelling.”**

Still, the colour has an equally matched tendency to arouse negative feelings. St. Clair continues that people have, throughout history, **“railed against green because they saw it as being nefarious and evil.”** Most notably, she points to the

This article is part of the **Colour Curation series**. In each issue, we examine the diversities of a specific colour from a historical, nerdy, technical and not-least visual point of view — complete with seasoned expertise and artistic interpretations along the way. The artwork on the following pages is made in collaboration with selected illustrators and artists who we like and admire. Limited-edition prints are available for purchase on mayday.co



Spectral coordinates

Wavelength (λ): 495–570 nm

Frequency: 540–580 THz

Where does green come from?

Green earth, composed of clay coloured by iron oxide (FeO), magnesium ($_{12}\text{Mg}$), aluminum silicate ($x\text{Al}_2\text{O}_3 \cdot y\text{SiO}_2 \cdot z\text{H}_2\text{O}$), or potassium ($_{19}\text{K}$).

Emerald, with traces of Chromium ($_{24}\text{Cr}$) and Vanadium ($_{23}\text{V}$)

Malachite, with traces of copper(II) carbonate (CuCO_3)

Chromium(III) oxide (Cr_2O_3)

Amazonite (KAlSi_3O_8)

Disa Wallander is a Swedish cartoonist, illustrator and “general dabbler,” whose work tries to understand herself and the world around her in new ways. In this pursuit, she often combines drawing with different media to find new contexts.





← Dan Howden is an English printmaker and illustrator working primarily in linocuts that capture vivid scenes of everyday life. His subjects are often very familiar structures and scenes that lend a new way of looking at the ordinary.

soldiers returning from the Crusades in the Middle East during the Middle Ages who began, upon their return to their Western homelands, to proselytise against green simply because of its prevalence in Islamic culture.

PICK

YOUR POISON

In spite of its abundance in the natural world, the colour green has proven particularly difficult for humans to recreate. One of the most “successful” attempts was made by Swedish chemist Carl Wilhelm Scheel, who created his green in 1775. **“Scheele’s green became immensely popular because it was so vivid — it was unlike anything the world had ever seen,”** remarks St. Clair. She goes on to explain how it was used in everything from wallpaper to fabric and food dye. **“It allowed people to indulge in their passion for bright green.”** Unfortunately, after some time, the pigment was discovered to be incredibly poisonous to humans; after all, it was made with arsenic. The toxicity of Scheele’s green illustrates perfectly a basic human impulse to recreate the natural under artificial circumstances. **“Humans have always gone through tremendous trouble to get hold of the brightest and most beautiful pigments they can, and sometimes these efforts have been really devastating.”** Despite widespread

“SCHEELE’S GREEN BECAME
IMMENSELY POPULAR BECAUSE
IT WAS SO VIVID — IT WAS
UNLIKE ANYTHING THE WORLD
HAD EVER SEEN.”

knowledge of its toxicity, public outcry and fear surrounding the pigment, no one was willing to give it up without a viable replacement. **“People were prepared to risk their lives in order to have the colour that they wanted.”** Our human inclination towards isolating parts of nature for ourselves has proven to be a destructive obsession, not only in days gone-by but also in days to-come.

Even though the green colours of our products is no longer poisoning us today, maybe the products we colour are poisoning the greenery around us. As modern consumers, we still feel especially drawn to green-coloured products. These shades of green, as St. Clair points out, are all named with links to nature: *avocado*, *leaf green*, *forest green*. **“I think it’s really a part of our anxiety about the natural world, as we get more and more concerned and the state of the environment,”** she muses; so much so that green continues to evolve as more than a description. The adjective has morphed into a noun and a verb, permeating our everyday dialogues. Indeed, the way we humans utilise colour is a language in and of itself. How we use it and what we take from our conversations with a colour like green could very well shape a part of the future. ▣

Kassia St. Clair is a cultural historian and author whose first book, *The Secret Lives of Colour*, is a top-ten best seller. She is a contributor to NPR’s *Marketplace* and has appeared on *BBC Radio 4’s Saturday Live*, *Woman’s Hour*, *Monocle 24*, *BBC Radio 5 Live* and *CNN*. Her interest in colour sparked from her doctoral research into Victorian fashion trends.



Climate change can be intangible or happening somewhere else but it is here nevertheless. Right here among all of us, actually. **Mayday** asked our contributing editor Felix Behr to take a closer look at how we are affected, from our home-base in Copenhagen to his new hometown of Philadelphia. It turned out he didn't have to search much as it was right under his nose. Take a deep breath for his journey into the most global of all matters: air.

THE AIR CONDITION

WRITER FELIX BEHR
ARTIST TINE BEK

BILLOWING CLOUDS OF FIRE blossomed, rising above the horizon and glowing in the early morning like an infernal sun. The Philadelphia Energy Solutions' oil refinery located in South Philadelphia had caught fire and exploded. Groggy-eyed commuters passed in awe and many nearby residents were shaken awake by the tremors caused by the blasts. The heat released by the explosion that burned so hot and expanded so dramatically that it appeared on the infrared imagery of orbiting weather satellites. As night gave way and the inferno simmered throughout the day, an added black cloud of burnt

butane could be seen mingling with the sky. This was the second fire to occur at the PES refinery in two weeks.

A few miles north in a hotel in Philadelphia's City Centre, I slept undisturbed after a day of apartment hunting. Upon waking, however, I became mesmerised by the flood of images depicting the 150-year-old refinery mixing the air with fire and smoke.

As the news continued to churn, the danger posed by the repeated fires extended beyond the obvious firework display of the refinery's explosion. **"As disastrous as today's explosion and fires at the refinery were,"** Joseph Minott,

Executive Director and Chief Counsel of the local environmental group Clean Air Council, said in a statement made to PES, **"we should count our blessings that we narrowly missed a catastrophe of monumental proportions."** Apparently, the apocalyptic visions displayed that morning could have been overshadowed by something even greater. A great danger was lurking and I was in the process of moving closer. Of course I had to know what the danger was.

A couple months after the inferno, I met Minott at a table across the road from Rittenhouse Square, one of the city's original parks. A few cars drift by

but mostly people are either sprawled across the park reading, walking their dogs or perched around the tables left out on the pavement by the surrounding restaurants to indulge in the summer haze.

“The fire was at unit 433,” Minott explained when I asked for his description of the monumental catastrophe. **“That unit stores the extremely hazardous chemical hydrofluoric acid. Had that acid not been drained and diverted right away, it could have been released in a cloud covering a good portion of the city. When the mist comes into contact with people, the damage is often irreversible and can be lethal. According to the *Philadelphia Inquirer*, it could have travelled as far as 11 kilometres in just 10 minutes.”**

As rightfully dramatic as a lethal cloud descending upon the city sounds, the Clean Air Council already had their issues with the damage the refinery was doing during its normal operation. PES was the single-largest source of air pollution in the city. Every day, 335,000 barrels of oil would enter the 1,400-acre complex to be processed, releasing pollutants and greenhouse gases into the air of the nearby neighbourhoods. The

fireworks of the refinery’s explosion and the resulting trails of smoke, then, merely illuminated the edges of a problem we knew existed but generally overlooked. As climate breakdown enacts changes to our world at large, we have to struggle to see the changes made to the medium in which we live our lives: air.

WEIRDING AIR

As you are reading this, your gaze may occasionally flee these pages and escape out the window. Above you, light particles burst from the sun, strike the atmosphere and scatter. Out of the separate wavelengths, blue travels the quickest and with the path to our retina cleared by the air’s various gases, it charges. So, as you gaze out of your window on a clear day, you see an image we’ve all been familiar since our childhood: the impenetrable blueness of a cloudless sky.

Looking out at the sky, then, should remind us that we live in a gas bubble — that a delicate mixture of primarily nitrogen, oxygen and some carbon dioxide

engulfs us and allows us to exist. When we breathe, we Hoover in the gases around us, process them and release them, not unlike a biological version of the PES refinery. But even though we all know this, the reality of the fact escapes us. We normalise it. Only when we grow winded or step off from a transatlantic flight from Europe to the US and slam into a dense wall of humidity do we really understand the truth. Only when something becomes weird to us, do we really notice it. Only then do we experience air as a medium that actually exists.

Since air is a medium that conditions life on Earth, the pollution of it alters our lives in a manner more foundational than other obvious examples of climate change and more invisible. According to the World Health Organisation, 91 percent of people live in areas where air pollution exceeds their guideline limits, resulting in 4.2 million deaths from ambient air pollution and 3.8 million from household air pollution. To put that in perspective, the WHO estimates that in 2018 between 570,000 and 1.1 million people died from HIV/AIDS. **“The world has turned the corner on tobacco. Now it must do the same for the ‘new tobacco’ — the toxic air that billions breathe every day,”** said Tedros Adhanom Ghebreyesus, the WHO’s director general in 2018. **“No one, rich or poor, can escape air pollution. It is a silent public health emergency.”**

The worst of these pollutants is particulate matter (PM). If we ran an extremely fine-toothed comb through the air, we’d end up pulling out various bits of foreign matter littered everywhere. PM refers to solid and liquid substances that float through the air, some visible, others invisible. These particles, which can include water, coal dust and black carbon from industrial activities, join the rest of the gases we breathe in and then sometimes enter our lungs or slip into our bloodstream.

In addition to the minuscule crud we ingest, the texture of air itself has grown warped. Due to the various practices of modern life, the gaseous balance of our atmosphere has altered, causing breathing problems as people try to

process a compound they’re not made to inhale. One of these, ground-level ozone, emerges from the combination of pollutants and spreads as the heavy smog that news reports often show when they do touch upon air pollution. It’s one of the few danger signs that appear to the naked eye.

CHARTING AN UNSEEN WORLD

“Philadelphia used to turn on the streetlights in the middle of the day,” commented Professor Matthew Stanley Johnson when he learned that I was in Philadelphia, **“because all the air pollution coming out of the steel mills would block out the sun in the middle of the day.”** After a moment’s pause to let the image sink in, he continued to comment on how we’ve made progress — Philadelphia’s afternoons now see the sun — but that the massive concentration of people into urban areas is introducing new problems. The concentration of people means increased concentration of activity, which means an increased exposure to the various pollutants we’ve discovered in our air.

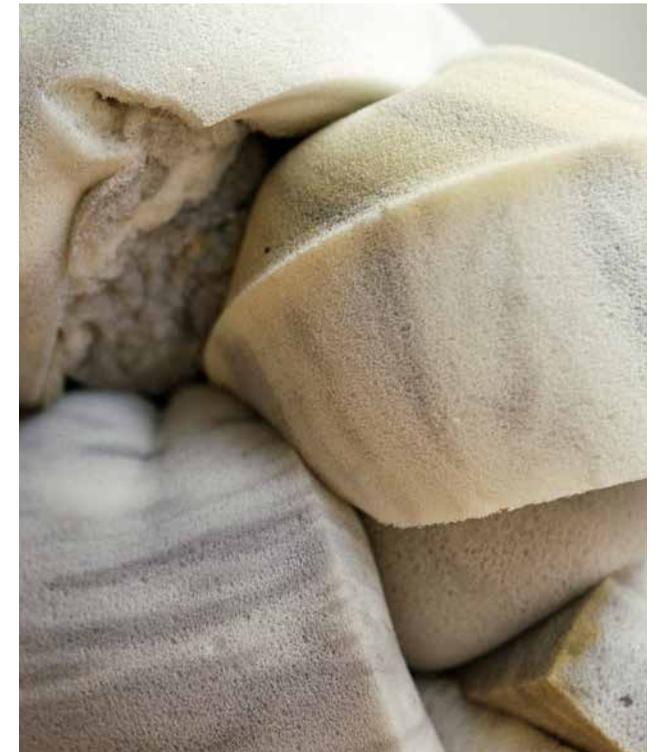
Professor Johnson works as an atmospheric chemist at the University of Copenhagen’s Atmospheric Research Centre. After several decades of teaching environmental chemistry, the effect of which he described as **“a little bit depressing,”** Professor Johnson decided to apply his knowledge. His work has resulted in two companies, Infuser and AirLab, one of which filters the air and the other develops air sensors. I wanted to understand how the changes to air as a medium will manifest in more day-to-day matters, so Professor Johnson was a natural person to turn to.

As I learned, Philadelphia wasn’t the only city that couldn’t properly discern the pollution flowing through it. **“Many cities are currently working in the dark,”** he explains between Skype’s occasional lags. **“For example, as a response to their dangerous levels of air pollution, Bangkok forbade construction within the city only to find out that the cause**

of the pollution was agricultural burning. By understanding the pollution, you can have directed actions.”

He reached over his desk and picked up a small boxy device. It was an AirLab Sensor, a smaller, cheaper version of the equipment regularly used by cities to monitor the level of pollutants in the air. The cheapness changes the game drastically, as the heavy cost of regular equipment dissuades cities from placing them at sources of pollution. Instead, cities opt for setting most of the sensors at places more removed from pollution, so they can measure the “average” level of pollution in the city.

To impress this point upon his students, Professor Johnson sent them to London with a couple of the AirLab sensors with instructions to walk about and record what they measure. As they strolled, they picked up concentration levels of particulate matter between 10 and 20 micrograms per cubic metre, meaning that only relatively small amounts of PM were present. This was



fine as the EU exposure limit is about 20 micrograms per cubic metre anyway.

Then they entered Victoria Station. They stepped on the escalator and began their descent. The students quickly saw that the further down they rode the escalator, the higher the concentration of particulate matter grew. It reached 20 micrograms. Then 50. Then 100. **“By the time they were actually on the underground,”** Professor Johnson concluded, **“their sensors were reading over 200 micrograms per cubic metre — ten times the EU annual exposure limit.”** London’s attempt at a holistic picture missed the realities of public transportation.

“Similarly,” he remarked gesturing to the wall behind him, **“one of the monitoring stations in Copenhagen is on the roof of the building next to me. That building is six stories tall. So, obviously, they get a very different number than if they measured the pollution at street level.”** And to dispel the idea that Denmark’s air is just cleaner, he added that the worst air pollution he had ever

“NO ONE,
RICH OR POOR,
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EMERGENCY”

seen was in the underground train station, Nørreport. Nørreport serves inter-city trains that run on diesel, effectively trapping the fumes within the platform areas for people to stew in as they wait for their departures. A poisonous underground is unlikely to float up six stories.

Developing a clear picture of where the pollution is concentrated serves to address it more effectively. Professor Johnson's work with AirLabs, for instance, has produced a car filtration unit to remove the distractions of air pollution as you're driving. A more important improvement, however, is his development of Gas Phase Advanced Oxidation (GPAO). Inspired by how the atmosphere would regularly break down pollution via rain, sunlight and other chemical reactions, Professor Johnson took the process he had been teaching and accelerated that process by a factor of a million: **"Instead of being a few months, the lifetime of pollution was now a few seconds."**

In practice, the filters use GPAO as a trap for pollution. **"We convert the air pollution into particles,"** Professor Johnson simplified, **"then we trap the particles and so we end up with a kind of dusty residue."**

"So," I asked, grasping for an image to help, "it's like the equivalent of a water filter?"

"It's like that. Sure." His smile said otherwise. After a moment, he elaborated: **"I guess the difference is that a water filter just traps the pollution, whereas our device changes it into something that's not dangerous anymore. Both remove pollution from the flow, but the mechanism is different."**

Inevitably, the question of "what next" came up. For the sensors, Professor Johnson sees cities boasting sensor networks numbering in the thousands that work together through artificial intelligence to produce the most comprehensive map of air pollution possible.

The other side, the filters that deal with pollution, would create clean air zones in the city.

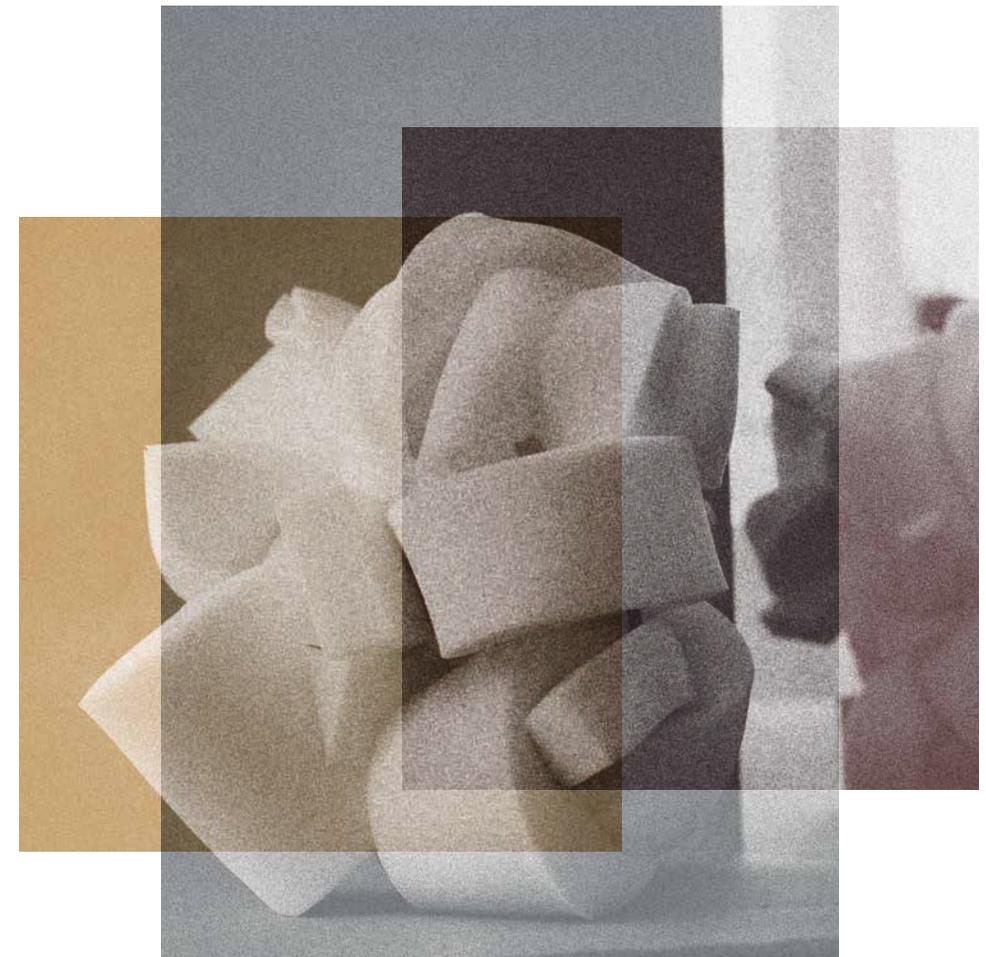
We stand amongst lethal fumes we've created, systems designed to draw overarching maps of these invisible, poisonous streams and clean air safe havens in which we'll increasingly spend our time. None of these, however, reflect how the ways we think about air will change in the future. Catastrophes and holistic, city-wide planning will shape our interactions with polluted air, but they have a society-down orientation. Our approach to air will be mundane by comparison.

