Reader #1
The Technosphere, Now

Friday, Oct 2nd, 2015

Technosphere
Research Project 2015–2018

Content

The Technosphere, Now
Opening of the research project TECHNOSPHERE
October 2nd at Haus der Kulturen der Welt, Berlin

11am
Triggers: Introducing the Technosphere
With Peter K. Haff, Mark B. N. Hansen, Erich Hörl,
Jürgen Renn, Birgit Schneider · Welcome by Katrin Klingan

2pm
Phosphorus: An Apparatus of the Technosphere
With Lino Camprubí, Zachary Caple, Gregory T. Cushman, Heather Davis,
Scott Knowles, Arno Rosemarin, Katrina Schwartz, and Frank Uekötter

5pm
Datum: On the Calculus of the Technosphere
With Jennifer Gabrys, Peter K. Haff, Mark B. N. Hansen,
Donald MacKenzie, Birgit Schneider, Mushon Zer-Aviv

8pm
Trauma: The Language of the Technosphere
With Rana Dasgupta, S. Løchlann Jain, Clapperton C. Mavhunga,
Matteo Pasquinelli, Lucy A. Suchma

Technosphere Research Project 2015–2018

What happens when technology rivals nature in shaping the Earth? How did we end up in this world of technological vertigo, this Mobius strip of world and planetary technics, wherein cause and effect, local and global factors, human and non-human agency, perpetually confuse and confound one another's borders? What governs this constitution (or collision) of forces? And what are the contingent, strategic, or historical events and networks that form durable apparatuses among them?

The dilemma of global technology and its identity will be the main theme of Technosphere (2015-18), a research project investigating origins and future itineraries of this technical world within a larger series of international events, performances, seminars, and conferences that will take place at HKW over the next four years.

Scientists and thinkers have introduced the term *technosphere* to describe the mobilization and hybridization of energy, material, and environments into a planetary system on par with other spheres such as the atmosphere or biosphere. The term emphasizes the leading role of the technological within this global system. At the same time this term encompasses the enclosure of human populations, forests, cities, seas, and other traditionally non-technical entities within systems of technical management and productivity. But where is that ominous technosphere to be found? How does it impact the everyday passions and experiences of humans, animals, a nation, or an ecosphere?

The coining of the term *technosphere* announces a conceptual innovation as well as a political challenge. As a conceptual innovation, the notion of the technosphere invites us to recognize and confront the reality of technical systems whose unintended consequences and internal dynamics have accumulated into a quasi-autonomous global force in the world today. Moreover, the very naming of these forces constitutes the posing of new political and social challenges that, though already widely felt, remain largely misunderstood. Their description and study will entail inquiries into physical and political science, but also topics as diverse as aesthetics, waste management, international law, social media, financial markets, animal studies, immigration, and colonialism.

From 2015 to 2018 the Technosphere project will host public events and seminars that explore the potential of this concept to coordinate conversations among scientists, artists, and the general public. It will explore the events, structures, and mechanisms by which the twentieth-century dreams of global unity and human hegemony morphed into disorienting compositions of technics and nature, of human and non-human actors. These investigative and experimental exchanges will ask how the technosphere operates today and endeavor to imagine alternative futures. The result will be a tentative vision of communities and understanding equal to the challenges of our world today.

Under the title "The Technosphere, Now" a daylong series of conversations and presentations will inaugurate the project on Friday, 2 October. Interwoven streams will address the infrastructural exploitation of earthly resources, how data monitors technical and social systems, and how the trauma maps out the dynamics of the technosphere on individual human bodies.

The event is part of *Haus der Kulturen der Welt*'s opening weekend of *100 Years of Now*, taking place from September 30th to October 4th 2015.

TRIGGERS

11am
Triggers: Introducing the Technosphere
PRESENTATIONS, DISCUSSION

What triggered the technosphere? In this introduction leading theorists of science, technology and media present a panorama of critical examples, events, disruptions, and breakdowns that catalyzed the rise of our contemporary technical worlds. Talks by art historian Brigit Schneider, geologist Peter K. Haff, media theorists Mark Hansen and Erich Hörl, and historian of science Jürgen Renn will allow for a tangible staging of phenomenological, cybernetic, and epistemic aspects of the emergence of the technosphere.

With Peter K. Haff (geologist, Duke University, Durham), Mark B. N. Hansen (media theorist, Duke University, Durham), Erich Hörl (media theorist, Leuphana University of Lüneburg), Jürgen Renn (historian of science, Max Planck Institute for the History of Science, Berlin), Birgit Schneider (Media studies scholar, University of Potsdam)

JÜRGEN RENN
The technosphere is a sphere in which humanity's metabolism with its earthly environment takes place. Since 1865 a factory using Justus Liebig's patent to produce meat extract transformed the Uruguayan town of Fray Bentos into a landmark of agro-industrial globalization: one of the many original sites where the chemical laboratory, the globe, and the Anthropocene meet half-way.

BIRGIT SCHNEIDER
Media studies scholar Birgit Schneider examines how the extracts of an equatorial tree triggered the global galvanization of the technosphere. By disclosing the role of Gutta-percha (a natural thermoplastic from a tropical tree species) within the construction of global telegraphic systems, Schneider shows how the fate of empire can spring from a colonial forest.

MARK B. N. HANSEN
Is the technosphere a single, definite event or is an iterative multi-event? In this talk Mark Hansen examines how the invention and reinvention of radio since the nineteenth-century triggered the rise of the technosphere.

PETER K. HAFF
Geologist and physicist Peter Haff examines the role of quantum mechanics as one of the key triggers of the technosphere.

ERICH HÖRL
Is the essence of the technosphere technological? In this intervention media theorist Erich Hörl discusses how cyberneticization—a process of turning linear processes into recursive feedback-based systems—triggered the rise of the technosphere in the twentieth-century.

PHOSPHORUS

Phosphorus: An Apparatus of the Technosphere
PRESENTATIONS, TALKS

Phosphorus is an element for visualizing the global reach of the technosphere in nature, culture, and engineering. Phosphorus is essential to all life: it is found in bone, DNA, RNA, and the energy transfer molecule ATP. It is also a critical ingredient of chemical fertilizers. Human and agricultural life depends on its industrial circulation. This panel investigates the network of technical, earthly, and cultural mediations that accelerate the phosphorus cycle and fertilize the world. Experts convened by Zachary Caple (cultural anthropology), Heather Davis (arts and humanities), and Scott Knowles (political history) will stage these processes in their scientific specificity, artistic singularity, cultural meaning, and environmental impact.

With Zachary Caple (anthropologist, University of California, Santa Cruz), Heather Davis (arts and humanities, Pennsylvania State University), Scott Knowles (political historian, Drexel University, Pennsylvania), Lino Camprubí (historian, Max Planck Institute for the History of Science, Berlin), Gregory T. Cushman (environmental historian, University of Kansas), Arno Rosemarin (marine biologist and environmental scientist, Stockholm Environment Institute), Katrina Schwartz (political ecologist, Florida), Frank Uekötter (environmental humanities, University of Birmingham)

OPENING: Zachary Caple and Arno Rosemarin

ACT I: Source: Histories and Futures of Phosphate Mining
Is the future of the technosphere in phosphate rock rather than silicon? In this presentation historians Gregory Cushman, Lino Camprubí, and Scott Knowles trace the history of phosphorus through the lens of phosphate mining and its geopolitics. How do corporations and states work together to transform the lithosphere into agricultural wealth? How does phosphate mining expose the seams of empire?

ACT II: Bonds: Fertilizing the Plantationocene
Move over Anthropocene, here comes Plantationocene. The plantation is the critical technology for transforming the lithosphere into human bodies. Mined phosphorus feeds crops that, in turn, feed humans and their livestock. What kind of feeding machine is the plantation? Using Hunter S. Thompson's *Fear and Loathing in Las Vegas* as a template, environmental historian Frank Uekotter examines farmers' addiction to fertilizer. Visual statement: Anna Tsing

ACT III: Sink: Eutrophication and Human Waste

The Plantationocene has consequences. Agricultural fertility seeps into the hydrosphere and impairs aquatic ecosystems. Phosphorus pollution from sugar cane plantations is transforming the Everglades. Social scientist Katrina Schwartz examines the technopolitics and ecological shifts animated by phosphorus in this irreplaceable ecosystem. Heather Davis interviews.

The industrialization of the phosphorus cycle forces another question: are humans the ultimate plantation crop? Sustainability scientist Arno Rosemarin examines the final leg in the phosphorus journey: human bodies and their excrement. How might humans reconfigure the technosphere to close the phosphorus loop? The global crises of eutrophication and phosphate rock scarcity compel us to rethink the valuable resource we flush on a daily basis.

ACT IV: Phosphorus Technosphere: An Apparatus Assembled

How do the elements of the phosphorus apparatus build into a technospheric force? Contributors come together to appraise the machine they've assembled and contemplate if and how it should be dismantled. Zachary Caple moderates.

Phosphorus — Research Notes

The technosphere is neither a "what" nor a "where." It is a how, produced by the constant adjoining, interfacing, exchanging, and correlating among times, places, and modes of existence. To schematically grasp the continuous conjoining that constitutes the technosphere, we asked our lecturers to submit Research Notes that offer schematic snapshots of the fields, entities, modes, and procedures producing phosphorus, datum, and trauma as streams within the technosphere. These schematic presentations serve as a supplement to the actual lectures—neither summarizing nor substituting the actual talk, instead they present a transversal addition to the main analysis—and serve as a snapshot of different levels and sites that participate in the ongoing, unfolding, open-ended event known as the technosphere.

Like the technosphere itself, these notes experimentally coordinate diverse entities—image, text, sound, experience, bodies—into chains of production.

There are three sets of Research Notes, corresponding to the three streams in our discussion. Together they provide a transversal view into the formal operations governing fields of the technosphere.

Contributors to the Phosphorus Stream identified a case or element in the cycle of phosphorus production and traced its transformation and impact as it travels through the "phosphorus apparatus," a chain of social, political, industrial and environmental actors coordinated to meet strategic needs.

Research Note #1: Scalability and Supermarkets
Zachary Caple, University of California, Santa Cruz

Economies of scale organize our lives. The ability to "scale up" modes of production, to make more and more stuff, is a hallmark of the capitalist world-system. Scalability structures our factories and plantations, but it also shapes our political ideologies and everyday culture. What would it mean to investigate the networked cultural spaces of the technosphere through the lens of scalability?

In my fieldwork in Florida, I study how the phosphate fertilizer industry has reached scalable proportions and transformed Florida ecosystems in the process. Florida is a convenient place to study phosphorus scalability: it has one of the world's most important phosphate mines and it has a politically powerful agricultural sector that consumes phosphate fertilizers on an industrial scale. It also has the essential third component: lots and lots of human eaters.

How do phosphate mines, plantation fields, and human eaters come together in a scalable technospheric apparatus? One key technology for converting the lithosphere into human bodies and growing populations is so ordinary it fails to spark our curiosity: the supermarket. The prefix *super-* is a clue that scalability is at work. Row upon row of identical can goods and uniform heaps of blemish-free produce are signatures of scalable design. In the United States, the supermarket is configured for the automobile—an icon of mass production. Almost always embedded in shopping centers with spacious parking lots, the supermarket is a fixture of suburban life and an apparatus of sprawl.

PHOSPHATE ARTIFACT
Publix Supermarket in the Southgate Shopping Center, 2515 S. Florida Ave, Lakeland, FL

Christopher Paulin, "Southgate Shopping Centre", 2010, https://flickr.com/photos/kevinandchris/4406873387, CC BY 2.0 (https://creativecommons.org/licenses/by/2.0/)

Bone Valley is a phosphate-rich geological region in Central Florida. Located within its boundaries is the sprawling city of Lakeland and the headquarters of Publix, the 7th largest supermarket chain in the U.S. In 1957, with great public spectacle, Publix founder George Jenkins unveiled the Southgate Shopping Center in Lakeland. The Southgate Shopping Center represented the state-of-the-art in American merchandising. Sixteen stores, including a Woolworth's, a "Beauteria,"

and, of course, a Publix supermarket, were grouped together under a 67-ton red parabola—an architectural flourish that has become a local landmark. In developing Southgate, Jenkins helped pioneer a new trend in the supermarket industry: building and owning whole shopping centers, instead of just occupying them.

