Delta Ontologies: Infrastructural Transformations in the Chao Phraya Delta, Thailand

Abstract: In this paper, we explore new delta ontologies that emerged in the 20th Century Thai Chao Phraya delta due to infrastructure development. In particular, we trace a contrast between terrestrial and amphibious delta ontologies originating respectively in Europe and Southeast Asia. As multiple histories of agency – of traveling engineers, scientists and traders, of states and kingdoms, of canals and dikes, and of landscapes – became entangled, the delta gradually turned into a palimpsest made of complexly layered terrestrial and amphibious infrastructures. An excavation of Chao Phraya's infrastructural histories allows us to elicit *delta ontologies* in contrasting forms and to shed light on the inter-delta networks that gave rise to them.

Keywords: Chao Phraya Delta, cosmology, infrastructure, ontology, Southeast Asia, Thailand

As a landform shaped by silt deposited by a river at its estuary, a delta is a meeting place between land and sea, an inherently intermediary space. As conceived by Western science, deltaic landforms are shaped by sedimentation of soil transported by the river and influenced by the sea tide. The interactions of river and sea give rise to complex geomorphological and hydrological features, including a harsh environment and proneness to flooding. The in-between state of deltas also makes it possible for local inhabitants as well as local and foreign 'innovators' to enact deltaic landscapes in radically divergent ways. Here we focus on divergent but co-existing ontologies in the Chao Phraya delta in Thailand. Characterizing these ontologies entails paying equal attention to processes of infrastructural transformation and cosmological orientation (Jensen and Morita 2015).

In the Western tradition of geomorphology and land reclamation, deltas are viewed as manifesting the capacity of rivers to shape land. In contrast, the "galactic polities" (Tambiah 1977) of Southeast Asia conceived deltas as extensions of the sea into land. Zooming in on these incongruent delta ontologies facilitates an analysis of their ongoing, open-ended dynamics.

'Large-Scale' Ontologies, Amphibious and Otherwise

Stanley Tambiah (1977: 69) used the notion of 'galactic polities' "to represent the design of traditional Southeast Asian kingdoms, a design that coded in a composite way cosmological, topographical, and politico-economic features." In particular, he suggested that "galactic" forms of political organization followed the geometric form of the mandala, as "an arrangement of its surrounding satellites" (Tambiah 1977: 73). Thus, the king's court is surrounded by lesser courts each of which encompasses yet smaller 'courts.' In the

following exploration of infrastructures and delta ontologies in South East Asia, we are inspired by this integrated account of the cosmological, geometrical, political and economic organization of galactic polities.

It is worth remarking on the scale of our analysis. As cultural anthropology became increasingly centered on ethnographic specificity and the explication of the minutiae of lived experience, macro-scale analysis and regional comparisons have fallen on hard times. Presently, works like Karl Wittfogel's *Oriental Despotism* (1957), which analyzed the general socio-political conditions of 'hydraulic societies', or Sumet[1] and Fuller's *The Naga: Cultural Origins in Siam and the West Pacific* (1988), which explored the emergence of culture out of watery environments, appear eccentric.

In the vicinity of anthropology, illuminating large-scale analyses are nevertheless still written. For example, the environmental historian David Biggs (2012) has described the long-term environmental and infrastructural transformation of the Vietnamese Mekong delta. However the most relevant comparison for our purposes is James Scott's (2009) *The Art of Not Being Governed*.

Scott's analysis focuses on Zomia, "the vast expanse of uplands" in Southeast Asia, "one of the largest remaining nonstate spaces in the world" (2009: 13). His 'anarchist' argument encompasses the vast inland territory 'behind' the delta area with which we are concerned. Scott explores "a new genre of 'area' studies, in which the justification for designating the area has nothing to do with national boundaries or strategic conceptions but is rather based on certain ecological regularities and structural relationships that do not hesitate to cross national frontiers" (27). In Zomia, Scott tells us, environmental inaccessibility and political detachment goes together. His aim is to understand the "fraught

dialectical relations" (2) between state centers and zones of relative autonomy.

While we are not out to develop a general political theory, we take inspiration from the argument that there is a connection between the environments in which people choose, or are forced, to live, and their relations with state making projects. In this regard, the significance of deltas is comparable to the mountain regions of Zomia. Yet, while deltas are inhospitable amphibious environments due to their location at the intersections of large rivers and the sea, this location can also be ideal for trade and travel, and crucial for state making projects that rely on flows of money, people and goods.

