MONSOON
[+ other]
AIRS

PREFACE

Monsoon Assemblages is a research project funded by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Grant Agreement No. 697873). Monsoon [+ other] Airs is the first of three publications by Monsoon Assemblages arising from symposia held at the University of Westminster (2017-2019). These form part of its agenda to foster interdisciplinary conversations between the environmental humanities (anthropology, environmental studies, political ecology, cultural geography and philosophy), the natural sciences (meteorology, climatology and climate science) and spatial design (architecture, landscape architecture, planning and urban design) to further understandings of the impacts of changing monsoon climates and rapid urbanisation in South Asian cities, and investigate their consequences for the environmental humanities and spatial design practice.

MONSOON [+ other] AIRS

EDITED BY LINDSAY BREMNER AND GEORGIA TROWER

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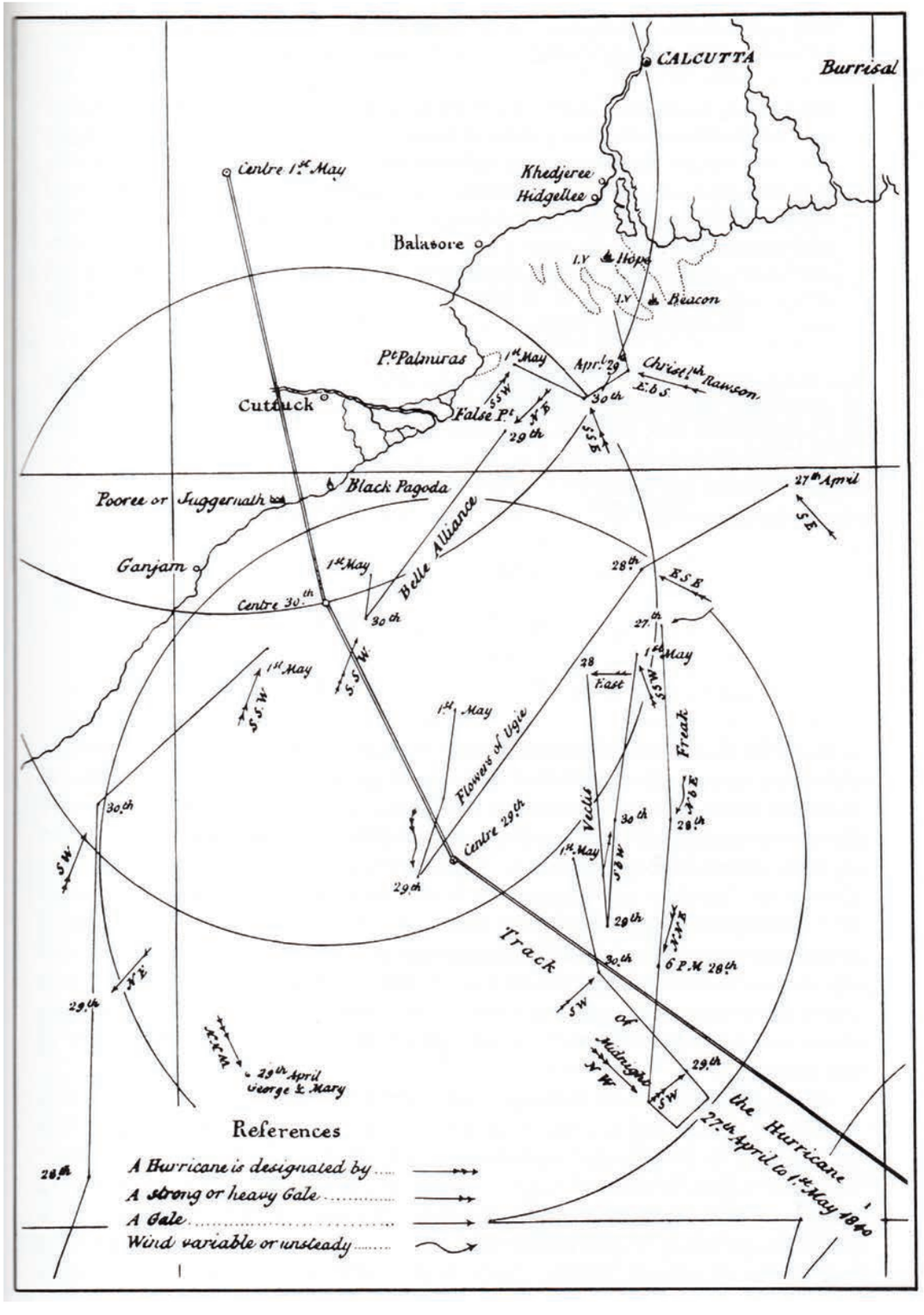
P008 Hurricane track over the Bay of Bengal, 27 April to 01 May 1840.
Eliot, J. (1900). *Handbook of Cyclonic Storms in the Bay of Bengal.* Calcutta: Government Printing Office.
Source: British Library, scanned by Lindsay Bremner, January 2017.



INTRODUCTION

Lindsay Bremner is an architect and scholar who began her academic and professional career in Johannesburg, South Africa, where she published, lectured and exhibited widely on the transformation of Johannesburg after apartheid. She was head of architecture departments the University of the Witwatersrand in Johannesburg and at Temple University in Philadelphia, before taking up her current post as Professor of Architecture at the University of Westminster. Her work positions architectural research within wider geospatial and socio-material concerns. This has included Folded Ocean, a project that investigated the transformation of the Indian Ocean world and Geoarchitecture, an exploration into intersections between architecture, geology and politics. She is currently the PI of Monsoon Assemblages, European Research Council grant no. 679873.

Beth Cullen is an environmental anthropologist specialising in participatory research methods, including participatory video and mapping techniques. Her applied work has involved developing collaborative and interdisciplinary approaches for understanding socio-ecological systems, mostly in the context of Sub-Saharan Africa. Beth's research to date has largely focused on exploring human-environmental relations, particularly water infrastructures and multi-species interactions. This has included investigations into the impact of a large-scale irrigation scheme on semi-nomadic pastoralists in the East African Rift Valley and the consequences of landscape-scale rainwater harvesting interventions for smallholder farmers in the Ethiopian highlands. During the course of these investigations, Beth has developed and utilised participatory research methods, both visual and spatial, to document changing livelihoods, landscapes, ecologies and weather patterns from an experiential perspective. In her work for Monsoon Assemblages, Beth is pursuing these interests by seeking to understand how people, and other species, experience and respond to monsoon weather in the context of the three focal cities.

Monsoon [+ other] Airs is the first of three publications that will follow symposia organised by the Monsoon Assemblages project at the University of Westminster in London between 2017 and 2019. These form part of its agenda to foster interdisciplinary conversations between the environmental humanities (anthropology, environmental studies, political ecology, cultural geography and philosophy), the natural sciences (meteorology, climatology and climate science) and spatial design (architecture, landscape architecture, planning and urban design) to further understandings of the impacts of changing monsoon weather and rapid urbanisation in South Asian cities and beyond, and their consequences for the critical humanities and spatial practice.

We live in a world where political geography and spatial planning are based on the separation of land, sea and and their associated knowledge systems. Land is understood as solid, stable, divisible and the basis of human habitation; the sea is understood as liquid, mobile, indivisible, and hostile to human settlement; air is understood as gaseous, mobile, invisible and indispensable to human life. The monsoon cuts across

these divisions. It inundates lived environments every year, connecting sky with land with sea. It is a spatial practice that reorganises air, water, land, settlements, cities, buildings and bodies through heat, wind, rain, inundation, flow and flood. It unites science with politics and policy with affect.

Today climate change is disrupting monsoon cycles and explosive socio-economic growth is transforming south Asian cities. How might the spatial design and environmental humanities disciplines respond to these twin conditions to advance uderstandings of lived environments as indivisibly natural, social and political and intervene in them through design?

In order to deepen its responses to these questions, Monsoon Assemblages is convening three symposia once a year for three years, structured around one of the monsoon's three material elements - airs, waters and grounds. This material framing is seen as a way of drawing out the relations (ontological, epistemological, political, cultural) of the monsoon with urban life.

The first of these, 'Monsoon [+ other] Airs' took place on 20, 21 April 2017. Consideration of the air, and monsoon air in particular, opened up questions of atmospheres, depressions, politics and policies; of winds, clouds, seasons and forecasts; of birds, seeds, insects, dust, disease and aerosols; of sounds and music; of wind driven trading systems; of monsoons on the air and in the media; of the many systems and technologies through which knowledge of air is produced – religious, cultural, political, scientific, everyday; of visualisations of the air and their political affect; of urban airs – airports, heat islands, air infrastructure; and of the micro-politics of urban life performed by air - air-pollution, toxic gases, air-conditioning, bodily airs.

Throughout our conversations, Timothy Ingold's reminder of the impossibility of disentangling air from lived experience was prescient:

> *It is precisely in the union of environment and sentiment, … the cosmic and the affective – that we find the essence of the atmosphere, and, with it, the guiding preoccupation of a kind of meteorology, not strictly scientific but neither purely a subject of aesthetics … Meteorology is the study of atmospheric phenomena, to be sure, but these are the phenomena of weather and not of climate, experienced but not measured, and registered in the tempering or attunement of human moods and motivations to fluxes of the medium, and in their mixture. And while we can readily identify the medium as air, this is not the air that physics or chemistry specifies by its molecular composition and that could exist perfectly well in the gaseous state without the presence of humans or any other beings to breathe it. It is rather the air that, when we breathe, carries our affective lives as they spill into the world around us. Air, in this sense, like wind and weather, is experienced, not recorded. 'I can't breathe,' says the suffocating man; 'give me air!' To be able to breathe again – that is what air is.*
>
> *(Ingold 2015, 79)*

The symposium began with a keynote address by Sean Lally, the Chicago-based architect of Weathers, a research based architecture practce, and author of *The Air from Other Planet, A Brief History of Architecture to Come* (Lally 2014). His presentation, titled 'Night White Skies,' discussed the concept of architecture as the design of aerial temperature gradient boundaries and as a dialogue between material energies and the body's sensorial envelope.

The following day's symposium was organised into three panels: 'Air Space,' 'Weather Reports' and 'Weather Politics'. The 'Air Space' panel, chaired by Anthony Powis, Monsoon Assemblages PhD fellow, presented an extraordinary combination of different epistemologies and visualisations of air from monsoon science to computational visualisations of pollution and pollen data to analysis of Yves Klein's thundercloud paintings. Dr. Andrew Turner, a meteorologist from Reading University, introduced the audience to the monsoon from a scientific perspective. He pointed out that although the monsoon is often associated with rain, temperature gradients between land and sea are its real driver. His presentation revealed the complexities of earth system dynamics and that there is still much to be learned in monsoon forecasting and prediction. Dr. Nerea Calvillo, architect, researcher and curator, discussed her visualisations of air pollution and pollen counts in Madrid, raising feminist perspectives as well as questions about the politics of data used to make them. Dr. Victoria Watson, an architect and Senior Lecturer at the University of Westminster, highlighted the contributions of artistic practice to questions of monsoon air, through her interpretation of Yves Klein's thundercloud paintings.

> *I attended the Monsoon Assemblages symposium with a little trepidation. How would I be able to communicate the key issues, in monsoon forecasting and modelling for climate change, to an audience largely made of up social scientists and architects? On the other hand, would artistic, architectural and anthropological findings surrounding the monsoon*

in India be of academic interest to me? I was encouraged to find an engaged and open audience, keen to gain a window into the science upon which we base our estimates of the future of the Indian monsoon.

(Andrew Turner, Lecturer in Monsoon Systems, University of Reading)

This was followed by 'Weather Reports,' a panel chaired by Professor Rosie Thomas, convenor of the Chevening South Asia Journalism Programme at the University of Westminster. Anasuya Basu, Rifat Islam Esha and Neha Lalchandani, all participants of this programme in 2017, reflected on how the monsoon materialises in their home cities of Kolkata, Dhaka and Delhi. Each of the reports offered insights into dominant media narratives and popular representations of the monsoon, associated urban politics, cultural practices and lived experience.

The two afternoon panels on 'Air Politics,' one chaired by Dr. Beth Cullen, Monsoon Assemblages postdoctoral fellow, and one by Professor Sudhir Chella Rajan, Monsoon Assemblages advisor from the Department of Humanities and Social Sciences at IIT Madras, featured contributions from anthropology, political science and philosophy. Dr. Stine Simonsen Puri, a postdoctoral fellow of the Department of Cross-cultural and Regional Studies at Copenhagen University gave a fascinating talk about her recent work with monsoon rain gamblers in Rajasthan, a practice considered illegal by the authorities. One of the most memorable images of the symposium was her photograph of a rain gambler squinting at the sky in order to hedge his bets on where, when and how much rain would fall, reminding us of just how much was at stake in these predictions. Harshavardhan Bhat, Monsoon Assemblages PhD fellow followed with a presentation on the complicit unknowns of monsoon air, drawing on scenes from his home state of Karnataka in South India. Dr. Hannah Swee, who holds a PhD in social anthropology from UCL presented her ethnographic observations of cyclone forecasting by locals in Far North Queensland, Australia, practices dismissed by scientists as unfounded, but firmly believed by those who live them. Dr. Etienne Turpin, philosopher and Monsoon Assemblages advisor, ended the day with an engaging presentation on the politics and problematics of mosquito fogging in Jakarta, drawing attention to interspecies ecologies and the power and agency of nonhuman entities.

The Monsoon Airs symposium was an extremely inspiring event; one of those rare moments where interdisciplinarity creates synergy and releases creative thinking. Coming from the field of anthropology, I was truly inspired by the visual and material approaches taken by other disciplines. The event not only enabled me to communicate my research on monsoon gamblers, I also developed my analytical arguments through my encounters with different approaches to the monsoon and air.

(Stine Simonsen Puri, Postdoctoral Fellow, Copenhagen University)

Professor Simon Joss, Monsoon Assemblages Advisory Board Chair, summed up the day. He emphasised the importance of crossing disciplinary boundaries and methodological reflexivity. He posed important questions about how assemblage concepts can be utilised productively to identify opportunities for purposeful intervention, and highlighted challenges around making academic discourse accessible to wider publics and translating research into accessible policy recommendations.

The symposium was accompanied by a multimedia exhibition curated by Anthony Powis. It included drawings, data visualisations and videos by a number of the speakers and students from the DS18 Master of Architecture design studio, and a video-based exploration of the architectural manifestations of the monsoon in the Srikalahasthi Temple in Andhra Pradesh, made by a group of young architects-in-training from Chennai.

The collective of voices and ideas the first Monsoon Assembly brought together inspires the possibility, of a plurality in how we construct the air, the rain, it's people, it's objects and the world. Strangely optimistic, the Assembly seems to sift through the complexities of the Air and the Rain in proposing that more can be understood in order to do better things. The venue juxtaposed the exhibition and the performances of the speakers – collaborating two ways of constructing, seeing and listening.

(Harshavardhan Bhat, Doctoral Researcher, University of Westminster)

This publication contains some of the papers and visual material presented at the symposium. With thanks to the Monsoon Assemblages Advisory Board (in particular Professors Simon Joss, Sudhir Chella Rajan and Rosie Thomas, Drs. Andrew Turner and Etienne Turpin) the Monsoon Assemblages team (Harshavardhan Bhat, Beth Cullen, Anthony Powis and Zahra Saleh), Design Studio 18 students (in particular Tom Benson, Cid Schuler and Calvin Sin) and to the speakers, exhibitors and attendees of the 'Monsoon [+ other] Airs' symposium for engaging with us in developing the Monsoon Assemblages thesis and contributing to this publication.

Videos of all the symposium presentations are available at http://monass.org/monsoon-other-airs-videos-available/

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THE INDIAN MONSOON IN A CHANGING CLIMATE

Andrew Turner Following a physics degree at Oxford, Dr. Andy Turner completed his PhD at the University of Reading in 2006 on the subject of the monsoon-ENSO relationship (a means for predicting a season's monsoon rains) in current and future climates. He looked in particular at how systematic errors in the ocean surface could limit the effectiveness of forecasts. Since then he has continued to study climate variability and change in the Asian monsoon region and is leading collaborations with the UK Met Office and internationally, including the INCOMPASS project – a ground and air-based field campaign as part of joint work between the UK Natural Environment Research Council and India's Ministry of Earth Sciences.

What is the Indian monsoon?

When most people hear the word monsoon they immediately think of rainfall, and indeed that is the monsoon's biggest impact on society. But really the word derives from an Arabic word mausim, meaning season. As India and its surroundings heat up in springtime, a large-scale temperature gradient is generated between this region and the cooler air over the Indian Ocean to the south. This temperature gradient is aided by the Tibetan Plateau, which provides a large region of elevated heating. Ascending motion over India leads to an influx of air at the surface, drawing moisture from across the Indian Ocean. The seasonal change in wind direction crosses the equator from south to north in the Indian Ocean and reaches India in summer. The characteristic C-shape of the Indian monsoon winds is caused by the Earth's rotation, leading to their passage along the eastern coast of Africa. Once the moist winds reach India the air begins to ascend and cool, allowing cloud formation and eventually the monsoon rains. The distinct difference between winter and summer wind and precipitation patterns is what characterises the monsoon in this and other regions (Fig. 01).

How will the Indian monsoon change in future?

Climate model experiments simulating a future, in which concentrations of greenhouse gases like carbon dioxide have increased, generally suggest an increase in monsoon rainfall when averaged across the country. This is thought to happen for two reasons: an increasing temperature contrast between the land and sea as the planet warms, and more importantly, warming over the Indian Ocean which allows more moisture to be carried to India. This leads to small enhancements of future monsoon rainfall, typically of five to ten percent. Climate model simulations also show different patterns of rainfall change, so it is difficult to predict how rainfall might change for particular regions within India. While most climate models suggest increasing monsoon rainfall in the future, observations made since the 1950s suggest the monsoon has been

weakening slightly. Some research has suggested this may be due to the influence of aerosol pollutants from industry.

A projected five to ten percent future change in total rainfall is similar to that encountered on a year-to-year basis: while India's summer rainfall is usually 850mm in the months of June to September, its interannual variation is around 10% in most cases. However, even these relatively small variations in the Indian monsoon can influence things like agricultural production and the stocks and commodities market; the effects of climate change on top of this could have significant impacts.

Floods and droughts

For many people in India it is variations in rainfall on shorter time scales that have the biggest impacts - intense heavy rainfall leads to flooding; breaks in the monsoon of a week or more lead to water shortage. Floods and droughts are a normal occurrence in India. In 2002 for example, a monsoon break saw July receiving only fifty percent of its normal rainfall, leading to cuts in agricultural output and GDP. Thinking about climate change in the context of how these extreme events will change can help farmers and users of water to understand its implications. Likewise, flooding in Mumbai in 2005, and again in 2017, led to significant infrastructure damage and loss of life.

It's difficult to blame or attribute a particular extreme event during the monsoon on anthropogenic climate change but we do know that the atmosphere in a warmer climate can hold more moisture, leading to heavier rainfall when it does occur. However, it will not be until we are more capable of simulating the day-to-day and week-to-week variations of the monsoon in our climate models that we will have more confidence in how these variations will change in the future. Given the increasing population of the region and need for food security, improving the scientific understanding in these areas is of utmost importance. In part, this can be achieved through better meteorological observations of the atmosphere and land surface and how they control the monsoon, for example in the INCOMPASS field campaign (www.incompass.org.uk).

NOTES

A fuller description of the monsoon and the impact of changing climate on South Asia can be found in
Turner, A. G. and Annamalai, H. (2012). 'Climate Change and the South Asian Monsoon.' *Nature Climate Change* 2: 587-595, doi:10.1038nclimate1495.

An earlier version of this article was published by the Royal Meteorological Society at
https://www.rmets.orgweather-and-climate/climate/indian-monsoon-changing-climate

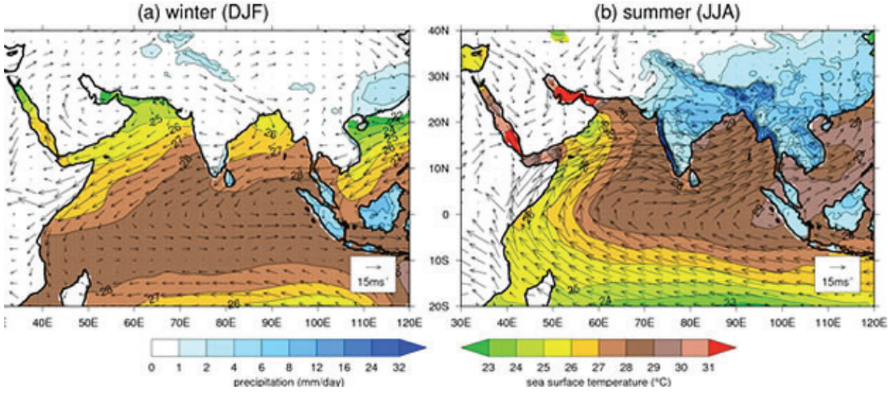

Fig. 01 Schematic diagram of boreal winter (December-February; left) and summer (June-August; right) daily mean precipitation, sea surface temperature (SST) and winds. Precipitation is shown only for the land regions of Monsoon Asia from the APHRODITE dataset (Yatagai et al., 2012); SSTs are from the HadISST dataset (Rayner et al., 2003) from while 850hPa winds are taken from the ERA-40 re-analysis (Uppala et al., 2005). Units are mm day-1, °C and m s-1 respectively; all data shown are from the 1958-2001 period.