During my fieldwork in Florida, I did not study supermarkets or the Publix chain, but I did do my shopping at the Southgate Publix. As I shopped—a cartoon of the anthropogenic phosphorus cycle etched in my mind—I contemplated the strange layering of phosphate geology the store embodied: *below ground*—an unmined layer of the Bone Valley formation; *above ground*—Bone Valley phosphate rock masquerading as food and human flesh.

FIELD OF IMPACT: HOLLYWOOD
In the 1990 Tim Burton film *Edward Scissorhands*, the differently dexterous Frankenstein, Edward, has turned up in Anywhere USA. It's the 1980s (or is it the 1950s?) and Edward is shaking things up in a pastel-colored subdivision with avant-garde topiary and hairdos. At the midpoint of the movie, the camera fixes on the Southgate Shopping Center's parabolic arc. Edward is at the peak of his popularity and Joyce, the vampish redhead, is giving Edward a tour of the vacant retail space where she hopes to launch a salon. Joyce's business dreams are anything but innocent: she has turned Edward's physical difference into a sexual fetish. Her seduction of Edward in the Lakeland mall ends in comedic failure, but it also marks a turning point in the story as Edward shifts from being a celebrated curio to a reviled other.

Edward Scissorhands offers a critical allegory of Anywhere USA and its culture of scalability. In Anywhere USA, the nuclear family flourishes; progress is synonymous with growth; and cultural difference is alternately appropriated or targeted for eradication.

FIELD OF IMPACT:
FLORIDA STATUES 211.32 AND 370.021
The Southgate plaza sits at the center of Burton's critical myth as an icon of American modernity; but Southgate also exists as a real piece of infrastructure in the sprawling city of Lakeland. In Florida, Publix supermarkets are a strategic technology of suburban expansion: city and county planners, real estate developers, and Publix representatives work separately and together to ensure that roads, sewer, and supermarkets are available to the ever-expanding periphery. By the 1970s Lakeland had expanded well beyond its 1957 boundaries and encountered a limit to growth: unreclaimed phosphate mines. Old phosphate lands with their irregular pits and spoil piles, industrial debris, and precarious settling ponds are ruins of scalability. These lands require significant capital to reclaim. Real estate developers and the City of Lakeland petitioned the state to action. In 1975, the State of Florida passed statutes 211.32 and 370.021. These statutes mandated phosphate fertilizer companies to

reclaim all new mines to "beneficial use." They also established the Non-mandatory Reclamation Fund, financed by a severance tax on phosphate, that offered reclamation monies to owners of pre-1975 mines. With mandatory reclamation and the Non-mandatory Reclamation Fund in place, a limit to scalable suburban construction was overcome. Phosphate pits became lakefront property. This is the American Dream in ruins, literally.

FIELD OF IMPACT:
COALITION FOR IMMOKALEE WORKERS
In Marsh 2014, I joined the Coalition of Immokalee Workers' protest outside the flagship Publix of the Southgate Shopping Center. Farm workers and their allies chanted and waved tomato-shaped protest signs condemning Publix for failing to participate in the coalition's Fair Food Program. The Coalition of Immokalee Workers (CIW) is a worker-led human rights organization that advocates social justice and fair labor practices in U.S. agriculture. Immokalee is the largest tomato-producing region in Florida. In the last decade, the Immokalee tomato industry's image has been sullied by numerous prosecuted cases of contemporary slavery.

Exploitable labor, like phosphate fertilizers, is a critical feature of scalable agriculture. The Immokalee farm workers—deprived of shade, safe working conditions, and a livable wage—formed the CIW and mounted sophisticated political campaigns against big retailers that leverage low prices from growers. The Fair Food Program requires participating retailers to charge an extra penny per pound for tomatoes, resulting in millions of dollars in premiums that raise an average farm worker's income from $11,000 to $16,000 a year.

CIW technologies of protests—its candlelight vigils, its colorful signs and banners, its network of activists using social media—have, in some cases, shifted cultures of scalability and the technosphere's distribution of wealth. Walmart, McDonalds, and Subway have all signed onto the Fair Food Program. Publix, however, remains committed to a de facto policy of scalability without responsibility.

Coalition of Immokalee Workers, "Consumers stand alongside farmworkers outside of one of Florida's first Publix stores in Lakeland, Florida", 2013

Research Note #2: Phosphorus Politics
Scott Gabriel Knowles, Drexel University, Pennsylvania

THE CASE: CKDNT

Kidney disease is killing sugarcane workers in Central America at alarming rates. A 2013 article in the *American Journal of Public Health (AJPH)* estimates that 20,000 men have died in an epidemic referred to as Chronic Kidney Disease of non-traditional causes (CKDnT), or sometimes as Mesoamerican nephropathy (MeN). Sugarcane workers mostly, in Nicaragua, El Salvador, Guatemala, Costa Rica, and Mexico are dying of renal failure, but without the normal epidemiological profile. In 2009 kidney disease was the second leading cause of death for men in El Salvador according to the *AJPH*, and CKDnT mortality in affected areas is 5-times higher than national rates in Nicaragua and Costa Rica.[1] The normal causes of kidney disease—hypertension and diabetes—are not present among these workers, and they often don't know they are seriously ill until the disease has progressed beyond hope of recovery. The lack of kidney disease registries has made it difficult for public health officials to say exactly when this epidemic emerged. The first paper documenting CKDnT in Latin America was published in 2002, and the Pan American Health Organization did not acknowledge it as a serious health issue until 2013.[2] The suffering and premature death of victims, the trauma to agricultural communities, and the overwhelming cost to overburdened health systems define a disaster that is enormous and still growing.

But the story does not end in Central America. Northern Sri Lankan rice farmers are also dying at a rapidly increasing rate from CKDnT.[3] It is estimated that 400,000 suffer from kidney disease, with 20,000 dying annually. The scale of the disaster in Sri Lanka and the recent publication of research linking CKDnT in Sri Lanka to agricultural fertilizers and herbicides moved President (and former health minister) Maithripala Sirisena to take action. In May of this year he announced that the country would ban the import and use of glyphosate, the world's most widely-used agricultural herbicide.[4]

THE ARTIFACT: "ROUNDUP"

Glyphosate (a compound of glycine and phosphonic acid) often goes by the trade name "Roundup," and was first produced by the Monsanto Company (USA) in 1974. Monsanto retains its own phosphorus mine in Soda Springs, Idaho in order to provide the raw materials for Roundup. Though Monsanto remains a major producer, Chinese companies today manufacture the largest percentage of glyphosate worldwide, and other manufacturers include BASF, Dow, and DuPont. Though it has now lost the exclusivity of its patent, Monsanto has retained competitiveness through the marketing of its genetically-modified "Roundup Ready" seed stocks. In a feat of chemical wizardry, Monsanto has made it possible for farmers to now grow plants that are resistant to a remarkably powerful herbicide. The crops survive, the weeds around them die.

"A worker without protective clothing only wearing a paper breathing protection sprays pesticides on vegetables in a greenhouse", Pedro Armestre/Greenpeace

The theory of glyphosate poisoning runs basically as follows: glyphosate enters the soil and water and bonds to heavy metals like cadmium and arsenic. After use, glyphosate by-products make their way into water supplies, and eventually into bodies, with the heavy kidney-function-disrupting metals included. Another theory holds that glyphosate is only part of the problem, and that glyphosate toxicity is augmented by the rapid expansion of phosphorus fertilizer use. The rapid and recent intensity of phosphorus fertilizer application in Sri Lanka means more workers are exposed to products that are themselves contaminated with heavy metals. So, be it from fertilizer or from herbicide—there is a strong case being made that phosphorus sits at the root of the problem. Research is an early stage, and multi-causal explanations are appealing. For example, chemical exposure combined with dehydration from difficult agricultural work may be a tough one-two punch for sufferers.

PHOSPHORUS APPARATUS: GOVERNMENT/INDUSTRY/PUBLIC HEALTH SCIENCE

FIELD OF IMPACT #1: GOVERNMENT

Sri Lanka's policy response to the CKDnT epidemic came shortly after the announcement in March of this year by the World Health Organization (WHO) that glyphosate is "probably" also a carcinogen, a result of a study by the International Agency for Research on Cancer. The Sri Lanka policy action comes in the middle of debate in the EU over banning glyphosate (still controversial), a move initiated by Denmark in 2003. The Netherlands banned the herbicide in 2014 and

1   Catharina Wesseling, Jennifer Crowe, Christer Hogstedt, Kristina Jakobsson, Rebekah Lucas, and DavidH. Wegman, "The Epidemic of Chronic Kidney Disease of Unknown Etiology in Mesoamerica: A Call for Interdisciplinary Research and Action," *American Journal of Public Health* 103: 11 (November, 2013): 1927-1930.
2   Luis Carlos Silva and Pedro Ordunez, "Chronic Kidney Disease in Central American Agricultural Communities: Challenges for Epidemiology and Public Health," *MEDICC Review* 16:2 (April, 2014).
3   "Mystery Kidney Disease Killing Sri Lankan Farmers," *The New York Times*, January 18, 2015.
4   J.D. Heyes, "Sri Lankan President Bans Glyphosate Nationwide to Protect the Health of the People," *Natural News*, June 8, 2015; Namini Wijedasa, "It's Official: Glyphosate Import is Banned," *The Sunday Times*,.June 14, 2015.

France has done so this year. Brazil, Germany, and El Salvador may not be far behind. The U.S. Environmental Protection Agency has never listed Roundup as a carcinogen, but will now undertake a new study in light of the WHO report.

FIELD OF IMPACT #2: INDUSTRY
Perhaps the manufacturers of glyphosate will get ahead of the crisis: the Chinese government, for example, has pledged about 100 million dollars to build a specialized hospital for treating CKDnT in Sri Lanka (Chinese companies export vast quantities of phosphorus fertilizer to Sri Lanka). Monsanto has taken a more combative path, seeking to undermine the scientific validity of the CKDnT- cancer linkage. Monsanto immediately demanded a retraction of the 2015 WHO study, complaining that it is "biased and contradicts regulatory findings that the ingredient, glyphosate, is safe when used as labeled."[5] The phosphorus industry has also strongly denounced what it sees as unfounded connections among sick farmers, phosphorus fertilizer, and glyphosate. A skeletal critique of phosphorus fertilizers and herbicides may grow flesh if and when the EU takes action, or when (if?) the U.S. EPA changes its mind about the "wizardry" of Monsanto. The so-called climate change "debate" in the United States has shown us the dangers of "waiting for scientific consensus" as a tactic of industrial producers who wish to keep sales high amid mounting evidence of harm. Still, the uncertainties of public health etiology do not necessarily inhibit the formation of public opinion against a perceived pollutant—and from this flows the "Politics of Phosphorus," or at least a possibility for politics.

FIELD OF IMPACT #3: PUBLIC HEALTH SCIENCE
"Global phosphorus" has effects at different scales—and one of these scales is that of the body of the individual farm worker. But can one sick worker, or even a few hundred thousand sick workers build a case against Monsanto? Discussion of the Technosphere invites us to think about the flow of material commodities like phosphorus—not only to study the "life story" of industrial materials, but also to locate the "apparatus" created when different actors (human and nonhuman) are drawn into a relationship. The slow disaster of phosphorus depletion through mining is compounded by the expanding and unregulated flow of phosphorus waste. Eutrophication is one result—and now we see the possibility of another grim phosphorus transformation—as an agent of heavy metal accumulation in the bodies of farmers. Cautious policymakers are already showing that they are not willing to wait for 100% certainty on glyphosate-CKDnT-cancer linkages before taking action. Whether or not farmers in developing countries dying of kidney disease will force a new *Silent Spring* moment remains to be seen. In the meantime, the global demand for rice and sugar is increasing all the time, and so is the demand for phosphorus in its many manufactured formats.