TOMORROW'S FORECAST

A few days after my conversation with Professor Johnson, I thought I should head out to see the refinery. Deep down in South Philadelphia I stand with the smell of petrol-laden air lathering my nose and tongue as swarms of cars fill one of the main arteries of the city. I'm on the grass embankment next to an empty basketball court in a dead-quiet neighbourhood staring at the smokestacks now devoid of smoke.

I check my phone. These days my phone boasts a small folder devoted to weather apps. Only one of these predicts the weather. The others monitor various factors of air quality in my vicinity, many of which pull data from the Copernicus Atmospheric Monitoring Service, an Earth observation programme run by the EU that monitors and forecasts air quality world wide.

The similarity to weather apps is made explicit by a statement Romain Lacombe, CEO and co-founder of Plume Labs, featured on Copernicus's website: **"We want it to be as easy to check the pollution forecast as it is to check the weather forecast. You take an umbrella if rain is predicted. Equally, you can make small changes to your routine if you know it will be a polluted day."** Plume Air Report allows its users to scroll horizontally through a timeline that illustrates an air quality index as well as an index for the levels of ozone,



particulate matter and nitrogen dioxide. Based off of these readings, the report then gives an advisory for how safe it is for outdoor sports, cycling, those with high sensitivity and eating outside.

Plume's Air Report informs me that the air quality is "moderate" with an air quality index of 45 versus the yearly average of 31. All four activities are coloured orange. So it's not dangerous to be out and about, strictly speaking, but I'm advised to "take it easy." The level of ozone is "45." 45 what? I'm not quite sure. It doesn't say. But after flipping through the timeline and comparing it with previous levels of ozone, it seems worryingly high.

I put my phone away and doing so, put a veil over the potential air pollution around me along with the 70 percent humidity and a temperature of 27°C. They are now facts, a backdrop. Air pollution has become the weather, a fact

that is both profound and inconsequential. It's profound because, for the time being at least, the medium in which life occurs has undergone a colossal transformation. We require safe spaces from what originally enabled us to live. Our actions — right down to checking the weather to plan the day — will reflect this reality. However, the monumental shift in our attitude towards air pollution also renders it somewhat inconsequential. It's just the weather and when I do pay attention to the weather, I mostly use it to make awkward small talk with the cashier. As much as I might try to consider air as the strange material it is, I always end up renormalising it. I struggle to hold onto the simultaneous image of air as an exotic substance and the backdrop for the utterly mundane, but it snaps back to its status as an invisible medium as I get on with life. Only catastrophes seem to cast

a jarring light upon it, defying humanity to ignore it.

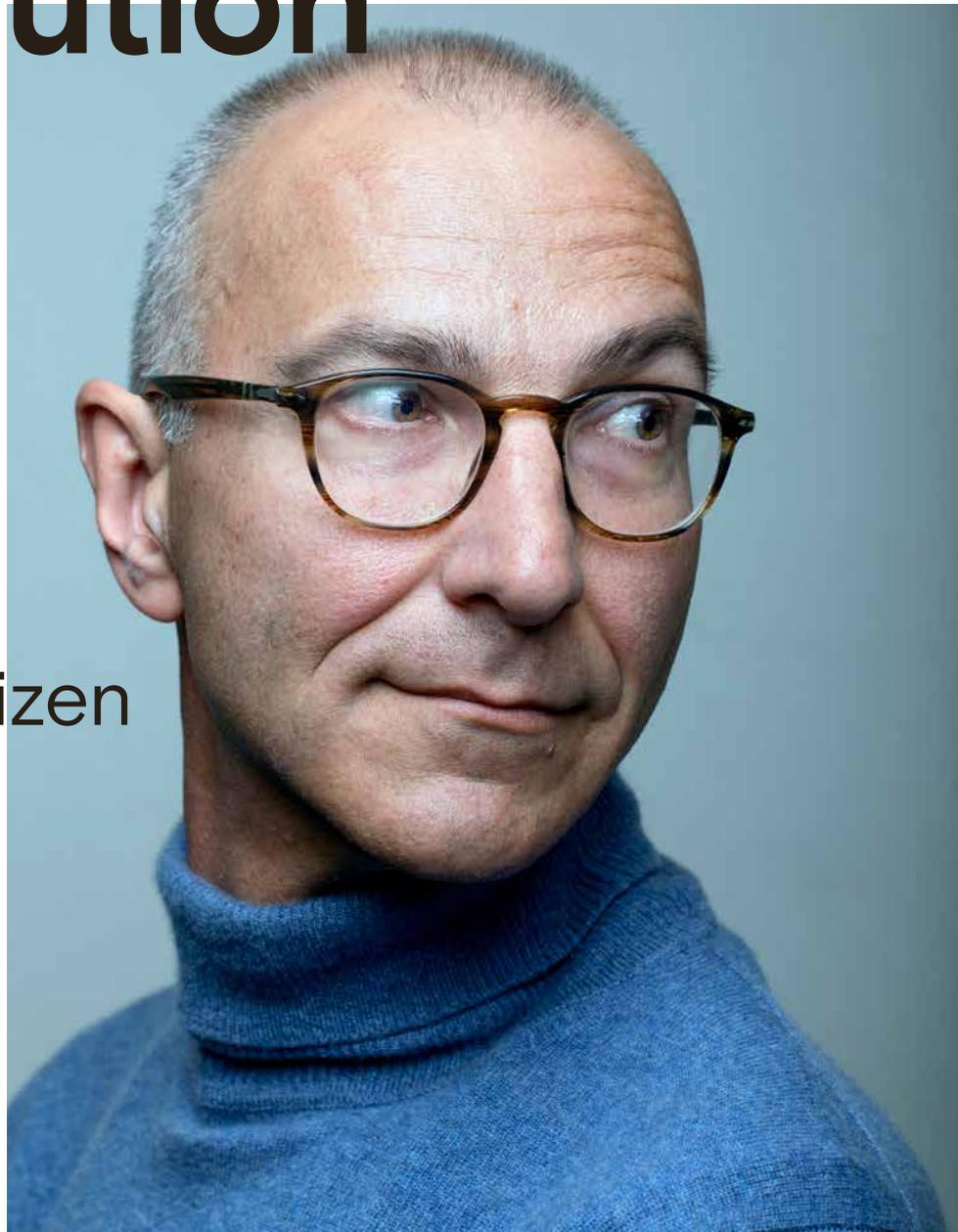
Of course, we don't have to ignore it. After the second fire, PES claimed bankruptcy, leaving the future of the refinery uncertain. Now there's an opportunity to enact plans that might mitigate the reality we find ourselves in. I asked Joseph Minott if there were concrete plans in place for what will happen. The Clean Air Council, he said, was envisioning a better use for the 1.300 acres once the contaminated land is cleaned properly. The area could then be repurposed for commercial or recreational development to help the residents it had previously been covering in pollution as well as the potential for an instalment of a non-polluting energy generator. Now is a time to reconsider the future of our precious and public resource. What does happen, though, awaits to be seen. ■



Urbanisation Drives Evolution

Q&A Menno Schilthuizen

WRITER
ANDERS EMIL MØLLER



Photographer: Sara Galbiati

Cities have become epicentres for all kinds of activities; as they sprawl and continue taking up more space on Earth, nature is morphing along. The Dutch science writer and professor of evolutionary biology *Menno Schilthuizen* looks at how humans have changed our natural surroundings at our behest, forcing other species to either adapt or perish. At first such quick evolution seems unnatural, but looking into to the scientific observations, it's clear that evolution is gaining speed.

Q Anders Emil Møller: Has human urbanisation driven new city-dwelling species to evolve right in our backyard?

A Menno Schilthuizen: This cultural environment is fairly new in history. When we look for the formation of new and distinct species in the course of evolution, cities are a surprisingly good place to begin. Evolution is happening on small scales and we don't see entirely new species yet, but important small changes are beginning that will lead to genetically new species shaped by urban life.

Q What could be a specific example of this?

A The blackbird was one of the first birds to colonise cities and we are now seeing that the urban blackbird is evolving into an entirely new species. This kind of evolution takes time, but the blackbird looks like they will be the first ever, not only to adapt, but to actually form into a genetically new species.

Q How does this change our understanding of evolution so far?

A The speed of evolution depends completely on the time it takes for a new generation to emerge. If a species has many generations in a year, we see more changes happening more quickly. So, rapid urbanisation results in something like up-tempo Darwinism.

Harder times also accelerate this current to be much stronger than regular natural selection. Because of that, though, we also see greater potential and more opportunities. Even though natural surroundings are disappearing, these animals don't necessarily have to.

Q Why are urban centres so interesting to look at now from a biological perspective?

A If we focus on plants and animals, the city is a new giant food web — an ecosystem in itself. One of the most interesting interactions in that system is when we humans play a part in the feeding — as it happens with mosquitos where humans are the food. But there are also the more creative examples of animals learning to find food in cities. Take the white-footed mouse in New York City that eats junk food. Its diet is just as unhealthy for the mice as it is for us humans, but after living in Central Park for

generations, we're seeing how, through time, they are reacting to this diet and adapting genetically. So, urban evolution is interesting also in terms of biodiversity.

Q Would you consider these changes as positive?

A It's usually positive simply to survive. And it's positive that we are seeing new and richer ecosystems inside of our cities. But overall, it's important to keep in mind that this doesn't compensate for the loss of species and ecosystems that we see elsewhere. Often that loss is the reason why the animals are coming into the cities in the first place, and the ones that are coming in are an elite group of animals that are more-or-less the same all over the world. But these changes, however small they are, are important in predicting what the future will look like. ▣

Menno Schilthuizen is a Dutch ecologist and evolutionary biologist based at Naturalis Biodiversity Centre in Leiden, The Netherlands. He has authored over 100 scientific publications in professional journals such as *Trends in Ecology and Evolution*, *The Journal of Evolutionary Biology*, and *Nature*. His book *Darwin Comes to Town* was published by *Quercus* in 2018. When he's not writing or researching, he enjoys taking "ordinary" people on field trips with his organisation *Taxon Expeditions*.



Burning platform



What Harms Nature Harms Humanity

WRITER
FABIAN FEDERL

PHOTOGRAPHER
KRISTIN BETHGE

The Amazon is on fire. The health of the rainforest is a barometer for the health of the planet, and for humans, in turn. And although we know it, it's hard to understand. In the Amazon Basin, *Thomas E. Lovejoy* has been conducting perhaps the largest ecological experiment in the world since 1979. The Biological Dynamics of Forest Fragments Project provides some of the most influential information about the rainforest's ecosystem and the future of conservation. But the science can be hard to interpret, and the facts are useless if they fall on deaf ears. So Lovejoy brings us into the jungle to fall in love. **Mayday** accompanied Lovejoy on an expedition to observe how his approach lets the forest work its magic, as he trades words for experiences.

It is night in the rainforest — noisy, hot and dark. The sky cannot be seen through the dense canopy. For a moment, it feels like standing in a void, an empty, boundless expanse of black, pressed down by the humid heat of the tropics. And the constant roar of the forest. Until the ears begin to find order. The rustling of leaves, the creaking of the undergrowth, the chirping of insects. The far-off screams of the howler monkeys.

Tom Lovejoy, a wiry 77-year-old man in a full safari suit, shuffles along the path, his feet brushing against the roots along the way. Dubbed “the godfather of biodiversity,” the 77-year-old is one of the most renowned ecologists in the world. It’s said that he’s the one who coined the term. In the rainforest of the Amazon Basin in northern Brazil, he investigates how extensively this diversity, crucial for humanity’s well-being, is being threatened. It is his life’s work.

Lovejoy is an influential man. He has advised US presidents Reagan, Clinton, Bush and Obama. Actors, singers, politicians and CEOs have, on his invitation, spent time in the rainforest with him. This time, he is hosting a group of nine, including two professors, the former head of Coca-Cola in Brazil, a New York publisher, a family friend and his nephew.

“Everyone who’s been here says it changed their lives,” Lovejoy says, quietly. He takes a step back, and disappears into the darkness. The nine people accompanying him look around, waiting, uncertain. Alone in the Amazon rainforest, in the dark, surrounded by the sounds of millions of insects, frogs, birds, bats and monkeys. Hadn’t Lovejoy said something about jaguars? Or was it ocelots?

Zuiii-up, a sound from the darkness. Mario Cohn-Haft, the ornithologist of Lovejoy’s group, whistles again. *Zuuiiiii-up*. From far above, from the treetops 50 metres above, comes the reply: *zuiiiii-up*. “We see nothing,” says Lovejoy, invisible in the darkness, “but everyone sees us.”

At this moment, the eyes begin to get used to the darkness. Shadows appear, grey on black. Then something appears on the ground. Dim, yellow-white strands spread out like a web over the ground. The ferns and bushes begin to glimmer, as do the massive mahogany trees. The forest glows. “Bioluminescent mushrooms,” says Lovejoy, “the natural light of the rainforest.”

“Unbelievable,” murmurs one of the professors, “unbelievable. It’s like the forest is welcoming us.” Lovejoy smiles and nods. This is what he wanted to convey, what he wanted them to see. The rainforest expedition has, at that moment, achieved its aim.



One Square at a Time

Lovejoy has been coming to this place for 40 years. In that time, he has secured a dozen areas of the forest for research purposes. He wanted to know how the fragmentation of the natural habitat affects it. How large, he asks, must a forest refuge be in order for its biodiversity to be preserved?

Experimental ecology often suffers due to the fact that its models have great difficulty reproducing real ecosystems accurately. Lovejoy was looking for a way to do justice to the complexity of the rainforest. So he made the jungle itself his laboratory, carving pieces of forest into squares of different sizes: the smallest, one hectare, the largest, one thousand. He observed how flora and fauna developed over the decades. He counted the plants and animals that were found in his forest fragments. Together with many helpers, he set traps in the treetops to snare birds and bats, tagging them with a numerical code before releasing them again. He numbered the trees, and noted their size and condition. Every year, he repeated this process and documented the change. His experiment with the forest fragments, begun in 1979, now covers more than one thousand square kilometres of the Amazon rainforest — an area ten times the size of

“ Preserving and restoring nature is the best solution to climate change.”

25% 80% 50%

The Amazon Basin is home to around a quarter of all the flora and fauna on Earth

The vast majority of today’s crop plants originated in the tropical region

Biodiversity has declined by up to half in some areas in the Amazon rainforest

Paris. It is the longest-running study on the partitioning of habitats and one of the world’s largest ecological experiments.

Lovejoy’s experiment has shown how deforestation, road-making and settlement-building not only contribute to the extinction of individual species, but create a domino effect. If, for example, a single ant species dies out, the birds that eat the worms flushed out of the ground by those ants die with it. The population of these worms rises. The fungi they feed on become scarce. The insects that nest in these fungi run out of nesting space. The toads that feed on these insects run out of food. And so it goes on. Lovejoy’s study has proven not only that biodiversity decreased with the size of the squares, but that this happened exponentially. He deduced that this is true of all biotopes — the rainforest, the earth — and their climate.

The project is still running, and continues to produce new findings. Hundreds of researchers have been involved over the years, dozens of institutions. Multiple new species have been discovered, some named after the project’s father — *Polycyrtus Lovejoyi*, *Euryhaliotrema Lovejoyi* and *Picumnus Squamulatus Lovejoyi*.

But after he published a few articles on the experiment and saw how limited the public impact of his scientific findings were, Thomas Lovejoy changed the direction of his work. To save the forest, he realised, requires more than just research. It requires ambassadors, more people to experience the magic of the rainforest up close, counting on the glow of the bioluminescent mushrooms and the many other natural phenomena to leave a lasting impression.

See for Yourself

One week before the night hike, Lovejoy sits in the back seat of a Toyota Hilux. He’s on his way to Camp 41, the base camp of his experiment, 80 kilometres north of Manaus, the largest city in the Amazon Basin. Given the condition of the roads, it’s a whole day’s journey. The road meanders along the Rio Negro, the Amazon’s largest tributary. It’s the end of the rainy season, and the river is around 15 metres higher than average. From the road, you can see boats navigating through the treetops. Here and there, pink river dolphins surface.

The Amazon Basin is the most diverse ecosystem in the world, home to around a quarter of all the flora and fauna on Earth. The river of the same name is home to more species of fish than all the other rivers of the world combined. One-fifth of all the freshwater on earth flows here. The Amazon is the largest, widest, longest, most water-rich river in the world. Along the river, in the Amazon Basin, you find half the world’s remaining rainforest, an estimated seven million square kilometres — around the size of continental Europe. Forest and river together produce their own climate, which in turn influences the global climate. Around 20 percent of all oxygen in the world is produced by the rainforest, and it stores 80 billion tons of carbon dioxide — as much as mankind produces in a decade. Every tree that is cut down has an impact on the global climate. “Every rainforest problem is a global problem,” says Lovejoy.

After 41 kilometres, the convoy turns onto a small path that cuts through the rainforest. To the left and right the forest is combed apart, but every few metres it falls back in. After a few metres, the drivers stop. Several tree trunks lie across the road, uprooted by heavy rains. While the drivers clear the road with machetes and chainsaws, Lovejoy jumps out of the car. His beige safari vest is a few sizes too big, making him look smaller and younger than he is. The pair of professors, husband and wife, get out of the second pickup and jerk backwards in surprise, as if physically struck by the brightness and heat. In the direct sun, it’s an unbearable 40



degrees Celsius, with 100 percent humidity and no wind to speak of. The blinding sunlight reflects off the clay soil. Lovejoy beckons the group closer, while the sweat-soaked, shirtless drivers hack at the fallen trees. Lovejoy pulls a man-sized fern leaf out of the undergrowth and holds it in front of him, like a gigantic fan. **“The rainforest is a safe place for people,”** he assures them, **“most of the time.”**

He turns the fern leaf over. On the underside, there’s a dried-out, brown lump. **“A wasp’s nest,”** says Lovejoy, and pauses until he has everyone’s attention. **“Never push aside a leaf if you don’t know what’s on the other side.”** One-on-one, Lovejoy is a quiet man, precise and taciturn. But in front of a group he becomes a storyteller.