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Source: https://www.rmets.org/weather-and-climate/climate/indian-monsoon-changing-climate

COSMOPOLITICAL VISUALISATIONS: SPECULATING ON MONSOON AIR

Nerea Calvillo is an architect, researcher and curator, and obtained her PhD at ETSAM Madrid in 2013. The work produced at her office, C+ arquitectos, and her visualisation projects like 'In the Air' have been presented, exhibited and published at international venues like the Canadian Centre for Architecture (CCA), the Contemporary Art Museum of Chile (MAC) or LABoral Art and Industrial Creation Centre. She is a Poiesis Fellow (NYU), Assistant Professor at the Centre for Interdisciplinary Methodologies at University of Warwick and Unit Master at the Architectural Association. She investigates the material, technological, political and social dimensions of environmental pollution, and her current work is on toxic politics, pollen and queer urban political ecologies.

We breathe. We fly. We dream looking at the sky. We talk about the weather. We know the names of the clouds. But what do we know about the air? The air is a multiplicity of elements, systems, objects and creatures that operate at local and global scales, entangled with the urban fabric and everyday life. Although mostly invisible and unaccounted for, in the last years the air is constantly in the media because it is polluted. The increase in the density of existing gases or particles and the appearance of new toxic ones are suffocating humans and more-than-humans to the extent that in some cities the urban landscape has been transformed. Visibility may be a condition of the past, and the thick air that used to hold cities together in the eighteenth and nineteenth centuries is back.

And yet, to understand relationship between the polluted air and the urban fabric we need to make some of its conditions visible. In science and policy making, the most common measures are concentrations of pollutants per cubic meter of air. However, we should not take these as the only possible description of the polluted air. What do we need to know when we want to make air visible? Scientific air pollution visualisations are commonly presented to the public as graphs that show the evolution in time of one single element, such as particulate matter (PM) or nitrogen dioxide (NO_2). Although useful to monitor compliance with international emission reduction treaties, one of the limitations of these visualisations is that they show only one parameter – micrograms per cubic metre, removed from any context. They provide no information about why, how or where pollution arises from, how fast it moves, here it is going to etc. This is perhaps one of the reasons why most people do not pay attention to air pollution data (Bickerstaff and Walker, 1999).

In order to overcome these problems, I have proposed to create airscapes, in which the components of air are located in space and time and in relation to each other (Calvillo, forthcoming). The opportunity of imagining pollution data as an airscape is that it enables their re-design. Contrary to what some visualisation scholars have claimed (Tufte, 2001

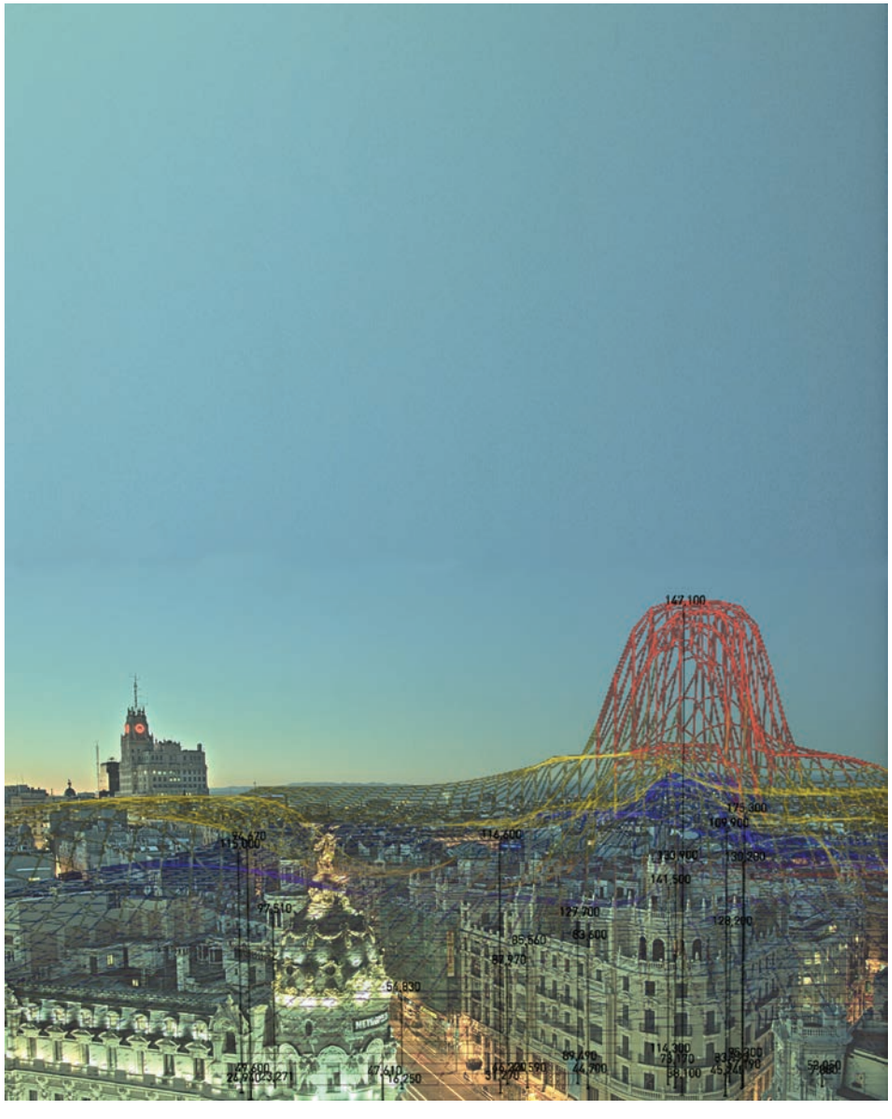

Fig. 01 In the Air (Nerea Calvillo and collaborators). Visualisation of the microscopic and invisible agents of Madrid's air (gases, particles). Permission: Nerea Calvillo.

among others), the fact that these airscapes are designed as drawings does not mean that they are inaccurate or aim to manipulate the viewer. Visualisation offers the possibility of providing new imaginaries not only of what the air is, but also of what it could be, in representational space.

Airs of the monsoon

Applying this to the airs of the monsoon, it becomes clear that other elements need to be made visible if one is to understand them. During the monsoon season in south and south east Asia, air pollution drops drastically. The air pollution graphs that show this demand knowing what has caused it. One of the reasons is that the monsoon brings with it intense rain and winds, which either blow or wash away pollutants or sediment particles suspended in the air (Zhao et al., 2010). Air and water become completely entangled. Thus to describe air quality, it is necessary to describe gases and particles and water vapour in the air. Water and air are complementary.

The monsoon clears up the haze of the winter; it is good for the air. Yet, what we normally see in local and international news is how bad it is for cities and populations, creating floods, disrupting traffic etc. What the news does not tell us is how desired and beneficial the monsoon is, not only for air pollution, but also to make high temperatures bearable for humans and animals and to water the fields. As Anasuya Basu, Rifat Islam Essa and Neha Lalchandani reported at Monsoon [+ other] Airs, in Kolkata, Dhaka and Delhi, the problem of the monsoon is not the monsoon, but the poor state of urban infrastructure. Disasters are not a consequence of the air, but of political economy. However, as Ana Tsing has written in her ethnography of matsutake mushrooms (Tsing, 2015), out of disasters other forms of living emerge. Basu, Islam Essa and Lalchandani told us that people rejoice and children play in the streets when the monsoon pours. How do we critically engage with an environmental condition that reduces pollution and waters crops, but creates other sorts of inconveniences and pain, and where the joy of its experience is silenced to the benefit of large corporations' interests?

Ecosistemic and cosmopolitical visualisations

To trouble scientific air pollution visualisations, instead of making them more simple, I suggest they should be made more complex. To understand the airs of the monsoon and their relations with urban life and fabric there needs to be a change in their representation, not only in graphic terms, as David Gissen argued in 'Theory of Air Pollution' (2012), but also in conceptual ones. We need to understand urban systems, or urban assemblages, as deeply intertwined with other systems; as ecosystems where changes in one affects all the others; assemblages that are environmental, as well as human and more-than-human. Even

if in philosophy, science and technology studies, new materialisms or feminist technoscience there has been a posthumanist turn to bring non-humans and more than humans into social life, in scientific descriptions of the environment only non-human data are represented. In this context, a reverse re-humanising turn is needed, so that humans, their responsibilities, agencies and affects are taken into account when representing environmental data. In order to do this, visualisations should aim to be what Donna Haraway calls "science art worldings," activist forms of "modest rehabilitation" (2016: 71), for dealing with our troubled times: science because visualisations make scientific data visible; art/design because they aim to create an engaged aesthetic experience; activism because they aim to transform collective ways of understanding air, not only in academia, but mostly outside of it. In the visualization of monsoon airs, environmental science, journalism, architectural design, student collaboration and visualisation techniques are knotted together, not only as an epistemic practice, but mostly as critical practice and political action.

These politics are different to the biopolitics inscribed in the wind maps of Times Square in New York (Gissen 2013), through which the authorities justified the redevelopment of the area. Cleansing the area of drug dealing and prostitution was enabled by justifying the need of aerodynamic new buildings to facilitate ventilation in case of chemical attacks. The politics I refer to here are cosmopolitical. Drawing from Hinchliffe and Whatmore (2006), who adapt Stenger's cosmopolitical project to urban studies, cosmopolitics are understood as "a political project that is concerned with a more broadly conceived accommodation of difference, better attuned to the comings and goings of the multiplicity of more-than-human inhabitants that make themselves at home in the city than conventional political accounts" (Hinchliffe and Whatmore 2006: 124). Therefore, cosmopolitical visualisations bring together air, water, infrastructures, buildings, people, winds, economy, beliefs and so on to create fictions and imaginaries as a form of doing politics.

In this context, this short text aims to be a speculation about what a cosmopolitical visualisation of monsoon air could look like, not as an end product, but as an instrument to think with its making, as a "speculating device" (Guggenheim et al., 2017:147). What if, instead of only drawing the levels of some gases and particles, we also draw particles of water, and the effects that they cause not only in the city but also in its inhabitants? The water/air of traffic jams, of saturated sewage pipes, of the laughs of teenagers not going to school, of the tension in the news because of the chaos of where cities get immersed. What air or what interpretation of the urban emerges? Bringing air and water into the same image poses not only graphical questions, but mostly conceptual ones. They have very different properties and forms of operation and involve different epistemic techniques and forms of handling (Tironi and Calvillo, 2016). What is the scale at which we want to think about the interaction between CO and water, for instance? Is it microscopic, or urban? Do we prioritise the positive effects of water cleaning up the air, or is it more relevant to point towards the positive effects in citizen's lives? Or are we more invested in the disaster caused not because of the monsoon itself, but because of the abandonment of public infrastructures by local and national governments? Even though in visualization, literature efficiency and storytelling are at the core of a good visualisation, here we consciously avoid making these selections. As opposed to controversy mapping, where only the actors and their connections are represented (Yaneva, 2012), we want to hold up the complexity of the situation, to enable different narratives to coexist.

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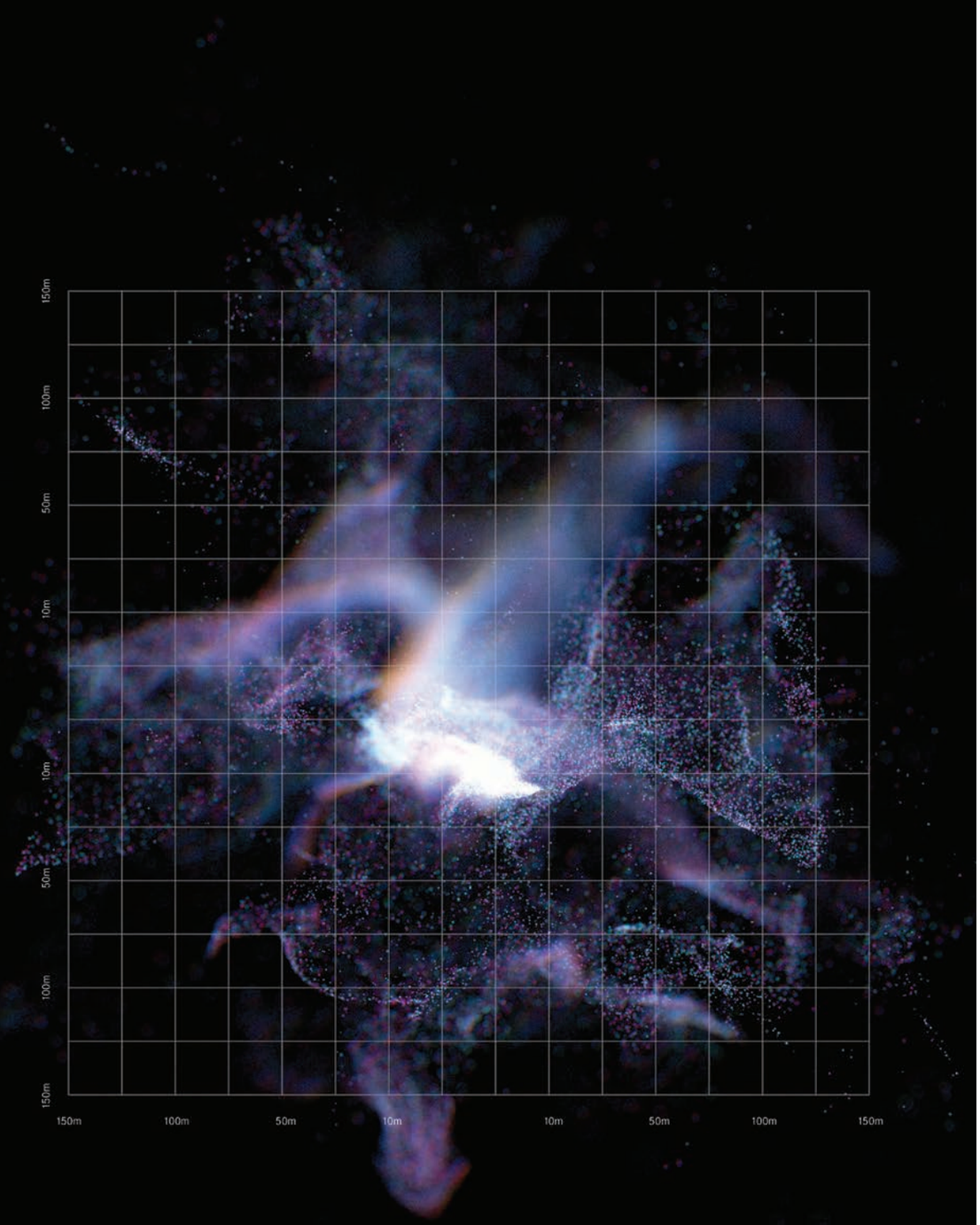
P026
Cid Schuler. Simulation of a thunderclap, plan view.
Tools: Cinema 4d, Realflow.



THE EARTH IS FLAT AND SQUARE: YVES KLEIN'S PAINTINGS OF THUNDERCLOUDS

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Thunderclouds are not unique to monsoons, but they are characteristic features of monsoon systems, and painting thunderclouds is by no means unheard of in histories of art (Fig. 1). This paper is about one artist's attempts to paint thunderclouds; his name was Yves Klein. Klein is of interest to monsoon air because at the time he began to paint thunderclouds he was already infamous for his proposals for an architecture of the air. These proposed that large areas of the terrestrial surface be climatically conditioned so that people could live naked, out in the open, seemingly floating on cushions of pulsating air. Klein explicitly mentioned monsoons within the scope of air architectures, which, as he explained, should be adapted to the circumstances of local environments:

> *The architectures of air should adapt themselves to the given circumstances and natural conditions, to mountains, valleys, monsoons etc., if possible without necessitating the operation of substantial artificial modifications. For example, where the wind changes direction every six months, the roof of air can be created with a minimal artificial support. In the end it is the old dream of men and of imagination to play with the elements of nature, to direct and control its phenomena and manifestations.*
>
> *(Klein, 2007a:97)*

By the time he got around to painting thunderclouds, Klein had already developed a wholly materialist mode of working and was able to demonstrate the architecture of the air with very few drawings, relying instead on material traces of events acted out with "air, gases, fire, sound, odours, magnetic forces, electricity, electronics" (2007a:97). In the constant cultural recycling of Klein and his art, the thundercloud paintings have attracted little attention. Certainly they are never included in discourses on the architecture of the air. It is my contention in this paper that these paintings are important to the architecture of

Fig. 01 Yves Klein. (1962). Untitled Fire-colour painting. Pigment and synthetic resin on fire-board, 106 x 94 cm. Credit: Adagp Images.

the air, and that they bear witness to Klein adapting air architecture to the given circumstance and natural conditions of the monsoon.

Hot Air

Ideally, the month of June marks the start of the monsoon season for the Eastern provinces of India. The land is brown and blistered, river beds run dry, moisture has been sucked from the surface into the relentless blue sky. Then one day shadows begin to fall across the land as great cloud masses move in from the south-west and begin to pile-up against the high ranges of the Himalayas. The clouds are carried by winds, streaming in across the land, bearing moisture laden air off the Indian Ocean. They bundle-up against the mountains until finally they are forced upwards toward the higher regions and lower temperatures. At those high altitudes the air expands and cools; it can no longer carry the great burden of moisture. The clouds burst, falling as rain in great torrents, the raining can go on ceaselessly for forty or fifty days and nights (Young, 1977:25). It is this rainy season that tends to go by the name monsoon, but from a meteorological perspective the wet and dry seasons must be taken together, because the monsoon is a global hydro-atmospheric system and not a local feature of the weather. The monsoon system runs thanks to the agency of the transitive energy we call heat. Heat is always at work in the environment, even if we humans are sometimes unable to perceive it directly.

In the many and varied processes artists have deployed for producing paintings, few have relied on heat. One architect-artist from the historical not-so-distant past who attempted to do so was Yves Klein. In 1961 he was given the opportunity to use the facilities of the testing centre of Gaz de France, just outside Paris in Plaine Saint Denis. It meant he had access to up-to-date equipment and expertise that he could use to continue his, until then sporadic and unstructured investigations of burning as a means of image making. Klein worked with a large fire-torch, using it like a paintbrush. He fired it at variously sized sheets of a compressed, fire-retardant board that resisted the combustion process and so gave him some control over the production of the fiery images. Klein's fire painting process also involved jets of water. A staged video shows his friend, Alex Kosta, dressed-up as a fireman, following Klein's gestures and intermittently dousing the flame as Klein, dressed in a suit, fires it from the torch. As a consequence, spots and drips are registered on the boards where they appear as foils to the texture of the burnt patches. Later, Klein expanded some of the fire paintings by adding colour, which seems to have been poured and spattered onto the paintings, contributing considerably to the dynamism and radiance of the images, (Stitch, 1994: 224-230). It is these fire paintings with additional colour that are referred to in this essay as Yves Klein's paintings of thunderclouds.

The thundercloud paintings are exemplary of Klein's working methods. On the one hand he went to considerable lengths to leave documentary evidence of a set of events, activities and participations that record the production of the paintings. On the other hand, there are the objects themselves, the physical artefacts that can be exhibited for contemplation in a detached gallery setting. One thing to notice about the thundercloud paintings is that there is no documentary record of the addition of colour to them, which leaves the circumstances of the colour work open and mysterious, contributing to the paintings' allure. As we look at them, they seem to evoke extra dimensions that are hard to resist, we are poised on the brink of some other space; objective, socially conditioned sensibilities recede into the background. We feel as if we are gazing into a primeval space, one where a rudimentary battle between mass and form seems to be constantly waging. In Klein's thundercloud paintings the battle is entirely fictional, with only a passing resemblance to the thermodynamics of actual monsoon thundercloud formation. But the fact Klein worked directly with fired-heat and sprayed-water does condition the look of the paintings. Unlike others of his paintings, the monochromes in blue, pink and gold, the anthropometries and paintings of levitating bodies, which are cool, these paintings look hot.

Another notable aspect of Klein's working methods was his habit of retrospectively visiting moments of his own work to locate them in an evolutionary narrative. Klein's Sorbonne Lecture of 1959 did just that, taking the opportunity to reflect upon his earlier work, representing it as a prelude to the architecture of the air. Sadly, not long after completing the thundercloud paintings, Klein died and so he never had time to revisit them and retrospectively locate them in relation to the architecture of the air. So, one way to approach these paintings today is to take them as evidence of Klein's thinking about how to adapt air architecture to the seasonal monsoon condition of rain.