5   Carey Gillam, "Monsanto Seeks Retraction for Report Linking Herbicide to Cancer," *Reuters*, March 24, 2015.

DATUM

5pm
Datum: On the Calculus of the Technosphere
I — Self-Fantasy: On the Autonomy of the Technosphere
II — Worlds of Data
PRESENTATIONS, TALKS

In this investigation scholars square off in dialogue and debate over the role of data in our world today. Data—scriptural traces that reduce the lived world to pieces of quantitative information—defines the relationship of the technosphere to itself and the world around it. But where is it? How does it rework the body politic or our biological substratum itself?

To think of data as a controlling and structuring element in the global system called the technosphere is also to imagine data in this way. In this conception, Datum denotes less an empirical fact than a series of structured transformations in and among domains. Instead of taking data as a definite and objective entity, we approach and investigate data—as tool, as argument, as proof, as weapon—according to its modes of appearance and transformation: Which kinds of visual or other traces are left by data? How and by whom is data made visible or invisible—and to whose benefit?

In "Self-Fantasy: On the Autonomy of the Technosphere" we confront three different ways of seeing data—and seeing how data sees itself. The conversation then turns towards "Worlds of Data," an inquiry into how data gets leveraged to make and break worlds.

With Jennifer Gabrys (Communication studies scholar, Goldsmiths, University of London), Peter K. Haff (geologist, Duke University, Durham), Mark B. N. Hansen (media theorist, Duke University, Durham), Donald MacKenzie (sociologist and STS scholar, University of Edinburgh), Birgit Schneider (Media Studies scholar, University of Potsdam), Mushon Zer-Aviv (designer and media activist, Shenkar School of Engineering and Design, Tel Aviv)

Datum I: Self-Fantasy: On the Autonomy of the Technosphere

PETER K. HAFF
Do humans, currencies, and molecules drift about the technosphere, like so many interchangeable bits of data? In this talk geologist and physicist Peter Haff discusses the scientific principles that would define a technosphere, and which would condition the movements of living and nonliving beings, as well as "social" and "natural" entities, in and amidst its flows.

JENNIFER GABRYS
If politics is a process, then is data its medium? Under technospheric conditions data intertwines with practices, perceptions, and participation at every step of political engagement. In this presentation Communication studies scholar Jennifer Gabrys considers how citizen-led projects to monitor the environment "creature" data—that is, imbue it with particular lived modes of perception and participation that rival (and complement) traditional scientific understanding.

MARK B. N. HANSEN
Does Big Data dream? In this analysis of the Ralf Baecker's artwork Mirage, media theorist Mark Hansen investigates disparate scales and types of data—geophysical, neural, computational, aesthetic—animating the technosphere today. He asks what kind of surfaces or environments for dreaming unfold in this data, whether computers have access to such dreams, and how it might be shared with human beings.

Datum II: Worlds of Data

DONALD MACKENZIE
What is the value of a few milliseconds in the technosphere? Historian and STS scholar Donald MacKenzie examines how the microtemporal management of financial data produces wealth and weaves the web of the technosphere. By focusing on the infrastructure and geography of high-frequency trading he uncovers the hidden materialities and geographies of the technosphere.

MUSHON ZER-AVIV
On December 7, 1972, the Apollo 17 spaceship, positioned in perfect zenith between the sun and the earth, allowed the first human sight of the earth as a single, large round globe in space. The photograph they took of Earth has become one of the most iconic photographs in history. Media activist and Designer Mushon Zer-Aviv examines what the history of this image and its manipulations tells us about the cultural origins of data.

BIRGIT SCHNEIDER
Can we calculate a climate? Media Studies scholar Birgit Schneider takes us on a tour of the climate data of the Northern hemisphere gathered by Alexander von Humboldt in 1816/1817, asking what aesthetic, political, and technical factors shaped its refashioning as representations of the earth. Schneider examines how a single entry of a weather "datum" can tell us something new about the world, but also the increasing need for more data and standardization.

Datum — Research Notes

The technosphere is neither a "what" nor a "where." It is a how, produced by the constant adjoining, interfacing, exchanging, and correlating among times, places, and modes of existence. To schematically grasp the continuous conjoining that constitutes the technosphere, we asked our lecturers to submit Research Notes that offer schematic snapshots of the fields, entities, modes, and procedures producing phosphorus, datum, and trauma as streams within the technosphere. These schematic presentations serve as a supplement to the actual lectures—neither summarizing nor substituting the actual talk, instead they present a transversal addition to the main analysis—and serve as a snapshot of different levels and sites that participate in the ongoing, unfolding, open-ended event known as the technosphere.

Like the technosphere itself, these notes experimentally coordinate diverse entities—image, text, sound, experience, bodies—into chains of production.
There are three sets of Research Notes, corresponding to the three streams in our discussion. Together they provide a transversal view into the formal operations governing fields of the technosphere.

Speakers in the Datum Stream identified a "piece of data", an entity, an artefact, and then followed three moments of its transformations as it gets disclosed, analyzed, and integrated to the operations of the technosphere.

Research Note #1: Sensing Air and Generating Worlds of Data
Jennifer Gabrys, Goldsmiths, London

THE PIECE OF DATA

Sensors are devices that are proliferating in environments, and which are meant to generate reams of data about environmental conditions. From air quality sensors, to light, temperature and humidity sensors, technologies are now available for monitoring environmental fluctuations and for producing data that might inform environmental action. Yet the basic diagram of technical sensors monitoring environments and producing data that has subsequent effects turns out to be less singular when operating in concrete conditions. The data generated through air quality sensors might then be referred to as "creatures," in the sense specified by Alfred North Whitehead, where "concrete facts" assume distinct forms. For Whitehead, creatures are the actual entities and occasions that participate in the world in particular ways, but which also signal toward abstract processes whereby creatures come into being.

DISCLOSURE

Air quality data might appear to be settled facts at the moment of collection. Yet these facts-as-creatures in their particular forms also have the potential to animate new relations and practices. An air quality sensor such as the Grove Dust Sensor from Seeedstudio uses the Shinyei Model PPD42NS Particle Sensor to measure and disclose particulate matter levels by counting concentrations or densities of dust within an established unit of time. Yet how does the signal of particulate matter concentrations to electrical currents to digital data, as an initial "disclosure" of particulate matter, transform into analysis and eventual reintegration toward having effects on the world?

ANALYSIS

What becomes apparent when working with environmental sensors such as air quality sensors *in situ* is that the data generated do not circulate as absolute and immediate indicators of the "fact" of air quality, but instead always require further analysis, as well as consideration of the environments of relevance in which these citizen-collected data might have particular effects. This is one of the trajectories informing the Citizen Sense project [www.citizensense.net], which undertakes a study of environmental sensors and citizen-sensing projects to understand how the data gathered from DIY sensors might concretely facilitate, change or re-route practices of environmental citizenship.

REINTEGRATION

This is another way of saying that data, whether institutionally or individually gathered, require extensive infrastructures for making sense of and acting on data. A single particulate matter reading, or a line graph analyzing particulate matter changes over time, must then be put to work in particular contexts in order to effect change. By attending to the creatures of data, the particular forms of concrete facts and their potential to generate new encounters become more apparent. Data-as-creatures, in this sense, might be seen to generate particular environmental practices and material-political worlds. Practices of gathering evidence related to air quality might then shift from an exclusive focus on "facts," to the concrete creatures and worlds generated through environmental monitoring with sensors.
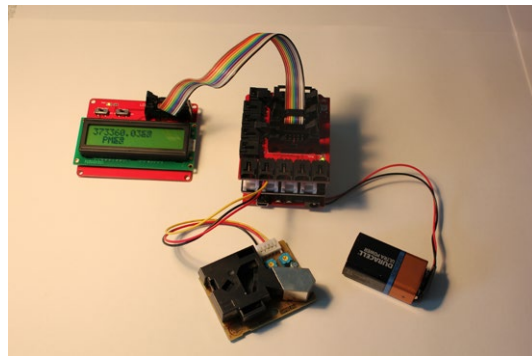
Citizen Sense, 2013
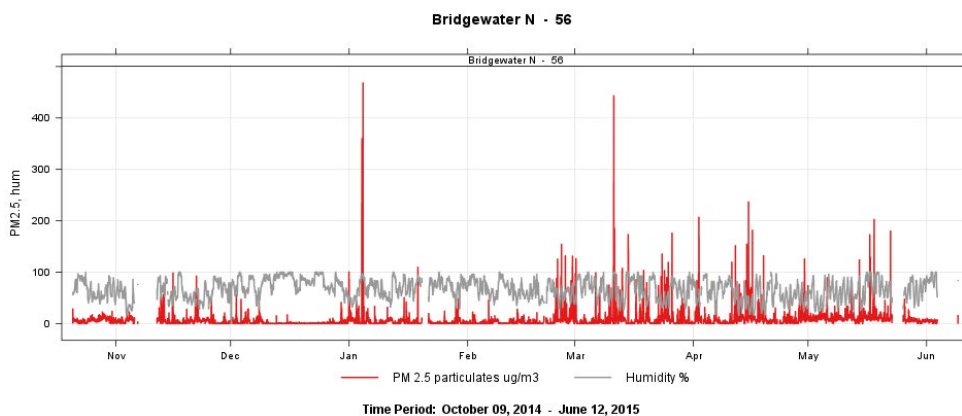
Citizen Sense, 2015

Research Note #2
Peter Haff, Duke University, Durham

European Central Bank, 2002, Wikimedia Commons,
Public Domain
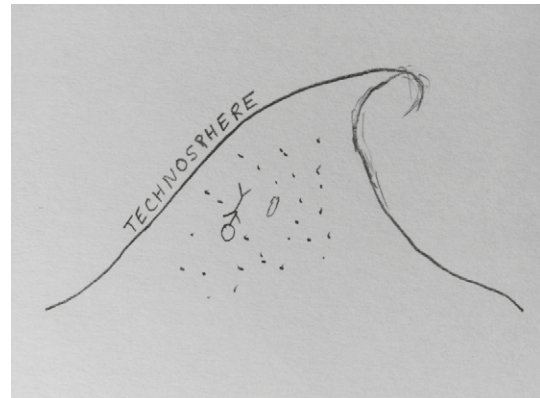
PK Haff, 2015

A one euro coin is my piece of data.

DISCLOSURE
The euro is disclosed by being placed on the table in
a restaurant, received as change in purchasing a cup
of coffee.

ANALYSIS
The euro is a piece of the earth, containing the ele-
ments copper, nickel, and zinc. In its manufactured cir-
cular form and its inscriptions, it is also a technological
artifact. Its dual existence as a geological and techno-
logical entity renders it a useful piece of data in analyz-
ing the technosphere as a new geological system.