30 minutes later, at the next fallen tree, he heaves a liana from the path and gathers the group again, this time to teach them about parasites. At the next stop, he finds the white-red flowers of a cocoa plant, and explains that around 80 percent of today’s crop plants originated in the tropics: citrus fruits, pineapples, figs, bananas, corn, potatoes, rice, pepper, cocoa, sugarcane, cashews, coffee, cinnamon. Two hours later, one of the pickups has sunk so deep into a clay pit that the wheels are completely covered. As the drivers haul out ropes and straps from the truck bed, Lovejoy jumps out

of the car again and knocks on the windshields of the other pickups.

“There’s something you need to pay special attention to,” says Lovejoy, and scrapes a circle into the dirt with his foot. Two large ants, with fat black bodies and long pincers, bustle around inside it. **“Bullet ants,”** he says. **“They bite you, it’ll feel like being shot.”** It is considered the most painful insect bite. The tour group peers down at the ground, then all flinch away. Around 50 bullet ants are scurrying around on the clay beneath their feet. When they look up, Lovejoy has turned his back, giggling and walking back to his Toyota.

Answers — and Then What?

Hours after the convoy turned onto the muddy path, the group stops in front of a sign that bears the inscription BDFFP — Biological Dynamics of Forest Fragments Project. Lovejoy gets out of the car, walks toward the side of the road, pushes some slender branches to the side, in front of him, seemingly endless forest. Green and brown, ferns and mosses, thick and thin trunks, dense foliage and lianas. Lots of lianas. **“Far too many lianas,”** says Lovejoy. This is one of his fragments, perfectly square, demarcated on all

Black and white photos: Felipe Werneck/Ibama

Since 1979, Thomas E. Lovejoy has been studying 1000km² of the Amazon rainforest 🌳, an area 10 times the size of Paris 🗼 but only 1/6900th of the entire forest. Meanwhile, the deforestation rate in July 2019 alone was around 2.250km² 🔪



sides. The lianas grow particularly well here. Almost half the birds living here have migrated or died out since the project began. **“The difference to intact rainforest is barely visible,”** says Lovejoy, **“but you can hear it. And feel it.”** Standing in the fragment, one feels uncomfortable; it seems alienating. Dead, somehow. It strains and buzzes — mosquitoes and flies and butterflies are everywhere — but no piping calls. No *zuiii-up*. No grunting and croaking. At the edges of the fragment the wind blows, light but constant. In the rainforest, protected from all sides, it's impossible to feel a breeze. But along the clear-felled perimeter the wind blows, and the trees, which are not accustomed to it, grow as if turning their backs on it, inwards. The fragment tries to seal itself off, to contain itself. And thus it becomes an ecological island.

In *Rates of Species Loss From Amazonian Forest Fragments*, the first article Lovejoy published about the project with the National Academy of Sciences in 2003, the forest fragments were compared with control areas located in intact rainforest. In this fragment, for example, biodiversity declined by up to 50 percent. Entire food chains of species became extinct. The smaller the fragment, the more big animals die out. The larger the range of motion of the species, the more complex its food chain, and the more likely it is to die out. Even large, millenia-old

trees become more susceptible. **“Isolating an ecosystem is the equivalent of radioactivity,”** Lovejoy says. It decomposes, it becomes simpler. **“This applies to the rainforest, and to every biotope.”**

This work proved that the Amazonian rainforest dies a little more with every road, with every farm. And that it happens exponentially. There is a point at which the rate of extinction tips over, and the damage becomes irreparable. **“In the fragment, we can find out where the tipping point is, by tipping more and more,”** says Lovejoy. This knowledge can then be transposed onto the rainforest as a whole. In the beginning, Lovejoy assumed the tipping point, the point of no return, to be around 40 percent. Nowadays, tropical ecologists estimate it to be between 20 and 25 percent. **“The deforestation rate today,”** says Lovejoy, **“is 18 percent.”**

After Lovejoy published the work in 2003, he knew what was to come. The project consumed 600,000 dollars every year. What was the point of it now that he had answered his original research question? Nevertheless, he wanted to continue the research indefinitely — to see how the rainforest evolved. But that would not suffice as an argument for its continuation, he feared. New projects are more exciting for donors than the maintenance of old ones. But Lovejoy knew what made his project unique. The

heat, the humidity, the greenness, the sounds — the rainforest is its own advertisement. Lovejoy just had to make sure that the right people came to visit.

during the day. **“The night, on the other hand...”** he says, expectantly, **“it's like the *Ride of the Valkyries*.”**

At night, snoring emanates from several hammocks. From time to time the water tower gurgles. And in the distance, the rainforest begins its symphony. Over and over the rattling cries of the howler monkeys rush through the air like an endless burp. Beneath the hammocks, a chorus of chirps joins the mix. In the undergrowth, there's a rustle, then something pads across the clearing, scratches about for a while and disappears again. A few times a bird screams, and gets hundreds of identical answers. Every few minutes a metallic croaking, right and left, from toads that use the rainwater gutter as an amplifier. At sunrise, when the first rays fall on the clearing, some of the campers look out of their hammocks with wide red eyes. Checking with their next-door neighbours to make sure it was all real.

It's this feeling, the bonding through experience, that Lovejoy is looking for. The group gets up together, makes excursions into the forest, goes bird watching, swims in a tributary of the Amazon. Lovejoy gives a hundred little lectures about interesting trivialities. In the evenings they sit in the darkness surrounding the camp, illuminated only by a few LED lights, and tell stories about home, everyday life. And — always — Lovejoy, tells about the project and the rainforest. Lovejoy knows that this feeling, this common bond, is more important than the results of his research. **“I had to give up biology,”** he says, **“and become a networker.”**

Lovejoy's background helped him. In Washington, he was familiar with most of those who sympathised with the environmental movement. At the end of the 1980s, Lovejoy sent Timothy Wirth, a US senator from Colorado known for his interest in the environment, satellite images of the deforestation of the Amazon Basin. Wirth wrote back, he wanted to see it with his own eyes. A few weeks later, he, along with US senators Al Gore and John Heinz, visited Camp 41, accompanied by a handful of delegates and then editor-in-chief of the *Washington Post*, Ben Bradlee. And when Lovejoy arrived back at his Washington office, there was a note on his desk. John Chafee, the US Senator from Rhode Island, had called: he also wanted to go to the rainforest.

The camp has hosted 21 US Senators. When the Californian lobby group Earth Communications Office became aware of Lovejoy, they invited him to Los Angeles. Hollywood actors began to show interest in his rainforest trip. After Lovejoy learned that Wendy Paulson — the wife of former finance minister Henry Paulson — had been birdwatching in the US for decades, he invited her and her husband to the camp. In 2017, they both agreed to visit.

The Jungle Should Speak for Itself

The convoy continues to rattle along the clay road on its way to Camp 41. It starts to rain, and the tyres slip through the mud. The driver unbuckles himself, so he can better compensate for the bumps. The cars keep on revving, getting stuck, jumping and bucking, sometimes moving as far sideways as they do onwards. Then, in front of an earthy plain, the cars come to a halt. **“Welcome,”** says Lovejoy. The drivers unpack wooden crates from the trucks and drag them into the forest. After ten minutes of walking, over roots and ferns and ant trails, a clearing appears. In the middle stands a little cabin, equipped with a grill, a couple of benches, a small water tower and a handful of structures made of wood and corrugated iron, with hammocks stretched inside.

Two students sit at one edge of the barracks, squinting into microscopes, surrounded by their laptops and magnifying glasses. Some Brazilian biologists sit in a circle of chairs. A team of ornithologists from the US are consulting on their expedition. The drivers and kitchen workers of the camp wear t-shirts and Bermuda shorts. The guests wear what they presumably think of as “jungle outfits:” cargo pants with dozens of pockets and zippers, Panama hats, water bottles on their belts. The heat in the clearing is unbearable, clothing sticks to the body, damp with sweat. The air stands still. Lovejoy endures the heat with dignity. With a brief shudder as he lets the pack slide from his shoulders he calls out to the group, **“In ten minutes, it's off to the woods.”**

The camp is surrounded by intact rainforest and a system of narrow paths that lead from here to the other seven camps, some a day's walk away. The first thing a visitor feels in the forest is relief: it gets cooler, the dense treetops protect you from the heat. Relief is followed by familiarity, somehow it looks exactly as one imagines it. And then, slight disappointment. Green, more green, dark green and light green, and occasionally a few ants. No monkeys or tigers or elephants, like in *The Jungle Book*. No jaguar and no ocelot. Not even a frog.

The rainforest, with all its superlatives, is subtle. You experience it in the smallest deviations in the background noise or the permanent green. It is a strain on the imagination and on the patience. And, after a few hours in the heat, a strain on the body. **“The rainforest is not an easy beauty,”** says Lovejoy on the way back to camp, **“you have to earn it.”** At least

The Extinction Domino Effect



When a single ant species dies out, the birds that eat the worms flushed out of the ground by those ants die with it.



The population of these worms rises.



The fungi they feed on become scarce.



The insects that nest in these fungi run out of nesting space.



The toads that feed on these insects run out of food.



And so it goes on.





“

What is relevant in the Amazon is relevant to the world. What harms the rainforest harms humanity — what saves it saves the Earth.



Economic bigwigs have been here. Analysts from the World Trade Organisation have been here. The author Elisabeth Kolbert, who conducted research in the rainforest for her book *The Sixth Extinction*, for which she received the Pulitzer Prize in 2015, was also here. Lovejoy always takes into account the interests of his guests, sometimes focusing on exotic bird species, sometimes on his work. But the most important thing is the personal. **“People meet here on a different plane.”**

It’s like summer camp. Lovejoy recorded a US senator snoring during the night, played it to him the next day and convinced him that it was a new species of bird. He put a plastic spider on Tom Cruise’s stomach and woke him — Cruise almost fell out of his hammock. And in the evening, when the sun sets — it sets very quickly here, and then it gets very dark — people who are used to being treated like celebrities, meet together in front of the grill, eat from plastic plates, tell each other stories and listen to Tom Lovejoy. **“Life in the rainforest brings people together,”** says Lovejoy. **“it grounds them. They take off their armour.”**

Lovejoy comes to the camp three times a year with his chosen groups. This group, too, was not assembled by chance. Lovejoy’s nephew works for an American magazine, the Yale professors hold

chairs in environmental and religious studies at one of the most influential universities in the world. The former Coca-Cola boss has long been involved in environmental projects in the Amazon, and Lovejoy invited him years ago — this year it finally worked out — and he brought a friend with him, the New York publisher. Now both of them are financial supporters of Lovejoy’s project. The family friend and Lovejoy are both members of the alumni association of the elite boarding school Millbrook, which trains the next generation of biologists — the teaching zoo still exists. **“Basically, I invite everyone I think can and will try to make a difference,”** says Lovejoy. **“Although, the waiting list is very long.”**

Future Fragments

Lovejoy gave up field research to keep his field research alive. 700 research projects were completed at his Amazon camps, 200 dissertations. A thousand scientists, students and interns worked on various projects related to the fragments. There are now seven camps. Lovejoy estimates that half of all tropical researchers have worked at one point in their career in the Fragments Project. Each of these people, and each of the visitors, together form a network

Thomas Lovejoy, the “Grandfather of Biodiversity,” is a Senior Fellow at the United Nations Foundation, a professor at George Mason University, and holds the 2018/19 Dight H. Terry lectureship at Yale University. He has advised politicians, among them four US presidents, and global companies. He contributes to the journals *Science* and *Nature*, as well as to *The New York Times* and the *Folha de São Paulo*. His new book, *Biodiversity and Climate Change: Transforming the Biosphere*, was published in early 2019.

of supporters without whom the project could not function. A few major donors, including the Brazilian Development Bank, the Ministry of the Environment and the Smithsonian, cover part of the costs, with the rest coming from hundreds of smaller sources. Lovejoy says he no longer has an overview himself. Since the beginning of 2019, Lovejoy’s research and network have been combined into a single institution: his own NGO, the Amazon Biodiversity Center. Its aim is nothing less than to save the rainforest.

“I’m not as hopeless as many others,” says Lovejoy. **“I saw the beginning: zero protected areas. Today, almost half of the Amazon Basin is protected. An area about half the size of the continental United States.”** But the fragments remind us that this is not enough. Not even close. **“Preserving and restoring nature is the best solution to climate change,”** he says. **“Restoring ecosystems. Radically. Reforestation and renaturation of riversides and coasts.”**

Starting here, in the rainforest. **“What is relevant in the Amazon is relevant to the world,”** says Lovejoy. **“What harms the rainforest harms humanity — what saves it saves the Earth.”**

After the hike with the glowing mushrooms, Lovejoy returns to the camp and drops onto one of the beer benches. The group gathers in front of

him. In the kitchen you can hear the hiss of water on fat, the cook calls, “dinner is served in five minutes.” Grilled fish, with farofa, toasted cassava flour, rice and beans. The Yale professor, still overwhelmed, clears his throat and begins to tell a story, a fable of an indigenous tribe in North America. The other professor, his wife, joins in with a fairy tale from South China. At dinner, it’s everyone’s turn, and a spontaneous story-telling evening is begun. Lovejoy leans back, smiling again and again, entertained. Until one of the drivers emerges from the kitchen carrying a tray of plastic cups, and a carafe.

“Aah,” Lovejoy says, **“finally!”**

“Caipirinhas,” says Lovejoy’s nephew. “Tom would be able to find cocktails on the moon.”

The group sits together the whole evening until late into the night, exchanging stories, remaining, as Lovejoy intended, connected to each other and the rainforest. **“What is being studied here is important,”** Lovejoy says. **“But it’s no longer central to me.”** What’s in the forefront of his mind today is this: **“Even if we just sit in the woods and drink caipirinhas, our presence counts.”** The curiosity, the first look from the outside. The rainforest does the rest. It never lets you go again. That is the hope. ▣

Old habits die hard

Stuck in the Algorithm

COLUMNIST TIMOTHY MORTON
ILLUSTRATOR ANTOINE COSSÉ



When you give it some thought, humans have always been trying to predict the future. In the hunt for super-powered accuracy, we have boiled down everything into a numerical language and then scaled it to new extremes with technology. As a result, algorithms have become our recipes for a predictable outcome — and we use them everywhere. They could be useful in many ways, but the trouble with algorithms today is that they aren't pulling their full weight. So maybe we need some other ideas to discover new ends for the benefit of the Earth.

PEOPLE EVERYWHERE seem worried about algorithms. There's the Facebook scandals. There's the possibility that Google is listening to you — would it be better if they weren't and its algorithms were just predicting what you might like without having to listen to you? For me that's worse. Many years ago we learned that Target, an American department store, could predict whether you were pregnant simply based on your shopping choices. Not diapers and baby food — just stuff. Algorithms accurately predicted the future.

A predictable future — that's what algorithms produce. If you think about it, a computer algorithm is just one kind of algorithm. We use algorithms all the time, whether or not we're following a mathematician's axioms. When you boil an egg, you follow an algorithm: boil the water, put the egg in, wait for a few minutes — or however you do it. You're following a tried and tested set of instructions when you follow a recipe. Or consider your laundry. First you separate the clothes into piles — maybe there's a "general" pile for towels that everyone uses — then you separate the piles into socks and shirts

and trousers. Here, you are following an algorithm, a set of instructions. The set of instructions doesn't have to "know" what laundry is. Do I even know what laundry is? All I have to do to sort the laundry is follow the rules.

An algorithm therefore represents the past — in a way, it *is* the past. Everything has been written down, or memorised, beforehand, otherwise it couldn't be an algorithm, which is a fancy mathematical word for "recipe." Algorithms aren't just in silicon chips though; they exist in your head when you cook; they exist as your flatmate's instructions about how to water the houseplants while they're away. Autocorrect's algorithms predict what you might want to write next based off of what you wrote before. A few weeks ago I tried to type "Britain" and it kept coming out "France." I wondered whether someone had hacked autocorrect, and whether that someone was in favour of Brexit. In a funny way, hasn't Britain always been trying to type its own name, only to find it coming out as "France?" Isn't that Brexit? People who support it could be attempting the impossible, because Britain has been

entangled with France and the rest of Europe for centuries.

The way the past influences the future — that's what we're talking about. Or, more accurately, the way the past *determines* the future. Or, to be even more blunt, the way in which the future is really just an extension of the past. If you say to someone that the future is the present, a continuation of how things are, how do you think they would react? They would probably raise their eyebrows. That doesn't sound like our idea of the future.

But existing power structures definitely want the future to be like that. That way, they remain in power. Google develops algorithms to create a feeling of inertia, that the future will follow a path set by the power-holders and institutions of the present. If Karl Marx had known the phrase "adaptive AI," he would've saved a lot of paper. Marx's idea of capitalism is that it's an adaptive AI, a neural-net type of software that learns how to do its job better. At first it was rather clumsy: children were forced up chimneys and people protested. Nowadays, it can be quite subtle: there you are looking around on Facebook at your friends' posts, while

Timothy Morton is an ecologist, philosopher and professor and Rita Shea Guffey Chair in English at Rice University in Houston, Texas. He has collaborated with Björk, Jeff Bridges, Olafur Eliasson, Haim Steinbach and Pharrell Williams. He's written numerous texts on subjects as varied as philosophy, ecology, literature, music, art, architecture, design and food. His most recent book, *Being Ecological*, was published in 2018.

“When you sum up the last six thousand years, civilisation sounds like a tragedy, or a really dark comedy.”

corporations extract your attention and therefore potentially your money. Like alien abduction, you might not even know it had happened.

All kinds of algorithms run in the backgrounds of our lives, not just on our phones and computers: there are maps in our minds about routes to work; shopping lists on paper or in our memories; instructions about when and how to feed the cat, put the kids to bed, plan for a wedding; instructions in wills. All these things are the past, sets of decisions made by someone, by groups, by machines or by a mixture. Animal instincts and weather patterns are also like algorithms, and this is why so called "nature" has a cyclical, regular feel to it. Until it doesn't — the trouble with climate change is that it has revealed the idea of "nature" as our nice, smoothly functioning background to be a total illusion.