Deluge

One of the most challenging features of the architecture of the air was Klein's solution for what he termed "the last obstacle," that being "the roof, the screen that separates us from the blue of the sky" (Klein, 2007a:96). To overcome the problem Klein came up with the idea of a "floating roof of air" (Klein, 2007c: 174) that would regulate the temperature and shelter the space below. A Kleinian air roof is not an inflatable, it's a layer of air, differentiated from the air around it by compression only, not sealed within a pillow. Like many avant-garde artists Klein was suspicious of the "miracles of technology," (Klein, 2007c: 175) and he didn't like to rely on technological solutions to what he regarded as problems of art. Be that as it may, in order to function, the air roof would have required considerable technological ingenuity, including enormous compressors and blowing machines, which would have produced a continuous noisy din as they sucked-in and squeezed-out air. Just as the technology required to realise air architecture was somewhat extravagant, so too was its programmatic justification a little strange: air architecture was to accommodate an outdoor oriented urbanity, where people would be free to roam naked, unimpaired by clothing, familial relationships or the need to work.

In a monsoon context the idea of outdoor urbanity carries a different set of cultural and climatic connotations to those adduced as justification for the Kleinian roof. For example, many groups within the populations subjected to monsoon rains actually like to be outdoors when the clouds burst. They celebrate the deluge as a release from the oppressive heat of the dry season, but also as relief from the anxiety of potential drought, crop failure and, ultimately hunger and starvation if the rain should fail. Assuming Klein was aware of the sacral, festive and celebratory aspect of monsoon rain, then it seems likely he would have wanted to adapt the principles of air architecture to work with those conditions. It is my contention that Klein was interested in the possibilities of introducing colour into the monsoon rain itself; and it was the beginnings of that thought which the thundercloud paintings began tentatively to explore. There is evidence that Klein had already experimented with the possibilities of mixing colour and rain. In the first place there is his Blue Rain, an installation piece from as early as 1957, it consisted of a dozen or so very thin blue wooden dowels, two to three meters long, clustered on a grid pattern and hung from the ceiling. According to one critic, "the lines of blue appear as temporal, fluid markings dangling in space. They become a kind of climate" (Stitch, 1994:92). Among the cosmogony imprints Klein made in 1960 there are several that involve rain, where Klein used pigments to colour paper and then exposed the surfaces to changing weather conditions over time. In his Chelsea Hotel Manifesto Klein relates how he created one cosmogony by placing a freshly coated canvas on the roof of his car and then drove from Paris to Nice:

> *I felt the urge to register the signs of atmospheric behaviour by recording on a canvas the instantaneous traces of spring showers, of south winds, and of lightning (Needless to say, the last-mentioned ended in a catastrophe) .... I placed a canvas, freshly coated with paint, upon the roof of my white Citroen. As I zoomed down Route 7 at the speed of 100 kilometres an hour, the heat, the cold, the light, the wind, and the rain all combined to age my canvas prematurely. At least thirty or forty years were condensed into one day.*
>
> *(Klein, 2007d:192)*

In 1961, at his solo exhibition Monochrome and Fire, Klein showed a Blue Rain piece, only this time it was accompanied by a similar installation in pink: Pink Rain. Later that year, in November, Klein showed his Planetary Reliefs for the first time. These were made by taking imprints from castings of terrestrial relief maps and carefully painting them blue. Not just any old blue, but International Klein Blue, a specialist paint developed by Klein himself to preserve the soft, dusty look of unbound pigments. For Klein the imprints were a way to picture planet earth, he thought of them as momentary captures of what was in reality a whirling cloud of cosmic dust orbiting the planet as it spins on its axis.

Klein had an entirely novel theory of planetary formation, the basis of which stated it was patently absurd "to believe that the earth is a globe in space." Klein argued: if "the earth really was a rotating, solid mass, as we are taught today, all of us and all that is not affixed to the surface of the earth would long since have been projected out into space" (Klein, 2007b: 162). Klein preferred to believe the earth was flat and square and he understood the dusty turbulence pictured in his planetary reliefs as caused by the dual rotation of a square earth spinning about its centre and a spun earth rotating about a vertical axis, between them creating a spherical dynamic (Fig. 2).

> *Spin a coin quickly; it will visually appear to be a globe. This globe is the optical illusion of a round earth, for the earth is flat like a coin and we live upon the surface constituted by the edges of the coin, which due to its rotation has become internal.* *(Klein, 2007d:162-163)*

According to Klein the apparent stasis and solidity of the terrestrial surface, as we usually perceive it, is merely a consequence of the way human sensibilities have evolved. The human perceptual apparatus is organised in such a way that humans are blind to the clouds of spinning dust that actually form the terrestrial body because a "flat earth turning on its axis at a terrifying speed that surpasses our vibratory potential of sensation, would effectively give the visual appearance of a round surface...by turning on its axis, the flat earth creates a void in the interior of its rotation that causes the force of gravity to rule upon the surface of the edges, which are almost continuously everywhere at once" (Klein, 2007d:163). However, Klein's model of the spinning disc does not explain the topology of the earths surface, characterised as it is by "mountains, valleys, oceans and deserts." To explain these phenomena Klein argued that "the cosmic dust of the atmosphere, attracted by the void created by the rotation on its axis of the flat earth, have not been able to pass through the barrier created by the terrible speed of its rotation and are held, like us (like all that is material, in our degree of concentration of vibration) and have formed an irregular terrestrial crust, which is perfectly adjusted to

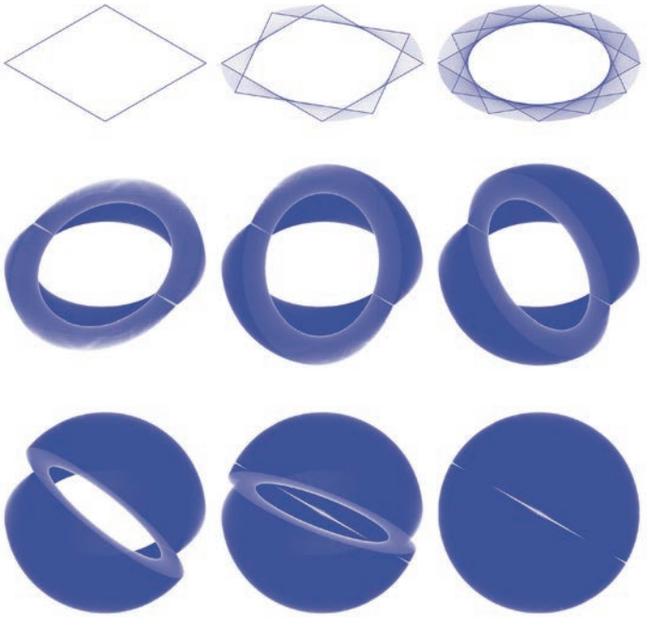

Fig. 02 Victoria Watson: Yves' Klein's logic of planetary formation.

the surface of the illusory globe" (Klein, 2007d:163-164). Finally, to round-off his argument, Klein proposed the flat spinning surface is "not round but square." He shied away from further clarification on the basis that "I am not a mathematician," concluding his theory of the earth with the proclamation: "nothing in nature is a circle; everything is square" (Klein, 2007d:163-164).

I suspect Klein wanted to express his theory of planetary formation in a sensuously perceptible form, and this ambition was linked to the idea of impregnating monsoon rain with base pigments. I think the thundercloud paintings should be understood as tests, or sketches for this highly improbable project. I don't mean improbable in the sense of that which is unlikely, I mean improbable in the sense of that to which we are totally blind, rather like a fish is blind to water. Consider a flying fish, for a brief moment the creature leaves its habitual milieu to hover in another, alien medium; then it plunges back. Does the fish remember the moment of suspension, I don't know, but surely it is affected by it in some way? Klein's research was all about the possibilities of a leap into the improbable, a leap which he himself attempted on many occasions and in many different forms. For me, it is important to revisit Klein today, precisely because of the improbability captured in his work. And I hope

working with improbability might be a valid approach for contemporary research; especially where the research is studying imperceptible agencies, such as weather and heat; and trying to understand them as factors in a world that is irreducible to, but at the same time inextricable from, the habits and behaviours of human agents, many of whom make paintings and architectures.

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WEATHER REPORTS

ETHNOGRAPHIC INSIGHTS ON FORECASTING AND RESPONDING TO CLIMATE UNCERTAINTIES

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It was an afternoon in January, and I was in the midst of conducting my fieldwork in Far North Queensland, a region in the Australian tropics. I had gone to visit one of my close informants, Christine, [01] a local woman in her forties who had spent her entire life in this region. I had visited her often in her home, and on this occasion I helped her to move a small plastic table and a few chairs from her kitchen to the driveway so that we could sit outside. We had got together to weave and since it was a bright, sunny day with no signs of rain, we decided to make the most of it and sit outdoors. The clear day was a welcome relief after what felt like a week of never-ending monsoon rain.

As I mentioned this to Christine, she replied that she did not think we would get many more clear days like this that week, since she felt that a cyclone would be approaching soon. Curious about her prediction, I asked her how she knew this since I had not heard any cyclone alerts during the past few days. She replied, “Hannah, look up there. See the clouds? See the way they’re arranged in that way. When it’s like that you know a cyclone’s brewing.” I looked up at the sky, scanning the clouds, trying to find a pattern. My confusion must have been obvious, so she added, “When something big is brewing it disrupts the clouds, they come out as ripples like you see up there. A long time ago my aunties told me that all of us Murris… used the clouds to predict cyclones, just like this.”

I begin this essay with Christine, one of many local residents in Far North Queensland (FNQ) who used signs in the natural environment to forecast the occurrence of cyclones and storms. While Christine’s use of the term Murri referred to her cultural heritage as an Aboriginal woman, [02] and her observations about the clouds were based on stories passed down to her from her ancestors, such observations were certainly not limited to those with Aboriginal heritage. Through my eighteen months of ethnographic fieldwork in the region, I found this approach to forecasting to be prevalent amongst all local residents regardless of their cultural heritage. This will become more evident in the ethnographic cases that I will discuss in the pages that follow.

To understand the commonality of forecasting in this way, however, we need to look at the weather and climatic context first. Located in the north east of Australia just under Papua New Guinea, FNQ is a largely agricultural, rural region. Its local resident population, who I will refer to as "locals" throughout this essay, is highly multicultural with significant Aboriginal groups. These locals live alongside the millions of tourists who visit the region every year due to its proximity to the Great Barrier Reef. FNQ's climate is typically tropical so it is warm all year with average temperatures around 31°C in the wet (monsoon) season, and 26°C in the dry season. The cyclone season coincides with the wet season from around November to April. During this time, large amounts of rain as well as cyclones are expected and anticipated. Each cyclone season, four cyclones develop on average in the Coral Sea, and while not all of them end up making landfall, some of them do. Cyclones come in different strengths from a Category 1, often described as a big storm, to a Category 5. Category 4 and 5 cyclones are considered to be severe and extremely destructive. In the past ten years, four severe cyclones – Larry, Yasi, Ida and Nathan – have made landfall in the region and these have caused significant damage.

For locals, cyclones, storms and heavy rain are lived experiences that occur with annual frequency, making this region an interesting site for generating insights on the social dimensions of hazards, disasters and climatic events. Drawing on fieldwork research based in the biggest town in FNQ, Cairns, and the smaller coastal dwelling towns that surround it, I will discuss these lived experiences through a series of ethnographic cases that focus specifically on the theme of forecasting. My aim here is to not only describe what these modes of forecasting are and how they are used, but also to explore how these modes of forecasting play crucial roles as responses to the uncertainty that comes with living with frequent cyclone threats.

Normal weather

One morning in March, while I was in the midst of my fieldwork, I had woken to find that my face was covered in what appeared to be hundreds of itchy, red bumps: an aggressive heat rash brought on by the sweltering heat of the night that had just passed. At the time, I was staying with Peg,a local in her sixties, and as I walked out to the kitchen for breakfast she took one look at my face and exclaimed, "Sweetheart, go out there in the rain and cover your face in that goodness!" Although I was a little skeptical, I decided to follow Peg's advice and dashed out into the garden. The rain was pelting down, and I was drenched within seconds. When I was back inside the house, Peg gave me strict instructions not to touch my face in order to allow the rain to dry naturally and be absorbed into my skin. This, she explained, was pivotal to allow my skin to fully obtain the healing benefits of the rain. Although she couldn't explain why or how, rain for her had the ability to heal since it always seemed to help relieve her skin issues.

Peg's faith in the healing powers of the rain was just one of many ways in which she, like many others in FNQ, expressed and enacted their close relationship with the weather. Active engagements with the weather were seamlessly woven into daily practices. For example, I was struck by how common it was to keep a domestic rain gauge in the garden to track patterns of rainfall. For Peg, checking her rain gauge was a daily activity carried out after breakfast, and she explained that tracking rainfall patterns was an activity that she enjoyed doing for her own amusement. Some mornings, after a night of heavy rain, Peg's practice of going out to the back garden to check her rain gauge was approached with a degree of excitement and curiosity. During these mornings, as we ate breakfast together, Peg would explain to me that it felt like a lot of rain had fallen. She would give me her predictions on the amount and explicitly expressed her eagerness to find out whether her predictions were correct. Her predictions always turned out to be approximately accurate, or close enough for Peg to feel reassured of her prediction skills.

Even though these observations were never written down by Peg, they did serve a purpose that went beyond her own amusement. As the morning passed, Peg would either make her way to one of the multitude of community groups that she was involved in, or to morning tea meetings with friends, and if she was not going out, she would spend many more hours tending to her garden. It was while she was engaged in these activities that Peg would also engage in conversations with friends, neighbours, or passers-by, whom she usually greeted when she was in the front garden of her home. These conversations would inevitably include her recounting her rainfall data from earlier in the day and evaluating them against others.' The discussion would be lively even if the other person did not have a rain gauge, since everyone had an opinion about the weather.

It was during these conversations about the weather that Peg and many other locals discussed climatic trends, and the seemingly mundane morning observations from a rain gauge in the garden were enbued with greater meanings. Within these daily conversations, a sense of what was considered to be normal weather, and what was expected to occur at certain times in the year was established and debated. Rainfall, in this case, constituted a specific pattern of weather that occurred with a dependable regularity and could be forecasted and anticipated. But what we also begin to see here is a sense of certainty that emerges as a result of these forecasting activities.

Forecasting through signs in the environment

Let us now return to Christine, whose methods for forecasting cyclones and storms I discussed at the beginning of this essay. I stated earlier that forecasting through signs in the environment were prevalent in FNQ, and not only limited to those with an Aboriginal cultural heritage. Indeed, the day after my conversation with Christine, I met with a group of three other local women, all of whom were not Aboriginal, but were born and bred in FNQ. We were sitting outside a café just before noon and, staring out at the sky; they too exclaimed that it looked as if a storm were coming. Of course, this caught my attention due to the conversation I had just the day before, and I asked the women how they knew this. Pointing to the clouds, they explained that when the clouds appeared low in the sky in relation to the surrounding mountains, it was a sign that a storm was brewing.

Several days later, I went to visit Linda, a lawyer who had moved to Cairns from New Zealand around ten years earlier. As we too attempted to sit outdoors, we noticed that her veranda was swamped with hundreds of green ants, huddled so close together that they appeared to be hugging each other. Linda explained that she had seen this phenomenon of ants hugging before, and had noticed that a storm or cyclone usually followed. Even though there was no obvious increase in wind or rain that would suggest a storm or cyclone was about to occur, the ants could somehow 'predict' that it was going to happen. For Linda, this highlighted the importance of nature and that nature knows how to protect itself.

Clouds and ants, as these cases show, were both extremely popular indicators of cyclones, and these signs in the environment were often referred to as a very practical way to predict and forecast cyclones. This pragmatism can be better understood in light of the way in which cyclones were forecasted prior to modern alert and warning systems. Those who had lived in FNQ since the 1960s or earlier recalled that there were so few warning systems at the time, and these were mainly announcements on the radio, that they just had to rely on the environment to indicate to them whether a storm or cyclone was coming. They did not distinguish between a storm and a cyclone, and they would simply prepare for destructive weather as a direct response to what was happening in the environment. As one informant explained to me, "growing up in Cairns there was no way of warning when a cyclone was about to come. When the weather started acting up then you just did what you had to do to bunker down." And, as Christine reminded me, her ancestors had survived cyclones for thousands of years because they relied on nature to forecast what would happen.

Clearly, using observations in the environment is an important method of forecasting. But, it also brought up tensions, particularly with the geoscientists in the region, who often referred to these methods of forecasting as bizarre. We can see this perhaps most prominently when we look at the way that locals forecasted the locations where cyclones would make landfall. As I mentioned before, FNQ as a region has experienced four severe cyclones in the past ten years, but Cairns, on each of the four occasions, has missed a direct landfall, at times only just. These near misses have contributed to an attitude shared by many locals that Cairns is protected from large cyclones.

The first time I heard someone mention this was in the first few weeks of my fieldwork. I had taken a short weekend trip up to the Kuranda Ranges, a popular tourist attraction around thirty minutes' drive from Cairns, where I joined a small tour group for a walk through the rainforest. Soon after we began our walk, we reached what could only be described as an enormous tree. At this point, the tour guide leading my group stopped us and proudly exclaimed that this tree was a survivor. He then proceeded to tell us that several big trees had fallen over the years due to cyclones Larry and Yasi, which were both Category 4 on impact.

Fig. 01 Hannah Swee. Cairns, surrounded by the Great Dividing Range, Far North Queensland, Australia.

He explained that the ranges that we were walking through served the purpose of a natural defence against cyclones, deflecting them away from Cairns (Fig. 01).

I was intrigued by his comments, as I wondered to myself how a cyclone such as Yasi that was around 500 km in diameter, could rebound off the ranges. As the months passed, however, I soon lost count of the number of times I was told that the mountain ranges that lie behind Cairns had the power to deflect cyclones, or that cyclones would rebound off the mountains and be redirected away. These ideas were always told to me as people tried to explain why cyclones seemed to come toward Cairns, but in the final hours before landfall, would rebound off the mountain ranges and be redirected slightly south. These ideas, or 'theories' as they were often called, also extended to the Great Barrier Reef, as locals would tell me how Cairns is "naturally designed to withstand cyclones" since "the mountains will protect us" or "the reef will protect us."

Between Theories and Myths

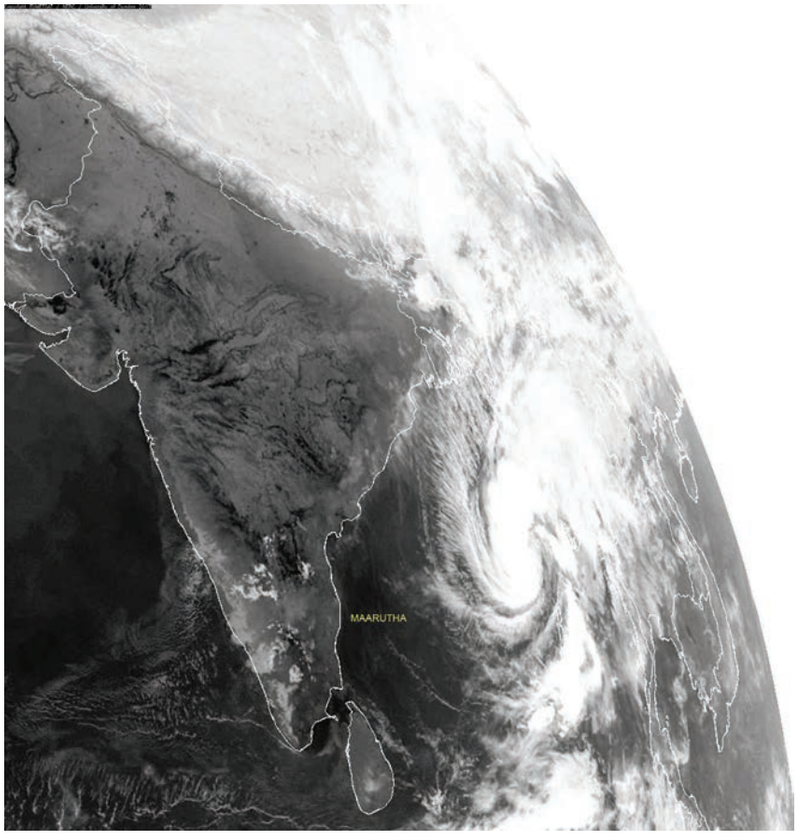
The geoscientists that I knew, however, were candid that these theories, which they termed 'myths,' had no scientific truth to them, and one even told me that he had plans to write a short guide specifically to "debunk the myths". Their studies showed that it was only by pure luck that Cairns had not been directly hit by a severe cyclone in the past fifty years. To them it seemed as if people just did not want to accept that they, too, were susceptible to potentially destructive cyclones. However, for the locals that I knew, it never seemed to matter whether these theories were right or wrong or had any scientific truth to them. Proving or disproving them never affected their belief in them. In fact, despite believing in these theories, people would still prepare and were cautious about every cyclone anyway. So, on the one hand, they would tell me that they believed that cyclones would rebound off the mountains protecting Cairns, and they would refer to these theories whenever a cyclone alert was announced to explain why they anticipated the cyclone would not make landfall on Cairns. Yet at the same time, they would also make sure that they prepared their homes with each cyclone threat, and they would follow the different meteorological tracking maps and the alerts issued by the authorities.