REINTEGRATION
The euro, like other components of the technosphere,
including humans, is subject to general rules that
govern the relation between a complex dynamic sys-
tem and its parts, dictating for example the necessi-
ty of forces to constrain the behavior of each part. The
fate of the euro as it navigates the rules of the techno-
sphere has much in common with the fate of humans,
who labor under similar constraints, and by such anal-
ogy helps illustrate the redefinition of the human con-
dition implied by the rise of the technosphere. As parts
of the technosphere, humans and euros are like mole-
cules of water trapped in the ocean wave that they
help define.
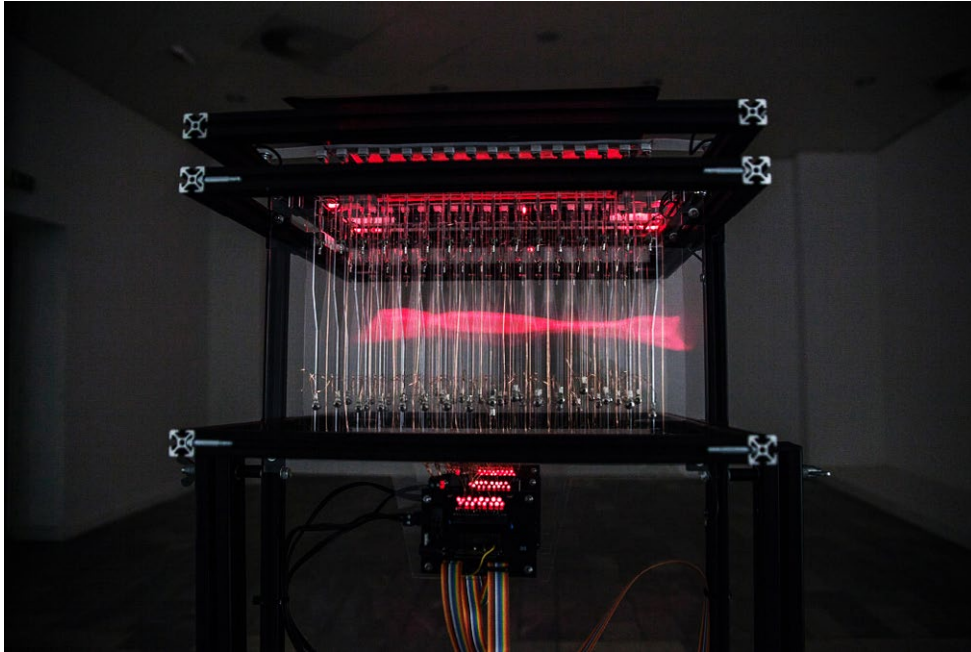
Ralf Baeker, Mirage (2014)

THE PIECE OF DATA
Ralf Baecker's 2014 art installation, *Mirage*, is my piece of data. *Mirage* is a physical or hardware installation that uses a flux magnetometer to register tiny changes in the earth's magnetic field.
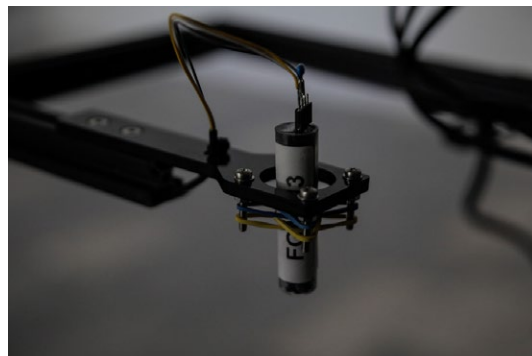
Flux Magnetometer

DISCLOSURE
The data it collects is then fed into an unsupervised learning algorithm (a so-called "Helmholtz Machine") of the sort now used by Google to find patterns in Big Data. The machine analyzes the signals it registers by creating new signals based on its past experience. Baecker refers to these new signals, the product of the machine's "sleep cycle" (its self-referential operation when it is cut off from new sensory input), as machine "dreams." Products of the algorithm's ability to find patterns in large and complex sets of data, these dreams are images of potentiality: possible relations of data that disclose variant realities.
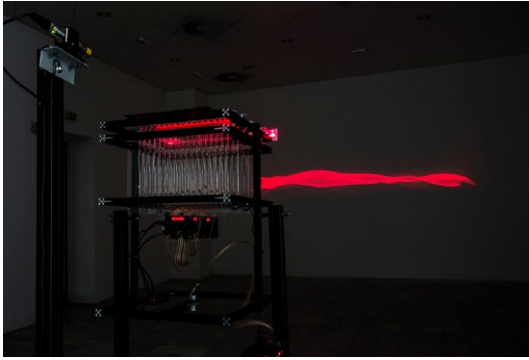
Laser Projection

ANALYSIS

Mirage presents these variations as a tangible experience for viewers of the work. It does so by translating them into a two dimensional matrix that deploys 48 muscle wire actors to physically modifiy a thin mirror sheet.
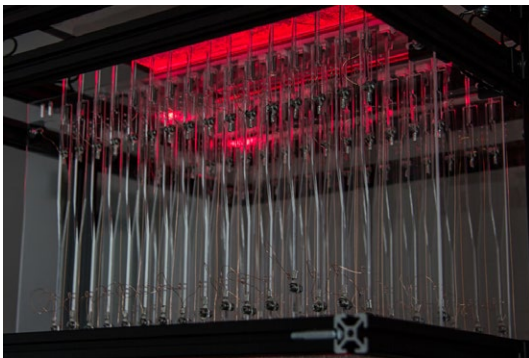
48 Muscle Wire Actors

Directly reflecting the changes in the machine's state, the transformation of the mirror sheet is made visually apprehensible by the projection of a thin laser beam shining at an acute angle on its surface. What results is a constantly shifting image of a landscape-like figure that depicts the dynamic evolution of the machine's dreams.
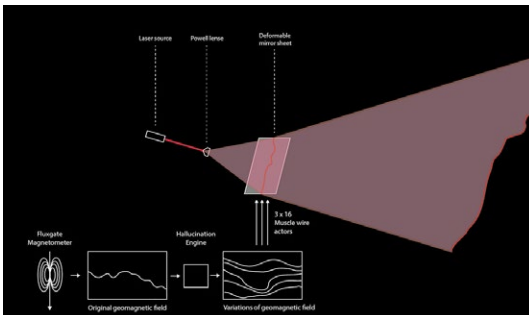
Mirage, Installation Schema

REINTEGRATION

Mirage can best be understood as a cosmic "mixing board" that materializes the complex operation of the latest algorithmic procedures for the analysis of large and complex data sets. By choosing to sample vibrations from the magnetic field of the earth as the data to be processed by his system, Baecker effectively brings a dimension of computational operationality that typically remains outside of human experience — the complex procedures that drive the unsupervised learning algorithms behind Big Data analytics — into the purview of our gaze.

The key question raised by *Mirage* is: what kind of data does this cosmic mixing board yield? Is the constantly fluctuating laser projection an image of complex, machine-detected patterns within the flux of data about the earth's magnetic field? Or is it rather an image of the transformational potential of the algorithmic procedures that are responsible for the detection of such patterns?

Research Note #4: The Microwave Tower of the New York Stock Exchange and the Physicality of Finance
Donald MacKenzie, University of Edinburgh

PIECE OF DATA

The piece of data I would like to consider during my visit to the HKW is the microwave tower of the New York Stock Exchange. Since that cannot be moved to Berlin, here are two photographs of it taken by 'Tyler Durden', the collective pseudonym for the bloggers zerohedge.com.

KDE Marble - Plain Map, CC BY-SA 3.0 (http://creativecommons.org/licenses/by-sa/3.0) and GNU Free Documentation License 1.2 (http://www.gnu.org/licenses/fdl.txt), modified by Taylor Spears

The six data centres are connected by fibre-optic cables, microwave links, millimetre wave links, and a system for sending financial data through the atmosphere by lasers on microwave towers and other tall structures. (The laser beams are infrared, which means that the citizens of New Jersey cannot see the data being flashed, literally above their heads.) The laser on the NYSE microwave tower is circled in the next of Zero-Hedge's pictures:

Tyler Durden, 2014, zerohedge.com

DISCLOSURE

I have singled out the NYSE microwave tower because it is very tempting to think of today's financial system as abstract and virtual, to imagine that globalisation has led to a 'flat world' and 'the end of geography', and assume that both time and space have shrunk. Time most certainly has shrunk — trading now often takes place so fast it is impossible for human eyes to follow it — but precisely because time has shrunk, space has not. Particular places, and particular routes between those places, are at least as important in finance as they ever have been.

ANALYSIS

The NYSE microwave tower is the gateway to an important location in what could be called (quoting the 'Manual' for our collective investigation) 'the technosphere as a kind of infrastructural game to be played, wherein certain objects and operations structure the ability to ... transmit entities across time and space'. That location is the New York Stock Exchange's data centre in Mahwah, New Jersey, which is one of the six crucial computer data centres in which the majority of financial trading in the US takes place. The entities which are transmitted across time and space among them — in streams that often amount to several million messages per second — are news of new orders arriving, and of old orders being executed or cancelled.

Tyler Durden, 2015, zerohedge.com

REINTEGRATION

What the fibre-optic, microwave, millimetre wave and laser links between the six data centres have done is to turn much of the US financial markets into a single, large, tightly-integrated technical system. Although the linkages between that system and its less sophisticated counterparts in Europe, East Asia and elsewhere are not quite as fast and quite as tight, they too are certainly real and important.
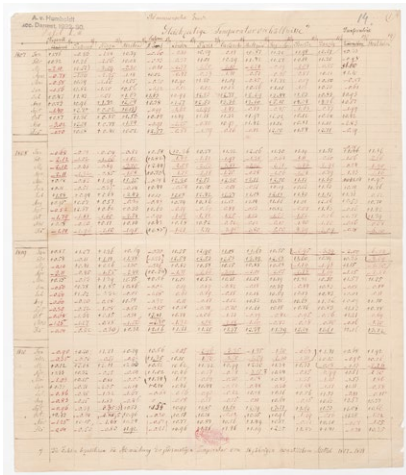
Finance's technosphere is deeply daunting. However, its very physicality reveals a certain lack of robustness. For example, for reasons that will be explained in my presentation, it is sometimes disrupted by the most mundane of physical phenomena: rain. My presentation will outline the processes — social, economic, cultural and technological — that have created this astonishing but also surprisingly delicate technosphere.

Research Note #5: From Raw Data to Cooked Visualizations: Materialities of Early Climate Data
Birgit Schneider

PIECES OF DATA

Masses of paperwork are at the center of a visual history of weather and climate. I look at early data collections of weather and how data was gathered and finally got visualized to form the first map of global climate after 1800. A standard history of meteorology simply states that only after 1781 "the possibility was given" to draw such maps to visualize climate; before that time instruments were neither good nor standardized enough or the daily hours of measurement varied – in any case it was impossible to compare the data because weather data wasn't robust enough. This is how many historians frame the issue. But the question gets more complicated if we abandon the perspective of technological progress and ask: "What took them so long? The 'so long' here is 33 years, give or take, and the ‚them' is the members and subscribers, and scientific heirs of the Meteorological Society of Palatinate [...]" Because there were over thirty years between the conditions of the possibility of knowing (and the foundation of the first weather network institution) and finally the realization of weather and climate maps.
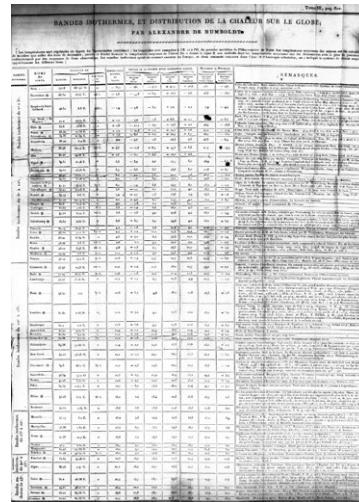
Hand-written weather measurements from Alexander von Humboldt's estate, large box 1, folder 8, No. 14, Staatsbibliothek Berlin — Preußischer Kulturbesitz

DISCLOSURE

Raw and cooked data The piece of data I look at is a very early list of climate data collected by Alexander von Humboldt in 1816/17 (fig. 1 and 2). He combined weather records from different places around the world, which he assessed to be robust enough for a statistical calculation of climate by that time. Fig. 2 therefore is the data basis for a visualization of averaged climate zones. Humboldt only assessed station from the Northern Hemisphere to be robust enough for this endeavor. The list consists of 58 local weather measurement lists. At some of the places (only a few already had the status of weather "stations", most of them were an outcome of individual research, therefore the table also represents the research network of that time) he had collected data for one year; the

longest record is a collection of daily measurements for over 10 years. Compared to today's climate lists consisting of thousands of weather stations and uncountable single measurements which were collected over many decades (the number 58 stands for a very wide-meshed weather network of data; still this network was a starting point for all later efforts to standardize, institutionalize, globalize and expand weather measurements in order to track climate.)