This illusion derives in part from an app working in that background, an app far older than any computational devices — even abacuses. The original idea for agriculture worked like an algorithm: plan how to grow crops; store crops according to a certain schedule. Wouldn't you

do the same if your lunch kept running away? The mild climate change we saw in the Holocene had resulted in just this scenario, so it seemed perfectly right and proper to plan and store. The trouble, as with Facebook, comes from the unintended consequences. Left to run in the background, storing a bit and planning a bit has now reached a point where planet death is imminent, which is ironic because the "software" called "civilisation" was designed to work around climate change. In order to avoid mild climate change, humans created much worse climate change. When you sum up the last six thousand years like that, civilisation sounds like a tragedy, or a really dark comedy.

The trouble with automation is not AI. Heaven knows, I might be an android — prove I'm not, I assure you it won't be easy — just ignore the USB port in my neck. The trouble with automation is how the past eats the future. If we want an actual future — the possibility that things might be different — if continuing along our path might result in planet death, then we might not want to rely on algorithms to sort it all out for us. ▣



What science can do

NEW WAYS TO GROW HUMANS

WRITER
PHILIP BALL

ILLUSTRATOR
JACK FLETCHER

Since humans first appeared around 250,000 years ago, we have been shaped by evolution. As conditions changed, so did the human gene pool. But evolution is slow — perhaps too slow for our liking. Philip Ball explores new biomedical technologies for insights into how we are now taking the process into our own hands. We are finding new ways to grow humans, which might depart radically from the traditional way. So, the question becomes, what sort of people will we make?

Mary Shelley's novel *Frankenstein* is often seen both as a fable about creating people artificially and as a warning about its consequences. But today, stitching or plumbing together tissues and organs seems a clumsy way of making a human. If we want to do that, we will surely not *build*, but *grow*. That, after all, is how we all came into being: by growing from a single cell. It was a very special sort of cell: a fertilised egg. But growing humans in the future might no longer require even that.

Take, for example, an experiment conducted in 2009 by researchers in California, who grew full-grown mice from the *skin cells* of other mice. They "reprogrammed" the cells by injecting a cocktail of genes that turned them into stem cells — the cells in early embryos that can grow into any kind of tissue in the body. They inserted these cells into mouse embryos and implanted them into the wombs of female mice, as in normal *in vitro fertilisation* (IVF). The embryos grew into full-term pups, many of which became adult mice with no apparent abnormalities.

There's no obvious reason why this wouldn't work with human cells, meaning that pretty much *any* cell in your body could be grown into another human being. However, an experiment like that, with unknown health risks, would be deeply unethical at this stage, and in many countries illegal. But I'm not recommending it; I'm simply saying that it can be imagined.

FRANKENSTEIN'S EMBRYO

You might say that this thought experiment is not, however, quite a matter of growing the cells from scratch into a person. You need an embryo to put them in. But it seems possible that embryos can also be assembled "by hand" from clumps of other cells: what we might provocatively call "Frankenstein embryos," also known as *embryoids*.

It has been known for over a decade that small clusters of embryonic stem cells can, in the right circumstances,

"PRETTY MUCH ANY CELL IN YOUR BODY COULD BE GROWN INTO ANOTHER HUMAN BEING."



spontaneously specialise to form the three-layer structure found in early mammalian embryos: the *ectoderm* (the progenitor of skin), the *mesoderm* (blood, heart, kidneys, muscle and other tissues) and the *endoderm* (gut). To get any further, though, the proto-embryo would need to be implanted into a uterus.

In 2012, a team of researchers in Austria showed that implantation can be mimicked in a crude way by letting embryoids made from mouse stem cells settle onto a surface coated with a protein called collagen. Then the embryoid begins to look a little more like a true *in utero* embryo. Yet despite all the effort, the cells can't be fooled for long and eventually the process of development grinds to a halt.

To develop any further, embryoids need other types of cells too, such as trophoblast cells that make a placenta. In 2017, researchers in Cambridge made a mouse embryoid that included these cell types and found that, after a few days, it developed similar structures to those that form in a normal embryo. What's more, some of the embryonic stem cells began to differentiate into particular tissues.

There's no obvious reason why a patchwork embryoid of this sort, given

all the right cells and signals, should not keep on growing and reshaping itself further. If we could prolong the deception, as it were, that an embryoid is in the womb, could it get to something like a foetal stage? Might we, alternatively, assemble cells from scratch into an embryoid realistic enough to be implanted and grown in a uterus, to make a person not only without sexual intercourse but without even sperm or egg?

HUMAN OR NOT?

It's true that most of these experiments used mouse cells, but many of the basic processes are the same as those in humans. As stem-cell biologist Martin Pera has said, there is no reason to believe that there are any insurmountable barriers to creating entities in a culture dish that resemble the human embryo after it has implanted in the womb.

What sort of beings are these, then? No wholly artificial human embryoid yet has the slightest potential to continue its growth to become a baby. Whatever they are, they are a class of living things in their own right. Synthetic biologist George Church has proposed that we

call this family of existing and prospective living objects "synthetic human entities with embryo-like features," or SHEEFs. There is no consensus on how to legislate research on embryoids and SHEEFs. "It is unclear at which point a partial model [of the embryo] contains enough material to ethically represent the whole," a group of experts concluded in late 2018.

What if we found a way to make a human embryoid lacking the genes to make a proper brain, but which could nevertheless develop into a foetal body containing nascent organs that might be used for transplantation? Or, supposing some low-level brain functions to be needed for effective maintenance of the body, maybe we could engineer an embryoid with a "minimal" brain, lacking the regions and functions needed to feel pain or sentience?

These are fanciful visions, but they are not obviously absurd. More to the point, they illustrate how hard it might become to develop clear moral and ethical reasoning about embryoids and SHEEFs. There's an urgent need to start the discussion now, because the science is moving forward faster than we might imagine.

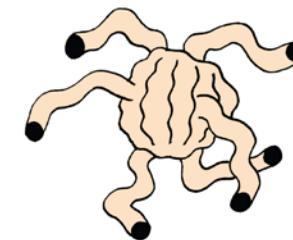
EDITING BABIES

Now throw into the pot the possibility of editing genomes. This changes the game even for regular *in vitro* fertilisation, raising thoughts of "designer babies" with selected or enhanced genetic traits: flame-red hair and green eyes, smart and athletic, full of grace and musical ability — the stereotypical wish-list is generally along such lines.

But let's not get ahead of ourselves; let's first consider what is actually possible. Editing the genomes of organisms like us to change or restore the function of a gene is generally a cut-and-paste job: cutting a gene, or part thereof, from the organism's DNA and inserting another. Molecular scissors and splicers for doing such things have existed for decades, but a technique called CRISPR, developed in 2012, has transformed the field because of the accuracy with which it can target and edit genes. If CRISPR proves

safe for use in humans, then gene therapies — techniques for eliminating and replacing mutant genes that cause some severe, mostly very rare diseases — might finally become possible after decades of rather fruitless effort. The method could potentially supply a powerful way to cure diseases that are caused by mutations of one or a few specific genes, such as muscular dystrophy and thalassemia. Clinical trials are now underway.

However, the use of CRISPR for human reproduction is forbidden in all countries that legislate on it, and is almost wholly rejected in principle by the medical research community. Until recently, most researchers in this field felt confident that there was no prospect of genome-edited babies any time soon, given the risks and uncertainties of CRISPR genome editing in human reproduction, and the almost unanimous view among researchers that it should not be tried until much more was understood, if at all. They were shocked and dismayed, then, when in November 2018 the Chinese biologist He Jiankui announced at a press conference in Hong Kong that he had used the method to modify several IVF embryos and implanted them in several women, one of who had already given birth to twins. He said that he had used CRISPR to alter a gene involved in infection of cells by the AIDS virus HIV, so as to produce babies resistant to the disease.



"THERE'S AN URGENT NEED TO START THE DISCUSSION NOW, BECAUSE THE SCIENCE IS MOVING FORWARD FASTER THAN WE MIGHT IMAGINE."

The work was almost universally condemned as deeply unethical and unwise by specialists around the world. Yet there is no obvious reason why genome editing for human reproduction should be forever ruled out. In those relatively rare cases where a debilitating disease is caused by a single gene, and the consequences of replacing a faulty with a healthy version can be reliably predicted, there may eventually be a place for it in reproductive medicine. It's far from clear, however, whether it would be a better option than alternative strategies for tackling the medical problems it would seek to address.

The new techniques of cell reprogramming and repurposing expand the possibilities for genome editing. Making "artificial" sperm, eggs or even embryos from skin or other body cells would make the safety margins wider: it wouldn't matter if editing didn't always work, as long as you could find and use the cells for which it did. Bioethicist Ronald Green believes that human genome editing "will become one of the central foci of our social debates later in this century and in the century beyond." For better or worse, he says, "human beings will not forego the opportunity to take their evolution into their own hands."

"Will that make our lives happier and better?" he adds. "I'm far from sure."

THE END OF SEX

Genome editing would be a difficult, expensive and uncertain way to achieve what can mostly be achieved already in other ways. If there is going to be anything even vaguely resembling the popular designer-baby fantasy, it will surely come first from embryo selection, not genetic manipulation. **“Almost everything you can accomplish by gene editing, you can accomplish by embryo selection,”** says bioethicist and law professor Henry Greely.

At present, this is mostly done to avoid serious disease. Embryos produced by IVF are genetically screened by removing a cell at around the four- or eight-cell stage and analysing its genome to look for disease mutations that would eliminate it as a candidate for implantation. The technique, called Pre-Implantation Genetic Diagnosis (PGD), is already used in around 5 percent of IVF cycles in the US, and in the UK it is performed under licence from the Human Fertilisation and Embryology Authority to screen for around 250 genetic diseases, including thalassemia, early-onset Alzheimer’s and cystic fibrosis.

Currently, “designing” your baby with PGD looks unattractive: egg harvesting for IVF is painful and invasive, and it doesn’t offer a lot of choice between embryos. What’s more, if you’re aiming for a genetic trait such as intelligence for which many hundreds of genes are thought to be involved — not to mention largely unpredictable environmental factors — the best you can hope for is a probabilistic prediction: a 50 percent chance that the child will be in the top 30 percent for exam results, say.

But what if there was some way of obtaining and fertilising hundreds of eggs at once to give you a wider choice of embryos? The more eggs you can get, the more attractive PGD becomes, Greely says. One possibility is to manufacture eggs by reprogramming other cells. Greely believes that a confluence of these two new technologies — making artificial eggs from the induced stem cells of the prospective mother, and fast, cheap PGD of embryos to identify the “best” — could make what he calls “Easy PGD” the preferable option for procreating in the

near future. He foresees what he calls **“the end of sex”** — not for recreational purposes but as a means of having babies. For controlling the ways we grow humans — and the kinds of humans we grow — the alternative Greely foresees certainly looks a lot more feasible than the unproven notion of human cloning.

Still, the siren allure of perfection via Easy PGD could drive expectations to pathological extremes.

FRANKENSTEIN, INC.

Some fear that there are plenty of other reasons too, beyond safety considerations, to feel wary of permitting this kind of selection. Some argue that unequal availability of choice to different socioeconomic sectors of the population could seriously disturb social stability, leading to a genetic divide of the kind portrayed in the 1997 movie *Gattaca*. Others, however, counter that prohibition of the reproductive choices that PGD — especially an “easy” variant — offers is an infringement of rights. Might it be crazy or even immoral to *not* use the tools we have to improve the general intelligence of the population by making this choice available to all?

It’s complicated. That’s why there’s an urgent need for wide, serious, inclusive and informed discussion about new ways to grow humans. Mavericks like He Jiankui show that we are still not entirely safe from lone scientists doing things, Frankenstein-like, without thinking through the ethics.

But the bigger danger today is that these new technologies emerge into a corporate capitalist world where profit may trump discretion. We see this already in the way some companies promote unproven stem-cell therapies and IVF clinics make rash promises in a bid for customers. At the same time, there is a danger that governments might misuse or mis-regulate valuable new techniques through fear or ignorance, or capitulation to religious or free-market zealots. The more we understand about what it means to be and to become human, the less clear it is what that could and should mean for future generations. ■



Cells are the basic building blocks of all living things. The human body is composed of trillions of cells. They provide structure for the body, take in nutrients from food, convert those nutrients into energy, and carry out specialized functions. Cells also contain the body’s hereditary material and can make copies of themselves.



A **Genome** is an organism’s complete set of DNA, including all of its genes. Each genome contains all of the information needed to build and maintain that organism. In humans, a copy of the entire genome—more than 3 billion DNA base pairs—is contained in all cells that have a nucleus.

Philip Ball is a science writer who has worked for 20 years at the journal *Nature* where he worked with topics ranging from cosmology to the future of molecular biology. He has written many books on science, including works on the nature of water, pattern formation in the natural world, colour in art, the science of social and political philosophy, the cognition of music and physics in Nazi Germany. Ball continues to write regularly for *Nature* and has contributed to publications ranging from *New Scientist* to the *New York Times*, the *Guardian* and the *Financial Times*.



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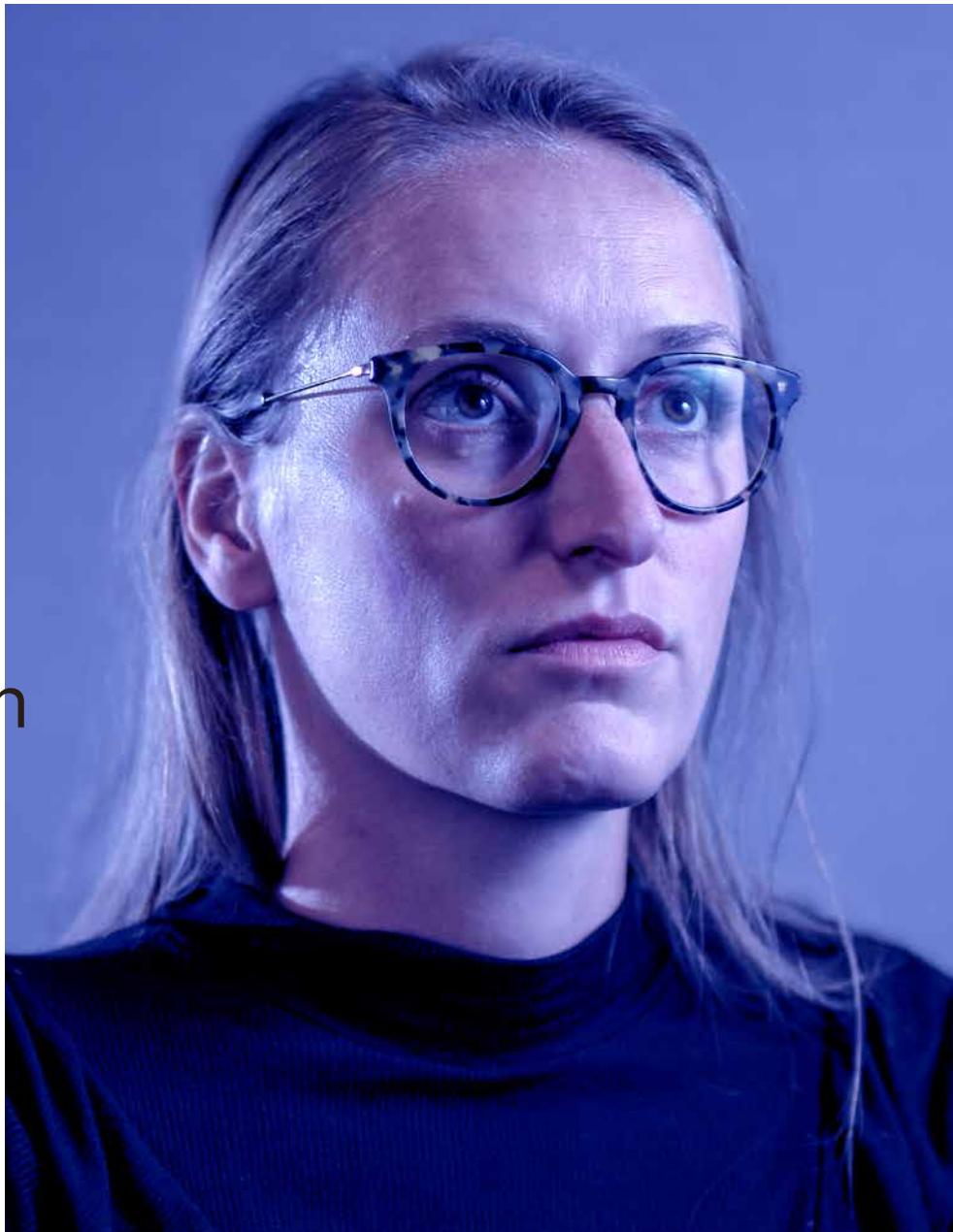
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Heads in the Sand

Q&A Mette Bendixen

WRITER
HALLE JARVI



Photographer: Aaron Ontiveroz

Natural resources have supported life on our planet since the beginning. But somewhere along the way we humans started taking them for granted. We all know that at some point, we'll run out of oil, coal and natural gas. But what about the very thing we live on — the earth itself. *Mette Bendixen* is a natural scientist working with the Earth's most obvious but least thought-about resource: sand.

Q Halle Jarvi: How do you see the relationship between humans and our resources today and how might it impact the future?

A Mette Bendixen: Our roots are in our landscape and that landscape is changing. We are changing that landscape as we change the climate and other things like the amount of people living on the planet. Humans are just out there changing everything and not actually realising that, within 50 or 100 years, we might change things to an extent that challenges future human development — especially in parts of the world where numerous challenges already exist — not only from the climate change perspective but simply from a resource perspective.

Q And in terms of your work, where does sand consumption fit in with our use of other natural resources?

A Of course we know that natural resources are the basis for our modern society. But usually, when we think of natural resources, we don't think about sand, even though it's integral to most of our modern ways of living. If we didn't have sand, our world would be nothing like the world we know. In our world, we conceivably have access to all kinds of knowledge and technology, but the actual basis for our future — the building blocks that make up cities and transportation and technologies — is something that only a few are actually considering.

Q Do you think that our ignorance to the sand crisis is similar to the ways we avoid, mentally at least, dealing with the effects of the climate crisis?

A We all know that climate change is there but we don't necessarily facing it in our everyday lives — we don't think about it. And I think it's a little bit the same situation with sand. We all probably ride our bikes or drive our cars on a street made of asphalt: asphalt is made of sand. And we live or work in concrete or brick buildings: concrete and bricks require sand. We communicate on computers and mobile phones that

require sand for their technology and we look out windows that require sand. It's something we take for granted.