Below, we explore new delta ontologies that emerged in the 20th Century Thai Chao Phraya delta due to infrastructure development. In particular, we trace a contrast between terrestrial and amphibious delta ontologies originating respectively in Europe and Southeast Asia. As multiple histories of agency – of traveling engineers, scientists and traders, of states and kingdoms, of canals and dikes, and of landscapes – became entangled, the Chao Phraya delta gradually turned into an ontological palimpsest made of complexly layered terrestrial and amphibious infrastructures.

Delta Infrastructures

Between September and December, 2011, the Chao Phraya delta region in central Thailand experienced a devastating flood. The main cause was unusually heavy rainfall, estimated by hydrologists as a once in 50 years probability (Komori et al. 2012). The flood hit major cities in the delta including the world heritage city Ayutthaya as well as industrial estates packed with hundreds of factories. 815 people died and the World Bank estimated 1,425

billion baht (US$ 45.7 billion) in economic damages.

Contrary to normal floods, the extreme 2011 flooding event revealed the vulnerability of modern infrastructures and the socio-economic development dependent on them (Morita 2015; cf. Mitchell 2002). These novel, and distinctly modern, forms of vulnerability are often contrasted with the resilience of traditional town planning centering on canals, water transportation and buildings more adaptable to changing flows of water. Thus, the English newspaper *The Guardian* reported that

> In monsoon seasons past, villagers in Pa Mok would quietly embark on their annual vertical migration as the Chao Phraya river swelled and spilled over its banks, inundating rice paddies and neighborhoods of this low-lying community in central Thailand. They moved to the upper level of their homes, which were built on three-meter high stilts.
>
> Then change rolled into town, around 45 years ago in the forms of cars, roads and a bridge […] "Now they park their cars under the house, and they add an extra floor [of living space] under their homes," said Klanarong Chuaboonmee, 69, [...] "As someone working for the city, I get people asking me, 'Why don't you make it so we don't flood?'[2]

Similarly, the innovative Thai architect Chutayaves Sinthuphanone reflected on the changes wrought by modernization:

> When we look back at the history of settlements of Siam, we see that all of the

> settlements were situated along the rivers. [...] How did they cope with flood in the past?
>
> The obvious answer was that houses were built on stilts. Another obvious answer was that some of the homes were built as rafts.[3]

These explanations point to changes in the design of delta infrastructures over the past 100 years that have dramatically impacted the adaptability of cities to floods. Yet it is not only the built environments that have changed. The 'natural' delta environment has been similarly transformed by the extensive construction of water management facilities, such as irrigation dams and canals.

In the early 20th Century, the Dutch engineer J. Homan van der Heide offered the following description of the delta scenery:

> The plain, where not cultivated, is chiefly covered with jungle grass, where herds of elefants [sic] feed upon, brushwood and bamboo. Extensive forests do not exist. Except in the highest tracts along the rivers, even clumps of trees are scarce, apparently in consequence of occasional floods and want of proper drainage (Homan van der Heide 1903: 3)

The difference between the present day delta, where people live more or less comfortably, and the rough environment described by Homan van der Heide is obvious. In fact, the lower delta remained marshy and relatively unpopulated until the 1957 completion of the Chao Praya River Basin irrigation system, which the Dutchman had originally proposed in

1903.

Since the Chao Praya is extremely flat, it is inundated annually during the rainy season. Floods sweep away young trees and keep the plains permanently 'deforested'. In the dry season, the treeless landscape becomes extremely arid because there are no trees to prevent water from evaporating. Lacking a proper network of canals, sluice gates and operation centers until the mid-20th Century, the delta posed severe difficulties for agriculture, and was generally inhospitable to human settlements, except on natural levees along the river (Takaya 1987).

Over the past sixty years, new irrigation systems and road networks are the most prominent infrastructural changes in the deltas area (Morita 2015). Here we are witness to a double infrastructural transformation: a change in urban planning from canal to road centered, and a concomitant change of marshy lowlands into productive paddy fields.