Data basis for the first climate visualization by Humboldt, 1817, consisting of 58 series, most of them short term, Alexander von Humboldt, "Des Lignes isothermes et de la distribution de la chaleur sur le globe", Mémoires de physique et de chimie de la Société d'Arcueil, Vol. 3 (1817): 462–602 (foldable chart which is included), Staatsbibliothek Berlin — Preußischer Kulturbesitz.

Humboldt used this table of data as a basis for "painting by numbers" to draw his early climate map in 1817 by applying the method of the isoline (an average line). The map derived from this list shows a segment of the Northern Hemisphere with Europe in the center and America and Asia at its sides. There are seven data lines –– "bandes isothermes" which run in symmetrically curved lines. With this map Humboldt for the first time visualized statistically manipulated weather data and made visible climate.

Instead of commenting on the very abstract form of the map (actually it is not directly identifiable as a map because it abstains some of the most significant features of a map), I want to ask about the historical situation in Europe when these data got visualized for the first time. Here the story connects to a history of table-making that is the production of structures consisting of lines and columns. At this point of history a new medium came into focus, a powerful transit medium of data before data visualization: the table. Without ordering data with the help of spreadsheets, data remains meaningless raw data. By giving order to the data with the help of a tabular structure, data becomes meaningful and produces knowledge.

So my questions here are: How did the weather have to be framed in order to make climate visible?

How was climate visually brought into being by processing the tables? When did questions of climate arise from the grid of the tabular weather spreadsheets? And why did researchers need decades to come up with the idea to visualize climate in this way before they started to criticize the limits of the tables?

Weather station at Hohenpeißenberg, 1897, Wikimedia Commons, Public Domain

History of meteorology made a series attempts to establish measuring networks since the 17th century. The data Humboldt's visualization was built on was an outcome of the first successful meteorological network founded by the Palatine prince of Mannheim Karl Theodor in 1781. Since the second half of the 18th century Mannheim was famous for its high scientific and cultural standard. Karl Theodor assigned Johann Jakob Hemmer (1733-1790) to organize the network called the *Palatine Meteorological Society* which belonged to the Academy of Science. Hemmer established a network with 39 locations — they even had some more applications but only 39 observers fitted to the strict expectations of the society. These strict expectations can be read in Hemmer's manual of how to be a good observer. Here he exactly describes the instruments — most of them placed at the disposal by the society like calibrated thermometers, barometers and hygrometers but also some instruments the observers had to build by themselves– and how to apply them to the observation space. Here we see how data are actually treated before they get notated in the table, they are handled like raw eggs: "When one observes the thermometer, which is attached outside of the building, one has to take care that the quicksilver doesn't get heated by the candle or the breath of the observer. Observations have to take place three times a day at precise hours at 7 am, and 2 and 9 pm. Who is prevented of observing should ask a skillful neighbor to do the observation — although this is not within the meaning of the Palatine society." If we think about the language of robust and hard data today it is interesting to see how sensitive at this state data collection actually is.

The servants who were obliged by this new practice were doctors, pharmacists, pastors, civil servants, schoolteachers, astronomers and mayors. We can imagine 39 well studied persons — all of them familiar with self-discipline by training — following the same routine for more than 15 years three times a day. It is unknown if any observer was found to be unreliable – Hemmer allowed only in exceptional cases to ask a "skilled neighbor" if the servant was prevented – although this wasn't within the meaning of the directive. All tabular forms are filled in with great discipline box by box. So behind all climate maps stands a huge number of faithful servants, — a disciplined and standardized bureaucracy of the weather or "Tabellenknechte" (spreadsheet servants) — filling in the charts day by day. Even today many activities creating weather data are executed by persons, e.g. the hundreds of weather balloons which are send up around the globe twice a day at world time.

REINTEGRATION
Such tablework operations can be regarded as technologies of describing the world and technologies of the archive. There were many effects of the early climate visualization realized by Humboldt and his successors. Measured data draw a distinctively different picture of climate zones than it was developed by pure mathematical speculation. By processing and visualizing the weather data therefore climate as a scientific entity was visually brought into being. At the same time there were many charges this early scheme brought up. The early visualization functioned as a concept for a method and practice, which had to be continued "for ever" in order to track weather and climate more precisely. Here we could talk about the bureaucratic materiality of such processes. For example there evolves a very strong duty of a table that commands to fill in the table like a letter case; but also the implicit command of this method to maximize standardization on all levels, be it instruments, operations and most important time. To the present day, the connection between analytical graphics, trust in numbers / data and scientific knowledge has not only persisted, it has actually intensified. The method of data visualization functions as an epistemic and heuristic instrument of knowledge production and it revealed climate change.

Extract of one of the oldest weather lists from a station at Hohenpeißenberg which is still operating today, Deutscher Wetterdienst

Research Note #6: The Blue Marble
Mushon Zer-Aviv, Shenkar School of Engineering and Design, Tel Aviv

NASA, "Blue Marble", 1972, Wikimedia Commons, Public Domain

Throughout most of human history, mapping the world was a failure-ridden poetic pursuit—an attempt to visualize that which is just too close to see. Cartographers collected discrete signals and attempted to put them together into "the big picture". In recent decades space travel has offered us a unique perspective to re-evaluate the map and the mapped.

DISCLOSURE
On December 7, 1972, the Apollo 17 spaceship was shooting to space, on its way to the moon. 45,000 kilometers above ground, positioned in perfect zenith between the sun and the earth, the spaceship's crew could see the earth for the first time fully illuminated as a big round circle in space. The picture they took, titled "The Blue Marble" has become one of the most iconic and widely distributed photographs in history. After every representation of the earth before it tried to map and patch together dispersed bits of spatial measurements, Blue Marble documented the first time the illuminated earth exposed itself to the naked human eye. And so it was in a way the first clear photographic proof that the world is indeed a sphere, confirming the speculation made by earth-bound astronomers and cartographers for thousands of years.

ANALYSIS
There was one problem spoiling the fun though, the continent most prominently present in the picture was Africa, with a bit of the Arab peninsula appearing near the edge, not North America, not even Europe. And worse, the photograph was actually showing South at the top and North at the bottom, with the island of Madagascar appearing to the left of the African mainland. Blue Marble confirmed our notion of the earth's shape as a sphere, but refuted our Eurocentric image of the North belonging at the top and the South at the bottom. Understanding the historic significance of the image, NASA decided not to publish the image as is, but to flip its orientation to indeed reinforce our existing image of the world.

REINTEGRATION
The original angle of the shot taken from the Apollo 17 was absolutely arbitrary, but the choice to flip it was not. It was a meaningful intervention that indeed could have happened in the moment of shooting, but it did not. By flipping the image NASA did an act of reverse-visualization. They manipulated a cleaner, more neutral representation (the photograph) to match the data-driven, symbolically-packed, historic image (the map).

This is a part of the personal biography of every discrete GPS datum, shot from a satellite circling the earth into our latest mobile devices, and then mapped to the longitude/latitude coordinates, that were set in the 15 century by ocean navigators looking for signals in the skies. The story of Blue Marble should serve as a reminder that "raw data" is actually an oxymoron. Every datum, whether it be numerical, textual, visual or other, is the product of language and culture, and should always be used, analyzed and appreciated as such.

TRAUMA

8pm
Trauma: The Language of the Technosphere
PRESENTATIONS, DEMONSTRATIONS, LECTURE PERFORMANCES

How is the technosphere inscribed into individual human bodies? How are they restructured along a complex machinery of instruments, techniques, simulations? Which kinds of injuries and frictions result from it? Five lecture-performances offer close readings of traumatic interface between humans and technology in the technosphere.

In this investigation we explore trauma as a way of understanding the impact of the technosphere on individual bodies, based on the premise that the technosphere body is disclosed in and through trauma. This conception frees the notion of trauma from its hackneyed psychoanalytic treatment and locates it within a general process of ontological- and epistemological-becoming in the technosphere. It conceives of trauma in terms of processes of recursion, iteration, and memory, by which violence and disruption inscribe themselves within cultural and technological systems. When this happens, it becomes necessary for the individual, the culture, or the environment to create new ways of living with and around the scars left by a traumatic event. TRAUMA therefore invites reflection on this polymorphic process of wounding, recovery, and adaptive (or maladaptive) reiterations. In this regard trauma includes not only violence but also responses that incorporate new and productive constellations.

With Rana Dasgupta (novellist, Delhi, London), S. Løchlann Jain (medical and legal anthropologist, Stanford University), Clapperton C. Mavhunga (africanist, STS scholar, Massachusetts Institute of Technology, Cambridge, MA), Matteo Pasquinelli (philosopher and media theorist, Pratt Institute, New York), Lucy A. Suchman (anthropologist, Lancaster University)

S. LØCHLANN JAIN
In this performance-lecture ethnographer S. Løchlann Jain examines how commodities and violence sustain one another in the technosphere. According to Jain, society dedicates ever-increasing sums of money to preserving life and preventing death on the highway. Yet the safety defined in this data is narrowly circumscribed by technical, economic, and even aesthetic imperatives of the autoindustry. In this performance Jain demonstrates the aesthetic limits of proof, demonstrations, and data on fatal accidents.

RANA DASGUPTA
Do we have any real "memory" of traditional relationships to earth, to nature, and to society itself? Would the loss of such memories constitute a trauma? And if it did, how would this trauma display itself in the life of a society? In this panoramic presentation novelist Rana Dasgupta traces the data-trails of the technosphere, from rural artisan cultures of India through new cultures of global desire, making stop-offs at Facebook and Hollywood along the way.

LUCY A. SUCHMAN
What happens to warfare transposed from flesh to data? In this lecture-performance anthropologist Lucy Suchman examines the connection between real and imagined trauma through a close-reading of Flatworld, a virtual world that trained U. S. soldiers for urban combat in Iraq.

MATTEO PASQUINELLI
Matteo Pasquinelli offers an archaeology of the cybernetic brain as it evolved from the interwar studies of German-Jewish neurologist Kurt Goldstein, to cast light on the multiple possibilities and histories embedded in our age of 'intelligent machines.'

CLAPPERTON C. MAVHUNGA
How does anticolonial struggle define the limits to the technosphere? In this intervention historian of technology Clapperton C. Mavhunga examines how the traumatic effects of colonialism in Zimbabwe became a site for the construction of indigenous modes of politics and technology.

Trauma — Research Notes

The technosphere is neither a "what" nor a "where." It is a how, produced by the constant adjoining, interfacing, exchanging, and correlating among times, places, and modes of existence. To schematically grasp the continuous conjoining that constitutes the technosphere, we asked our lecturers to submit Research Notes that offer schematic snapshots of the fields, entities, modes, and procedures producing phosphorus, datum, and trauma as streams within the technosphere. These schematic presentations serve as a supplement to the actual lectures—neither summarizing nor substituting the actual talk, instead they present a transversal addition to the main analysis—and serve as a snapshot of different levels and sites that participate in the ongoing, unfolding, open-ended event known as the technosphere.

Like the technosphere itself, these notes experimentally coordinate diverse entities—image, text, sound, experience, bodies—into chains of production.

There are three sets of Research Notes, corresponding to the three streams in our discussion. Together they provide a transversal view into the formal operations governing fields of the technosphere.

Participants in the Trauma stream identified a media artifact, an event or a specific disruption that represents the processes of repetition, recursion, and recollection—both de-structive and pro-ductive—that integrates traumas into the technosphere.

Research Note #1
Rana Dasgupta, novelist, Delhi, London

EXHIBIT
The recent Disney animation movie, *Inside Out*, which tells the story of a girl named Riley.