What I want to suggest, then, is that looking at the actual purpose of these theories and forecasting methods allows us to gain a better insight into these conflicting responses. Through my fieldwork it became clear that forecasting was a practice of reading the weather, which could produce a sense of confidence in the natural environment. The way that people forecasted using signs in the environment was a way in which they enacted a degree of faith in it, and established a sense of certainty and control amidst the unpredictability of cyclones. Forecasting thus created a representation of reality, offering a sense of protection against the unpredictability of cyclones, even as it is impossible to predict in advance their exact landfall location. Indeed, any form of weather forecasting, whether from observations in the natural environment or computer-generated models from a meteorological agency, involves predictions of the future which are responses to uncertainty. This point is perhaps best expressed by Seb, a close informant who was one of the few locals I knew who did not believe in these theories. He described why these theories were so popular in the following way, "it's the fear of the unknown, of something they can't control. It's the uncertainty of not knowing where the big, catastrophic ones are going to hit".

NOTES

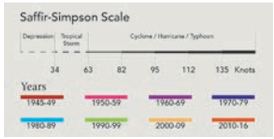
01 All names in this article have been changed to protect the anonymity of my informants.

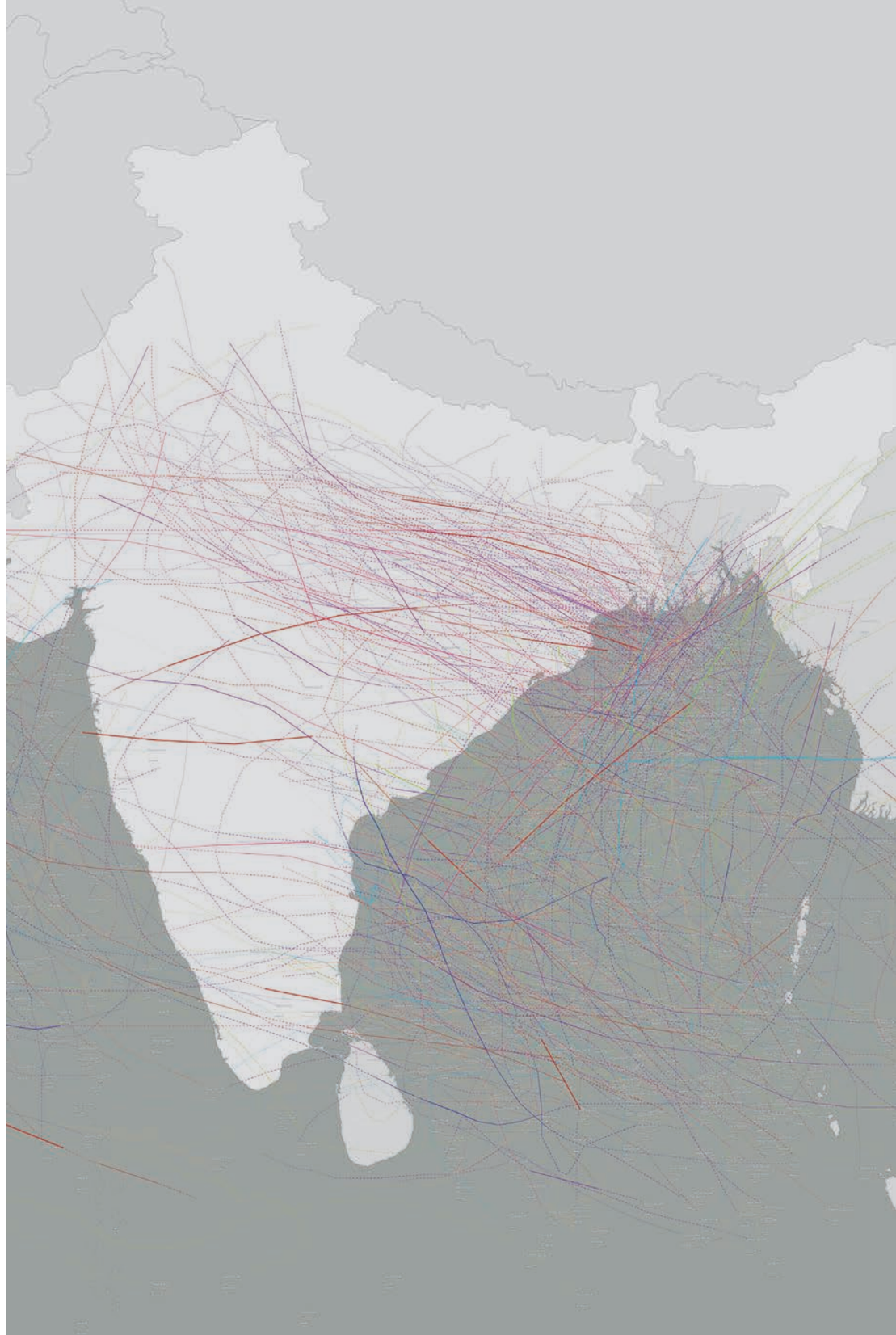
02 Christine's Aboriginal cultural heritage is Djabugay; the Djabugay are one of the original inhabitants of the FNQ coast..



P044 Cyclonic Storm Maarutha tracks in a north, north-easterly direction over the Bay of Bengal with a 3-minute sustained average wind speed of 35 knots (40.3 mph) and gusts of 45 knots (51.8 mph). 15 April 2017.
Source: University of Dundee Satellite Receiving Station.
http://www.sat.dundee.ac.uk/gallery/gallery_imagedetails.php?id=2171

P045 Calvin Sin. Cyclones in the Bay of Bengal, 1945-2016.
Data Source: Joint Typhoon Warning Centre,
http://weather.unisys.com/hurricane/s_indian.php
Tools: Rhino, Grasshopper.





WEATHER REPORT CHENNAI

J. Pradeep John is an independent Chennai based weather forecaster and blogger. He posts on Facebook under the name 'Tamil Nadu Weatherman,' and has around 250,000 followers. His posts provide accounts of when and where rain is falling at a very local scale, and predictions of how this is likely to change, sometimes at hourly intervals. They combine predictions, warnings, social commentary, instructions on how to interpret weather data and simply a love for rain. They are a detailed source of information about monsoon air, its behaviour, what influences it, how to predict its movements and what the consequences are for humans when its water vapour condenses and falls as rain. The following extracts are taken verbatim from posts on his Facebook page during the first half of August 2017, when the Monsoon Assemblages researchers were in Chennai.

20170801, 12.00 pm
What a day it turned to be Tiruvarur, Thiruvannamalai, Vellore, Salem, Erode, Thanjavur, Madurai, Pudukottai, Tiruppur, Dindigul, Thoothukudi, Tirunelveli....it can go on. Many 100 mms recorded for 1st time in this SWM season through Convective rains.

20170802, 2.37 am
As expected, storms converged and some intense spells of rains are being dumped along OMR and ECR. Very high intensity rains. My friend reports 50 mm dumped in 30 mins in Palavakkam. Absolute battering.

20170803, 1.37 am
If a convective storms deserves a post at 1.30 am, It has to be today. To be honest, never seen such an intense storms for a while.

20170803, 10.49 am
Groundwater Levels of Tamil Nadu show that not much improvement nor not much worsening seen in July 2017 when compared to June 2017. This will change in August as the recent rains in the State would have lifted the Ground water levels in most districts.

20170804, 5.10 pm
Chennai Rain update - fast moving clouds seen in Radar, we can see some moderate - light rains in Chennai with lots of breaks and it will be isolated. When ever west coast is active, what did i always say, we wont see towering clouds or Intense Thunderstoms but fast moving rains with sharp spells.

20170806, 3.38pm
Exciting days ahead for Tamil Nadu and Chennai. Lots of 100 mm can be expected on regular basis in those days. This will not solve the water problem, but is sure going to improve the ground water a lot and also the standing crops.

20170807, 8.07 pm
Enjoy the rains. Dont stand under the tree.

20170808, 7.02 pm
Southern Tamil Nadu lighted up with Madurai district getting battered. Kallikudi in Madurai records 100 mm in an hour. Delta too is joining. Chennai no sings of any clouds formation till now. Lets see in the night.

20170810, 7.20 am
Heavy rains for Chennai missed by a whisker as Chennai wakes up to monsoon like morning, again its a dream day to Tamil Nadu.

20170811, 5.33 pm
Beasty Spell on the way for Chennai - After a long time, There is going to traffic Chaos once the rains start. It might rain at least 1 hour with very high intensity. This is very level Thunder storm. Entire City will be covered. Enjoy the beasty on the way. Dont get caught in the traffic. Just stay in your office till the rains ends.

20170812, 5.36 pm
With Axis stuck up to Himalayas, the Giants in West Bengal Dooars are rocking. Assam, Bihar and Jharkhand too are getting dumped by huge rains. When ever the monsoon axis gets stuck up in the Himalayas foot hills and Tamil Nadu gets rains. In Tamil Nadu, there is no risk of floods, but all devastating floods in Bihar, Assam, West Bengal and Jharkhand have happened with this pattern. When all over India is silent, these areas are clocking huge rainfall for days. And with monsoon axis no sign of moving down for some more days, this is a flood which is going un-noticed. Soon there will be a stage, where it will hit headlines like the famous Kosi Floods in Bihar, if not that scale, still its pretty big rainfall happening there.

20170813, 4.57 pm
Chennai rain update - Sea Breeze triggered rains forms over the city itself, sudden burst of rains possible in City. Who would have thought we will get rains with a cloudy start, but then the good heat and sea breeze has done the trick. In such a short time, clouds have towered and become intense. So it will be short burst of rains. Lets see if it can manage to bloom. Yep it is blooming.

20170815, 9.14 pm
What is flood in an urban area? It was heavy rains indeed in Bangalore. No doubt about it. And water should been stagnated for some 2-3 hours max. But the water stagnation was for more hours. It shows the poor drainage system in Bangalore. It was the 1st spell after a long drought in Bangalore. 1st spell of rains, there will be some percolation. But sadly all are paved surface.

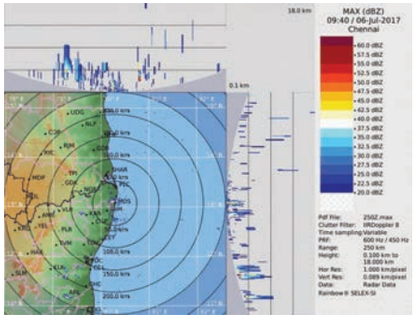
20170816, 9.52 am
Too perfect day for Chennai, Tiruvallur, Kancheepuram districts. Perfect heat with convergence of winds associated with Sea breeze is going to be the trigger for rains. Overhead formation of clouds and rains are possibility. Chennai should not miss rains today. Enjoy the rains. Its been one of the dream days for Tamil Nadu for past 10 days. From Deficient rainfall, Tamil Nadu has gone into excess.... no no...huge excess category.

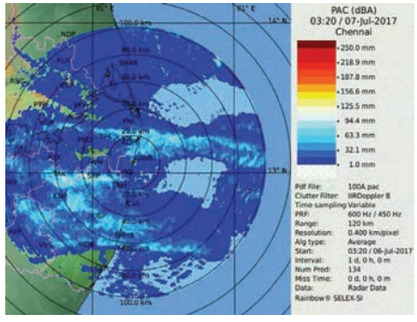
20170817, 5.14 pm
More Spells of rains expected in Chennai as the main storms which are into the Sea now triggering new clouds. This may grow again and converge and give rains again at many places in Chennai. Seems to be an historic night for Chennai as next set of bands are following up. This is also going to be a smashing spell. We expected rains but clouds forming back to back. Most unexpected. Reminds me of the August 2011 storms (which was the most heaviest August storms in 200 years).

20170818, 3.45 pm
Its absolute high intensity trashing in North Chennai. South Chennai dont feel missed out. U too will get ur chance of rains tonight. Beast on the way. Entire Chennai is going to be smashed with high intensity spell. Radar fullah ratha karai. This is going to be one hell of a spell of rains. Zero visibility. Omg semma semma rains in Anna Nagar.

20170819
Dream August isn't it. It might have stopped raining in some parts of the state in the case for Chennai, Tiruvallur and Kancheepuram the action is expected to continue but with reduced quantum and isolated spots unlike the past few days. Tamil Nadu now has got whopping 35% excess rainfall till today for the SW monsoon season. Thoothukudi town and surrounding areas if you can see the normal itself is so less. Its the driest place during SW monsoon in entire even drier than Thar Desert. I have never seen such an active rainfall during August. And rains may slow down a bit, but it will continue.

P050-P051
Meteorological data, Chennai, 01 July - 19 August 2017.
Source: https://www.facebook.com/search/top/?q=tamil%2nadu%20weatherman


MAX (dBZ)
09:40 / 06-Jul-2017
Chennai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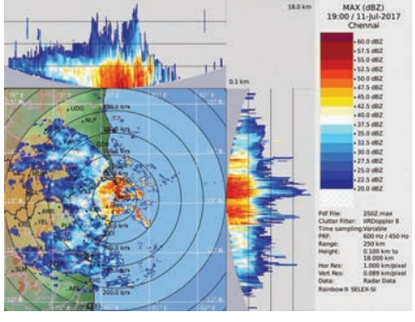
MAX (dBZ)
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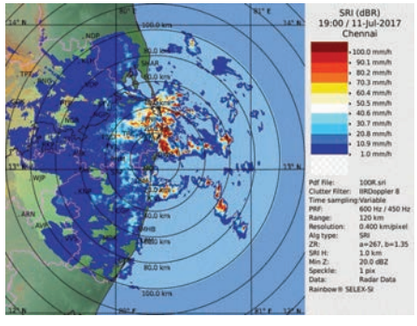
Chennai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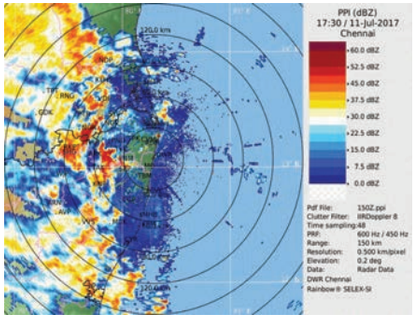
Chennai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17:30 / 11-Jul-2017
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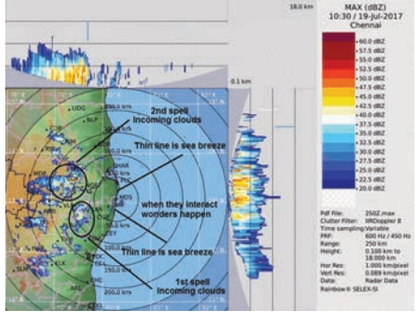
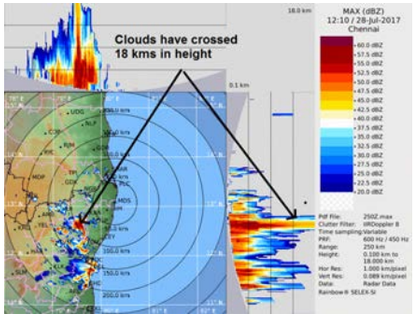
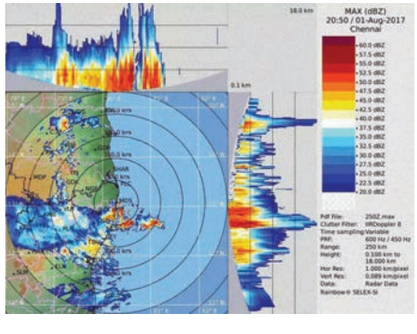
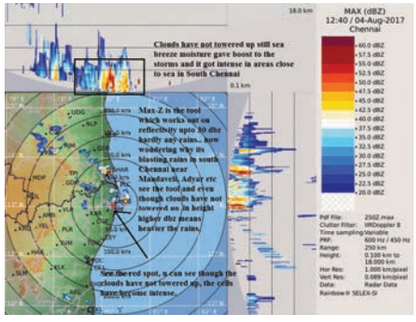
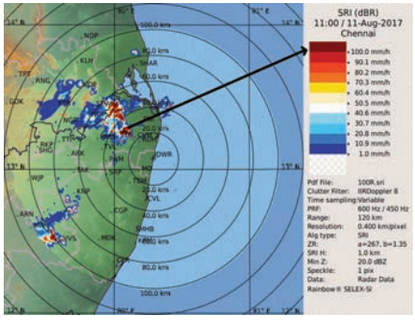

MAX (dBZ)
10:30 / 19-Jul-2017
Chennai
2nd spell incoming clouds
Thin line is sea breeze
when they interact wonders happen
Thin line is sea breeze
1st spell incoming clouds


Clouds have crossed 18 kms in height
MAX (dBZ)
12:10 / 28-Jul-2017
Chennai


MAX (dBZ)
20:50 / 01-Aug-2017
Chennai


MAX (dBZ)
12:40 / 04-Aug-2017
Chennai
Clouds have not towered up still sea breeze moisture gave boost to the storms and it got intense in areas close to sea in South Chennai
Max-Z is the tool which works out on reflectivity upto 30 dbz hardly any rains.. now wondering why its blasting rains in south Chennai near Mandaveli, Adyar etc see the tool and even though clouds have not towered on in height higher dbz means heavier the rains.
See the red spot, u can see though the clouds have not towered up, the cells have got close intense.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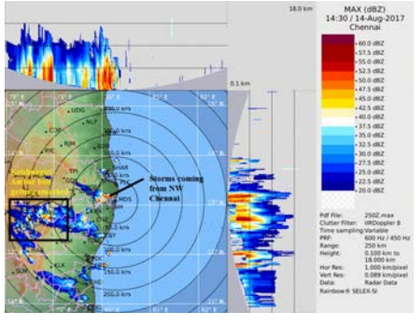
Chennai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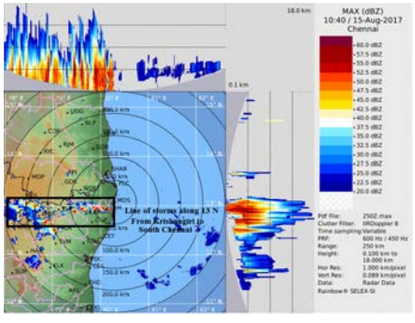
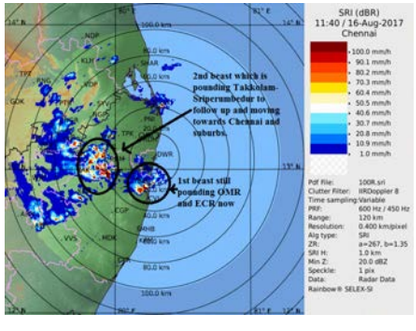
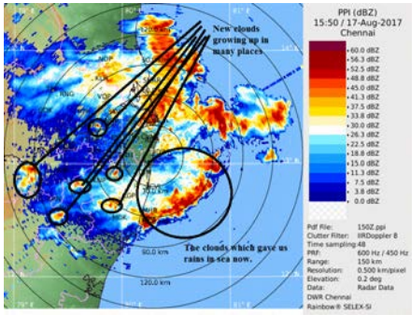
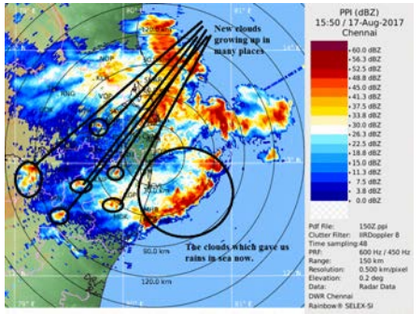
Chennai
Storms coming from NW Chennai


MAX (dBZ)
10:40 / 15-Aug-2017
Chennai
Line of storms along 13 N from Krishnagiri to South Chennai


SRI (dBR)
11:40 / 16-Aug-2017
Chennai
2nd beast which is pounding Takshlam-Sriperumbedur to follow up and moving towards Chennai and suburbs.
1st beast still pounding GMR and ECR now


PPI (dBZ)
15:50 / 16-Aug-2017
Chennai
New clouds growing up in many places
The clouds which gave us rains in sea now.


PPI (dBZ)
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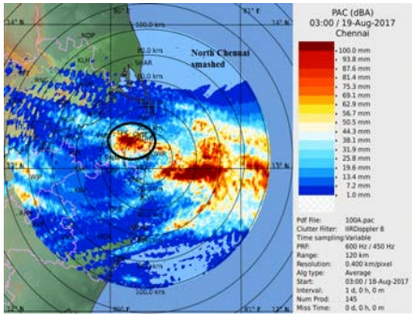
Chennai
New clouds growing up in many places
The clouds which gave us rains in sea now.