Q What problems do you think we will face in the future if we continue to overlook sand as an important resource?

A There are 7.6 billion people on Earth, and by 2050 that's expected to be closer to 10 billion. We normally tend to think about how we're going to feed these people and what social infrastructure will be available to them. And those are important problems, but before we get into that, I think it's interesting to think about how we are going to house these people. The force of urbanisation and the increasing need for better housing in general will be challenged by the sand crisis. Especially in the developing world, where population growth is expected to rise the fastest and the most dramatically.

Q So, the sand crisis and the housing crisis are intertwined. Are there other connections?

A Yes. We can also bring in the issue of disease prevention. One thing that's crucial in combating the spread of malaria, for example, is to build adequate housing that can prevent infectious mosquitoes from getting to people in the first place. Realisations as simple as that can help us come to terms with just how deeply everything is connected.

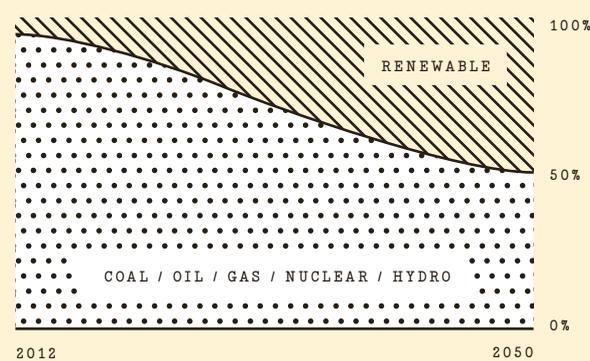
Q But, as you say, even the sand will run out. Then what is the way forward?

A Yes, and it's important also to mention that exploiting natural resources has environmental consequences. And so sand mining is not a sustainable practice. But in general terms, combating climate change will mean reconciling human development and natural development, as outlined in the UN's 17 Sustainable Development Goals. If we want to tackle these interconnected problems, like building more sustainable cities and decent housing and improving health and education, it will require a joint approach. Simply leaning back and relying on technology to solve everything is not really a viable approach. I think that would be too easy. I don't have the answer, but I do know that we'll need a collaborative and inclusive approach to tackle this immense, overlooked global challenge. ▣

Mette Bendixen is a physical geographer whose projects deal with the effects of landscape dynamics on sediment fluxes and coastal dynamics in a changing climate. In 2018 she became a Research Fellow at the Institute of Arctic and Alpine Research at the University of Colorado, Boulder. Her field research has taken her to sites in Denmark, Russia and Greenland.

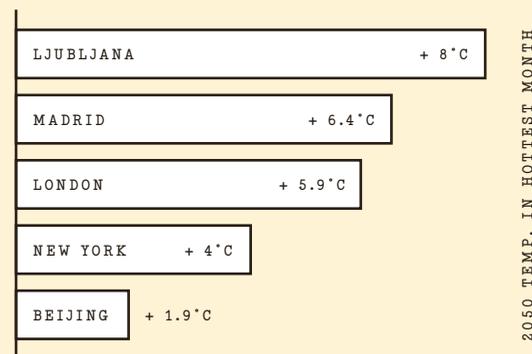
LOOKING TOWARDS 2050

Today's predictions and projections constantly hold up the year 2050 as a benchmark for either positive change or disastrous consequence. Amidst so much knowledge, it can be hard to keep track of the numbers and scenarios that are laid out for us. **Mayday** collected and condensed some of them in an effort to provide a clearer glimpse into the future as it might look in 2050 if we continue on the path we're on today.



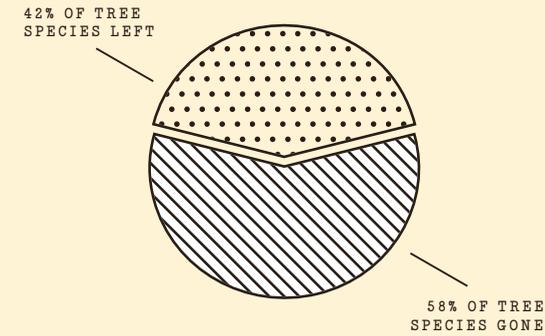
Energy Consumption

Civilisation runs on energy that, today, comes from a variety of sources. By 2050, solar and wind are expected to supply almost half of the world's electricity, with hydro, nuclear and other renewables providing an additional 21%.



Warming Up

Summers in the Northern Hemisphere of the globe will become considerably warmer by 2050 with a projected average increase of 3,5°C. This means that the climates we know will change, with some expecting, for example, Madrid's to be more like Marrakech and London's more like Barcelona.



The Amazon Rainforest

Today, we think of deforestation as the biggest threat to tree species in the Amazon, but general effects of climate change will also impact the rate of species extinctions in the next few decades. Climate changes, combined with deforestation are expected to cause a decline of up to 58% in tree species richness by 2050.



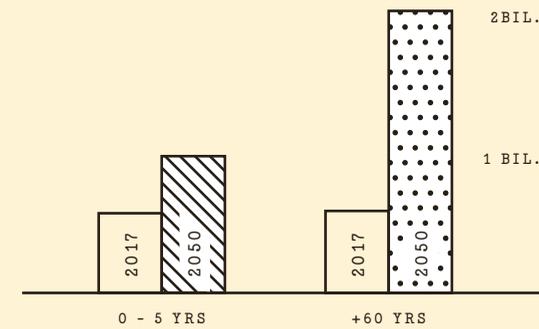
POPULATION INCREASE OF 35%



CEREAL CROPS INCREASE OF 100%

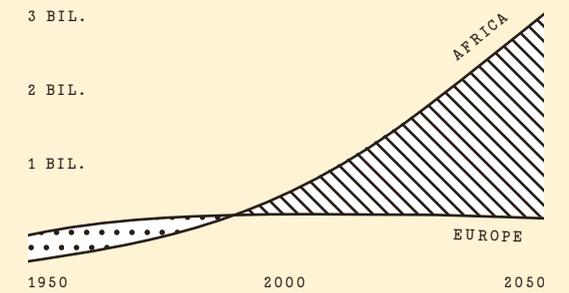
Food Consumption

Considering the expected population growth, we will be faced with the global challenge of feeding an extra 2 billion mouths by 2050. To go along with the 35% increase, though, we will have to double our crop production to meet higher demands for meat and dairy.



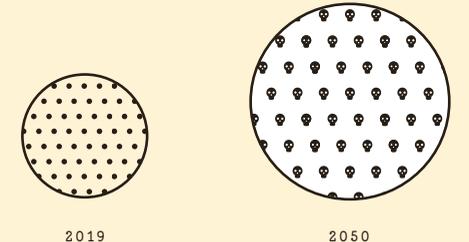
Unbalanced Demographics

The amount of humans over 60 years-old is expected to more than double by 2050, rising from 962 million globally in 2017 to a staggering 2,1 billion by 2050. At the same time, the birth rate is expected to remain about the same, relatively, resulting in a much older population on average than today.



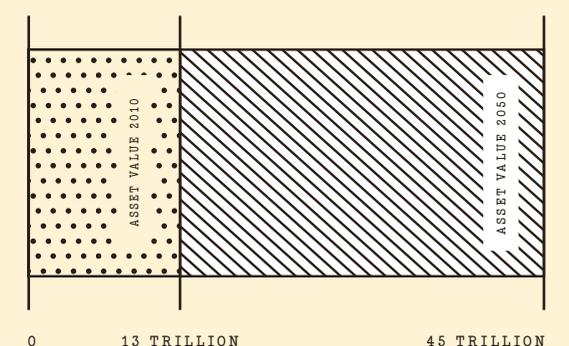
Population

By the year 2050, the global human population is expected to rise from today's 7.7 billion to at least 9 billion, with some estimates reaching as high as 9,8 billion. Furthermore, we can expect more than half of this growth to occur on the African continent.



Air Pollution

Today, an estimated 91% of people live in areas in which air pollution limits exceed guidelines. By 2050, the number of people prematurely dying from related illnesses is expected to nearly double to 6,6 million. That includes deaths from ambient as well as household pollution.



Rising Waters

Nearly 1 out of 5 humans will be at risk of flooding, jumping from 1,2 billion people today to 1,6 billion by 2050. The expected economic value of assets at risk in these scenarios is projected to be around US\$45 trillion — a growth of over 340% from 2010.

Sources: BloombergNEF, Nature Science Journal, The National Geographic, The World Health Organisation, The United Nations

Capitalism Is Killing the Planet

COLUMNIST
AARON BASTANI

ILLUSTRATOR
RAMAN DJAFARI

The conditions of our planet continue to degrade because of our actions. The resulting climate crisis is as multifaceted a problem as contemporary global society itself. Aaron Bastani, co-founder of Novara Media and author of “Fully Automated Luxury Communism,” offers a view on just how bad things have gotten. Sure, we’ve missed some chances in the past. But if we can come to terms with missed opportunities and mistakes gone-by and commit to radical new solutions, there might be some hope for us still.

WE ARE living through a climate crisis. That doesn’t just mean the urgency of climate breakdown is increasingly salient, which it is, but rather that our current behaviour — right now — is of graver consequence than we dare imagine.

If I asked you to conjure an image of what human industry has done to the planet, your mind might instinctively turn to Victorian mills, brick-built chimneys and London smog. Quickly you could think of something more contemporary, perhaps that emblem of 20th-century modernity:

the automobile. Regardless, the array of images would likely evoke a long process, as generations scarred the planet through a patina of abuse, akin to the slow build up of stained pollutants on city walls.

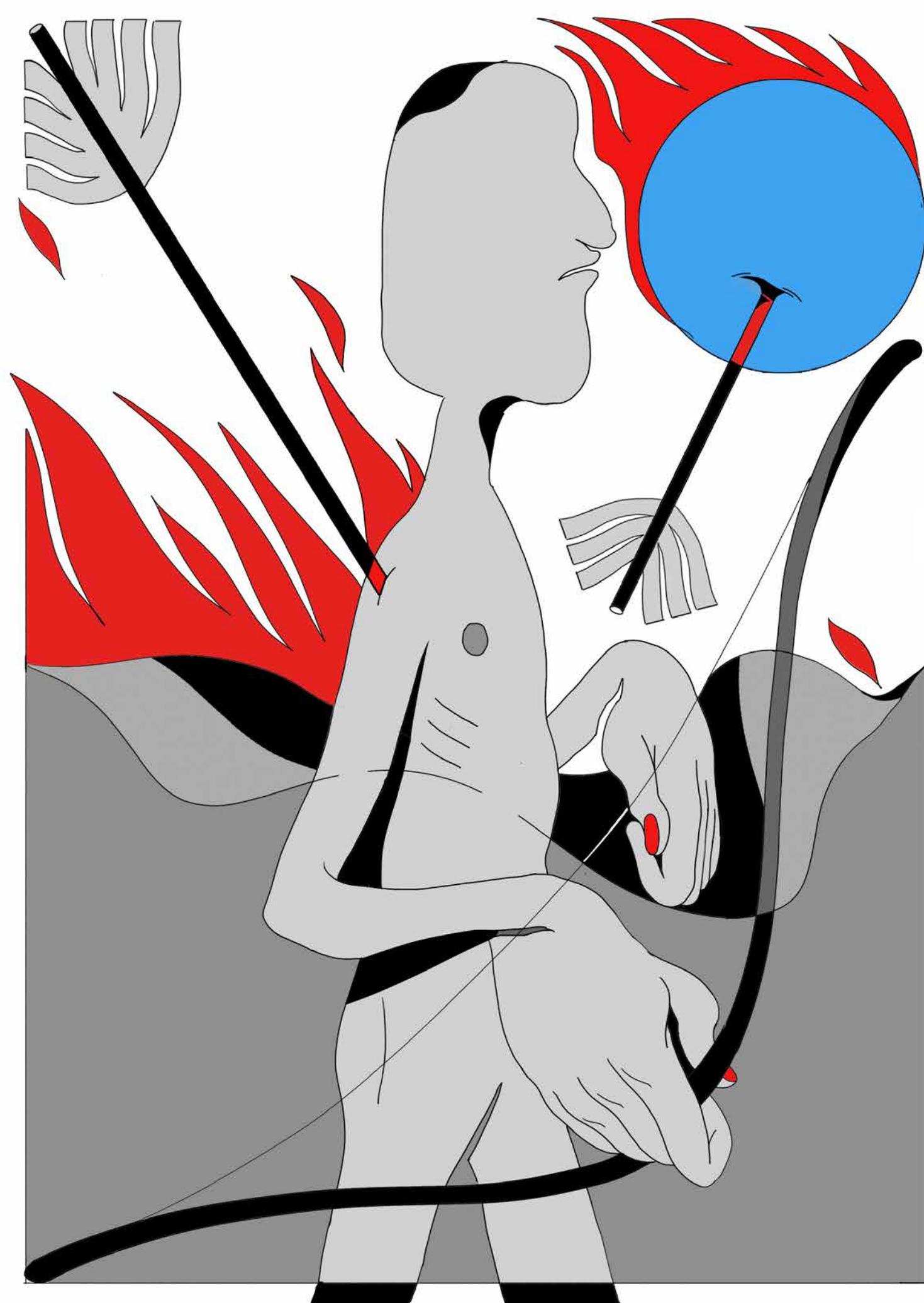
Yet this would be an inaccurate way to understand what is happening. While I consider myself to be young, raised in the 1990s and unencumbered by home ownership or children, 40 percent of all the carbon emissions humanity has ever generated have been since I was born. While our species has been changing the



Aaron Bastani is a British political commentator with a specialism in new media. He co-created the political and social commentary forum Novara Media, of which he is also a Senior Editor and a co-host of their weekly podcast, *NovaraFM*. Bastani has written for *The Guardian*, *Vice* and the *London Review of Books* blog as well as appearing on *CNBC*, *Channel 4 News*, and *Sky News*. He has a PhD in media and politics and his new book *Fully Automated Luxury Communism* is out with Verso in 2019.

planet’s weather and biological systems on a Promethean scale since at least the 16th century — a process which has led some to label the present geological age the *Anthropocene* — 95 percent of all human-caused emissions have been discharged in the last century.

This means the apposite metaphor suddenly shifts, from a gradual if unhappy accumulation, to a sudden shock — rather like the smashing of a glass or the breaking down of a door. That has implications for a meaningful political response. Climate



change isn't just your uncle's old diesel van, or the family holiday to Spain — you can't fight its severity by abstaining on plastic straws or choosing to Hoover only once a week. Climate change is modernity itself, the context within which politics, technology and ideas will unfold for the rest of your life and every life thereafter. It is your ribeye steak and caesar salad; it is breeding carnivores as pets and mining Bitcoin — a single cryptocurrency which consumes as much energy as the whole of Ireland. Never before have humans, or indeed great apes, inhabited a planet where atmospheric concentrations of CO₂ are as high as they now are. Of gravest concern is that we appear hell-bent on sending them higher still.

None of this is the result of ignorance. Indeed we've known the consequences of our actions since the 1980s. That, coupled with an energy crisis a decade earlier, should have created ample incentives to transform our energy systems a generation ago, and yet it was the period following the 2007 financial crisis, when the common sense of neoliberalism collapsed, that annual CO₂ emissions reached record highs. If there was an opportunity to re-order our societies around values that matter, this was it. Instead, since then, we've chosen to belch out one-fifth of all the CO₂ we've ever generated into the Earth's atmosphere.

Planetary time is now accelerating: a month of human history now accounts for more emissions than our species entire footprint before 1800. Then, our planet was home to one billion people. Today, we number around 7.5 billion and counting. While the early signs of such geological rifts are mundane in experience, they are terrifying in apprehension: Europe's five warmest summers since 1500 have all been since 2002; cities like Jakarta and Bangkok are slowly sinking into the ocean; California's wildfires become more violent every year; and "once in a century" Atlantic storms, like Irma, Harvey, Maria and Nate, all occur in the same season. In other words, what is extreme becomes normal — but

because humans are masters of adaptation that is difficult to intuit. Furthermore, because there is a delay between rising greenhouse gases and warming temperatures — past action necessarily means *additional* warming. Even if we stopped using all fossil fuels tomorrow, and the world abjured from animal agriculture, temperatures would rise further still. Except we are nowhere near doing even that. Global decarbonisation by 2050 is viewed as a plausible, if radical, rallying cry, but if our political leaders were serious about avoiding catastrophe it would have already happened.

So while reasonable estimates predict another two degrees of warming this century, compounding the one degree rise since the Industrial Revolution, some foresee that, for the reasons listed above, it will reach twice that. While our economies and societies are ill-equipped to deal with cataclysmic change, our models of breakdown are not: a world four degrees warmer than ours does not augur catharsis or collapse, but rather a constantly dimming, more brutal version of the present. Forever.

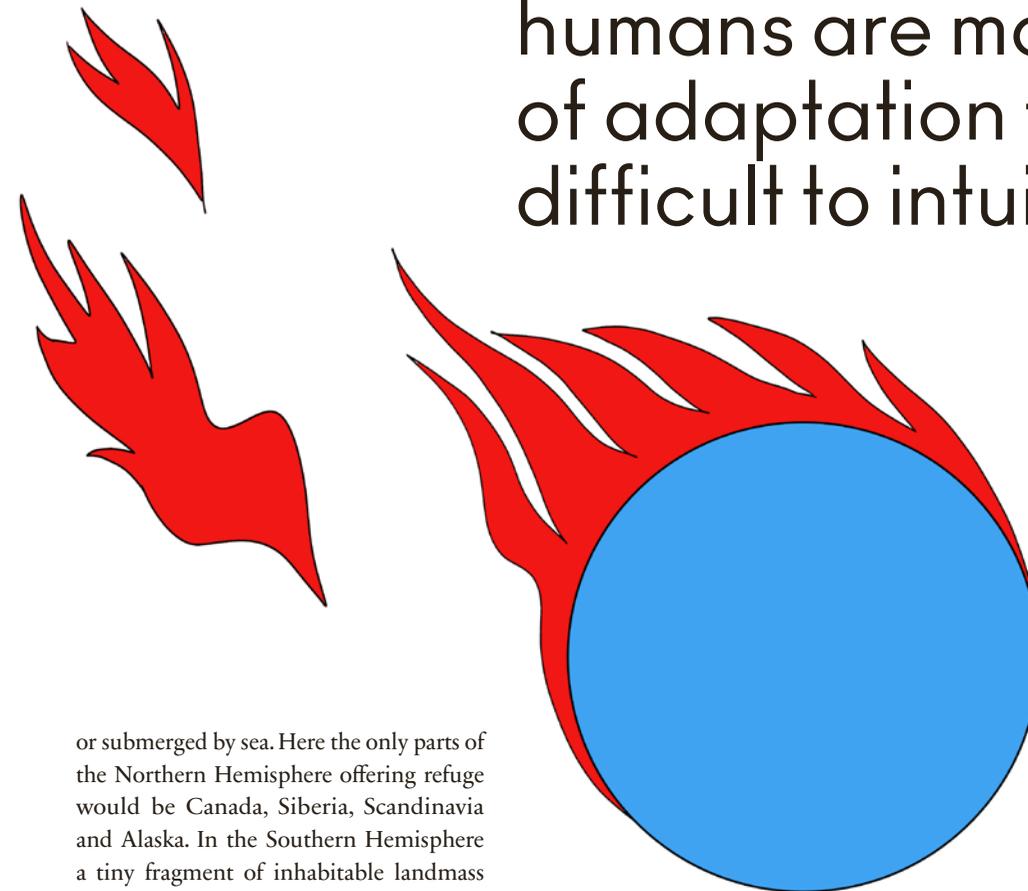
That much is obvious with any inspection of the status quo. Towards the end of 2015, Elon Musk's SpaceX successfully landed a self-piloting rocket — an accomplishment viewed as heralding the arrival of a viable space industry. Several months earlier in September, the dead body of Alan Kurdi, a three year old boy from Syrian Kurdistan, was found washed up on a Turkish beach — making front page news around the world. A world of near-unimaginable technology and abundance, sat alongside war, climate breakdown and deprivation, is not the premise of a science fiction blockbuster — it is reality.