Riley looks like normal eleven year-old girl. In fact she *is* a normal eleven year-old girl. In the world of *Inside Out,* however, normal eleven year-olds are not the authors of their own lives. Though she does not know it, Riley is operated by five characters who live inside her mind, controlling everything she does. By manipulating her feelings and memories, these benign managers programme Riley's behavior, and so secure for her what she cannot secure for herself: happiness.

In this sense, Riley does not have what children in film and literature are traditionally admired for: *personality*. Nor is she, in the conventional sense of the word, a *character*. She is more a *product*, or an *effect*, or technological processes. The real protagonists of the film are the managers in her inner "Headquarters". They are the ones who have character, conflict, and a "job to do". Riley — the human creature — is simply an "output".

NOTES
It is immediately apparent that human interiority in this film has the visual structure of computers. Riley's glowing memories are stored in server-like stacks. They remind us of 1940s and 50s vacuum tube computer rooms, and Riley's operators of their masterful administrators.
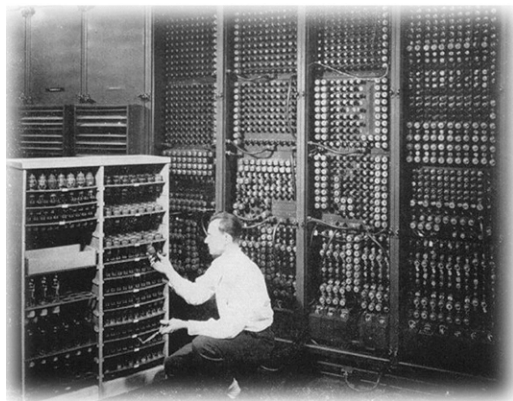
ENIAC, U.S. Army Photo, circa 1947 — 1955, Public Domain

Of course, cinema has been full for a long time with computer-controlled human beings. What strikes me as novel about *Inside Out* is not the *fact* that Riley is controlled by technological forces inside her head, but the *mood* that attends it all. For unlike almost all previous treatments of such themes, here there is no horror. The mood is not in the slightest way uncanny. It is entirely, extravagantly, lyrical.

It would seem that, at the present stage in the relationship between human beings and computers, the partial take-over of the one by the other no longer seems to threaten the category of "the human." In fact, in this film, it is *precisely the internal console and database that allows the human being to realize its humanity.*

It is as if, in the emerging technosphere, the raw human being is "not enough." Its irrational moods and limited intellectual powers prevent it from becoming what it is. Only with technological prostheses (of the kind that are already organic to the youthful audiences of *Inside Out*) can the human being realize itself. The technosphere reformulates the ancient oppositions. "Becoming-computer", now, is the prerequisite to "becoming-human".

ENIAC, U.S. Army Photo, circa 1947 — 1955, Public Domain

31
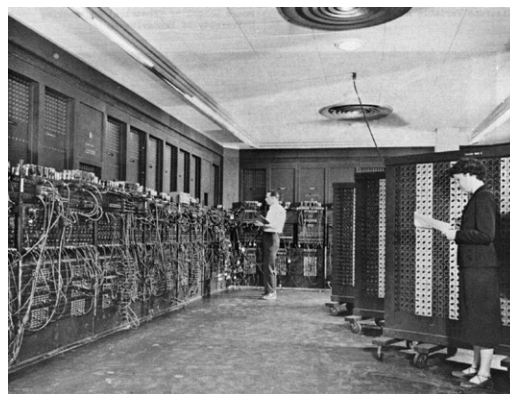
Research Note #2: Traumasphere, Thinking through Commodity Violence
S. Løchlann Jain, Stanford University, California Santa Clara

S. Løchlann Jain, 2015

Littered ground: decaying leaves, cigarette butts, dislocated feathers. Unnoticed detritus pushed by each passing wheel further into the macadam, further from the notice of any passerby who may — many will, after all — fall also under the tread of the tire like so much extruding yellow paint.

An instantaneity inheres to the crash. Barely time to notice what happened or to prepare for what is to come. And a public invisibility to the crash — though we have all witnessed one or two, though several in each 100 of us will still be hurting, some badly, as the result. Strewn flesh, glass, and metal are generally cleared from public view within a matter of quarter hours.

One isn't surprised to guess that the genus of the feathers in this image is probably Columba, and that whether considered "thoroughbred of the air," or "flying rat," the pigeon punctuates daily human life in many urban centers. A dead pigeon is more or less the same as a live pigeon, hardly worthy of a second glance. Thus, the ubiquity of roadkill. Human lives are another story.

Investigators and forensic scientists search the remains, seeking to isolate and lay out a reconstruction of events that culminated in a crash and human death. They aim to find fault, to explain how things might have gone differently. The practice holds within it the promise of safe passages through everyday life, if only... something had not gone wrong, rules had been obeyed.

Powerful institutions enforce a notion that traffic violence is merely accidental. Whole systems dedicate huge sums of money and vast numbers of hours to ensuring that we understand that these traumas might be avoided and that we acknowledge that they occurred only because of a malfunction in a carefully constructed system in which all roles are inscribed. The direct and indirect aftermaths are managed and this infrastructure serves to smooth over any potential social rupture. And the infrastructure offers an expiation of sorts.

One senses that higher investments underlay the project of fixing broken bodies and crumpled metal. The key investment is maintenance of the myth of the viability of the system. It is this sinister founding ideal to which the strewn bird feathers call attention. The automobile industry itself has played no small part in laying out the ground rules for the apotheosis of the car. The genesis of car safety has emerged only within the context of, and nearly by permission of, the industry. The commodity and the violence hold each other, patch each other up, make each other possible. Artists have struggled with how to make material this visceral relay among mechanical vitality, decay, and destruction: how might we bring these stakes into relief in ways that resonate without purely illustrating, disturb without objectifying, interrupt without contradicting?

Traces and counterfactuals provide clues to the formation of the traumasphere's scars and the costs of cohabitate with, and inside of, the hurtling projectiles of everyday urban life.

Research Note #3: Colonial Rule, Trauma & the Innovation of Survival
Clapperton Chakanetsa Mavhunga, Massachusetts Institute of Technology, Cambridge, MA

How may key sites of trauma and struggle in Zimbabwe's history help us think about the twin notions of technosphere and Anthropocene? Through the pictures enclosed here, I hope to show a clear itinerary from:

a) The colonial occupation of the lands of the local African inhabitants, the Shona and Ndebele, in 1890 and 1893 respectively.
b) Their resistance (called chimurenga) in 1896–7 and Rhodesian responses to it
c) After the suppression of chimurenga, the traumatizing African experience of colonialism as oppression (1890-1980), and:
d) The African struggle for self-liberation (1962-80) as response to colonial trauma, and the Rhodesian state's response.

All five moments are explored from an angle they have not been examined before: as a battlefield between two sides, involving innovations against each other, the sort that brings rewards (wealth, security, freedom) through injury to others, injury that both leaves trauma and turn trauma into technology (means and ways) of achieving an objective. What might they (not) mean from there?

The Rhodes Colossus - Striding from Cape Town to Cairo", 1892, Wikimedia Commons, Public Domain

OCCUPATION
The starting point in this narrative is the colonization by the chartered corporation, the British South Africa Company (BSAC), and the personal ambitions of its chair and prime mover, Cecil Rhodes, to create a British Empire spanning the entire continent. This ambition is represented rather nicely in this image of Rhodes, straddling all Africa, and imagining what it would mean for his mining empire to build a railroad from Cape to Cairo. Fewer images summarize the interweaving of the individual, environmental, financial, technical and political than this 1892 cartoon.

National Archives of Zimbabwe

RESISTANCE
Rhodes's imperial, personal, political, and corporate ambition to occupy the lands north of the Limpopo River (what is now Zimbabwe, Botswana, and Zambia) could only be accomplished through violence. The result was the rising of the Shona and Ndebele (Africans) in 1896-7. I will show that, contrary to the popular perception that Africans lost this war because of inferior guns, archives demonstrate clearly that African guerrilla warfare--specifically the use of mountains as defensive and offensive infrastructure--had virtually neutralized the firepower of the Maxim and Nordenfeldt guns the British forces were using. The rinderpest decimated the horses and oxen required to cart the heavy guns. In desperation, the British forces resorted to using dynamite to blow up entire communities hiding and fighting from the hills, and opening up with Maxims on anyone trying to go to the fields to plow. Thus, mass starvation became a critical weapon of war. This example must force us to rethink the Eurocentric narrative of "tools of empire," which foreshadowed the concept of technosphere and anthropocene in its universalistic, yet Western-centric conceptualization of global events.

In the aftermath of failed resistance, in 1890-7, Africans were violently stripped of their lands and freedoms, and their leaders arrested, many beheaded, and their heads sent to Britain as evidence of capitulation. This image (National archives of Zimbabwe) shows African warriors captured during the 1896-7 risings (also called *chimurenga*), awaiting death row. I use it to invite dialogue on the colonial prison as a technological space, with chains, the law, and guns as three among many technologies of imposing colonial rule. But notice the defiance in these men's eyes, interlocked arms, and firm standing posture, and how it exudes a psychological refusal to succumb to their traumatic torture and impending execution.

33

COLONIAL TRAUMA

Early resistance failed; outgunned, Africans yielded to Europe's colonialism, which they experienced and remember not as "colonialism" but *hudzvanyiriri* (oppression)*, hunhapwa* (slavery), and *kubatwa semhuka* (dehumanization). First, Africans were violently removed from their land to make way for white mines and farms, and resettled in overcrowded, infertile, and disease-infested areas called "native reserves." These labor reservoirs were open to any white settler who needed forced labor (*chibaro*); to ensure supply, the colonial government imposed a slew of taxes, and made failure to pay a criminal offense. Either way, the settlers were assured of labor: the African would either come willingly, earn a wage and pay taxes, or as convict labor for failing to pay them. The entire road, rail, urban, mine, and agricultural infrastructure of the colonial period was built using either poorly paid or convict labor. This is how Africans subsidized colonial settler prosperity and became the tools of empire. They became the extractive instruments through which the colonizer turned the environment into minerals (gold, iron, copper etc.), agricultural produce (tobacco, maize, cotton, sugar), and livable space (cities, farms, mines). The marker of the sub-human condition of Africans in the white colonizer's eyes is symbolized in the "color bar," which designated access to everything according to the color of one's skin. This image (National Archives of Zimbabwe) shows the racial segregation of roadside and park benches into a "Whites Only" privilege.

National Archives of Zimbabwe

INNOVATING SELF-LIBERATION

Chimurenga would become the inspiration for the second and decisive armed struggle against the colonizer in the 1960s-70s, hence its name: *the second chimurenga*. A key aspect of this war was the unity of action between the guerrilla and the rural masses. Fewer images capture this symbiotic relationship between the gun (guerrilla) and the cooking stick and grinding stone (women) than this photograph from *Zimbabwe News*, the official newsletter of the Zimbabwe African National Union (ZANU), the political wing of one of the two main liberation movements,

Zimbabwe News

the Zimbabwe African National Liberation Army (ZANLA). The other, equally important, guerrilla army was the Zimbabwe People's Revolutionary Army (ZPRA), the armed wing of ZAPU (the Zimbabwe African People's Union). ZPRA was armed by the Soviet Union and Cuba, trained in Angola, and operated out of Zambia; ZANLA was armed by China, trained in Tanzania, and later Mozambique, from where it operated since 1971. ZANLA was an ally of the Frente de Libertação de Moçambique (FRELIMO), which had fought the Portuguese until it secured independence in 1975. Having already reached a military pact and fought side by side in northern Mozambique prior to independence, FRELIMO now granted ZANLA freedom and space to establish military bases across the entire frontage of its border with Rhodesia (see map below).
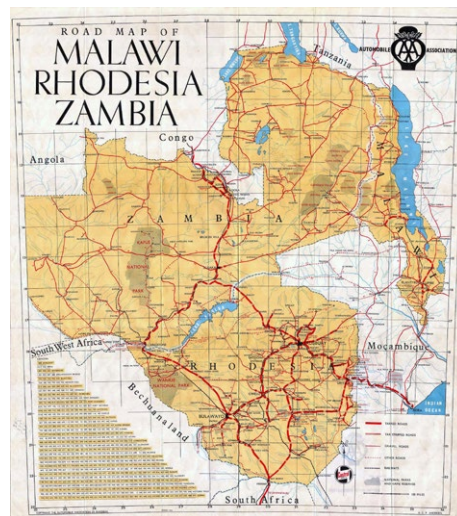
National Archives of Zimbabwe

INTERCONNECTED LOCALS = GLOBAL: BUT CONSTRUCTED FROM WHERE?