PAC (dBA)
03:00 / 19-Aug-2017
Chennai
North Chennai smashed

WEATHER REPORT KOLKATA

Anasuya Basu is a journalist with an English daily, The Telegraph, published by the ABP Group in Kolkata, India. She was a Chevening fellow in the South Asia Journalism Programme at the University of Westminster in 2017. She writes on urban issues, development, and how it affects the environment. She also covers art and culture and heritage architecture in Kolkata. She is currently researching on issues of riverfront development. The folowing is a report on the 2017 monsoon season in Kolkata, written at the end of August 2017.

Monsoon 2017 in Kolkata so far has been locally scattered and dispersed rather than heavy downpours all over the city, though the quantum of rain received has been normal say weather officials at the Meteorological Office at Alipore, Kolkata.

Through the months of July and August, the rains have in a majority of cases been local showers with either the north of the city experiencing a deluge and the south remaining dry or experiencing a scattered rainfall or at best a drizzle or vice versa. The showers were so local that while travelling in the city's rapid transit system, once could experience rain at one stop and found dry weather at the next stop, several kilometres away.

There have been a couple of occasions when depressions over Bay of Bengal has caused medium to heavy rainfall in the city. But once the depressions cleared, the weather turned dry and sunny with local showers dominating the season.

The volume of rain recorded at Kolkata Municipal Corporation (KMC) drainage department reveals a drastic difference in precipitation between areas. On July 3, while Dum Dum recorded 40.5 mm of rain, Alipore recorded a mere 15 mm. While Behala recorded 145 mm of rain on June 20, Ultadanga and Dum Dum in the north recorded only 20 mm and 10 mm respectively on that day. Areas like Bowbazar or Esplanade in central Kolkata received a meagre 15 mm and 10 mm respectively. In the last week of June, the rainfall scenario became just the reverse. Records available with the KMC drainage department show that while Esplanade and New Market in central Kolkata and Muktarambabu Street in the north got waterlogged due to a sudden heavy downpour, Alipore and Behala recorded zero rainfall.

The reason, according to meteorologists is the absence of a big enough system to trigger heavy showers across the city. It often happens at the beginning of monsoon, they said. "While we have had circulations triggering showers sporadically, a typically big monsoon system has so far eluded the region. These systems usually form in the north-west Bay of Bengal and approach south Bengal. They cover a bigger region and usually end up triggering rain across a wide area, including the whole of Kolkata. But we are still waiting for such a system to form," said GK Das, director, Regional Meteorological Centre (RMC), Alipore.

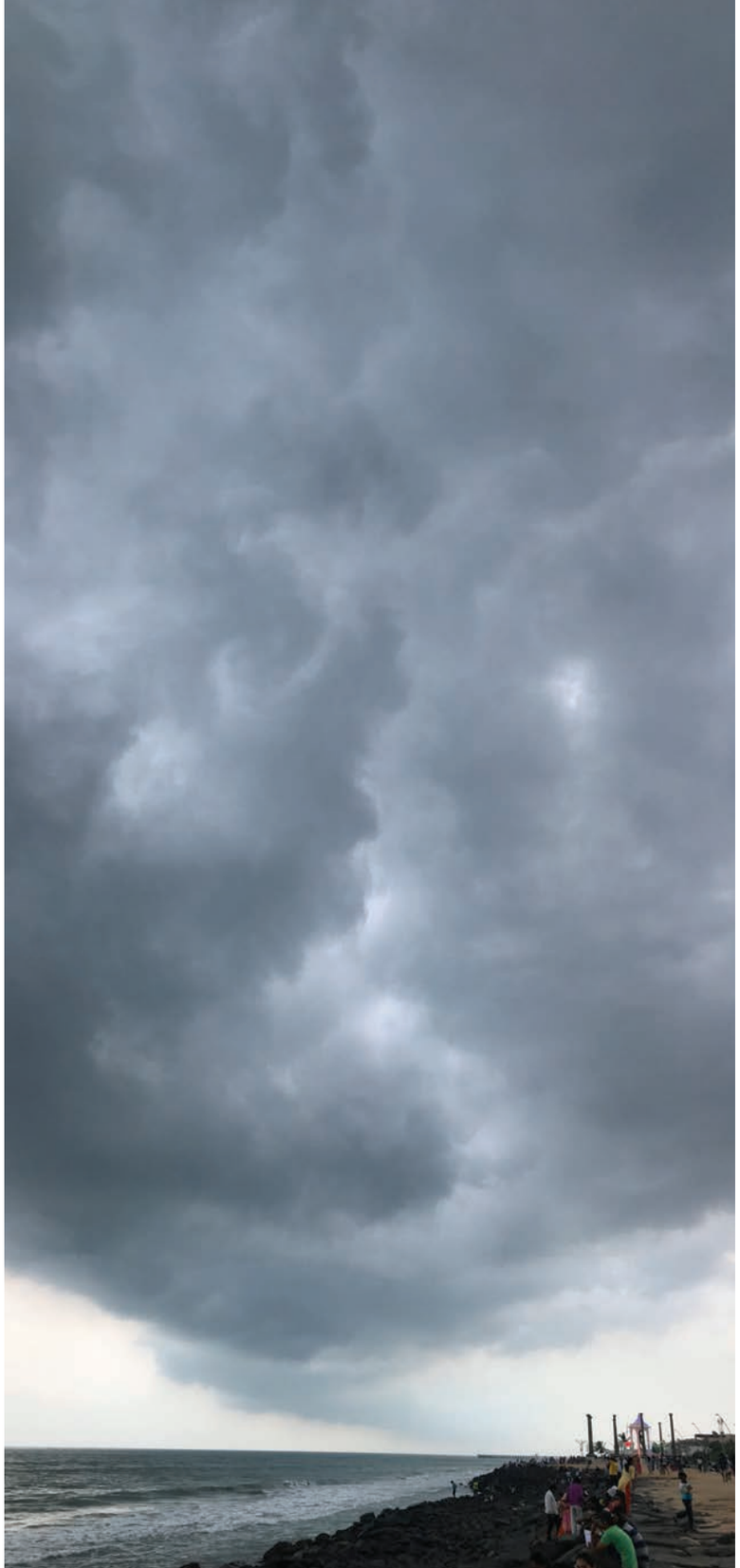
Things could change in September though. Systems form more frequently and are usually bigger in July-August but it could also be in September. The monsoon lasts till October in Kolkata. The volume of rain, too, consequently increases during these months. "We are now approaching the peak monsoon period. While rainfall should get progressively heavier, systems will also be bigger. They should trigger uniformly heavy showers across Kolkata. We had one such system about two weeks ago. But it moved away towards Bangladesh," said Das.

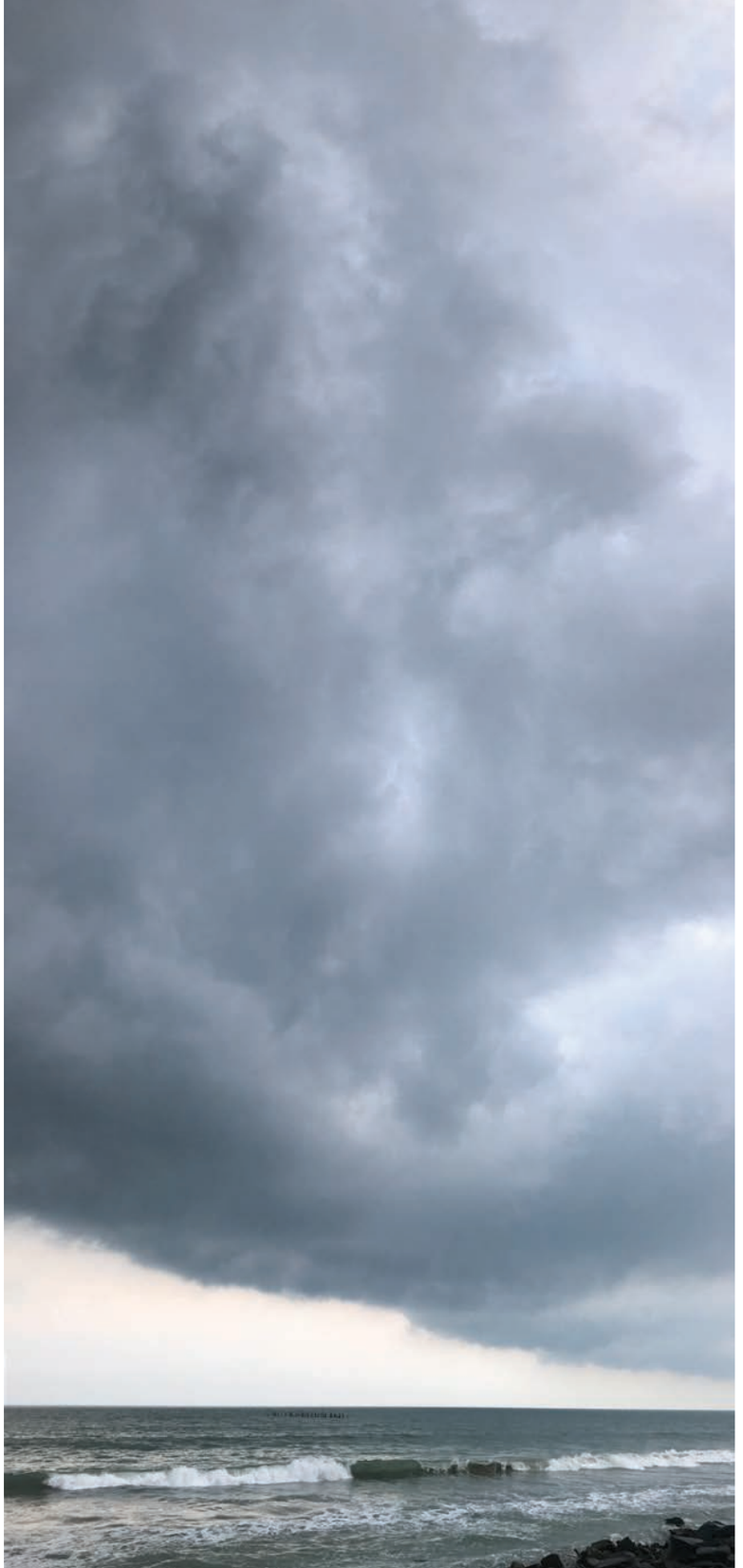
One of the offshoots of such scattered rainfall during monsoons is that the silvery delight without which no monsoon feast can be complete has been missing from the platter this season. A combination of unfavourable weather and import restrictions have ensured that the soft, succulent hilsa fish remain in short supply. Kolkata has been receiving just 20% of the daily supply it received in July-August 2016.

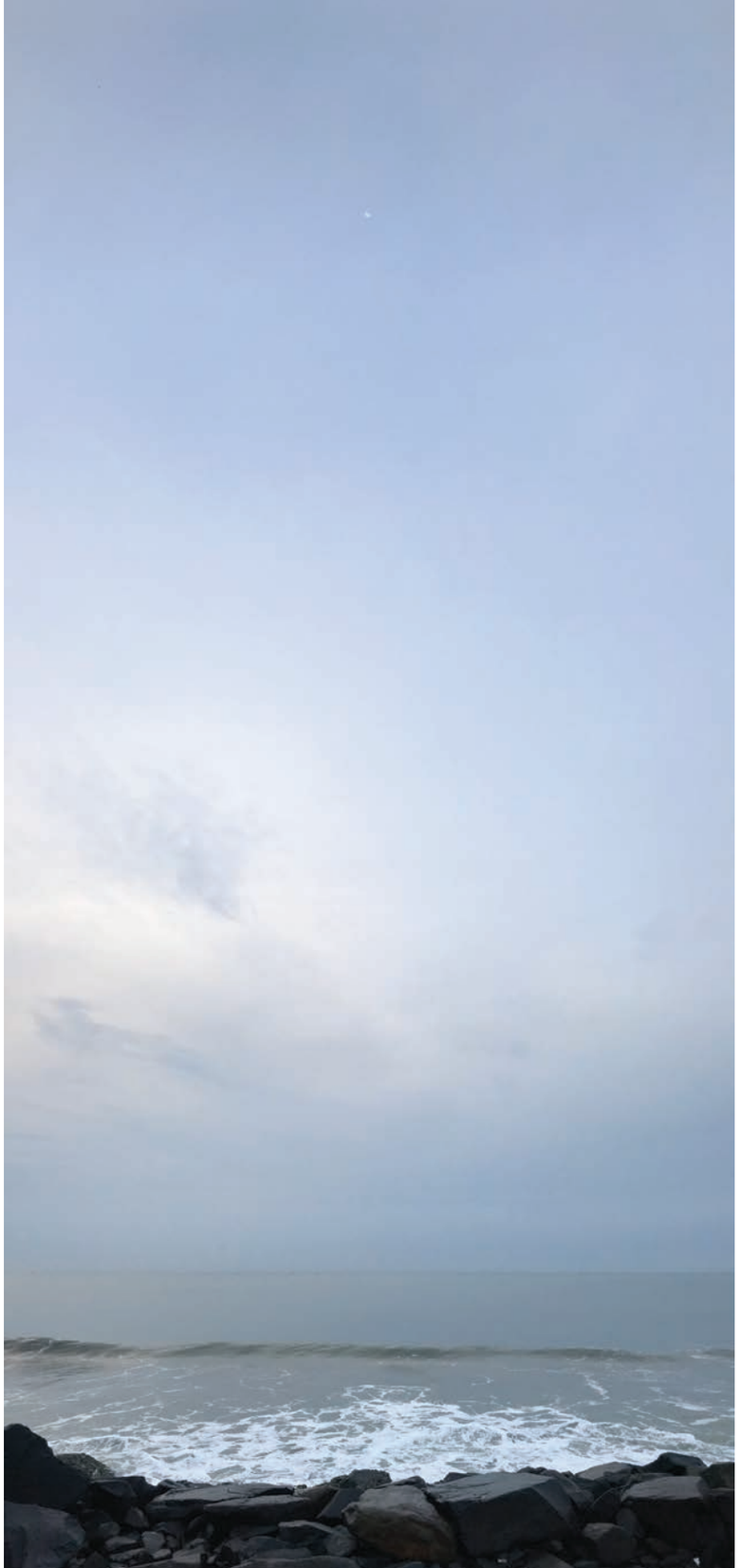
A poor catch has been the principal reason behind the sharp supply drop. Inclement weather has prevented trawlers from venturing out into the Estuaries rivers and the sea from where the bulk of the hilsa supply is procured. It has brought the supply to Kolkata markets down to a trickle. Compared to a daily supply of 15-20 tonnes a day last monsoon, this year we have been receiving less than three tonnes. The local variety is being substituted by the Myanmar hilsa which is neither fresh nor as tasty," said Syed Anwar Maqsood, secretary of the Fish Importers' Association (FIA). With import from Bangladesh having stopped three years ago, Myanmar is the lone source. But the hilsa season in Myanmar is a different one, February-March. As a result, the imported fish are stored for the local season which begins in July. "The fish naturally loses freshness and taste. It can't be compared to the fresh catch that comes from Digha, Frazerganj or Sunderbans. Almost 80% of the hilsa now selling across Kolkata markets is the Myanmar variety," added Maqsood.

Bijon Maity of the Kakdweep Fishermen's Welfare Association agreed. "Bad weather and inadequate rain have combined to reduce the hilsa catch. Heavier rain helps to reduce salinity in the water and attract more hilsa. But it hasn't so far happened," he said. But last week's heavy showers in south Bengal will make a difference, Maity felt. "With the weather having improved, trawlers returned to the sea on Wednesday.

P054-P057
Lindsay Bremner. Monsoon Airs, Pondicherry, August 2017.







AIR POLITICS

THE FOG OF WAR MACHINES

Kali Stull is an activist and a recent graduate from the Master of Public Health program at the Universityof Pittsburgh, where her research focused on nonhuman agencies which affect human health.

Etienne Turpin is a philosopher, research scientist at the Massachusetts Institute of Technology, and director of anexact office, a design research practice based in Jakarta and Berlin. With Anna-Sophie Springer, he is co-principal investigator of the exhibition-led inquiry 'Reassembling the Natural' and co-editor of the *Intercalations*: paginated exhibition series, published by K. Verlag and the Haus der Kulturen der Welt. He is also a co-editor of *Fantasies of the Library* (MIT Press, 2016), *Art in the Anthropocene* (Open Humanities Press, 2015), and *Jakarta: Architecture + Adaptation* (Universitas Indonesia Press, 2013), and editor of *Architecture in the Anthropocene* (Open Humanities Press, 2013).

Fig. 01 Pedro Neves Marques. (2017). Still from *Aedes Aegypti.* Digital animation video, 1'50'', produced by Pedro Neves Marques and Stenar Projects, with the support of Berardo Museum Collection. Courtesy of the artist.

Nothing can hold out against civilization and the power of industry. The only animal species tosurvive will be those that industry multiplies.
(Say, 1828)

A female *Aedes aegypti* remains in suspended pregnancy until she ingests vertebrate blood.[01] With hundreds of eggs in her ovaries, she begins a search for carbon dioxide and heat. Once detected, she lands on her host to penetrate the skin with her proboscis and deposit saliva, which as an anti-coagulant, ensures her meal of blood will flow smoothly to the next generation (Fig. 01). Within sixty hours of this fluid exchange—spit for blood—oviposition is triggered in the expectant *Aedes aegypti* and her eggs are released along the surface line of still water where they complete their embryogenesis and wait. As rainwater delivers new microorganisms into this watery exometabolic womb (so often unwittingly prepared by humans), respiration reduces the available oxygen and causes the eggs to hatch. Without vows or affection, humans and mosquitoes become kin, bound by blood to the rhythm of microbial breath.

Mosquitos sucked the blood of vertebrates for millions of years before *Homo sapiens* emerged from the evolutionary phylum, and until recently, humans weren't particularly appealing hosts. But then they tilled, irrigated and settled, and as the Sahara dried, their settlements became the primary source for the blood and water that *Aedes aegypti* needed to survive. A sylvan arthropoid first domesticated the land, and was in turn domesticated as host; an evolutionary lesson in becoming-hospitable (Powell and Tabachnik, 2013).

While settlement patterns drew almost all of *Aedes aegypti*'s host species near—dogs, cats, rodents, cows, pigs, and birds—they still came to favor blood from its human architects.[02] Due to low levels of isoleucine, the blood of *Homo sapiens* extends the life of *Aedes aegypti* and ensures the production of offspring counts in the thousands. Not only that, but with higher levels of lipids than in other primates, human blood helps co-produce thirstier vectors (Harrington, Edman and Scott, 2001). Because mosquitos' sanguine preference is based on their first successful blood-feed, as humans become ever more densely arranged into their urban settlements, the likelihood that *Aedes aegypti*'s first feed will be on human blood increases in turn, thereby establishing a lifelong affection; affine commitments are this way produced without the awkward requirement of affinity.

As humans continue to design and deploy new techniques intended to sever ties with this unwanted bloodline (Fig. 02), the fact that mosquitoes rapidly overcome the best efforts to keep human blood sacred should come as no surprise. For *Aedes aegypti*, it is precisely

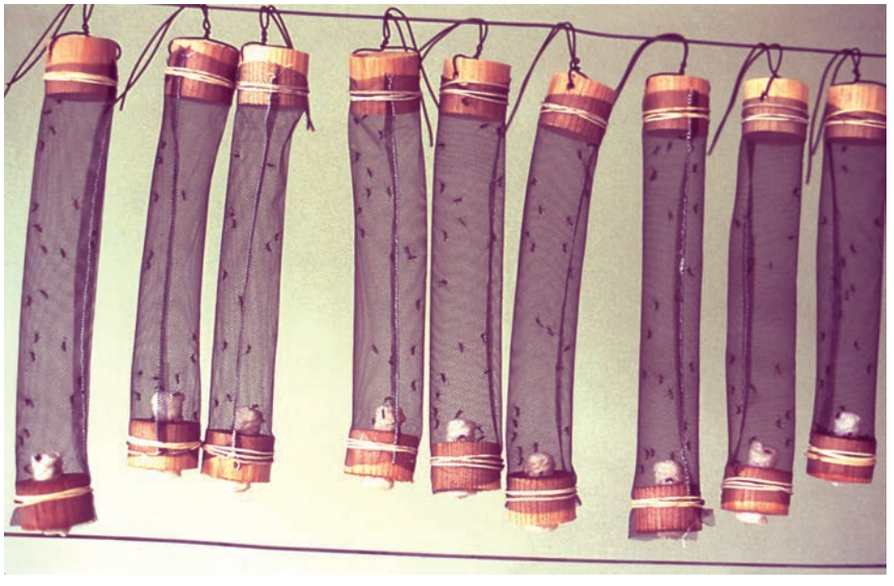


Fig. 02 Bioassay field tests are used to determine the efficacy of a given substance on a specified organism, in this case, mosquitoes. Used in field testing in 1981, this wire stringer of miniature bioassay cages allowed for the collection, counting, and analysis of endemic mosquitoes by Centers for Disease Control (CDC) entomologists. Photographer: unknown. Content provider: Centers for Disease Control. Source: https://phil.cdc.gov/phil/details.asp.

those terrestrial, aquatic, and atmospheric architectures designed to deny them any access to *Homo sapiens*' blood that have proven to be the most compelling invitation to intensify this multispecies co-evolution (Robbins, 2016). In this respect, anthropogenic climate change promises many further, intensive trajectories.