Yet, it is not the case that 'modernity' has fully replaced 'tradition'. In many cases new canals and ditches have not eliminated older ones, and the conversion of traditional stilt houses into modern Western ones is not complete. Nor is this very surprising: Since infrastructures consist of a multiplicity of interlocking elements (canals, roads, sluice gates, houses, etc.) it is almost impossible to effect synchronous change. A more fitting image is of infrastructures running in parallel, sometimes entwining, and often taking the form of palimpsest, where new systems, rather than replacing older ones, are added on top them. Beneath older forms remain opaquely discernible.

An excavation of Chao Phraya's infrastructural histories allows us to elicit *delta ontologies* in contrasting forms (cf. Jensen and Markussen 2008; Jensen 2015) and to shed light on the inter-delta networks that gave rise to them. In the following, we describe two

ontological ‘histories of agency’ (Pickering 1994) drawn from the different forms of interplay between ideas, infrastructures and deltas. Western terrestrial ontology shaped by colonial irrigation projects and techno-scientific expertise, imagined the potential of river deltas in terms of the possibility for land reclamation for agriculture. This led to an infrastructural orientation focusing on drainage and the making of dikes. In contrast, an amphibious ontology affiliated with Southeast Asian galactic polities did not rely on an agricultural imagination (Brummelhuis 2005). Instead, deltas connected inter-Asian trade networks (Hirosue 2004) and were primarily perceived and engaged as extensions of the sea. This infrastructural orientation centered on water traffic and trade and on architectures capable of tuning in with the flows of deltas.

The Land Forming Forces of Deltas and Rivers

Of Greek origin, the world delta was adopted on the basis of the similarity of the letter Δ (delta) and the estuary landform of the Nile River. When Herodotus wrote his *History* in 5th century B.C it was already used as a proper name. However the delta did not acquire its generic meaning until Alexander’s invasion of India, where similarly shaped landforms were found at the large river mouths. Strabo, the Roman geographer, cited several Greek writers comparing the Nile Delta with the newly visited Indian alluvial areas. Francis Celoria (1966) has argued that the term gradually gained generic meaning through such comparisons. Thus, the Western concept of the delta was deeply embedded in the formation of inter-delta travel routes and encounters between different worlds.

Coining the well-known phrase “Egypt is the gift of the Nile,” Herodotus (1890) observed that the mighty river transported soil to the delta, particularly during seasonal

inundation. While we would not assume any direct continuity between ancient Greek usage and modern European sciences, it is still interesting to note the commonality between his observations and much later views from hydrology and geomorphology (Leopold et al 1964). What remains stable is a view of rivers as central forces in making landscapes. In fact, however, the modern focus on the power of rivers must be seen as a re-emerging insight, which early modern geology had lost. To get into view some cosmological underpinnings of this understanding, we examine how agriculturalists and, later, geologists and geomorphologists, came to terms with the histories of agency of earth and water.

The idea of creating land by controlling water, particularly through draining, has long been an important agricultural concern in West Europe. Karl Wittfogel (1957) noted, with reference to China, that land reclamation by means of hydraulic infrastructures was not limited to Europe. Yet the European interest in reclamation exhibits some unique characteristics that tend to be marginalized in most of Asia. In contrast with China, where the emperor's power was premised on controlling huge irrigation networks spanning the semiarid inlands, Europeans concentrated on reclaiming fenlands. They were more concerned with removing excessive water than with supplying it to areas of scarcity. This focus is epitomized in the Dutch lowlands, where large tracts of agricultural land were created using windmills and dikes. Originating in the middle ages, Dutch technology eventually spread all over Europe and turned the reclamation of swampy land into the core of much European agricultural development (Danner et al. 2005).

Since the early Modern era, the force of water to shape landforms also gained significance in the transformation of Western cosmology. The discovery of the force of water, which slowly but relentlessly erodes rocks and removes earth, was important in this

regard. While Herodotus observed that rivers transport soils, Ibn Sina (known as Avicenna in Europe) pointed out that landforms are shaped by erosion. His observations left a lasting legacy on European geological thought (Chorley 1969). The study of geological strata and of erosion contributed to the formation of 'uniformitarianism,' which argued that mountains and valleys are slowly shaped by geological forces. Geologists came to present the history of their discipline as one in which enlightenment triumphed over myths, like the Christian story of Genesis. (Bowker 2005; Rudwick 1985).