FRELIMO was an ally of the Soviets; strategically, that meant Mozambique received and deployed Soviet-made hardware in support of ZANLA. In October 2011 I toured almost all of ZANLA's wartime bases from Tembwe in Tete Province right up to Maputo where I was shown locations of safe houses and residences of major political leaders of ZANU, the South African National Congress (ANC), and other liberation movements in the 1970s. Among the photos I took on this tortuous 2000-mile journey drive is this Soviet

tank at Masenjeni, inside southwestern Mozambique near the Zimbabwe border, with weeds growing through it three decades after the massive bombing in a Rhodesian crossborder aerial raid in 1979. It opens up dialogue on the interweaving of local struggles and Cold War superpower rivalries.

Clapperton C. Mavhunga, 2011

Also striking were Rhodesia's own innovations, very visible on the battlefield. It is all summarized in this image of a military convoy.

Peter Baxter

To the present these convoys still come to my dreams, still as scary as they happened, bulldozing into my dreams just as they did then when detouring off the rural roads of Chihota communal lands to avoid landmines planted by the guerrillas, and plowing through our barbed wire fences and maize crops. They were called the "Crocodile" or "Puma" armored cars, with 2 cm of armor plate, virtually moving bunkers--designed and made in Rhodesia, to traumatize any onlooker visually, and deter any support to the "gooks," "commies" (communists) or "terrs" (terrorists), the derogatory terms the Rhodesians used to describe the "freedom fighters" (according to the black majority). Back to the photo: so out in front are the landmine detecting and clearing vehicles, the "Pookie," another Rhodesian innovation. Two "Pumas" follow, then two soft-skinned Mercedes Benz of German make, yet retrofitted to the point of hardly being recognizable even to its manufacturer. And so on. From troop carrier and anti-landmine vehicles to Cessna vehicles turned into military spotter planes to deadly chemical pesticides like Thallium, napalm, and multiplex torture techniques, Rhodesia's machinery of war invites us to go beyond moral questions to ask deep technoscientific questions. To often, black scholars demonize the Rhodesians and see only the oppression, ignoring that even oppression required innovation. In turn, ex-Rhodesians demonize ZPRA and ZANLA and see only "gooks," "commies," and "terrs," ignoring that

being a "gook" required innovation. The technosphere I seek to explore is in-between: the battlefield.

PAYING THE ULTIMATE SACRIFICE: THE STRUGGLE AS TRAUMA

In the aftermath of a combined Rhodesian ground, air, and biochemical attack on ZANLA's military headquarters at Praça Adriano (Chimoio) on November 23, 1977, casualties ran into thousands, and survivors could only bury their comrades in mass graves like these, mere mounds of earth in wartime, rehabilitated after independence. Today at Chimoio the Zimbabwean and Mozambican flags flying side by side, testimony to wartime black solidarities

Clapperton C. Mavhunga, 2011

against the oppressor. The names of those that died during the bombing are written on the black granite memorial underneath, facing row-after-row of mass graves. Visiting Chimoio and most of the major Zimbabwe guerrilla bases of the 1970s inside Mozambique along the border in 2011 (all the photos are mine), I was told of the restless souls of the dead, with strange goings on at these sites, now virtually abandoned by the very people they died to put in power. It is from there that I will end my reflections on the notion of technosphere.

Research Note #4: Order as the Sign of Trauma (The Object of Trauma is the Most Abstract)

Matteo Pasquinelli, Pratt Institute, New York
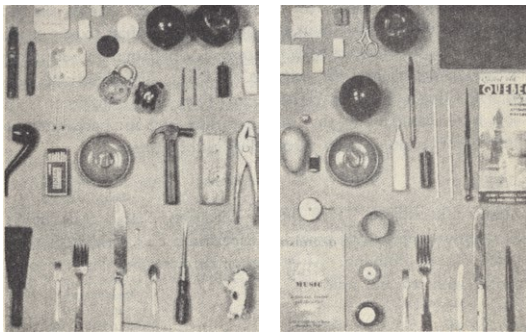
Kurt Goldstein and Martin Scheerer, "Abstract and Concrete Behavior: An Experimental Study with Special Tests", *Psychological Monographs* 53/2 (1941): 80., Public Domain

How can we visualize or depict a trauma? Usually we perceive and register the psychological effects of a catastrophe or trauma as a physical disruption of our environment, social relations, habits, infrastructures, individual and collective affects, which happen to be difficult to heal. We usually identify trauma as a turbulent state of disorder—a wound that is difficult to recover to its previous organic unity. The object that is recalled to exemplify trauma has to show the signs of violence and the fatigue of a recursive attempts to heal.

A century ago, the neurologist Kurt Goldstein and his colleague Adhémar Gelb formulated a different hypothesis. In Frankfurt, and later in Berlin, they were studying WWI soldiers that were arriving back from the front with severe brain injuries. They noticed that some of them were keeping their hospital rooms perfectly in order. Everyday, within the space of their rooms, they were cleaning and sorting things in a maniacal way. A sudden change in the disposition of the objects, or an external event like an unexpected visitor, could provoke immediately discomfort, pain and violent reactions. The patients were no longer able to tolerate the minimum degree of disorder within the Umwelt of their objects: order was the sign of trauma.

It happened also that other patients were able to grasp objects, but they were unable to point to them with their forefinger when simply asked to do so without grasping. Others could recognize a square (like a window) only upfront, not when the square was shown from an oblique angle. The syndrome is called *visual agnosia* and also affects the recognition of a familiar object or face that is appearing in unusual circumstances (an event sadly common to many encounters with Alzhaimer's patients).

Goldstein and Gelb made then the following hypothesis: that brain traumas were precisely affecting and undermining the patient's ability of abstraction, that is the ability to recognize abstract shapes despite their context and also the ability to live in a space of a chaotic disposition of objects and people. Goldstein and Gelb thought that spatial order is not necessary: objects' order and function can be mentally reconstructed and manipulated without intervening in their very physical disposition.For this purpose they introduced a clinical test to be performed with common objects and hardware tools (see Fig. 1) that were supposed to be sorted according to their shape or function. Later on, after being arrested by the Nazi police and emigrated from Germany to US, Goldstein developed a new test to detect brain traumas (which curiously resembles a children's game, see Fig. 2).

Science Museum/Science & Society Picture Library

Does trauma have a shape in its own? The French mathematician René Thom proposed a topological model for catastrophe, that was inspired for his own admission by Goldstein's theory of cognitive catastrophe. Thom indeed attempted to give to the catastrophic genesis of trauma a universal form.
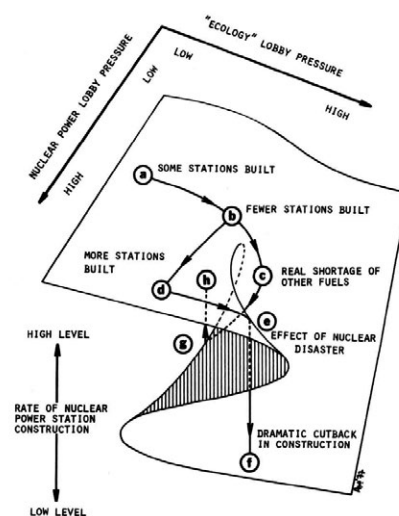
From CATASTROPHE THEORY by Alexander Woodcock and Monte Davis, copyright © 1978 by Alexander Woodcock and Monte Davis. Used by permission of Dutton, an imprint of Penguin Publishing Group, a division of Penguin Random House LLC.

These models are curiously similar to each other. Maybe too much: the mathematical description of the collapse of the Roman Empire resembles the one that describes aggressive behaviour in dogs, or this one (Fig. 3) about the development of nuclear power. Nevertheless this topological model for catastrophe can be used eventually to illustrate Goldstein's theory as a catastrophe of the mind's Gestalt and trauma as a regression of the mind of a previous and poorer state of cognition.

Research Note #5: A document of real/virtual trauma in the Technosphere — FlatWorld
Lucy Suchman, University of Lancaster
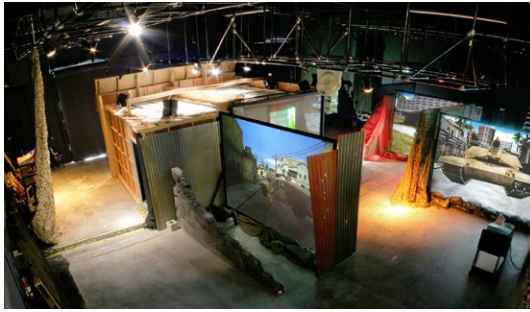
Jarrell Pair, 2005

In his book *Virtuous War* (2009 [2001]), political theorist and U.S. military chronicler James der Derian identifies the opening of the Institute for Creative Technologies (ICT) in 1999 as a founding moment in the emergence of what he names the military-industrial-media-entertainment network. Explicitly committed to strengthening the synergies of the entertainment and defense industries, the U.S. Army allocated $45 million for the first five years to the University of Southern California to create a research laboratory dedicated to the development of advanced simulations. der Derian proposes that "[b]y its very task and potential power to create totally immersive environments — where one can see, hear, perhaps even touch and emotionally interact with digitally created agents — the ICT is leading the way into a brave new world that threatens to breach the last fire walls between reality and virtuality" (ibid:167).

What should we make of these 'fire walls' between the real and the virtual? In exploring the archival remnants of FlatWorld, a flagship project at the ICT from 2001 to 2007, my aim is to attend critically to the imaginaries that are realized in the simulation's figurations of places and (raced, gendered) bodies, as well as through its storylines. This is part of a wider project of understanding how distinctions between the real and the virtual are productively elided in technoscientific military discourses, in the interest of recovering differences that matter.

A central challenge for military simulations, as conceived by their sponsors and those for whom they are designed, is the achievement of 'realism' or verisimilitude between the simulation's figurations and sites of projected operation, their inhabitants, and potential events that might occur there. It is this challenge that the special effects know-how of the entertainment industry is called to address.

In 2006, with funding from the U.S. Office of Naval Research, the FlatWorld project was elaborated as the Infantry Immersion Trainer (IIT), aimed at training for the U.S. Marine Corps in preparation for deployments in Iraq and Afghanistan. Installed in a large, abandoned tomato factory in Camp Pendleton in California, the simulation's promise was 'to inoculate the Marine rifleman from the sights, sounds, smells, and chaos of close quarters urban warfare while enhancing his ability to make correct legal, ethical, and moral decisions under the stress of combat.' First used by the Marines for training in November of 2007, the press were invited to 'embed' with the Marines in a demonstration training exercise combining 'live action role players' and 'virtual Iraqis', projected onto holographic screens to create interactive battle simulations.

Jarrell Pair, 2006

In the larger project of which my engagement with the FlatWorld archive is part, I focus on the military concept of 'situational awareness,' and more specifically the requirements of 'positive identification' and 'imminent threat' that underwrite the canons of legal killing. I'm thinking about the trope of 'situational awareness' through related questions of intelligibility and identification, and more particularly through a frame inspired by Judith Butler's theoretical analysis of recognition's generative agencies. In *Bodies that Matter,* Butler suggests that the intelligibility of the body includes always its "constitutive outsides," those unthinkable and unlivable bodies "that do not matter in the same way" (1993:xi). "Bodies that do not matter in the same way" takes on further resonance in the context of simulation, as another sense of bodies differently materialized. FlatWorld's distinction between 'us' who are actual, and 'them' who are virtual plays as another layer of intelligibility and identification, which works in a complex dynamic with other readings of 'us' and 'them' that are so central to the operations of war. At the same time, we begin to see how our bodies immersed in virtual environments are transformed, while 'their' virtual bodies are also reiterative and generative of actual ones.