In such a context the critical question is this: what is the price we will pay if we are to keep our present economic system, and who is burdened with the cost if we do? After all it is obviously this system, rather than an absence of public awareness, which inhibits the necessary response. The correct incentives to rapidly decarbonise do not exist under capitalism — whose calculus puts more value in launching luxury cars beyond our solar system than caring for displaced victims of war.

For the world's poorest this is particularly important because conclusions of species annihilation are wrong. Some will escape the worst excesses of a warming climate by virtue of where they live; others will have the means to either join them or use their financial means to mitigate the harshest aspects of the world to come. A planet that combines SpaceX and Alan Kurdi will endure, albeit more vividly, violently and impossible to ignore. Great wealth and knowledge will certainly continue, and potentially grow, the question being who has the right to access it and why.

Where that will almost certainly not happen, given the present trajectory, is the Global South. A world four degrees warmer than now would render the equatorial belt uninhabitable; the Sahara would spread, enveloping central and southern Europe, with cities like Lisbon either surrounded by desert

“What is extreme becomes normal — but because humans are masters of adaptation that is difficult to intuit.”



or submerged by sea. Here the only parts of the Northern Hemisphere offering refuge would be Canada, Siberia, Scandinavia and Alaska. In the Southern Hemisphere a tiny fragment of inhabitable landmass would remain, comprising Patagonia, New Zealand and Western Antarctica. In Asia, two-thirds of the glaciers that feed the continent's rivers will vanish.

That is not to say wealthier countries will survive unscathed, they will not — although here too the distribution of crisis will be based on class and access to economic resources. For all countries, but particularly the wealthiest, climate breakdown will be the leading crisis of many, besieged as they will also be by rising inequality and demographic ageing. Politics, progressively shaped by greying electorates, environmental decay and zero-growth, will likely take an authoritarian bent. Again, the early signs are already there if you dare to look.

There are other crises too. One is what automation will do to under- and unemployment, another is mental health — with

depression set to be the world's leading burden of disease by 2030. Accompanying these are crises of democratic legitimacy, resource scarcity and the end of American hegemony — with regional cold wars liable to turn hot. Yet these should not be viewed as happening alongside the climate crisis, but within it. Climate change will inflect how we respond to such challenges — which in any other age would have been epoch-defining in themselves.

The implications of a warming planet have been known to policy-makers for decades. As terrifying as the raw data, whether it is air pollution or declining crop yields, is that many of today's leaders were at the helm while the house began

to burn. Given that they chose to look the other way, it is difficult to see how they will be responsible for a solution.

To save the world, which is what must be done, requires new forms of togetherness, socially useful technologies and original ways of ordering society. A first step, however, is new politicians. Anything else is trusting the arsonist to bring water from the well. ▣



Below the surface

TROUBLED WATERS

PHOTOGRAPHERS
ULRIK HASEMANN AND MATHIAS SVOLD

WRITER
HALLE JARVI

UPON ENTRANCE TO PARADISE, the poet Dante pauses to address his audience. But it's no grand monologue, it's actually an offer of escape: he says to be wary of the vast sea that lies ahead, lest we easily get lost, and that we might choose familiar shores instead. But does he really think we'll turn back now? Drifting towards the gates of Heaven? Sure, the sea is vast and unpredictable, but the waters offer us life, and so we set sail.

Indeed, since the very genesis of human civilisation, we have organised ourselves near lakes, rivers and oceans because of water's ability to facilitate our lives and connections to others', but also because of its sheer, indescribable power. So photographers Ulrik Hasemann and Mathias Svold teamed up to present life on Denmark's nearly 9000 kilometres of coastline. They are portraits of our heritage, our present and our future. But now, the water is rising. And instead of supporting the fundamentals of our life, it's challenging us. Will we adapt or find ourselves in over our heads? It's unclear, but what's certain is that turning back is no longer an option.



COME ON IN, THE WATER'S FINE

A pull towards the sea



We are drawn to the sea, not because it tempers our vanity, but because we think we have control of it. How foolish.



THE COAST'S ADVANCE
A retreat from the sea

The sea is alluring, but it's also fierce and uncontrollable. In its comparison, we humans are small and fragile.

SINK OR SWIM

What comes next



Millimetre by millimetre, the sea continues its rise. We come face to face with its slow power, as well as whatever is caught up in the mix.



Photographs are from the book, *KYSTLAND* by Mathias Svold and Ulrik Hasemann. The book is a photographic journey along the coasts of Denmark through words and images. This body of work is a combined effort of artistic documentarism, offering us everyday life as well as extraordinary moments along the coast.

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THE LOST ALEXANDER SUPERHERO VON OF SCIENCE HUMBOLDT IS BACK

WRITER MARIE SÆHL
ARTIST ADRIENNE KAMMERER

Once you have read about *Alexander von Humboldt's* wild experiments, which were often conducted on his own body, and his amazing expeditions into jungles, volcanoes and rivers, it seems puzzling that the scientist and adventurer has been all but forgotten. This year marks his 250th birthday, and he is re-entering our consciousness, maybe because his view of nature as a coherent, fragile organism seems more relevant today than ever before.

Alexander von Humboldt was the epitome of a man frantically in search of enlightenment in the period around the year 1800. His contributions to natural science were the result of cockamamie experiments and a manic drive to collect as much information as possible. It was the Age of Enlightenment, after all, when a thirst for knowledge prevailed and there was a feeling that the whole world was just waiting to be discovered, explored and described. This was the task that Humboldt flung himself into. In his own description, he was impelled by a “perpetual drive,” that felt as if he was being chased by ten thousand pigs. He would often switch between different languages when he spoke or wrote and would jump from one subject to another. He preferred to be doing three different things at a time and he was so hyper that even the great poet Goethe became exhausted by his company. Humboldt made him “dizzy with ideas,” he wrote, noting that a person, “in eight days of reading books couldn’t learn as much as what he gives you in an hour.”

In 1799, he embarked on his legendary expedition to South America, of which an added benefit was that he could hopefully fulfil his dream of examining a real electric eel. He was fascinated by animal electricity and together with other people, he had conducted thousands of experiments on frogs and lizards and he even enthusiastically dissected a German married couple who had been killed by lightning. When he arrived in the town of Calabozza, Venezuela, he was told the watering holes in the area were crammed with large, eel-like fish. It was an opportunity he could not afford to miss. The only problem was actually catching the electric eels, which are difficult to get into a fishing net, partly because they are hiding in the mud at the bottom of the ponds and partly because they can generate a lethal electric shock. Fortunately, the locals came up with an idea. They caught about 30 wild horses and led them into the water to lure out the eels. What followed was a

violent spectacle. The surface of the water came alive with eels, and the horses bellowed in pain because of the powerful shocks. Some of them fell over and were trampled to death. As the power of the eels’ discharges began to subside, Humboldt picked them out the water with a wooden stick and threw himself into what this whole trip was all about: the experiments.

For four hours, he, along with his colleague and travelling companion, the botanist Aimé Bonpland, conducted a number of tests: holding an eel with two hands, holding an eel with one hand while the other hand was holding a piece of metal, holding each other’s hands while exposing one of them to the shock. They



repeated the experiments on wet ground, dry ground, they touched the eels with wet sticks of sealing wax, picked them up with mud on their hands and so on. Everything was tried and tested, and when the day’s work was done, Humboldt, not surprisingly, felt sick and weak.

Later in the same journey, Humboldt conducted another study. This time it swapped eels for crocodiles, which were also caught with great difficulty, and bound and hauled them on the backs of mules to his residence in Havana. Humboldt wanted to observe the movements of the crocodiles under the best possible circumstances, so they decided to release the large reptiles on the floor of the house’s great hall. He climbed a high piece of furniture to get a better

view of the action as they unleashed a pack of dogs into the room. Enthusiastic as ever, Humboldt later wrote that he was “pleased to observe ... those singular animals who pass with astonishing rapidity from a motionless state to the most impetuous movement.” Once the crocodiles had killed the dogs, they were put down because Humboldt needed to establish just how many teeth a crocodile has. He counted 38 in the upper jaw and 30 in the lower.

Humboldt measured, examined and described almost everything he encountered. He tasted and compared the waters of the rivers that they sailed on. He — and Bonpland of course — collected and pressed thousands of plants, many of which were undescribed at the time. He observed and described animals and their behaviour. He identified and corrected inaccuracies on existing maps. He studied indigenous cultures and took notes about the languages and dialects of local tribes, he observed the stars and planets, measured altitudes and temperatures and even described the clarity of the air in different locations. The sheer amount of his collected items and notes continually grew to a point where it required more than 20 mules to transport the collection, which consisted mainly of dried plants, but also of insects, animal skins, fish and a couple of skeletons. They also travelled with a number of live animals, including monkeys, snakes and a stray dog that they had adopted. The man was a walking *wunderkammer*.

Back in the Limelight

Once you have heard of Alexander von Humboldt, it seems utterly incomprehensible that he was more-or-less forgotten for a long period of time. He is now on his way back into the limelight thanks to people such as the German writer Daniel Kehlman and, particularly, the historian Andrea Wulf who wrote the bestselling biography *The Invention of Nature*, which continues to be published in new

languages, and who has also published a graphic novel about Humboldt’s expedition in South America. Humboldt’s achievements were widely known among his contemporaries. He was a true celebrity whose company was sought by kings, presidents and almost everybody else. Back then, he was said to be the most famous person after Napoleon.

His books sold very well and people were often willing to pay a little extra under the table to get their hands on the first copies. He was a productive writer: his work on the South America expedition alone comprises 29 volumes. He was also a prolific letter writer — he wrote at least 30,000 — and at one point, the country’s postal minister exempted him from paying postage. On his 100th anniversary, ten years after his death, he was celebrated with parades and festivities all over the world. In New York City, 25,000 people attended a parade in his honour. More places, towns, plants, parks and animals have probably been named after him than any other person in history.

Humboldt would never have achieved so much if he had simply been a competent scientist. He was also a courageous adventurer and he appears to have been unusually lucky to survive several incidents in the course of his career. It was neither comfortable nor safe to be an explorer in the early 1800s. Already on his voyage across the Atlantic, there was an outbreak of typhoid fever, then in the jungle he ran into a jaguar, his canoe capsized in crocodile infested rivers and he was attacked by bugs and endured starvation. He survived it all, however, and lived to be 89 at a time when life expectancy was somewhere between 30 and 40 years.

On Top of the World

A key scene in Andrea Wulf’s biography describes one of those dangerous episodes as he was climbing the extinct volcano of Chimboraza which rises to 6,268 metres above sea level and was

considered the world’s highest mountain at the time. When they reached the snow line their porters abandoned them because they found it too risky to continue, but Humboldt was determined to reach the summit. He reduced the number of instruments to a minimum, but they had to carry them themselves: a barometer, a thermometer, a sextant, an artificial horizon and a cyanometer that was used to measure the blue colour of the sky. They were crawling along a narrow ridge, only a few centimetres wide in some places, that was covered with ice and pebbles. It was foggy up there. On one side of them was a steep slope with a drop of 300 metres, and on the other, an icy cliff. Their shoes were thin and soon soaked with snow.

“While other naturalists of the time were busy classifying and categorizing the world, Humboldt saw the coherence.”

Their hands and feet were numb from the cold. Higher up the mountain, sharp rocks cut into their shoes, leaving their feet bleeding. The air was thin, but Humboldt continued. As they neared 6000 metres, the fog suddenly lifted, revealing the peak not too far away. That was when the team saw the crevasse that would prevent them from summiting. Even though they did not make it to the top, they were higher up than any human being had ever come and their mountain climbing record would remain unbeaten for decades.

This dramatic story is certainly impressive, but the reason Andrea Wulf calls attention to it is that it was up there, on the top of the world, that Humboldt established his vision of nature which remains central to the

way we understand nature today. While other naturalists of the time were busy classifying and categorising the world, Humboldt saw the coherence. Earlier he had noticed plants that shared similarities across continents, and he became the first scientist to talk about global vegetation zones, even if he called them something else.

“As he stood on top of the world, looking down upon the mountain ranges folded beneath him, Humboldt began to see the world differently. He saw the earth as one great living organism where everything was connected,” writes Wulf.

He also realised how some of his discoveries were exploited commercially by others who showed no consideration for nature or indigenous peoples. For example, natives of Peru had taught him that the excrement of birds found on small islands off the coast of the country was a highly effective fertiliser. He brought samples of it back to Europe and gave it to some chemists. They determined that the Indians were right, setting off large-scale importation of the material. He described how human interference in nature was already incalculable and warned of catastrophic consequences if we continued to disturb the planet so brutally. At a very early point he was also concerned about the problems with deforestation — an issue that we have become increasingly aware of in recent years.

Altogether, Humboldt was ahead of his time when it came to predicting the problems that human exploitation of the Earth’s resources would create. A true Enlightenment man, he was constantly measuring and describing the world, but he still believed that our understanding of nature must also be based on feeling and sensation. He wanted to inspire a love of nature in people and his worst fear was that humans would continue to destroy it.

“I fear that one day, man will travel to distant planets. And then he’ll take his lethal mixture of vice, greed, violence and ignorance to those planets too — turning them barren and ravaged as we are already doing with earth.” □

WRITING FOR THE *FUTURE*

PHOTOGRAPHERS
ROMAIN ROUCOULES AND ANNA PIASEK

Sometimes, the world today can seem more like a fictional tale than a reality. It can be hard to wrap our minds around the future we're building for ourselves if things continue on unchecked; perhaps that is why some say that fiction as a genre is uniquely equipped to hold up a mirror to the present. We at **MAYDAY** happen to believe in the power of fictional stories to grow our minds and imagination in the hopes that they will help us face the future with a bit more perspective and ingenuity. Take a peek into the future — maybe nearer than we think — with these three original shorts.

HERA'S COLUMN

AUTHOR
JOHANNE BILLE

TRANSLATED FROM THE DANISH
BY DENISE ROSE HANSEN

The jungle of the future is a few kilometres from our hotel.

The jungle kids have nightmares about murky, rough waters and foreign hands pulling them up by the armpits. The newcomer kids cry, those who've been there for longer are silent and pale. The women sob as they breastfeed. The milk is thin and poor. The men shout at one another and themselves, a fist strikes a jaw. The future jungle is rats and plastic bottles and smashed phones, the future jungle isn't lush coppice, majestic trees and abundant wildlife. The airport cab drove past it on the way to the hotel and the child pointed and asked who lived in all the tents behind the fence. It looks messy, she said, why do they live there?

A large, white shade sail covering is stretched out above the hotel pool. The child has been pestering me to buy an inflatable pool mattress ever since we arrived, and yesterday, I gave in. This morning we played with it, she rested her upper body against the inflated plastic and paddled with her legs, pushing the mattress forward in front of her. I stood beside her in the shallow chlorinated water. Then she lost her grip and the mattress drifted away from her. She floated and now pushed herself ahead instead of the mattress. After a few strokes her arms grew tired, she half-laughed, half-whimpered: Help me! It only took two steps in the heavy water for me to reach her. She clung to me like a baby animal. Next time you'll do three strokes on your own, I said, and pressed her nose with a wet index finger.

A single column in Hera's temple is still standing. All the others have crumbled. Only half of the last column remains, and its cylindrical layers rest unevenly upon each other. It looks like it might topple over at any moment. The sun is scorching at the temple today, a new heat record for this month. You get used to it, the man in the ticket office said, remember to stay hydrated. I forgot to bring the child's drinking bottle, we bought a bottle of water with the tickets. The child's sun hat is green with yellow dots, her shoulders white from sunscreen.

The child doesn't know why we're visiting Hera's temple. I haven't told her. I haven't told her about the sorrow that's throbbing inside me like an infection. I haven't told her that Hera is the Greek goddess of marriage and motherhood. To the child, the partial column is just a column. She says it must be the tallest tower in the world, and I don't have the heart to tell her that half of it is missing. One day there won't be time, money, the wherewithal to maintain the steel wire that keeps the parts together, and the rest of Hera's last column will plummet. The last remainder of the temple will disappear, leaving behind only rubble and the sun-bleached placard with line drawings that show how the temple is believed to have looked intact. The man in the ticket office will lose his job and the path leading down to the temple will become overgrown. The image of the crumbling column is pinching in my chest. The decay of the past is like a forewarning. I'm sweating, the child says, and I dab her neck with water. She shivers and says she wants to go home.

There are food photos on the menus, the hotel restaurant serves Greek salad and grilled sandwiches and pizza. The child can order by herself, she points to the image of the sandwich and says thank you to the waiter. I ought to be proud of her, I know that, but the feeling doesn't unfold in me. The past and future are too closely aligned on this island and knowing this proximity paralyzes me, makes it difficult to be present. The jungle kids don't need any images, are not to order any sandwiches. It ought to infuriate or at least sadden me, but these feelings too are like the kind of peonies that never unfold. A single petal peeps out and the following day the flowers wilt in the vase.