However, the importance of rivers in these processes was not understood in detail until the mid-19th century. Sir Charles Lyell, the 'father' of modern geography, saw waves and tides as major forces in making landscapes. He observed that valleys and mountains had been shaped by sea-currents at the time when islands and continents were submerged under the oceans. Only decades later, however, did geologists begin to see the river flows as major land-shaping forces.

In the mid-twentieth Century, the geographer Richard Chorley and his colleagues argued that the relatively slowly developing understanding of river forces was due to the "temperate" environment in which most geologists resided. In such environments, waves are comparatively bigger than in sub-tropical and tropical regions, and their relation to coastal erosion is more plainly visible than that of river flow. In the view of Chorley (1964) and his colleagues, the recognition of river forces were prompted by the colonial-environmental encounter between European geologists and huge tropical rivers, the cyclical flooding of which attested to their landscape shaping capacities.

Over time, the major importance of fluvial forces in relation to erosion, transportation and sedimentation was scientifically established. In the 1960s, furthermore,

geomorphological processes became tightly integrated with hydrological and hydraulic processes at the level of the 'drainage basin:' the area drained by a river and its tributaries (Leopold et al 1964). Geomorphology came to view the drainage basin as the fundamental unit of landform analysis, providing "a clearly defined, unambiguous unit, within which topography, hydrology and hydraulics… (can) all be inter-related and studied in a nested systems approach" (Clifford 2011: 505). In the era of computer simulation, the drainage basin also became an important interface between geomorphology and other earth sciences (Morita forthcoming; cf. Edwards 2010).

The Western geo-sciences have thus developed a sophisticated framework for studying the interplay of land and water. In contrast, land formation has not occupied an important place in Southeast Asian cosmologies, which emerged in the string of interconnected deltas situated between the Indian Ocean and the Western Pacific. In the next section, we turn to some relevant contrasts with the galactic polities of Southeast Asia.

River-Basins and the Single Ocean

The idea of delta reclamation was not prominent in the vast region stretching from mainland and insular Southeast Asia to Japan. Here, hydraulic agriculture took place in intermountain basins located in the upper stream of rivers rather than downstream in the deltas. These basins provided continuous access to water. Networks of ditches designed to distribute water to the fields depended on steep gradients, which allowed farming communities to construct small-scale irrigation systems without massive investment. Zomia's landscape, stretching from northern Burma across northern Thailand and over to Yunnan in Southern China, was dotted by principalities of Tai speaking peoples, which had

their economic base in rice farming made possible by such systems (Ishii 1978).

The cultural and economic position of delta communities was very different. Rather than relying on agricultural, their economic base was long distance trade (Hirosue 2004; Ishii 1978). Referred to as 'port polities', these traditional states prospered by engaging in sea trade with merchants from China, Japan, India and the Middle East. Rulers gained huge profits by exporting highly valued tropical forest produce collected from their hinterlands (Kathirithamby-Wells and Villiers 1990). Until the mid-19th century, downstream rivers were mostly viewed as extensions of the sea.

John Michael Gullick (1958: 21) describes the relation between port polities and rivers as follows:

> The territory comprised in a State was related to […] the use of rivers as the main lines of communication and trade. A state was typically the basin of a large river or (less often) of a group of adjacent rivers, forming a block of land extending from the coast inland to the central watershed. The capital of the State was the point at which the main river ran into the sea. At this point the ruler of the State could control the movement of all persons who entered or left his State…

In this trading system, rivers were crucial because they connected upstream areas with the sea. The prosperity of coastal port polities depended on their strategic position. Bennet Bronson (1977) and Masashi Hirosue (2004) both developed models of the river basin trading system, according to which the port cities that engaged in overseas trade were usually built at the estuary and thus depended on cities located midstream for the collection

and transport of goods that was produced further upstream. Though the aim of these scholars, was to comprehend the flow of goods rather than the flow water, they shared the river basin as the relevant unit of analysis with hydrologists and geomorphologists (Hirosue 2004).

Crucially, delta *land* was of very limited importance within this system of exchange. In an ecological history of the Chao Phraya Delta, Yoneo Ishii (1978: 28) described the delta as "a belt of mud stretching between the continent and the sea, which, under natural conditions, is unsuitable for inhabitation." Its only conceivable use was as a space for transport. Maintaining this space required digging canals and extending naturally occurring flows of water and the Ayutthaya and Bangkok Dynasties both dug canals with great enthusiasm. In the early 19th century, extensive transversal canals connected the Tha Chin, Bang Pakon and Mekhlong rivers running parallel in the Chao Phraya Delta (Takaya 1987). Transversal canals facilitated the transport of sugar and pepper from Chinese-run plantations and enabled easy dispatch of soldiers to the borderlands.