So I close with a question, which sets up my research agenda: how can we think simulation and actuality together through their resemblances — their real, corporeal connections — *and* articulate their crucial differences, particularly when it comes to acts of wounding and killing? If the construction of the enemy is not a singular or determining act but rather a process of reiteration, how might we reconceive 'training' from training the body in recognition and response (the current conception of 'situational awareness'), to training as itself *productive* of the entities to be recognized? Seen as another mode of reiteration, simulation is then deeply implicated in performing the realities that it cites.

CONTRIBUTORS

LINO CAMPRUBÍ
Lino Camprubí is a Research Scholar at the Max Planck Institute for the History of Science in Berlin. He is author of *Engineers and the Making of the Francoist Regime* (Cambridge; Massachusetts 2014: MIT Press). Camprubí obtained a PhD in history at UCLA and then became a member of the ERC-funded project The Earth Under Surveillance, where he published on phosphates at the Western Sahara. His current project deals with oceanography, acoustics and the global environment.

ZACHARY CAPLE
Zachary Caple is a Ph.D. candidate in Cultural Anthropology at the University of California Santa Cruz. Zachary investigates multispecies landscape change in relation to histories of industrial disturbance and state restoration schemes. His dissertation, *Holocene in Fragments*, describes how one industry — the phosphate fertilizer industry — has transformed the Florida peninsula through mining and agricultural runoff. His research has been funded by the National Science Foundation, Wenner-Gren Foundation, and the Social Science Research Council.

GREGORY T. CUSHMAN
Gregory T. Cushman is Associate Professor of International Environmental History at the University of Kansas. His research interests include Latin America; history of science and technology; the Pacific World; indigenous peoples and global history. His book *Guano and the Opening of the Pacific World: A Global Ecological History* (Cambridge 2013) has won four international awards. He is the recent recipient of a Carnegie Fellowship to research the historical roots of the Anthropocene.

RANA DASGUPTA
Rana Dasgupta is a novelist and essayist. His texts concentrate on issues of home and homelessness as well as rootedness and motion in a globalized world. Dasgupta is winner of the Commonwealth Writers' Prize for his novel *Solo* (2009). His latest book, *Capital: The Eruption of Delhi* (2014, in German: *Delhi: Im Rausch des Geldes*), is a non-fiction exploration of his adopted city of Delhi, and, in particular, the changes and personalities brought about there by globalization. Dasgupta is Distinguished Visiting Lecturer and Writer-in-Residence in the Department of Modern Culture and Media at Brown University.

HEATHER DAVIS
Heather Davis is currently a postdoctoral fellow at the Institute for the Arts and Humanities at Pennsylvania State University where she researches the ethology of plastic and its links to petrocapitalism. She is the editor of *Art in the Anthropocene: Encounters Among Aesthetics, Politics, Environment and Epistemology* (Open Humanities Press, 2015) and *Desire/Change: Contemporary Canadian Feminist Art* (MAWA/McGill-Queen's Press, forthcoming). Her writing can be found at heathermdavis.com.

JENNIFER GABRYS
Jennifer Gabrys is Reader in the Department of Sociology at Goldsmiths, University of London, and Principal Investigator on the ERC-funded project, "Citizen Sense." Her publications include *Digital Rubbish: A Natural History of Electronics* (University of Michigan Press, 2011); and *Program Earth: Environmental Sensing Technology and the Making of a Computational Planet* (University of Minnesota Press, forthcoming).

PETER K. HAFF
Peter K. Haff is Professor Emeritus of Geology in the Nicholas School of the Environment at Duke University, North Carolina. His research is on physical properties of the technosphere (network of humans, human society and technology) that do not depend on details of its parts. This non-anthropocentric perspective helps reframe the understanding of our place in the world by directing attention away from individual human purpose and highlighting the forces of cooption that bind us to the technosphere.

MARK HANSEN
Mark Hansen is professor of Literature and Visual Studies at Duke University. Crossing a host of disciplines, including literary studies, film and media, philosophy, science studies, and cognitive neuroscience, he investigates the role of technology in human agency and social life. Exploring the meaning of the relentless technological exteriorization that characterizes the human as a form of life, his research pays particular attention to the key role played by visual art, literature, and cultural practices in brokering individual and collective adaptation to technology from the industrial revolution to the digital revolution.

ERICH HÖRL
Erich Hörl is full professor of Media Culture at the Institute of Culture and Aesthetics of Digital Media (ICAM) at Leuphana University of Lüneburg. He is also senior researcher at Leuphana's Digital Culture Research Lab (DRCL). His research interests include the elaboration of a general ecology of media and technology as well as the description as well as the critique of the process of cyberneticization. He is the contributing editor of *Die technologische Bedingung. Beiträge zur Beschreibung der technischen Welt* (Berlin 2011: Suhrkamp). Among his articles is „A Thousand Ecologies: The Process of Cyberneticization and General Ecology", in *The Whole Earth. California and the Disappearance of the Outside*, ed. by Diedrich Diederichsen and Anselm Franke, Berlin 2013: Sternberg Press, pp. 121-130.

S. LØCHLANN JAIN
S. Løchlann Jain is Associate Professor in the Anthropology Department at Stanford University, where she teaches medical and legal anthropology. Jain's publications include, among others, *Injury* (Princeton University Press, 2006) and *Malignant: How Cancer Becomes Us* (University of California Press, 2013), which won the Victor Turner Prize, the Edelstein Prize, the Diana Forsythe Prize, and the Fleck Prize. Jain is currently working on three projects. The first is developing methods for anthropology from theater and art practices, the second is studying origin stories of HIV, and the third is on the history and theory of automobile crashes.

SCOTT KNOWLES
Scott Knowles is associate professor in the Department of History at Drexel University. His work focuses on risk and disaster, with particular interests in modern cities, technology, and public policy. His most recent book is The Disaster Experts: Mastering Risk in Modern America (UPenn Press, 2011), and he is series co-editor of "Critical Studies in Risk and Disaster." Presently he is also a faculty research fellow of the Disaster Research Center at the University of Delaware.

DONALD MACKENZIE
Donald MacKenzie is Professor of Sociology at the School of Social and Political Science at the University of Edinburgh. His work constitutes a crucial contribution to the field of Science and Technology Studies. MacKenzie's current research is on the sociology of markets, focusing on automated trading, the use of mathematical models, and the evaluation and trading of bonds. MacKenzie has worked in the past on topics ranging from the sociology of nuclear weapons to the meaning of proof in the context of computer systems critical to safety or security.

CLAPPERTON CHAKANETSA MAVHUNGA
Clapperton Chakanetsa Mavhunga is an associate professor of science, technology, and society at MIT and a visiting professor at the University of the Witwatersrand, South Africa. Prof. Mavhunga is the author of *Transient Workspaces: Technologies of Everyday Innovation in Zimbabwe* (MIT Press, 2014), and has just finished his second book, tentatively entitled *What Does Science Mean from Africa? A View from Dzimbahwe* and an edited volume entitled *What Do Science, Technology, and Innovation Mean from Africa?* His next two book projects focus on African Chemistry and an edited volume on Global South Epistemologies of Science, Technology, and Innovation.

MATTEO PASQUINELLI
Matteo Pasquinelli is visiting Assistant Professor in Media Studies at Pratt Institute in New York. He writes and lectures frequently at the intersection of political philosophy, media theory and cognitive sciences. He wrote the book *Animal Spirits: A Bestiary of the Commons* (NAi, 2008) and, among others, he edited the anthology *Alleys of Your Mind: Augmented Intelligence and its Traumas* (2015) published by Meson Press at Lüneburg University. In Berlin he co-curated the exhibition *The Ultimate Capital is the Sun* (NGBK, 2014) and the symposium *The Metabolism of the Social Brain* (AdK, 2014). Together with Wietske Maas he wrote the *Manifesto of Urban Cannibalism* (2012). www.matteopasquinelli.org

JÜRGEN RENN
is director at the Max Planck Institute for the History of Science in Berlin and honorary professor at Humboldt-Universität and at the Freie Universität Berlin. His research focuses on structural changes in systems of knowledge. Renn is co-initiator of the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities and co-founder of the innovative book series Edition Open Access. He has been responsible for numerous major exhibitions on the history of science. He has taught at Boston University, at the ETH Zurich, and at the Tel Aviv University. Since 2005, he is an elected member of the German National Academy

of Sciences Leopoldina. In 2014, he was awarded the science prizes "Premio Anassilaos International," "Max Planck Communitas Award," "ESHS Neuenschwander Prize" and the "Francis Bacon Award."

ARNO ROSEMARIN

Arno Rosemarin is Senior Research Fellow at the Stockholm Environment Institute. His specialities include ecological sanitation, nutrient flows, eutrophication of freshwater and marine systems and aquatic eco-toxicology. He has carried out projects in diverse countries including "Governance Surrounding Global Phosphorus Limitation" and participated at the 2nd European Sustainable Phosphorus Conference 2015 in Berlin. Rosemarin co-wrote *The Challenges of Urban Ecological Sanitation. Lessons from the Erdos Eco-Town Project* (2012) and worked on numerous scientific articles and reports.

BIRGIT SCHNEIDER

Birgit Schneider is substitute professor of media ecology in Potsdam. She worked as a graphic designer from 1998 to 2003 and was research associate in the project "Das Technische Bild" at the Helmholtz-Zentrum für Kulturtechnik at Humboldt University from 2000 to 2007. Since 2008, she is Dilthey Fellow of the Fritz Thyssen Foundation at the Institute for Arts and Media, University of Potsdam, and in 2009 was a substitute professor for cultural techniques at the Bauhaus-Universität, Weimar. Her current research focuses on the visualization of climate since 1800 and on a genealogy of climate change visualization in between science, aesthetics and politics.

KATRINA SCHWARTZ

Katrina Schwartz is a Research Affiliate at Florida Atlantic University's Center for Environmental Studies and spent the last year as a Residential Fellow at the Woodrow Wilson International Center for Scholars. She is writing a book on the politics of implementing large-scale ecosystem restoration in the Everglades. Schwartz has published the monograph *Nature and National Identity after Communism* (2006) and articles in journals including Environment and Planning A, Environmental Politics and Political Geography.

LUCY A. SUCHMAN

Lucy A. Suchman is Professor of Anthropology of Science and Technology at the Department of Sociology at the University of Lancaster. Her research interests within the field of feminist science and technology studies are focused on technological imaginaries and material practices of technology design, particularly developments at the interface of bodies and machines. Suchman's current research extends her longstanding critical engagement with the field of human-computer interaction to contemporary warfighting, including the figurations that inform immersive simulations, and problems of "situational awareness" in remotely-controlled weapon systems.

FRANK UEKÖTTER

Frank Uekötter is a Reader in Environmental Humanities in the Department of History at University of Birmingham. His research concentrates on archaeology of environmentalism, monoculture production systems and non-organic ressources. His publications include Am *Ende der Gewissheiten. Die ökologische Frage im 21. Jahrhundert* (Frankfurt; New York 2011: Campus) as well as *Die Wahrheit ist auf dem Feld. Eine Wissensgeschichte der deutschen Landwirtschaft* (Göttingen 2010: Vandenhoeck und Ruprecht).

MUSHON ZER-AVIV

Mushon Zer-Aviv is a designer, an educator, and a media activist based in Tel Aviv & NY. His work and writing explores how the interfaces of the techno-culture redraw politics, design and networks. Mushon studied design at Bezalel and interactive media at NYU's ITP. He is an honorary resident at Eyebeam. He teaches digital media as a senior faculty member of Shenkar School of Engineering and Design.

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