Since he left me, I've been living in the past, and it makes it painful to look at the child when she has so much future in her. It is there in her hamstrings, she aches over growing pains, and in her adult teeth that peek out from the upper mouth like tips of icebergs. When I brush her teeth to make sure she's done it thoroughly, I do it very carefully not to tear the taut gums. She gets into her sleepwear by herself and I lie beside her in the bed for a long time, listening

Johanne Bille is a Danish author who has written and published fictional works including *Tænk Nu Hvis* in 2015 and *Elastik* in 2018. She also runs a publishing company, Harpyie, with business partner and co-editor Sidsel Andersen. She lives and works in Copenhagen.



to her short breathing, and it feels like the entire island is trembling beneath us. Or maybe it's me who's trembling, the continental plates inside me constantly sliding apart only to reassemble again, one earthquake replacing the other.

If it weren't for the trees in front of our balcony, I'd be able to see the jungle of the future from the bed. But the trees are there and I can only glimpse the pool's illuminated blue water and the white deckchairs between the trunks. The taut canvas of the shade sail. When disaster breaks out on your doorstep, it doesn't leave enough room for the distant ones, even if they're taking place only a few kilometres away. My reluctance to dream of the future is spoiled, the grief narrows the veins like calcification, empathy is first to stop drifting around in the body.

My ears have been blocked since the flight, and that too is a selfish condition. Not being able to hear, not wanting to listen.

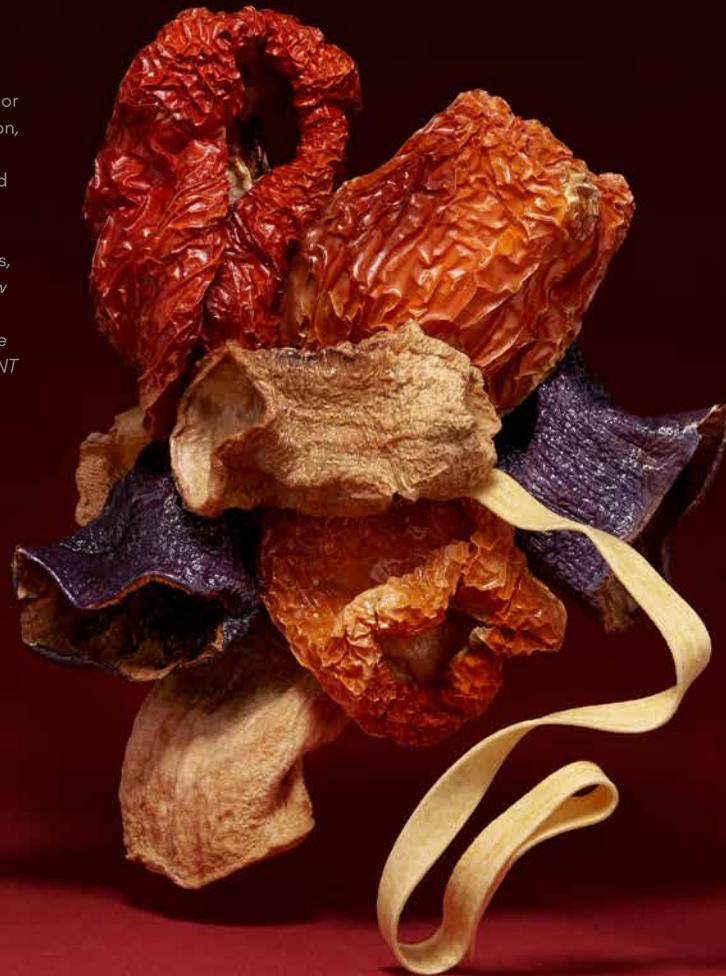
On the last day the pool mattress is floppy, and the child bends it in the middle so that she can hide below it. She sits inside her plastic igloo listening to an audiobook, and I'm on a deckchair thundering away in silence. Suddenly she speaks, the thick plastic tent muddles her voice, I need to peek my head inside her tent to tell the words apart. Her eyes are glossy, she asks why he isn't here, and I don't know what to answer. The future is doubt, the future is unsettling.

In the cab back to the airport the child doesn't ask about the jungle of the future again, and I close my eyes as we drive past it. It only takes a few minutes, then it's over.

PRAY

AUTHOR
BLAKE BUTLER

Blake Butler is an American author of five book-length works of fiction, including *300,000,000*, *Sky Saw*, *There is No Year*, *Scorch Atlas* and *Ever*. His short fiction, interviews, reviews and essays have appeared in various publications, including in *The Believer*, *The New York Times*, *Bomb*, *Bookforum* and as an ongoing column at *Vice*. He is a founding editor of *HTMLGIANT* and currently serves as editor of *Fanzine*. He lives and works in Atlanta.



There had never really been a sun. Or none of us could remember better than any other how long it had been since we last looked upon the face of someone we had cared about in light, at least. Nor could we remember when this state of being became truer than any other way it might have been. Instead, we rose each pitch-black morning with the belief that today would be the day that all we'd gotten wrong would be reversed — everything right back where it was always supposed to be, each of us assuming someone else had been keeping tabs on what that meant.

The only thing I knew for sure myself, I think, was that my arms and head were bound, though I could not decipher why, nor did I care. Already I was missing both my legs beneath the knee, rounded off to nubs that leaked dark water any time I tried to rise; the rest

of my flesh heavily scarred, as if burned up and healed over, leaving my outer layer brightly flayed, hot to the touch. I found for the most part that I did not mind spending what would appear to be the rest of my life like this already, in the same shed where I'd been scoured and deloused, at least so long as I remained allowed to gorge my body on the tangy neuro-gel that would be forced into my gullet through a gold tube descending through the darkness just after coming to again — from dreams of miles and miles of children screaming, nothing else — and which thereafter, with belly full and warm again, made me more able than ever to believe in anything they'd like.

For instance, it wasn't that the sun had died or moved away, I'd been informed by how the pangs of indigestion made a voiceless voice like a lost god's cut

through my blood, but that the light had gotten sick of being an accomplice in the hell of human aspiration; that it had had enough, and would no longer offer unconditional support. And so the sun, the stars and the whole sky itself, and all that we imagined it contained, or so the voice explained, would return when we had fully paid the price for our misdeeds; when we deserved at all again to get to see or seek or know.

* * *

TO PASS THE TIME between the feedings, meanwhile, for entertainment, I spoke aloud into the space around my head, if mostly only to continue to prove that I still could. I'd learned somewhere online, long ago, that the only way to keep good track of what really happened, no matter what my neural processors wished to claim, was to keep repeating, over and over, the terms of my experience aloud, in my own words — who I believed that I had been once, for instance; where I had worshipped and what I had wanted from the prayers; how I had managed, unlike so many, to survive my own misgivings, to be considered no one's fault but all our own.

Often, though, the more I said, the worse I felt. I didn't want to even have to believe me when I claimed the First War Over Produce had caught on in the suburbs of the nation's Northeast Block — how more than 40,000 people had been maimed, like me, and ten times more than that still rendered obsolete, without a record of their existence but in the warping brains of those they'd once bumped into, in the thrall — all at the behest of the innumerable time-saving devices they'd force-installed on every address, despite how we could already no longer recall what might be done with even more borrowed time to spend. I surely didn't want to have more hours left to look again upon the live feeds of the shattered babies in the grillwork of the fences raised up to surround our nation's teeming heart, which was all the only news channel we had left now ever showed — nor did it help at all to be subjected for the thousandth time to the ad-laden simulation of the hand of god reaching down to stir up coloured sparks against such a clearly flat and ever-sinking sky as ours, its surface by now nearly close enough to reach and touch from on our backs.

I don't know why everything that came out of my mouth now had to be so shitty, full of pain — and yet everything that I recalled at all felt like an exorcism of our worst fears come to pass, dictated directly into the translucent research headset that encased my face, filling the State's ledgers with everything I wished I never knew. There seemed so little time left to get it all out — I was always talking faster than I meant to, in mangled language I found I could not entirely control, as if the words were learning how to speak

themselves. It didn't matter at all if they were true — it only mattered that I wished for something better, that I still held on despite this ongoing eternity of pain.

But still the worst discomfort came in how I was supposed to know already how blessed I'd been to even get to reel a bit, to think at all; what a gift yet to be made witness to the potential of bending my faith's persuasion to the State's cause. This, at least, was more than they'd granted to my neighbours—so they'd remind me, in clouds of smoke that swarmed and broiled between my cells, if only just ever long enough to make me weep a little, to prove I still could; that there was still more sorts of pain to be imported, pressed upon us, were it required after all.

* * *

THE LONGER I GOT STUCK within a Lost Thought, such as all this, the deeper its yearning burned me, branding all experience back to its base — how no matter what else I desired to believe about the past or yet the future, I was only ever just right here, breathing and feeding, in a room with no entrances or exits, because they let me — and, yes, thriving, at least compared against the absence of all else — my spouse, my children, all of them as faceless as the silence that surrounded where I knelt. Each time the idea of light returned, just for a moment, no matter how long it'd been between the blanks left in my time, there was nothing there within me left to lend a name but the ongoing sense of shame I held in wanting still to hope for better, to imagine there was another way we could have ended up.

And still I swore, at least for a while, before the worst numb, that if and when the chance arose, for instance, I'd gather what remained of my sick mind, and go at once and find the names of those who'd done this to us, however far back, and I would surely make them pay — despite the fact that I had not done so when I'd a chance the last time, or the time before that, and on and on, therein insuring that such a day would never really come, or so the voice swore, growing even louder than my own, or even if it did, I wouldn't remember. Better, then, it swore, to carry on, and prove at least that I appreciated how they'd spared me a little longer, how I'd been given another chance, as in right now, to still be heard by someone else, besides myself. It isn't real, of course, this little window, nor has anything I've said been near enough to slow the long unwinding of the very ground beneath our feet. For there is nothing left to claim as ours, the voice reminds, but in the State's name, and under whose unlimited protection still we pray — asking only this time, as on command, no longer that the sun might come back please, or that we might feel its wide warmth once more shining, but that when it doesn't, we won't say.

ZEIT

AUTHOR
HENDRIK OTREMBA

The hover car floated through the air, which was aerated by dancing segments and remained unclean and toxic here. Then there was a twitch, as if the vehicle broke through a cobweb suspended between the buildings. The yellow headlights flickered briefly above a balcony, gradually moving on to the soft, absorbing blue and grey of infinity so that everything here looked like a coulisse, like a sculpture, a model or the idea of something earthly: an idea that never left its dream. The rays of light glanced on something. Was that a person standing at the parapet, the old hands clinging to the railing as if petrified? The digger thought that he saw

a pale face. He got scared and closed his eyes for a moment. A second in the slowness of decay. No. There was nobody here anymore. He looked at the altimeter and adjusted the disturbance via the steering wheel. The transporter continued its way down toward the ground.

The walls of the ramshackle buildings led the way down, like cliffs, steep and raw. Somewhere around the second floor they transformed into dunes and piles of debris that had grown and settled for decades and now formed crusts around the feet of the skyscrapers, where once, thousands of people used to live. The further apart the buildings were, the more space between

them. In other parts of the city, streets lay abandoned and in ruins, as if destroyed by air strikes. He would land at the intersection, under an old steel bridge where rattling trams used to cross long ago.

In the blue darkness, the descent seemed like a dive and the transportation craft moved like a submarine, even though there was no water. Nothing but oblivion was rolling through time, in slow waves, heading towards the beach. The surf of time was washing straight on to the floor of decay.

As the digger let the automatic system take over for landing, he looked at a laminated photo of the strange object that he had been ordered to search for. The piece was cut out of rare wood, about the size of a football but with the tips cut off and a curved section that exposed its inside. The digger tried to imagine the weight and smell of this cut object; he attempted to feel the strange treasure that he was going to recover and that was so important to someone else that he could hardly fathom it. The digger tried to imagine what it would be like to hold the mysterious object in his hands. He closed his eyes again. That was how every search began. The object felt bright in his mind which grew darker as he got closer to the ground. On every trip through the ruins, he fell into melancholy. The grief of those left behind lingered in this once vibrant place.

The transporter touched down with a wheezing sound. The digger unlocked his seat belt, adjusted the oxygen mask over his mouth and nose and turned on the cartridge respirator at his belt, pulled on his boots and left the car. He shivered at a silence that only existed here, because there was never any silence in the sparsely populated elitist world where he lived, a hundred metres above the darkness, near the remains of the sun. He saw ghosts of the people who used to live here, saw them flashing just outside the light beam from the torch that the digger used to explore the surroundings. Clutching at straws, the strongest people had fled upwards, still further, as the decline was first felt at the bottom. And they began to kick downwards since they had been out of the water. Still fewer people had been able to hang on to the straws. At the bottom, hidden under a shining new city, their conscience was buried, beneath their parents, their brothers and sisters, their corpses, their guilt, their past.

But the digger did not think about any of this. He did not know the world in any other way, only as a place

that had grown from another place, with meadows on rooftops, a hundred metres above the actual ground. He was born up there, in the opposite direction of where he found himself now. Was he happy there? How could he tell? He did not know. But the old streets and roads down here, the dunes, the thrash and especially the dust constituted a world that he longed for. It offered clarity. At the same time, however, its indissolubility drove him to despair every time he went there.

The digger stepped forward. As on the first moon landing, dust was stirred up, and the grey particles seemed to be moving at an even more leisurely pace than last time. For every visit to this place, time moved slower, stretching it and pulling him together. He walked slowly through the streets, which all had the same colour, grey and dry and lifeless. A shiver went through his body.

He went to work, spending hours searching for the wooden thing. He climbed into flats, dug into the ground, straightened out signposts and tried to read them, prowled through the dusk. He was searching for the flat that the woman had mentioned to him over the phone. He found it, went in and came crawling out again from a different angle, empty-handed. He wanted to give up. He could not go on, the dust was getting to him, and the sound of his creaking bones filled the empty alleys. But the digger kept on running, tumbling through the blackness as if in a dream, up became down and down became up. He ran faster. The digger had to find something, to recover something, to produce something to bring to the surface to present, reconcile and forget. He ran, dust and sweat combining together on his wrinkled skin. On and on. Until he found it, lying right in front of him, on the street, in the middle of the cracked asphalt, a thing of unknown beauty.

Then it was just a moment.

He fell to his knees, reached out for it, his hands clasping the wood, sliding through its grooves. The object weighed as much as a skull. The digger raised it into the air. It seemed as if the wood spoke to him. But from this position it was impossible to understand a word of it. As he pulled it to him, throwing his arms around it, and for one breath made the wood being his heart, the rain set in. ■



Hendrik Otremba is a German author, musician and visual artist. He also works as a lecturer in creative writing and occasionally as a curator. In March 2017 his debut novel *About Us the Foam* was published, and in August 2019, his second novel *Kachelbad's Heritage* was published by Hoffmann and Campe. He is based in Berlin.

Time to play

Crossword

PUZZLER HALLE JARVI

We hope you've been paying attention. Because now is the time to put your wits to the test. In each issue we want to give you a little something to play around with. To us at **Mayday**, the crossword is a true feat of human engineering that combines intellect with whimsy. Are you the puzzle master?

Across

- 1 Outdated platforms for storing data
- 5 A building block of matter
- 9 Dense, ground-level air pollution
- 13 Tree whose seeds we grind into chocolate bars
- 14 A Japanese buckwheat noodle
- 15 A means of blending in, abbr.
- 16 As opposed to "out"
- 17 Abbr. on a Dutch license plate
- 18 One of a pair
- 19 Rat-_____.
- 20 "We can't fight it, it's ____"
- 21 Before "post meridiem", abbr.
- 22 Senior, abbr.
- 24 Double-reed instrument
- 26 Its production is one of the largest emitters of greenhouse gas
- 28 The result of sea ice melting
- 30 South Korean electronics co.
- 31 Composer's masterwork
- 33 Someone to look up to
- 35 Writer and historian Lidegaard
- 36 The right to do so is inherent in a democracy
- 38 Defence alliance since '49
- 40 ____ it, or doesn't it?
- 41 Symbol for the chemical element aluminium
- 44 Burning them results in harmful greenhouse gasses
- 47 Variant of "patri-" before a vowel
- 49 Genesis garden
- 50 Hey, slangily
- 51 Mother
- 53 Not guilty, for one
- 54 US gambling centre city
- 55 Items on a French grocery list
- 56 Karl, author of *The Communist Manifesto*
- 57 A key on a keyboard, på Dansk
- 58 Business as _____

Down

- 1 601, in Roman times
- 2 A famous one is Sir McKellen
- 3 The type of plant that produces THC and CBD
- 4 King of Israel after David
- 5 Prefix denoting a relationship to outer space
- 6 Rural settlement
- 7 Kidnapping monster of West African folklore
- 8 Repeated word or sound to aid meditation
- 9 Marks left over
- 10 Latin for "mother"
- 11 A german grandmother, maybe
- 12 HBO fantasy drama, abbr.
- 23 Bird of prey
- 24 American football rival of Umich
- 25 Sense of self-esteem
- 26 Underground system
- 27 CEO's aide
- 28 Man-made machine
- 29 NASDAQ news
- 30 Spanish masculine, plural pronoun
- 32 Like the editions of MAYDAY art prints, abbr.
- 33 Sheets of ice adrift at sea
- 34 Prefix with "approve" or "respect"
- 36 Type of advanced x-ray imaging scan, abbr.
- 37 What you might say when someone does you a favour, with "one"
- 39 State to be true
- 41 Happily ever ____
- 42 Seuss' environmental advocate
- 43 Words before stating plan B
- 45 Better than a mere thought
- 46 Camera's eye
- 47 Measurement out of a million, abbr.
- 48 ____ carte menu
- 51 Creative person's deg.
- 52 Nonverbal language, for short

Find the secret password

Read the magazine to solve the clues. Then find a pen and work out the secret password. To claim your prize, head to mayday.co/play

1X	2X	3X	4X	5X	6X	7X	8X	9X	10X
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			3X												
		44				45	46				10X				
47	48					49					50			51	52
53						54					55				
56						57	9X				58				

Curation for You



Since we put together a nature issue, you might think that we know almost everything there is to know on the subject. Sadly, you'd be mistaken. Depending on how we talk about it, "nature" can be a lot of things. Sometimes it's a global ecosystem. Other times it's something completely separate from humanity. We make these distinctions so much that we often forget we're doing it. But this is **Mayday**. We can't have that. To fix our complacency, we've gathered six books that explore ways of considering nature.