While trade goods came from upstream, much of the social and cultural life of the port polities oriented towards the sea. The historian O.W. Wolters (1999: 44) refers to the Southeast Asian Sea as "the single ocean;" a "vast expense of water from the coasts of eastern Africa and western Asia to the immensely long coastal line of the Indian subcontinent and on to China." In contrast with the Mediterranean, where seaborne trade was often monopolized by dominant powers, no empire ever succeeded in seizing control over this body of water. Wolters argues that indigenous rulers respected, and even insisted on, "the freedom of the sea." When the Portuguese and the Dutch successively tried to monopolize trade, they met strong resistance from the port polities.

The freedom of the sea gave rise to traditions of hospitality to foreigners and to curiosity about new ideas and knowledge in the cosmopolitan port cities. Because prosperity depended on attracting foreign trade, "suitable port facilities, fair trading practice and protection from sporadic piracy in local waters" (Wolters 1999: 46) were vitally important to the rulers. Foreigners were often appointed administrators to provide facilities and services and to supervise trading and management of the royal warehouses. In Ayutthaya, for example, both a Greek and a Persian held the position of highest ranked minister in charge of supervising trade. At lower ranks, Chinese, Portuguese and Japanese all served as sailors on the King of Ayutthaya's merchant fleets, as managers of trading houses and warehouses, and as mercenaries (Ishii 1978).

Materializing the Galactic Polity

Amidst this impressive diversity, Hindu-Buddhist cosmology served as a common ground of the political, social and natural orders (Wolters 1999). Thus, the socio-cosmological form of 'galactic polities' described by Stanley Tambiah (1977) is of particular interest. According to Tambiah's (1977: 73) influential analysis, South-East Asian polities are patterned after the *mandala*: "an arrangement of a center and its surrounding satellites and employed in multiple contexts to describe, for example: the structure of a pantheon of gods; the deployment spatially of a capital region and its provinces; the arrangement socially of a ruler, princes, nobles and their respective retinues; and the devolution of graduated power on a scale of decreasing autonomies."

Wolters (1999: 15) argued that this cosmological pattern originated with the region's prehistoric settlement, which were comprised "of numerous networks of relatively

isolated but continuously occupied dwelling sites," that depended upon one another for trade. According to his interpretation, the cosmology of galactic polities can be understood as an emergent effect of demography, geography and trade. Similarly, we view delta ontologies as *entanglements* of landscapes, cosmology, politics -- and infrastructures.

Southeast Asian kingdoms generally assumed the parallels between "Macrocosmos and Microcosmos, between the universe and the world of men" (Heine-Geldern, 1942). According to this scheme of galactic replication, individuals and social groups attain harmony and prosperity by following the given cosmological order. The central role of traditional states and kingships was to maintain this order by organizing city space, rituals and administrative forms. In the galactic polity, the king and his court were surrounded by lesser rulers (loosely corresponding to Bronson and Hirosue's mid-size riverside towns).

According to the principle of cosmological harmony, the king's power were derived from "a single and indivisible divine authority and each ruler claimed unique and universal sovereignty" (Wolters 1999: 27). Thus, rather than conceiving of a trade space in which export goods and water flow from upstream to downstream – as in Bronson and Hirosue's models – the galactic model has divine authority emanating outwards from the capital and gradually receding with distance from the center.

The mythical location of the holy Mount Meru -- surrounded by six rings of continents and seven rings of oceans -- made the importance of the relation between water and land for this cosmology explicit. The same relation reappears in the Thai coronation rite, where sacred water from all over the country is poured onto the king's head to consecrate his divinity. Not coincidentally, most of the rite was performed on a huge decorated raft surrounded by numerous ceremonial boats (Sumet and Fuller 1988).[4] But

while the symbolic and political importance of water for the galactic polity can hardly be overestimated, the relation between cosmology and water reached further. In the Chao Phraya delta, the radial flow of divinity also came to take the form of infrastructure.