Climate

Governance is well named. It describes well the destruction of what is implied by a collective responsibility with regard to the future, that is to say, politics. *(Stengers, 2015: 54)*

The biogeographical distribution of *Aedes aegypti* result from a combination of factors, including various anthropogenic, climatological, evolutionary elements. Most notable for those living on a rapidly warming planet, heat is especially enabling: rising temperatures that provide local indices to climate change also speed up *Aedes Aegypti* development and rapidly alter its behavior; every stage in their life cycle is condensed

when incubated in heat, and warmer temperatures make *Aedes Aegypti* hungrier for blood. As noted by Ian Angus in his recent book *Facing the Anthropocene*, "It is virtually certain that our descendants will live in a 4°C World before the century ends, unless greenhouse gas emissions are radically reduced soon. A 4°C World would not be just warmer: almost all the world will be in a new climate regime" (Angus, 2017: 99). Quoting Clive Hamilton, Angus goes on to contend that this is because:

> *Living in the Anthropocene means living in an atmosphere altered by the 575 billion tonnes of carbon emitted as carbon dioxide by human activities since 1870. It means inhabiting an impoverished and artificialized biosphere in a hotter world increasing characterized by catastrophic events and new risks, including the possibility of an ice-free planet. It means rising and more acidic seas, an unruly climate and its cortege of new and unequal sufferings. It's a world where the geographical distribution of population on the planet would come under great stress.*
> *(Angus, 2017: 190-1)*

The stresses created by this geographical re-distribution of environmental risks and benefits will, of course, affect all living things, not just humans. But, it is crucial to remember that evolutionary repertoires are conditioned by historical processes, latencies, and numerous contingencies that are challenging to isolate; said otherwise, species evolve in a dynamic process that leaves little in terms of a priori certainties. Nevertheless, what this essay will try to show is that *Aedes aegypti* are in a far better position to take full advantage of a warming climate. Indeed, scientific studies are already pointing to anthropogenic climate change as a significant factor driving both the evolution of mosquitos and pathogens they help disseminate among human settlements.[03]

Virus

> *Individual animals and plants are like temporary "experiments" with which gene pools probe current environmental conditions to make sure that past successes are still viable.*
> *(DeLanda, 1992)*

When *Aedes aegypti* takes blood from a viremic host in the early stages of dengue, the blood moves into the mosquito's midgut, where the virus binds to receptors, enters the circulatory system and makes its way to the salivary glands. Once sufficient viral replication has occurred in the glands - a process lasting four to ten days on the calendar adopted by most *Homo sapiens* - the virus is transmissible to other humans. The mosquito remains infected for the rest of its life (World Health Organization, 2016).

When the dengue virus quietly initiated this vectors-with-benefits relationship, the *Aedes aegypti* was its sole host; then, as the virus evolved to live in primates, they became a vital agent of transmission. During each infection, dengue renovates the genetic structure of its host by altering no fewer than 147 proteins in *Aedes aegypti*'s RNA, thereby repatterning the mosquito's behavior. In essence, the virus makes the mosquito over as an ideal vector: smelling more acutely and hungrier for human blood, infected *Aedes aegypti* are also more likely to re-feed after interruption (when swatted at, for example, by a human). The dengue virus also uses the RNA alteration as a means to adjust mosquitoes' saliva production, making it even more hospitable to the virus (Sim, Ramirez, and Dimopoulos, 2012).

When an infected mosquito follows its heightened sense to feed on human blood, virus-rich saliva is deposited beneath the epidermis at the start of the meal. In fact, the virus is likely to be passed subdermally several times as the *Aedes aegypti* is a skittish feeder. Once inside the human body, the dengue virus quickly spills over from the saliva to the epidermal cells and then on to the lymph nodes, where it spreads throughout the lymphatic system. Three to eighteen days of incubation later, symptoms emerge. But, before they do - typically a day or two before the sudden onset of fever - the virus is already transmissible. Homo sapiens hosts are not simply unwitting victims of the dengue virus received from mosquitoes, they are also unknowing perpetrators who, while making multispecies kin, transmit the virus the next generation to *Aedes aegypti*.

The dengue virus has itself been adapting to the changing behavior of *Aedes aegypti* for thousands of years (Powell and Tabachnick, 2013). As these mosquitos migrated across the taxonomic register from zoophagous to anthropophagus, dengue adapted to live, and thrive, among humans as well, ensuring the enlargement of its spatial range by way of its host. Dengue can also infect the same human host four times, with each illness more painful and life-threatening than the previous one; because human antibodies cannot situate their relationship to a similar-but-distinct dengue serotype, they tend to boost, rather than prevent, the sickening effect of any novel strands of dengue. Human weaknesses such as these are not left unexploited in the arms race of adaptation. This adaptive dynamism of the virus has been the most consistent obstacle to the creation of a vaccine, several of which have been in development for nearly 100 years.[04] Likewise, pathologists are concerned that, given the virus's highly mutable and adaptable character, it would even be able to adapt advantageously to anthropogenically modified vectors (Lafrance, 2016).

With tears and toiling breath,
I find thy cunning seeds,
O million-murdering Death.
I know this little thing
A myriad men will save.
O Death, where is thy sting?
Thy victory, O Grave?
(Ross, 1897 in Stone, 2015)[05]

For most of the nineteenth century, dirt, debris, and immorality were usually cited as causes of malaria. Then, in 1897, Ronald Ross, a young British scientist, cultured twenty mosquitoes from larvae collected in Secunderabad, India, and paid his patient Hussein Khan eight annas to let the mosquitoes feed on his malarial blood.[06] One month later, he dissected these mosquitos to confirm the presence of the malaria parasite in the blood of their midgut (Sinden, 2007). By 1902, the Syrian scientist H. Graham also found that the dengue virus was transmitted by mosquitoes, writing: "Besides its maleficent function as the transmitter of malaria and yellow fever and its general character as pestilent nuisance, there is yet another disease of tropical and warmer temperate regions that is being credited to its mischief: Dengue" (Graham 1903: 28). These discoveries immediately and radically redesigned public health efforts to focus on the eradication of the vector.

In his remarkable study of "atmoterrorism," philosopher Peter Sloterdijk has noted that the characterisation of pestilential life - in his example, rodents as vermin—led to a particular disposition toward exterminism as a solution to problems of human settlement. He is careful to explain this comportment, noting: "Exterminism constitutes a simplification of sadism as classically described by [Jean-Paul] Sartre. No longer a mere question of usurping the other's freedom, it is primarily concerned with freeing one's own freedom from the freedom of others" (Sloterdijk, 2009: 28). Most urgent for any consideration of so-called vector-borne illnesses such as dengue is not, despite its decisive political consequences, the ability for scientists to transfer their enthusiasm for exterminism from one species to another (as Sloterdijk goes on to narrate with respect to the Holocaust), but rather that the exterminist has as his objective the elimination of the environmental conditions upon which his victims' lives depend. For Sloterdijk, prior to the development and combat deployment of chlorine gas in Ypres, Belgium, by the German army during the spring of 1915, humans could more or less assume that the atmosphere upon which they depended was a stable source of life; but by introducing techniques of warfare into the environment itself, it is rendered (or "explicated," in Sloterdijk's terminology) as an existential medium that cannot be taken for granted. Because of this, "The twentieth

Fig. 03 In the southern United States, dynamite was a preferred tool of the military's malaria eradication effort Determined to eliminate any standing water bodies that might serve as a breeding ground for female Aedes aegypti, the military built drainage channels in and around their military bases to encourage the movement of water. The most expedient method of removing tree stumps from the planned drainage channels was by embedding dynamite underneath and within tree stumps, as photographed here during the 1940s or 1950s. Content provider: Centers for Disease Control. Source: https://phil.cdc.gov/phil/details.asp.

century will be remembered as the age whose essential thought consisted in targeting no longer the body, but the enemy's environment" (Sloterdijk, 2009: 14). Indeed, this is also the case for human settlements in the tropics, where the discovery of the *Aedes aegypti* as a vector also led to a new exterminist imaginary (Fig. 03).

"If an enemy's body can no longer be liquidated with direct hits," Sloterdijk contends, "the attacker is forced to make his continued existence impossible by his direct immersion in an unlivable milieu for a sufficiently long period of time" (Sloterdijk, 2009: 16). As public health officials came to better understand the life cycle of the dengue virus, the war changed its front; *Aedes aegypti* were no longer just irritating pests, they were harboring a formidable enemy. Mosquitos became vectors: agents capable of transmitting infectious pathogens to other organisms, including humans.

P068-P069
Fig. 04 Fogging in Jakarta, Indonesia, May 2016. Photograph courtesy of Kali Stull.

In response, not long after WWII one begins to find among the budgets of municipal administrators in Southeast Asia a new line item: “Fogging.” Thus began the interspecies war of atmoterrorist eradication that has become so banal that few urban residents bother to give it second thought, even as clouds of toxic fog are repeatedly sprayed into their homes, mosques, and schools (Fig. 04).

Poly-sedentism

Getting hungry, eating, partially digesting, partially assimilating, and partially transforming: these are the actions of companion species.
(Haraway, 2016: 21).

For thousands of years, as humans re-designed other animals in order to improve their utility and obedience through breeding and domestication, third-tier synanthropes were co-domesticating alongside them. On 25 May, 1779, David Bylon, a Dutch surgeon living in the Dutch colonial city of Batavia (now Indonesia’s capital, Jakarta), suddenly became ill with a severe fever, causing him to leave the company of his companions and go to bed early. In what is cited as the first clinical report of dengue from the torrid zone, Bylon describes intense muscle and joint pains into the third week of his illness. Ultimately, he fully recovered, yet Bylon’s illness represents one case among an ongoing and often devastating cycle of epidemics reported in Asia, Africa, and North America throughout the 1780s, all of which followed the broader trend of outbreak patterns occurring along colonial shipping and trade routes. Initially moving from Africa to the Americas aboard slave ships, the range of the dengue virus was expanded while *Aedes aegypti* were fervently breeding among the countless casks of stagnant water accompanying colonial troops.

Dengue broadened its geographic reach again by travelling aboard military planes and boats during WWII, initiating the emergence of distinct viral genotypes. The post-war economic boom also resulted in heightened international trade, and the movement of both goods and people were accompanied by the *Aedes aegypti*, further distributing the virus. In 1953, a child in Manila became the first patient to die from dengue. By this point, the virus had manifested into more severe forms, including dengue hemorrhagic fever and dengue shock syndrome, which cause a combination of bleeding from the nose, ears, or underneath the skin, vomiting, and circulatory shock caused by plasma leakage into the interstitial spaces of the body. Inevitably, the increasing severity of symptoms caused the war of extermination to intensify.

By 1968, numerous cases of dengue were reported in Indonesia. By the end of the year, fifty-seven clinical cases and twenty-four deaths were reported and a national public health campaign to identify and treat dengue cases was initiated (Fig. 05). The following year, fogging technologies were deployed for the first time in Jakarta. Their purpose was as simple as their design: spray organophosphate pesticides into the air to kill *Aedes aegypti* populations. It is now known that dengue’s RNA structure produces one mutation every genome replication, largely because it does not go through a “proof-reading” stage, resulting in the pathogen being genetically destined for expansion and diversity (Miller and Vasilakis, 2009). Four genetically distinct serotypes and nearly fifty genotypes have developed in the last three hundred years, thus guaranteeing its survival in distinct geographic niches and among various demographics (Twiddy, Holmes and Rambout, 2003). Today, dengue is endemic in over 100 countries, with 400 million people a year becoming ill from the virus; it is thirty times more common than the flu and hospitalises half a million people annually (World Health Organisation, 2016). While the domestication of nonhuman species contributed to the development of denser human settlements, the designs that guided this manipulation of genetic development also created the conditions for pathogens to reproduce, mutate, spread, and find a preferable host species in *Homo sapiens*.

Fig. 05 A fumigation team prepares to board cargo ships in the Port of Jakarta, Indonesia, 1969.
Photographer: Unknown. Content provider: Division of Vector-Borne Diseases (DVBD), Centers for Disease Control.
Source: https://phil.cdc.gov/phil/details.asp.

Dengue's genetic typos are designed for urban living, with diverse genetic pools offering niches for experimental virus strains to survive. The urban landscapes of human settlements were thus optimal environments for the dengue virus to re-design itself through expeditious reproductive cycles, while also strengthening the fitness of its preferred vector - *Aedes aegypti.*[07]

Pestilential Urbanism

Terrorism is the maximal explication of the other from the point of view of his exterminability. *(Sloterdijk, 2009: 28).*

Ask anyone in Jakarta why groups of men are stalking narrow residential streets with awkward silver boxes strapped to their sweat-soaked bodies and it is likely they will say that the dense fog being dispersed from these machines kills mosquitos. This reply is only partially true. The war machines mix gasoline and pesticide in a heated chamber designed to produce microscopic droplets of insecticide; the machine's proboscis then ejects a thick, white cloud, dramatic and eruptive. The 'fog' is directed toward the most common places in city that the *Aedes aegypti* is found, usually dark nooks, hidden corners, and covered ditches. Yet, the target of the fog is only nominally the Aedes aegypti. More precisely, the 'fog' of these war machines is intended to make the environment within which dengue lives unlivable. Such aggressions reveal a decisive anthropocentric bias: although the bodies of Homo sapiens are also environments that host the virus, the 'fog' is not meant to kill humans, at least not immediately.

After nearly twenty years of fogging in Jakarta, a national spike of dengue incidences in the late 1980s shifted the deployment of these atmotechnics from being used responsively - where cases were recorded - to a broader, preventative performance. In other words, the war of eradication became total. Subdistrict health officials advised residents to open their doors but vacate their houses for three hours while fogging was taking place and to cover anything that might later come into immediate contact with human skin. Pesticides enter mosquitoes through their outermost organ, the cuticle; cholinesterase then binds to internal receptors which would normally receive the signal to move, paralyzing them completely. The men who carry out the fogging were thus advised to regularly check the level of cholinesterase in their blood to ensure the paralyzing effect was not also bioaccumulating in their own bodies.[08] Wars of attrition are not won without sacrifices.

Yet as the exterminism continued, it was not the price paid by frontline human subjects that was most disturbing. Nearly three decades after the first fog of war was deployed against *Aedes aegypti* in Indonesia, scientists observed among samples of dead mosquitos something unexpected: the pesticides were no longer working. The studies revealed *Aedes aegypti*'s resistance to organophosphates, the active ingredient in larvicide and malathion-based fogging (Widiarti, 2007; Mulyatno, Yamanaka and Ngadino, 2012). Human health agencies responded to these genetic defenses hermeneutically; they re-interpreted provincial law in Indonesia which required officials to "use pesticide rationally" as mandating a rotation of pesticides once every three years, or every three to six months, or to continually increase the dosage of the pesticide (Jakarta Provincial Government, 2007). Pesticide rotation proved incapable of keeping pace with the twenty-one-day mosquito lifecycle, and dengue, replicating as it does with every new host, produced countless new generations with potentially advantageous mutations.

What began as genetic anomalies in *Aedes aegypti* became adaptive features that all but guaranteed the flourishing of future generations. In Indonesia, *Aedes aegypt*i have doubled their rate of "knockdown resistance genes" in just the past ten years (Wulandari, Lee, White et al., 2015) and pyrethroid fog no longer causes paralysis or death.[09] Another trajectory of resistance can be found in the 1016G mutation, which produces detoxification enzymes that metabolize pyrethroids before they reach the target site to paralyse the mosquito. Humans, it should be noted, are far from the mosquito's first adversary; *Aedes aegypti* already evolved detoxification mechanisms thousands of years ago to cope with the organic chemicals that leached from rotting plant material in the stagnant water of their larval habitats. What is novel about the role of humans in the last century is their ability to design an environment optimized for their mutation and evolution. In 1946, there were only twelve cases of insecticide resistance reported worldwide; in 1990, five hundred species of mosquitoes were resistant to at least one pesticide (Karunamoorthi and Sabesan, 2013). The human designs for settlement and its atmoterroristic defense became indistinguishable from the environmental pressures within which *Aedes aegypt*i learn to adapt and thrive.

After nearly fifty years of intense pesticide usage (and tens of thousands of generations of mosquitoes), today fogging is synonymous with dengue control in Jakarta. This intangible infrastructure has also gained a monopoly on the human imaginary with respect to multispecies interactions. Despite the limited effectiveness of fogging, the psychosocial comfort it provides for urban residents is significant. Although nearly all public health officials agree that fogging can only be effective when other social behaviors are routinised (such as restricting *Aedes aegypti* breeding grounds by eliminating stagnant water), simple citywide strategies like dumping or covering water containers have done little to encourage human participation. Fogging is a more demonstrative mode of domination, even if it is less effective, impossible to maintain in the long term, and tends to diminish the importance of behavior-oriented

dengue control efforts (Sungkar, 2016). Importantly, the atmotechnical performance and compelling visual theatricality of urban fogging still communicates to residents that someone, somewhere is thoroughly governing the environment upon which their health depends (Butler, 2015).

As with political economies, toxins accumulate differentially among the "respiratory economies" of human agents (Sloterdijk, 2009: 99). While *Aedes aegypti* evolved to produce detoxifying enzymes, primates like Homo sapiens cannot rely on such extraordinary capacities. Meanwhile, the long-term effects of residing among these increasing levels of toxicity are rarely the subject of political debate or independent scientific research.[10] More common is the assumption that someone, somewhere, must have rationally weighed out the trade-offs before further perpetuating this interspecies *Jus ad bellum*. That such wanton hostilities are enabled by an anthropocentric bias is no secret, but the act of standing down as a species also means overcoming the fog of war. As Colomina and Wigley have recently suggested, "Design is a defense of the human, but what is being defended is never clear" (2016: 141). This ambiguity is perhaps nowhere more disorienting than among the intangible infrastructures of atmospheric governance, which simultaneously enable human settlements at the scale of a tropical megacity and redesign human vulnerabilities in the adaptive arms race of evolution.

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NOTES

01 A previous version of this essay, addressed more precisely to the provocation of 'posthumanities', appeared in *e-flux* (Stull and Turpin, 2017).

02 On the history of human settlements as "multispecies resettlement camps," see Scott (2017).

03 For a review of recent reports, see McNeill (2017).

04 The first dengue vaccine, Dengvaxia, was approved by the World Health Organisation in April 2016. As of August 2016, Mexico, Brazil, The Philippines, and El Salvador also licensed the vaccine. The cost and a concern that the vaccine will not protect against all strains of the virus have caused many of the 128 dengue-endemic countries to abstain from vaccine purchasing and implementation.

05 This poem was written by Ross the night he first discovered that mosquitos transmit malaria.

06 Eight annas have a value of less than one US cent.

07 For a re-evaluation of the history of human settlements, and sedentism in particular, see Scott (2017).

08 Pyrethroids have been the pesticide of choice for nearly twenty years in Indonesia, replacing organophosphates, which were shown to have negative human and environmental health impacts after thirty years of use. The discovery of DDT's endocrine disrupting effects and subsequent ban initiated the development of pyrethroids, which are heralded by pesticide companies and government alike as the safer options for non-mosquito beings (despite their acute toxicity to fish, bees, dragonflies, cats, and sometimes dogs), while still offering a mortal mosquito knock-down (Elyazar, Hay and Baird, 2011).

09 *Aedes aegypti* had a head start building resistance from decades of exposure to DDT, which targets the same channel. Mosquitoes were shown to be resistant to DDT just four years following their use (Sayono, Hidayati, Fahri et al., 2016).

10 On this point, see Mitchell (2002).

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BECAUSE THE LAKE BURNS

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This essay is a brief observation on the complexities of an air sensed through a particular history and cultural/linguistic lens. It's a personal entry too, because the linguistic references used in the essay are from the south Indian Dravidian language of Kannada, predominantly spoken by people who live in the Indian state of Karnataka. In citing key moments that encompass the private, the political and the spatial, I try to think with the vocabulary and discourse of the anthropocene to extend the thesis of the anthropocene into a wider range of imaginations. The argument I make is that a theory of air in the anthropocene inhabits many different human possibilities, when viewed from separate independent cultural viewpoints. Some sensibilities are blended into formats of the divine and of surrender; some sensibilities are entangled with the overwhelming desire for capital and development; and some sensibilities, while meshed in a deep history of ideas with certain concepts of nature, remain disconnected from reality and the air is somehow forgotten. So how in this time or *kala*, which translates to the word 'time','age' or 'phase' in English, are we to think of the anthropocene? What is it that a theory of *kala* might show about the anthropocene that would be different from the English notion of time or '..cene' in the anthropocene? I do not offer an answer but I attempt to open up a conversation, to provoke the possibility of a plurality of times cohabiting the airs of the anthropocene.