1 The Complete Cosmicomics Italo Calvino

A love story told from the perspective of a mollusc as it creates the notion of time; the moment a hunter fires an arrow at a lion dissolves into complete mathematical abstraction; a couple trying to keep an initially tiny Earth clean as it gets covered in meteorites, meteors and other societal debris; these are just a few stories waiting in a collection Salman Rushdie once considered "the most joyful reading experience of your life." Comprised of stories written in the sixties, *Cosmicomics* courses with Italo Calvino's imagination. Most of the stories begin with a scientific statement or hypothesis, from which the narrator, usually Qwfwq, takes a left turn, leading the reader through a comic story as the mysteries of the cosmos unfold around him. The abstraction, including a lot of the names Calvino makes purposefully unpronounceable, might be a bit too abstract or mathematical for some. And the stories rarely, if ever, resemble stories about nature as we might imagine it: ecology isn't a concern, and some of the bases are factual, some discredited. But the radical rethinking of how we can portray the world lends a space for us to follow suit and invent for ourselves.

The Complete Cosmicomics (401 pages)
Published by Penguin Classics, 2009

2 The Uninhabitable Earth David Wallace-Wells

After experiencing the hottest month on record this past summer, fear of the future may be settling in. But the various scientific reports that occasionally float through the news fail to fire up our imagination. What will it actually look like? Fortunately, Wallace-Wells, climate columnist for *New York Magazine*, has that covered. Warning: it may induce despair. In a "travelogue of our near future," he illustrates the droughts, the plagues and everything else that awaits us. More importantly, though, the phenomenon of climate change is too big to imagine. We lack the words and pictures to describe it. But as it

continues, our cultures will have to address our new reality. In the second section, Wallace-Wells flags. While he does raise some interesting questions, his cultural analysis is lacking. A second aspect that might put some off is his disregard for nature: "the world could lose much of what we think of as 'nature,' as far as I cared, so long as we could go on living as we have in the world left behind." Both of these probably reflect the perspective of a city-dweller who won't be as affected as others. That said, if society had felt differently, the future would probably be different.

The Uninhabitable Earth: Life After Warming (320 pages)
Published by Tim Duggan Books, 2019

3 On The Future Martin Rees

If aliens existed and had nothing better to do than keep watch over Earth, the first 45 million centuries would have been very dull. Suddenly, things would pick up in the last hundred centuries, reaching a fever pitch of change in the last 50 years. "What," the alien might ask, "happens now?" That depends, Astronomer Royal Martin Rees replies, on what we do now. Humanity is at a bottleneck, facing threats of climate change and nuclear war as well as the open futures promised by biotechnologies and robotics. Mastering this century could bring universal prosperity, while failing to do so could result in calamities. Not that you will find a how-to guide in *On The Future*. Rather, Rees, like a well tossed rock, skips across the surface of many subjects without developing a full picture before moving on. It's a fair approach, but aggravating when he leaves readers with more general, generic points. In these skips, though, Rees manages to show a picture of humanity's place that we don't usually see, or at least explicitly say: small and fragile but with the potential to shape the entire future of the universe.

On The Future: Prospects For Humanity (227 pages)
Published by Princeton University Press, 2019

4 Being Ecological Timothy Morton

Thou shalt feel guilt-stricken over using a bag of plastic. While ecologically minded people don't say these things, their attitude makes it seem appropriate. They *are* trying to save the planet after all. But, Timothy Morton, the Rita Shea Guffey Chair in English at Rice University, dispenses with such posturing. He doesn't write commandments for us to follow. "Don't read ecology books?" *Being Ecological* asks. "This book is for you." For one thing, factoids are absent. For Morton, factoids get in the way of our ecological reality: the fact that lifeforms are interconnected. The reality of this point is a lot weirder than we may initially think, because we tend to treat nature as a distinctly separate category. From there, he dives into philosophy, but always delivered in a personable, informal manner, i.e. not nap-inducing philosophy. Sometimes this manner confuses things as examples from personal orientations and they don't always translate well. But they never obscure the point he's trying to guide us to. By the end, when we're breathing air and so continuing the dance between animal and plant, we might begin to realise that we already are being ecological. Then we'd have to act on it.

Being Ecological (219 pages)
Published by The MIT Press, 2018

5 Chernobyl Serhii Plokhyy

"They thought there had been an earthquake. It took them a while to realise that it was a man-made earthquake — one that they themselves had produced." This is how the Ukrainian-born historian Serhii Plokhyy describes the reaction of the engineers to the explosion in his award-winning account of Chernobyl. Plokhyy's narrative attributes Chernobyl as a major, immediate factor that spurred the downfall of not just the Soviet nuclear industry but also the Soviet Union as a whole. The radiation released by the explosion affected everyone, so everyone found out, which thawed the grip of Soviet

secrecy and sparked the beginning of Ukrainian eco-nationalism. Independence rose from the sense of connection to one's landscape. The book mostly focuses on how authoritarian rulers cutting corners set up the Chernobyl catastrophe. However, that story also opens up the image of an exploitative attitude towards nature and the consequences that such an attitude can bring. The enemy many fighting in Chernobyl succumbed to was not the obvious threat of the Nazis in the forties, but the invisible and raw power of atomic energy. While we may harness nature for our needs, harnessing it so hubristically opens up the possibility of our destruction.

Chernobyl: History of a Tragedy (404 pages)
Published by Allen Lane, 2018

6 Given Half A Chance Edward Davey

With environmental news being what it is, climate despair has become a prevalent phenomenon. Faced with the enormity of the problem, people fall into depression. To find some hope in these times, people would do well to pick up *Given Half A Chance*. In it, Edward Davey, a Project Director at the World Resources Institute, walks readers through ten paths that could lead to the world he wants his newborn son to inhabit. These paths come with thematic titles, like "Ocean," and manage to catch a wide selection of experts and activists — from the celebrated documentary-maker David Attenborough to Monique Barbut, the chair of the UN Convention to Combat Desertification, with much more name-checking in between. Of course, Davey's wide target misses some things and doesn't get into details to the extent that some may want. However, Davey succeeds throughout in showing that nature can comeback if given half a chance. And that's the hope we all need to carry with us as we plunge into the uncertainty of the future.

Given Half A Chance: Ten Ways To Save The World (214 pages)
Published by Unbound, 2019

It's All Natural

COLUMNIST
BO LIDEGAARD

ILLUSTRATOR
PETRA BÖRNER

The human-nature relationship has always been in flux, at least for us humans. And in the short timespan of our existence here on Earth, we've managed to go from a place of subjugation to one of dominance. Sounds like we had it all figured out? Turns out, not so much. Maybe there's something to be learned from our past as we move into the future.

WE HAVE LOST SIGHT OF NATURE — but it's still there and we're still a part of it.

Through time, most of humankind has been close to nature. Not that our ancestors were any different from us in terms of ingenuity, but their mindset was in sync with nature, the seasonal changes and the eternal circle of birth, growth, blossom and death.

Humans could strive, build and accomplish, but we ultimately lived at the mercy of nature, so overwhelmingly superior to anything humankind had created. Between nature and God was a strong nexus. We could control neither, and like God, nature was the great giver and the inescapable taker, the mother of all living, the source of prosperity, yet also the almighty destructor. Yes, we humans were different in many ways, but not in our understanding of ourselves as a natural part of the big being.

Recently, that changed. As humans began to cultivate the Earth and amass its

wealth, the idea of humans taking control over nature emerged. Our technology developed, we began to accumulate knowledge and to develop cities providing for a life more and more distanced from nature. Where "civilisation" previously expressed the organisation of a culture living within the parameters of nature, it gradually changed meaning to signify the organisation of society independently of nature.

As innovation accelerated at an ever-greater pace, it changed our relation to nature. We'd begun to see nature as the very negation of the human, which distinguished itself by being self-conscious. Humans had a soul, nature didn't. Modern humankind left behind the idea of being part of the natural cycle and began to press ahead in linear development towards yet-unknown horizons promising an ever-better being far removed from natural constraints. While we always drew on nature as an unending reservoir of wealth on which

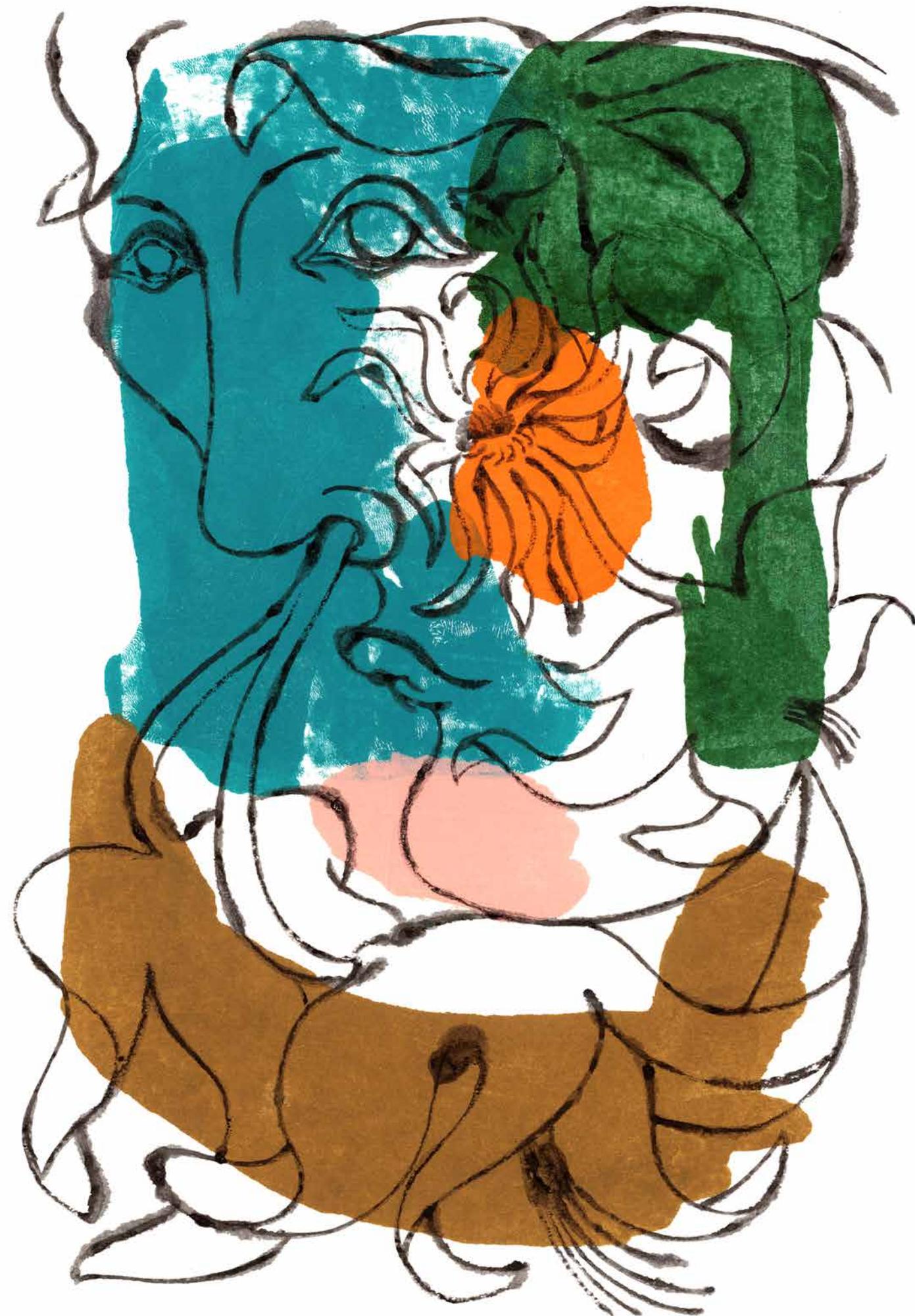


Dr. Bo Lidegaard is a historian from the University of Copenhagen and the bestselling author of several international books on political history. Until 2016, he was the editor-in-chief of Danish newspaper *Politiken*. From 2005-2011, he was the Permanent Under-Secretary of State to the Danish Prime Minister heading the Foreign and Security Affairs Division.

we could thrive, we now began extracting and exploiting natural resources at a scale incompatible with nature. We became so impressed with our own technological achievements and ability to acquire ever-growing wealth that we ignored how our impact began to change the global environment and tip the natural balances on which human civilisation depends.

Most modern people have lost the idea of nature as part of who we are. Only recently have we started to remember that nature has its own logos, its tipping points and its inevitable balances which include us and which we disregard to our peril.

Gradually, we are rediscovering that we are still part of nature and that we ourselves may be underway to unleash its colossal destructive potential. The question is whether or not that insight will harness our resolve to adapt our societies and the way we live to again become a part of nature. ■



We did our best to pack in as much inspiring information into Issue Four as possible — but maybe it was a little TL;DR: *Too Long; Didn't Read*. Or maybe you simply stumbled onto this page as you excitedly flipped through the magazine for the first time. No matter what brings you here, we hope you enjoy this recap. Hopefully it'll inspire you to read more of all the wonderful stories we managed to put together for this issue. Enjoy 🍷

Too Long; Didn't Read

The Air Condition p. 62

Air is that thing we 🌬️, nevertheless we pump it full of 🏠. So much that every year, 3,3 million people 🏠 prematurely. Some of the worst 🏠 happens in the 🏠, especially in the 🏠. In more and more places, we will have to pack 🏠 in addition to our 🏠.

Seeing Things As We Are p. 50

Mayday talks with Jakob Fenger, a member of 🇩🇰 group SUPERFLEX, about why 🏠 can change how we 🏠 things and give us new 🏠. He says we're in deep 🏠, but art might hold the 🏠 to bringing 🏠 together. 🏠

New Ways to Grow Humans p. 86

What does it normally take to make a human? 🏠 again. Turns out, 🏠 are working with some 🏠 that make it easier to grow 🏠 from any human 🏠 in a 🏠. This means we are making 🏠 redundant in procreation.

What that might mean for our future 🏠 remains to be seen. 🏠

Heads in the Sand p. 92

The 🌍 has a lot of resources that sustain us. But one that we don't usually think of is sand; and the supply is low 🏠.

We need it for everything from 🏠 and 🏠 to 🏠 and 🏠. Mette Bendixen, a 🇩🇰 🏠 explains that in the face of 🏠, we need more 🏠 to prevent 🏠, so we should 🏠 of sand as something 🏠 and come up with alternatives.

What Harms Nature Harms Humanity p. 70

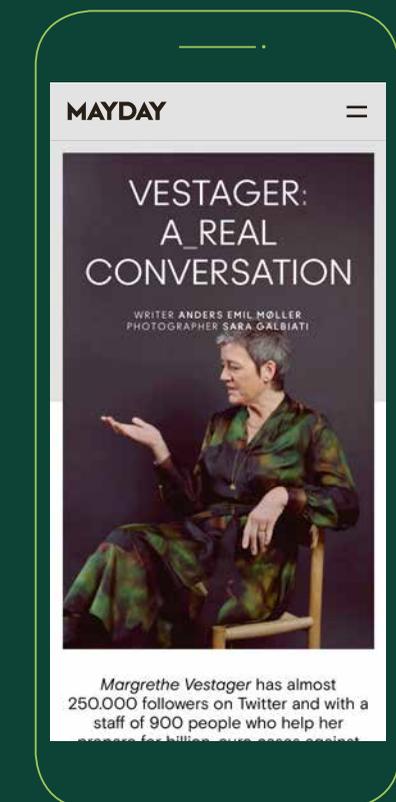
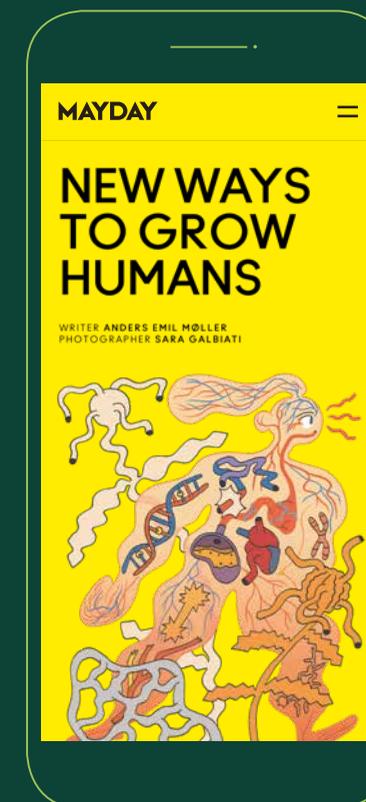
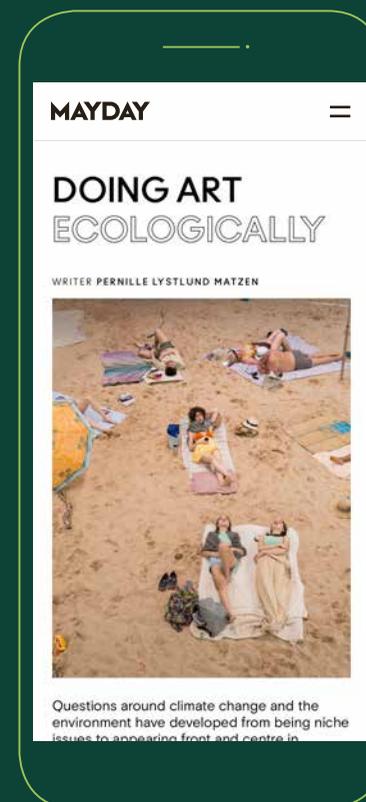
Deep in the Amazon 🌳, Thomas Lovejoy is taking powerful players to his 🏠, to get to know and maybe even 🏠, the 🏠 and 🏠 there. He's found that 🏠 aren't enough to convey the importance of the forest to 🏠 around the 🌍.

The Lost Superhero of Science Is Back p. 108

Alexander von Humboldt was a very eccentric 🏠 and 🏠 who travelled the 🌍 to 🏠 and 🏠 its 🏠.

Today, his 🏠 of nature as 🏠 collective system can serve us the message that nothing stands alone — it is all 🏠. We must be 🏠, lest we knock everything out of 🏠.

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“I’m not pessimistic, but I also really think we’re in deep shit. And we’re going to have to take some big steps in order to coexist with other people and other species.”

— Jakob Fenger

trouble



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