One

On the evening of 16th February 2017, Bellandur Lake, Bangalore's largest water body caught fire. Sewage and industrial scale dumping of waste into the lake had transformed the water body to a pool of toxic fluids, strangely vegetal and frothy like foamy soap bubbles, that took to the air. On that particular day, the lake caught fire. From its life as a living lake to a condition in which it was terrified and searching for breath - it's self-immolating act was its last call for help, before a certain death. The lake was screaming at the human consensus through the air. Just as the media reported the incident as a problem that troubled motorists and local residents, democracy had shrunk to the citizenship offered by

real estate and motorised development. The idea of development had consumed nature as an object, within humanly perceptible scales. The lake could not survive this onslought. The burning lake was both a constant metaphor for the grave precariousness of the anthropocene and the translation of material into the air through particulates and fire.

Bangalore, also known as Bengaluru used to be known as a city of lakes and is even today conveniently advertised as a garden city, in memory for what once was. Bangalore's temperate climate and strategic position next to Mysore and other cities of Karnataka and the south, made it particularly attractive for empires, including the British, who set up a presence there at one point. When Kempe Gowda 1, ruler of the *Vijaynagara* kingdom in the 1530's set out to make Bengaluru his capital, his mother is said to have advised him of two principles; '*Keregalam kattu, marangalam nedu*,' which directly translates 'to build lakes and plant trees' (George, 2016). The notion of *prakriti*, which translates conceptually as 'nature' is assumed as a foundational concept in this process of city making.

Not a long time ago, a younger version of me used to visit Bangalore during school holidays. The air was not something I distinctly thought of at the time. The air was just the air. But, in my memory, Bangalore's air was distinct. It used to get really cold in the evenings. I also remember how I used to argue with my cousins about switching the fan off at night. I remember the mist that carried the morning chill. Bangalore conjured the idea of *challi* and *shita*, the former translating as 'chilly' and the latter translating as 'cold'. "It's easy to catch a cold, if you go out in the morning without your head covered," my mother would say. Bangalore's air was a space where the morning dew would perform as a mist, playing with the trees and the moving mobilities of the street. The morning mist does not exist anymore. My intent here is not to express a moment of nostalgia but to say that the air has changed. Urbanisation transforms the air and dust has replaced dew. The very nature of climate is transformed in the process. From a notion where *prakriti* served infrastructure, today Bangalore, in line with India's neoliberal growth story, is attuned to a very different desire and imagination of infrastructure. This breaking out from one view of the world, to another is a noisy one. Naresh Narasimhan (2014) calls it urban amnesia, where a society forgets what a city looked like.

From over 400 lakes at one time, to 280 lakes through the 1960's, eighty by 1993, today the city is left with only seventeen healthy lakes (Murali, 2016). Bangalore has in-fact expanded over ten fold in the past few decades (Nagendra, Unnikrishnan, and Sen, 2013) and has lost a significant percentage of its tree cover (Nagendra and Gopal, 2010). For the city, the air and water in this mode of growth are framed within a project of othering, where the elements constitute a form of disposability. Almost all of Bangalore's lakes were human-made, in history, through processes of some kind of planning. The resulting ecosystems were important both to human and non-human life (Ramachandra, Ahalya and Payne, 2003). Mathur and Da Cunha (2006: 215) write that "The uncertainty and blurring injected by today's open economy merely underscores the point that Bangalore is not necessarily a demarcated entity to begin with." Furthering that spirit of blurring, it can be argued that the economic growth the information technology sector has provided has out-scaled the ability for plans and the desire to control politically any limit to the profit space and capital can offer. Bangalore being the nation's primary IT hub is a major contributor to India's GDP with the information technology sector contributing as much as 18 percent of India's GDP (Times of India, 2016). The workings of ecology and the workings of capitalism juxtaposed on this terrain operationalize very different logics of time and speed. This suggest a certain kind of complicity in the making. The infrastructure of lakes and trees in a certain regime of thought competes with the infrastructure of neoliberal capitalism and development. This mode of advanced capitalism conditions the city, the earth and life (Braidotti, 2013).

Bangalore's *kala* (translating roughly to 'time/age') today is a present with an uncertain future. T. Ramachandran of the Indian Institute of Science argues that its ecological crisis will make the city unlivable by 2020 (Bhashti, 2017). Bellandur Lake's toxicity translating to an aerial mode is a perfect example of its contemporary condition. It's a moment that visibly connects earth, water and air in entangled precarity. It is caught up in a deep complicity where the actors of toxic supply are aware of the consequences of encroachment and waste disposal. However, it is convenient and profitable to do so and in time informal-formal systems allow for domestic real estate to consume the life of the lake by covering it with material. While the National Green Tribunal this August lashed out at the responsible agencies, asking "why they should not be prosecuted for negligence" (Press Trust of India (2017), the lake still burns, because the only way it has is to burn. Mark Wigley and Breatrix Colomina (2016: 25) argue that "if the human is a designing animal and the earth is its design studio, this animal is not unique and distinct creature moving and thinking within that vast studio. The figure of the human is not sharply defined. It is part of the living earth that it designs just as the living earth is part of it." What fantasies therefore will a political project have to procure in time and *kala* to serve living? Is there a way for *kala* to exist as a concept of time where a particular notion of agency can be enabled?

Two

A little over three hundred kilometers west of Bangalore, after the descent from the ghats, in a village, my grandmother used to sit out in an open porch overlooking her lands. On a seemingly random evening, at the dawn of the monsoons, she'd say that the rains would arrive. Her nose was one with the monsoonal winds. It was like the air spoke to her; she was never wrong. Perhaps, partially because the monsoons attended a certain regularity with her senses, even on those odd years, when the clouds were not kind, there was a sensibility to its very non-occurrence. She was a human of the agricultural hill and forest, in tune with a smell of plants, soil, listening to birds, insects, cows and the general fluctuations in life that enabled her to read her relatively small world with comfortable accuracy. For her, the monsoons seemed to be communicated through the air. The air informed her that they were coming. Every facet of rain and storm did things to the ecology of the landscape she was part of. "Did you know that thunder and lightning informed the growth of particular mushrooms?" "Oh look at the flowers that bloomed because of the rain last week," she said. Beneath the agricultural knowledge system that informed crop and harvest, there seemed to be an underlying relationality to life in general. The monsoons informed that relationality. She seemed aware that these winds came from other places. Yet, her location on the land as her constant sensing agent, anchored these winds perceptually.

The concept of the anthropocene for her rested in something she called *Kali Yuga*, the 'age of the demon.' According to Sanskrit scriptures, this is the last in a series of four cycles the world goes through. Kali Yuga is a time of great quarrels and a certain tyranny. For Honnamma, my grandmother, the *Kali Yuga* indicated unpredictability. Her world was challenged in time. "Nothing can be said these days," she used to say. The knowledges and practices that enabled her sensibilities of prediction seemed to dim. The ecosystem had changed and so had she. The very nature of the wind had changed, she said. In a moment of angst, she sometimes remarked that this was a spoilt air. The use of *Kali Yuga* in her vocabulary merged with igana kala (translating roughly to nowadays or these days). She started saying "These days you never know what's going to happen." In the formation of *igana kala* as a concept, *Kali Yuga* is only a backdrop. The former evolved because of the latter. *Igana kala*, of course also comprised *Male kala* the season of the rain. There was a design to this time, a design that she recognised but did not completely understand, and it was clearly not of her doing. This was not happening to her as a person, but was a change in the nature of the wind and the air. In humility to time and the making of time, all she could do was to surrender. Her political encounter with the air was one of acceptance and surrender. What could one do but breathe the air and drink the water?

My grandmother's was a complex integration of the air. It was not an air that cared about politics or democracy. The air of igana kala gathered the object sensibilities of the many, concerning things, people, thoughts, gods, stories, cars, devices, family, jobs, nature, circumstance, fertiliser, newspapers, care, fruit, fire - in an ever growing list of possibilities. In time, rain became fickle. The wells were shallow. Fungi invaded the arecanut trees and peculiar little dot-like sticky insects buzzed around the bulb outside the door. A simultaneous invasion on the senses from all sides, of all forms, convened. Igana kala described the air, but it also described everything else, just like the air. In her description of this *gaali* (wind), air is both a carrier and a state of life. The wind as a force of the air, mixes worlds and makes new worlds. As a concept, it was the Anthropocene already.

As Haraway (2016: 35) writes "It matters what thoughts think thoughts. It matters what knowledges know knowledges. It matters what relations relate relations. It matters what worlds world worlds. It matters what stories tell stories."

In this knowledge system of entanglement, it was possible to understand the air in its complicity with other forces. Yet, conceptually, a surrender because of an overwhelming *kala yuga* would only indicate a redirection of agency. However, the burning lake only shows us that if we treat air with linearity and void, it gives back a similar treatment, just like Gaia's revenge (Stengers, 2015). For the lake, water made worlds with air just as air made worlds with fire. If one thought that the harvests of the ground had no connection with the harvests of the air, these were times to deeply reconsider such positions. For the actors of the Bangalore condition, the question is not just of complicity but why a certain toxic version of the future must reign? For *Honnamma*, the question was how can complicity be invented when the automatic response is to surrender? In Honnamma's view of the air and life, entanglements don't go unnoticed. They're embraced. In Bangalore's new emerging developmentalist modernity, the environment is an externality, just as real estate colonises environment as a commodity. None of these are ideal views but what if there could be a world that embraced entanglements at scale? What if the lake was not alone but in community with life (Morton, 2017) and a very particular kind of complicity needed reinvention, where life was let to prosper.

In urgency. The lake had to burn to be seen and because people and other life were in the air's world, breathed.

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AIR PRACTICES

INTERVIEW WITH SEAN LALLY

Sean Lally is the founder of 'Weathers' and the author of the book *The Air from Other Planets: A Brief History of Architecture to Come* (2014). He is the recipient of the Prince Charitable Trusts Rome Prize from the American Academy in Rome in Landscape Architecture and the winner of the Architectural League Prize for Young Architects and Designers Award. Lally is currently associate professor in the School of Architecture at the University of Illinois at Chicago.

Tom Benson and **Calvin Sin** were students in Design Studio 18 at the University of Westminster from 2015 to 2017, and assistant tutors in the undergraduate programme over the same period. Tom's final project ,'Datascape: Instrumental Wetland,' researched into and proposed how to restore the Pallikaranai Wetland in south Chennai using algal blooms. Integral to this design and its implementation was a series of prototypes deployed in the marsh as a parametric, responsive system to rehabilitate the polluted wetland over time. Calvin's thesis project 'The Forgotten Marsh' researched the seasonal monsoon wind patterns in south Chennai and proposed a housing prototype shaped by these patterns to be built over a seasonal marsh. The objective was to recreate a lifestyle in synchrony with seasonal monsoon winds and, at the same time, to retain the marsh as a seasonal wetland. Tom and Calvin's DS18 work was exhibited at the Monsoon [+other] Airs symposium and they interviewed Sean Lally on his visit to London as keynote speaker at the symposium.

SL Sean Lally
CS Calvin Sin
TB Tom Benson

CS: For people who aren't familiar with your work, could you give us a brief introduction to it and how you use energy to organise space?

SL: I don't really think of architecture as an autonomous entity as we don't just create and we don't just talk to ourselves. The short version about my work is that I am trying to figure out what the biggest pressures are outside of architecture that we should be engaging with. For me this has a lot to do with the changing environment, everything related to climate change and an evolving environment that we are part of, and secondly, the human body, the idea that the body is evolving. With wearable technology, with health care, we can see our bodies themselves as open ended. I think this is an important moment for the discipline. Architecture has a really big role to play. If the environment can be reimagined through materials and if the body can be directed to perceive materials like energy, then the architect can figure out what spaces are possible and how to shape them.

CS: When I look at your work, the way you look into different types of energy through the use of computational fluid dynamics (CFD),

it comes across as very exploratory, You relate the risks this involves to Neil Stevenson's paper 'Innovation Starvation,' in which he argues that in order to truly innovate, one has to accept the possibility of failure. Do you think you have to have that one signature built project to validate your research?

SL: Yeah one wants to get things built and wants to get ideas out there, but this can come in a lot of different ways. It can come through writing, it can come through design projects that you know may never be built, or hope they will but realistically know that they never will. These kinds of projects are more short-term. The projects that you spend more time on are more like ten year projects; ones that you don't think you will see return on for ten years, but you think the research and the wait is worth it. Some projects are five year projects, and some are two year projects. They will have different levels of return in terms of innovation or approach. A book, for instance, is a five-year project; you have to lay out the framework for where you want things to go over a five-year period. For a ten-year project, it might be design ideas that you are testing out. I don't think my buildings are going to get built right away but they are going to help me keep moving forward. A two to three-year plan is when you have the green light today and you can actually pull it together and get it done within that time frame. It's important to work with these three or maybe four time periods in mind. But when you are doing two year return projects, it's hard to remember sometimes about the 10 year plans and keep focused on what you're shooting for.

TB: in terms of percentage of time you spend on two, five and ten year projects, what would it be?

SL: It changes month by month. There are times where I'm really excited about the two-year project and then it's dead. Then I shift over to the ten-year project. So this month I'm shifting to the ten-year and then I'm still trying to get opportunities so I can shift back. One of the big moves I have recently made was to reconfigure my practice as a non-profit. This lets me be a bit more engaged with communities to bring them together with technology through design. My ten-year plan is now directed towards addressing the big pressures I mentioned at the start by building prototypes, testing them, running them, shutting them down and doing it all over again. I'm still trying to flesh this out, so while I'm waiting for this to happen, I jump ahead to things that I don't have to wait around for ten years to materialise.

CS: I am also aware that you produce podcasts.[02] You invited Philippe Rahm[03] to one of your podcasts earlier this year. Do you find that your projects relate to his? Rahm talks about the energy gradient very often in his projects too. There is one project I have in mind in particular - the Jade Eco Park in Taiwan.[04]

Fig. 01 Sean Lally. (2006). Amplification. Installation as part of the Gen(h)ome Project, Los Angeles California. Permission: Sean Lally.

SL: Yeah, I am surprised that is not getting as much press that it should,[05] but I didn't ask him this when we talked on the podcast. I have known him for ten to twelve years. The first time I met him was in 2006 in a show called 'Amplification' at the MAK Center in Los Angeles (Fig. 01). I had the outside garden, he had an interior space. I was made aware of his work at that point. I thought his installation was great and we stayed in-touch. I invited him to lecture at Rice University when I was teaching there, he had me go out and give a talk in Copenhagen, we invite each other to write pieces in journals we might be editing, so we kind of switch back and forth in order to keep a dialogue open.

CS: I think Jade Eco Park has recently been completed. It's a very new approach to the design of a park, but I think it is very difficult to make people to realize how different it is since you don't really see energy.

SL: Yes, that's the million-dollar question. How do you make visible something that's invisible? Inside a building it's easier - you don't have to wear as many clothes as the air is warmer inside. How do you do that with external micro-climates requires secondary and tertiary inputs. An example of this being that you don't see heat in the middle of winter, but if you see a patch of green grass you know something is leaking from a pipe somewhere, giving off heat warming the soil growing the grass. The question for a designer becomes how to create those moments. Maybe what the Eco Park needs is a little time, so that people do not photograph

the technology but instead photograph people interacting and enjoying themselves in different ways that have been set up by that technology.

CS: In Rahm's project, he uses similar methods to yours to develop his work, such as CFD diagrams of how energy flows or how temperature changes at different positions.

SL: I have started to do less and less work with CFD, primarily because when you use it at smaller scales it is more realistic, but as you jump in scale, unless you can bring in engineers from large corporation to really run the simulations, you end up creating intentions. CFD can become very technical, instead of figuring out some of the social-spatial implications which I think people want to know more about. I think the CFD is very helpful on one level, but I don't think that's the primary level I want to engage with.

TB: So what kind of programmes do you normally use in the office?

SL: Right now a lot of the work is prototyping, trying to build 1:1 or half scale prototypes. That is a tough thing, because when you are talking about concrete, steel or glass, its easier to model, you can make it out of foam or wood and people understand it that it is supposed to be a steel or concrete. But when you do anything with energy it is difficult to scale. A lot of the prototypes that we are making now are half scale versions, which is is enough to get the general logic behind it. This is where some of my teaching comes into play too. Doing a little bit less CFD stuff, more prototypes to scale ideas, or imagery that shows the implication of these prototypes.

CS: So now you have moved to prototyping.

SL: By doing prototypes I can push my design intentions further. Because they are built, I can say that something is plausible, you can do it. With competitions, the best way you can show it's plausible, is to show something that looks like something people know and sneak something in, to get the thing you want. But with prototypes, I can point to something and say to people, "This is what I am going for."

TB: And if the prototype does not work, can you still extract the positive from it?

SL: Absolutely!

CS: Do you test or measure impacts of prototypes, I am thinking about your project 'Wandering?'

SL: Yes, in that case, it was about how to do it, one of the things learned from Amplification in 2006. I couldn't figure out how to access the metrics of performance. Now with open-source and all the various things that you can plug-in and play with, getting sensors to get readings and feedback and so on, things have become a lot easier. That's where I use most of the technology, to track ideas and get feedback, to try to understanding how a prototype is performing and tweak the design.

TB: So you normally use Arduino and sensors and measure the results?

SL: Yes, just to get some metric to understand how a prototype performs. One thing I regret about 'Amplification' is that I did not use sensors, though part of the project did have some level of indexical indication of thermal processes. The aryclic boxes all had milled edges where condensation formed, so one could see which one was more thermally active, which one was more dormant, through a visual indicator. It is still important to see what is happening.

CS: I had one more question on 'Amplification' What were the different variables you used to determine the design of the project?

SL: The idea was there were six shapes that had the same form and visually looked similar, but internally they operated differently. In one, there were no controls, no electricals and no systems involved; the exterior climate was all that was affecting it. Some were heated and controlled regardless of what was going on outside. The others had a selection of five or six variables that were activated differently. One was air velocity using a fan that moved the air around the interior. Another contained water with a dye in it. This dye is used for tracing water sources in natural environments to see where water moves; if you run a black light over it, it goes from translucent to opaque. The idea was to heat the water up high enough to see if any of the dye would evaporate, but it didn't. Then there was one with vegetation inside, heated from the bottom with a thermal element. The idea was that if you came to look at them on different days, they would be doing different things. Some were on a 48-hour cycle and others were on a 24-hour cycle; They all looked similar in form, but they all behaved in different ways. It was basically an outdoor art laboratory.

CS: How did the public react to this, because I don't think the project was very easy to understand?

SL: Well it part of a bigger show, with seven or eight other projects about domestic space on at the same time. Many people probably just saw it as an outdoor garden, which was fine.

TB: So if you were going to do this project again, what would you do differently?

SL: Well what was good about doing it at the time was that we made prototypes and ran simulations on them, and found that he prototypes didn't work the same way the simulations did (which is kind of expected). After that we made a new prototype that worked better. So being able to understand better the development between simulations, prototypes and the built work was what was good about that project. What I would do differently is to layer the project with sensing systems to really understand the metrics better. Back then, in 2006, I just didn't have access to the systems or know how to pull that off. I knew what temperatures I had set, but not how the object would perform. At the time, it was just about spatial performance. Now my interest is more in the body and how it relates to space, in trying to get metrics about bodies and spaces, to understand why people use a space, what they are trying to get from it and how they perceive it differently.

CS: Does prototyping relate to your mode of teaching?

SL: It changes, so in the last year or two, we haven't really done much prototyping in the school, it has been more about model making and scenario building through imagery. This year I have three classes to teach - the core graduate technology class, a third year undergrad studio and a final year undergrad option studio. This is a good mix for me. For the technology class, sometimes we do prototypes, but they can only be things that last for four to five weeks, because you have a curriculum to get through. In the option studio, students want to do prototypes, but at the same time they want to get on with their design projects. So we go back and forth between what students are required to have in terms of a design project, or putting all our energy into a prototype which may not be so easy to communicate to people. This is why I started the podcast, as a way to communicate with people, in a way that I wouldn't have had otherwise. I think there are twenty now, but only four or five are conversations with architects. The rest of them are with people from a range of backgrounds, like bioethics, or anthropology. It is how you bring that work into the realm of architecture that is beneficial.

CS: When we do research in our studio,[06] we don't really look at the work of architects but quite often at reports from other disciplines such as a scientific reports, IPCC assessment reports etc.

TB: I have read so many reports on bio-engineering, or algae! They never directly relate back to architecture but then it is my job to then bring them into architecture.

SL: Yeah, and this is the tough part for education. How do you instil the principles of the discipline when you go beyond it and bring something else in?

TB: Do you have goals to extend the scope of your practice?

SL: Actually, I don't. I have quite a few ambitions, but size of the office isn't one of them. I like what I do. If I can do it in small group, I would rather do that.

TB: So you can have a full control of it, not miss out anything on a project?

SL: Yeah, maybe but I don't need to be involved in every moment of every project. I am not a control freak in that sense. it's just that if the opportunity comes to get larger that would be great but if it doesn't, it doesn't undermine the project.

CS: When did you start working on your ideas for your practice, 'Weathers'?

SL: Probably not until I left college. I have an undergrad degree in Landscape Architecture and a degree in Architecture. It was only when I left college that I started to piece it together. My work is hugely influenced by my time at UCLA, by some of the thinking and some of the people there. Not in terms of the actual project but the way you approach a project: you find the problem and figure a way to engage with the problem or a series of problems. Sometimes that takes a long time.

CS: Looking back now, it seems you have identified problems in architecture and your solutions seems to be somewhere between landscape and architecture.

SL: At some level, I think landscape is the place to engage architectural discourse today. I think that for most part it has been left behind. A lot of people will be angry to hear that, but I think that in general, the idea of landscape is not at the forefront of thinking about the future. We still talk about landscape, we still talk about conservation, we still talk about sustainability, we still talk about these kinds of indicators of what the environment should be. We can be more ambitious. Working with landscape, building space up from landscape and at some point, adding enough materiality, capturing enough activity to make architecture, not landscape architecture but actual architectural form, that is how I want to work. An example that I always go back to is the street light. It has shape, it has interior, it organizes space, it organizes activity. It does everything

that we define as architecture, it makes an architectural space, except it has no walls. If we start there and keep on going, adding more and more, at what point does it become an architectural form without having to default to surfaces and walls? To do this, I think it's important to engage landscape as the starting point.

CS: I suppose it is very difficult for architects to get into that mind set. I understand the street light example, but when I try to implement it in architecture, it is challenging.

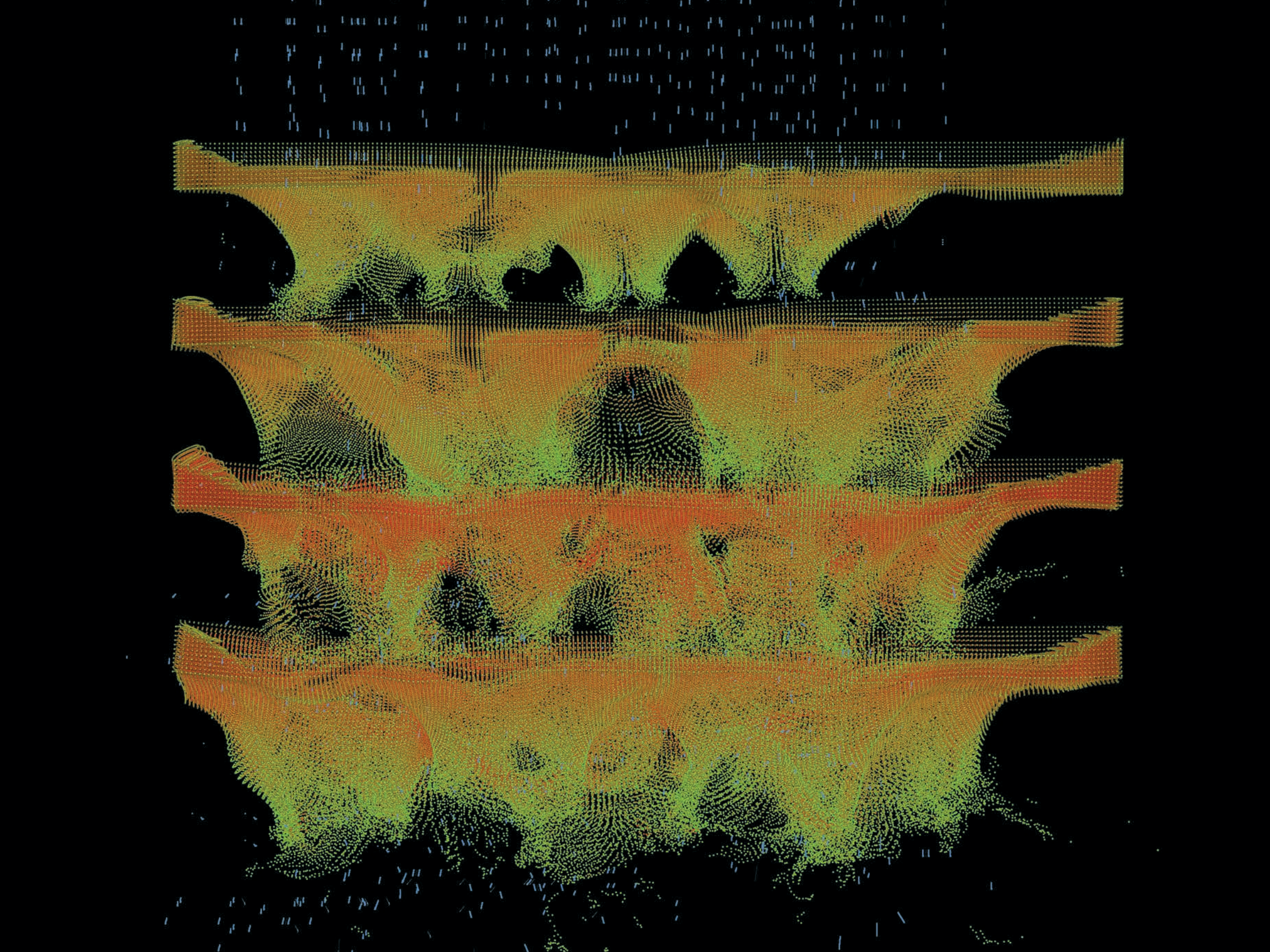
SL: It is, if we are given a commission to build a library, this approach is not going to be very helpful. The question is how to split the program into different components and realize part of it in the manner of the street light. Eighty percent might still have an interior in traditional sense, on a bad day, all of it. Can we get five to ten percent to do something different with new technologies? Part of this is an exercise to see what we can do, not what we should do. I believe its important to have some aspect of the work being about just seeing what si possible, how far can we push this. At other stages, its about integrating abilities with objectives and looking for overlap.

Fig 02. Sean Lally. EOS Series / Untitled One, 2014. Energy as a building block for the future. Permission: Sean Lally.

NOTES

01 https://www.wired.com/2011/10/stephenson-innovation-starvation/
02 http://www/nightwhiteskies.com; https://itunes.apple.com/us/podcast/night-white-skies/id1144753799?mt=2
03 Philippe Rahm is a Swiss Architect based in Paris, http://www.philipperahm.com/data/about.html
04 http://www.philipperahm.com/data/projects/taiwan/
05 Jade Eco Park has been recently published in *Architectural Review* https://www.architectural-review.com/buildings/building-with-heat-humidity-and-light-jade-eco-park-in-taichung-by-philippe-rahm/10020675.article
06 Design Studio 18 at the University of Westminster.

P094-095 Tom Benson. Abstract simulation of acid rain deforming layered plates. Tools: Realflow, Grassshopper.



ON THE MAKING OF 'ARCHITECTURAL MANIFESTATION OF THE PANCHASTHALA TEMPLES. PART 1 SRIKALAHASTHI TEMPLE, ANDHRA PRADESH.'

Keerthana Muralidharan is an architect from Chennai pursuing a masters degree in Architectural Conservation at the School of Planning and Architecture, New Delhi. She has an interest in traditional knowledge systems, in particular the temple architecture of south India. She is exploring these with Aishwarya KV, an architect pursuing her masters in Architectural Conservation at the School of Planning and Architecture in Bhopal and founder of 'Samarya'a heritage research initiative' under which she has presented papers in various conferences in India and Sweden; with Koushik Krishna, a research fellow at Care Earth Trust in Chennai and a free lance architect who has executed projects in different parts of Tamil Nadu; and with Vishal Gowtham, also a research fellow at Care Earth Trust, currently working on the urban design of open areas and public parks for the Greater Chennai Corporation.

In Tamil literature one finds a mythological classification system known as the *PanchaBootha*, (*Pancha* meaning five and *Bootha* meaning elements). The five elements are *Kaatru* (air), *Neer* (water), *Aagayam* (sky), *Nila*m (earth) and *Neruppu* (fire). It is believed that all forms of life are built up by the combination of these five elements. They are also believed to influence various other natural phenomenon like seasons. Each of the five elements has a nominated deity and an associated temple, collectively known as the *Panchsthalas*. The temple of the air, or wind, is located at Srikalahasthi in Andhra Pradesh, while Thiruvannamalai, the temple of fire, Thiruvanaikava, the temple of water, Kanchipuram, the temple of earth and Chidambaram, the temple of space or sky, are located in Tamil Nadu. Surprisingly these temples were not conceived and constructed as a single project.

The documentary film 'Architectural manifestation of the PanchaSthala Temples. 1. Srikalahasti Temple, Andra Pradesh' was inspired by the need to explore and understand the origin of the concept of the *Panchasthalas* and the relationship of the *PanchaBhoothas* to Dravidian temple architecture. We studied Srikalahasthi, the temple to the air (or *vayu* meaning wind) in Andhra Pradesh in detail. It was analysed on the basis of various parameters such as location, history, development over time, spatial planning, materials, construction, architectural details and iconography, in order to understand the influence of the monsoon on it and its planning.

In Hindu mythology, the monsoon is caused jointly by the wind and water gods (*vayu* and *neer*). Since ancient times people worshiped these deities and conducted specific rituals to please them. The type of worship and offerings varied according to the landforms and occupations of the people. Tamil Nadu has historically relied largely on the north-east monsoon since it lies in the shadow of the Western Ghats and south-west

monsoon rains are rare. The arrival of the monsoon is celebrated with exuberance. *Adi Perukku* is a unique festival in Tamil Nadu celebrated during mid-July-August by women. It falls on the 18th day of Tamil month of *Aadi* and celebrations take place in a grand manner near river basins, water tanks, lakes and wells. The festival pays tribute to water's life-sustaining properties.

The research for the film started with an initial visit to the temple to understand its location and surroundings. It is sited at Srikalahasthi in the broad valley of the Kailasagiri between the Durga hill and the Swarnamukhi River. We collected secondary data from the *sthala puranam, periya puranam*, and *tolkapiyum*m literature, inscriptions, books published by the Archaeological Survey of India and various other sources from various time periods. The study of secondary data was followed by a second visit to the site where field data was collected.

As architects we knew and understood the generic parts of the temple and its function, but we were unaware of the science and reasons behind many of its elements. In the attempt to understand the temple architecture better, we interviewed a number of experts: Sthapathi Neelamegam, Sthapathi SundaraRajan, environmentalist Dr Jayashree Vencatesan, saiva sidhantha pandit Chandrasekar and the priests of the Srikalahasthi temple. Each of them added different layers and more depth to our understanding. For instance, according to Dr Jayashree Vencatesan, Indian culture is closely associated with its environment. The word *Srikalahasthi* is a combination of the Sanskrit words *sri* meaning spider, *kala* meaning cobra and *hasthi* meaning elephant. The name itself throws light upon the native species which are particular to the semi-arid forest region where the temple is located. These species are symbolically represented on the lingam of the main deity of the temple, *Srikalahastheeswara Shiv*a. Mythically this lingam is believed to breathe, causing the constant flickering of the lamp in the sanctum, and associating the temple with vayu, the wind element of the *panchabhoota*.

With a proper understanding of the temple and its various layers of development, we were given permission by the temple management authority to undertake photo documentation of its iconography and elements. We also undertook detailed video documentation, which was then edited to make the final documentary film.

The Monsoon [+ other] Airs symposium gave us the opportunity to explore the vayu phenomenon of the Srikalahasthi temple. 'Architectural Manifestation of the PanchaSthala Temples. 1. Srikalahasthi Temple, Andra Pradesh' premiered at the symposium. We hope to decode the marvels of the other Panchasthala temples one day.

'Architectural Manifestation of the Panchasthala Temples.
1. Srikalahasthi Temple, Andra Pradesh' can be viewed online at:
https://www.youtube.com/watch?v=oinDNjE_IYk&t=3s

CREDITS

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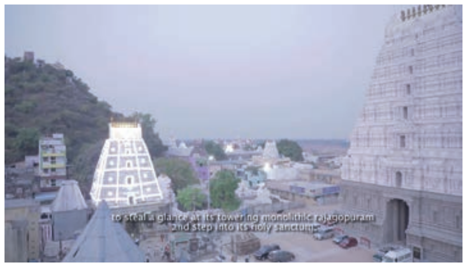
P100-P101
Keerthana Muralidharan, Aishwarya KV, Koushik Krishna N, Vishal Gowtham B and Vinusha K.
Screen shots from Architectural Manifestations of the Panchasthala Temples. Part 1. Srikalahasthi Temple, Andhra Pradesh.


Jambukeswarar temple, Thiruvanaikaval for Water;


Its practical marvel has been entwined with its mythos


to steal a glance at its towering monolithic rajagopuram
and step into its holy sanctum


Revered as one of the ancient houses of Shiva
in accordance with canonical Saivite lore, hymns


such as cobras, elephants, peacocks
and various reptilian forms adorning the temples pillars as references


The rich, iconographic carvings
and inscriptions depict


hosting large crowds of people from the nearby villages during events,
auspicious occasions or even disasters.


Mandapas display the grandeur of the era
with decorative carvings on the pillars, roofs and almost every surface.


Dr. Jayshree Vencatesan / Care earth
This consolidation is not only symbolic but its actually reflective of species
that are typical to that region, native to that a certain extent to that region


SRI KALAHASTHI
PAKALA
Google Earth

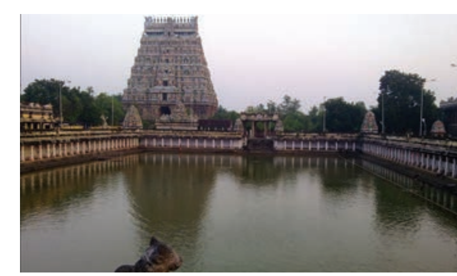

and sole of foot is the faces of the gupuras, Jwadastambam or kodi-maram
is the genital part, Mani-mandapa is the stomach .


and Srikalahastiswara temple, Srikalahasti for wind,


Arunachaleshwarar temple, Thiruvannamalai for fire;


Jambukeswarar temple, Thiruvanaikaval for Water;


Ekambareswarar temple, Kanchipuram
for Earth,



A CRITICAL REFLECTION ON THE MONSOON [+ OTHER] AIRS SYMPOSIUM

Simon Joss is Professor of Science & Technology Studies at the University of Westminster (London), and co-director of the International Eco-Cities Initiative. Simon's research addresses the governance of, and policy-making for, environmental, economic and social sustainability, with special focus on urban development. He is the author of numerous research articles and books, including *Sustainable Cities: Governing for Urban Innovation* (Palgrave Macmillan, 2015). He is coordinator of the Leverhulme Trust-funded international research network Tomorrow's City Today: An International Comparison of Eco-City Frameworks, and co-investigator of the ESRC-funded SMART ECO multi-centre research programme on smart cities. Simon serves on the board of directors of Ecocity Builders (USA), and was appointed Fellow of the Royal Society of Arts in 2005.

In a recent research paper colleagues and I have been using assemblage theory to try to make sense of how the public is variously mobilised into smart cities. Attending this symposium, I was, therefore, particularly intrigued to find out more about how the Monsoon Assemblage project pursues its conceptual and methodological inquiry. What seems particularly innovative is the understanding of the monsoon and related weather events as existing not outside the social system, but rather in a dynamic co-productive relationship between the physical and social spheres. If, then, an assemblage theory approach affords us with more multi-facetted and dynamic insights into complex phenomena than comparably more conventional concepts, we should at the same time be wary of some potential pitfalls.

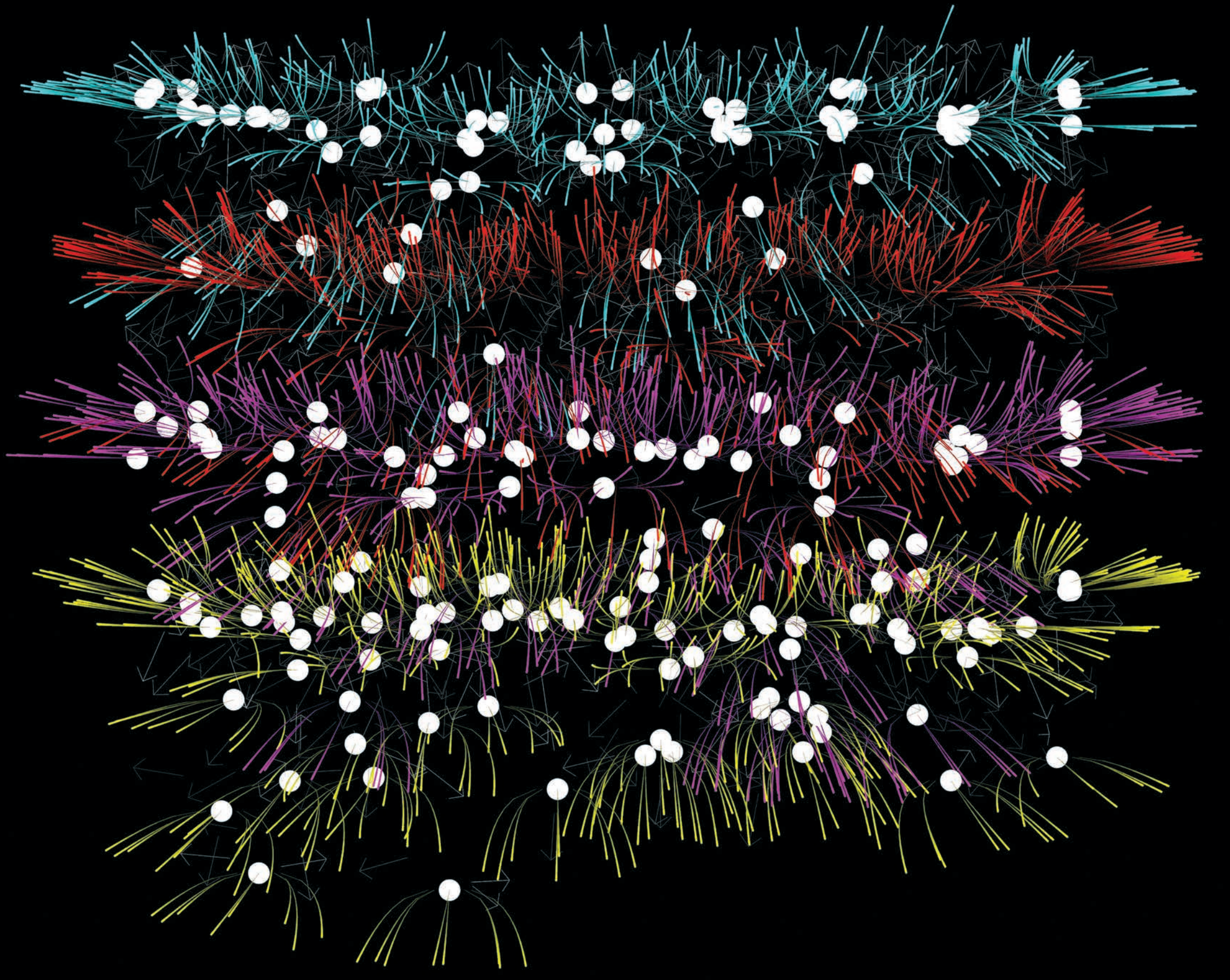
First, in conceptual and methodological terms, there may be the temptation to use assemblage in a rather descriptive manner. It is sometimes said in jest that when social scientists are met with unusual complexity in their research, they readily refer to assemblages to explain away such intricacy. Here, it is worth recalling that an assemblage is not simply a happenstance, an innocent collection of people, materials, events and actions. Rather - as the original English translation, working arrangement articulates, an assemblage functions as a deliberate realisation of a distinctive plan, based on multiple processes of formation (both stabilising and destabilising). In turn, this prompts us to consider the agency of both human and non-human actors involved, and the power relations arising among them. This then also prompts us to consider the possibility of intervention as researchers: our own role may not only be that of analysts, but potentially also co-designers, especially where research is immersive involving in-depth ethnographic approaches.

Second, in more practical terms, a major challenge of the assemblage approach lies in its translation into policy and wider public discourse. At the level of research, the approach may produce

sophisticated, nuanced and even radical insights; however, unpacking this in an accessible way ready for policy advice and public debate is no easy undertaking. This has, of course, as much to do with the linearity and compartmentalisation of the policy process. Still, bridging this gap between our own discourse and that of policy-makers is critical if research is to have any positive impact. Likewise, while the intention of the assemblage approach is to grasp as closely as possible real life experiences (more so than more conventional methodologies achieve), the language can often seem remote ('non-human actants' etc.) and probably rather daunting for outsiders. Again, therefore, translating the assemblage perspective into accessible language is imperative if our research is to encourage and enrich public discourse meaningfully.

On a final and not directly related note, it is commendable that the European Research Council has seen fit to fund such an ambitious and innovative research programme, which some other funders might well have found too unconventional and thus risky to support. This point resonates particularly at present while the majority of British-based researchers await with bated breath the outcome of Brexit.

P106-107 Tom Benson. Vector Field of abstract simulation of acid rain deforming layered plates. Tools: Realflow, Grassshopper.



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