The extensive canals built by the Bangkok dynasty exhibits the entangled agencies of galactic polities and delta water flows. The cyclical changes of delta water flow made it possible to dig canals radially in all directions, creating trajectories along which sovereign power could travel. This, however, is also a point at which terrestrial and amphibious ontologies diverge. Indeed, some canals confound Western scientific and engineering expectations, as they neither serve any agricultural purpose nor divert water from up- to downstream.

The earliest modern canal project in Thailand, the grid-like Rangsit network, located northeast of Bangkok, was dug from south to north. The main canal extended northeastwards without being connected to any river or canal at the end, thus blatantly disregarding what the fundamental features of drainage basins. The strange layout was not 'corrected' until 1924 as part of new dam and canal constructions carried out, not incidentally, by a foreigner. Yet from a galactic perspective, the peculiar radial design can be seen as replications of kingdom's cosmology at the level of topography. It was made possible by to the extremely flat topology of the delta, where the sea tide influences the water flow far upstream. Galactic polities and delta water flows, two histories of agency that might appear radically disjoint, thus found an unlikely meeting point in amphibious infrastructure development.

Delta Palimpsest

In Thailand, interactions between forms of infrastructure and delta environments have given rise to what Andrew Pickering has called "complex topological transformations" (1994: 201). These transformations have shaped the boundaries between water and land, and between environments and peoples' modes of knowing, operating in, and transforming them.

The problems Southeast Asia had with water were quite different from the ones faced by Europeans. Britain, the master of modern irrigation in the early 20th century, did not *need* irrigation at home, since rainfall was available year-round. British irrigation technology was instead developed in India as part of a colonial effort to reconstruct deteriorated irrigation canals dug by the Mughal Empire (Headrick 1988). Similarly, Dutch technologies were useless in the hills and mountains of Java. Once forced sugar cultivation was introduced, Dutch engineers were required to build paddy field irrigation, which of course had no counterpart in the Netherlands.

In 1902, the government of Thailand led by King Chulalongkorn (Rama V) invited the Dutch engineer Homan van der Heide to Bangkok. Due to the declining export of sugar the Thai economy had become increasingly dependent on rice export (Yamamoto 1998). But although the idea of improving irrigation intrigued the king and a few ministers, it failed to arouse much political support. Indeed, the primary motive behind the king's invitation was that he wanted to introduce modern hydraulics to maintain the transversal canals (Brummelhuis 2005).

Because of the delta's slight gradient, the effect of tides can be felt almost 100 km upstream from the cost. The high tide caused stagnating or reversed flows, and this led to silt deposits of the riverbeds. The canals thus grew shallower. At the end of the 19th

century, many were so silted that they could only be travelled at the highest tide. The consequence was massive traffic problems and salt damage. The digging of smaller transportation canals by local people meant that salt water travelled further inland.

After the submission of his 1903 report, Homan van der Heide was appointed as head of the newly founded Royal Irrigation Department. He drew up an ambitious plan for an irrigation scheme that would connect every existing canal in a coherent system by constructing a huge barrage at the mid point of the Chao Phraya River. However his grand ideas about agriculture improvement met with little enthusiasm. While he carefully designed sluice gates, dikes and ditches in support of terrestrial agriculture, he was mainly allowed to repair, maintain and upgrade the existing amphibious infrastructure. Rather than simply transforming amphibious infrastructures into terrestrial ones, his legacy was to layer infrastructures, recreating the ontology of the delta as palimpsest.

In 1957, more than half a Century after, Homan van der Heide's vision finally came to fruition. Since then, the Chao Phraya dam has diverted water from the main river course into the Noi and Tha Chin rivers as well as into new irrigation canals, which provide water all over the delta (Takaya 1987). In retrospect, his scheme thus did turn out to be an infrastructural turning point. Taking the form of new roads, sluice gates, dikes and drainage, terrestrialization of the delta landscape has proceeded. The construction of extensive highway network in the delta region since the 1960s, which is often built on top of waterways, has dramatically altered transportation patterns. Where people used to mainly sail they now generally drive.

Modern infrastructure development has brought about something akin to a figure-ground reversal in Thai townscapes. Roads were constructed in parallel with but at some

distance from the river. Thus, they faced the backyards of houses, the main entrances of which faced rivers and canals, the major traffic routes. With the increasing dominance of roads, this urban orientation literally turned around. Backyards became front entrances and the traditional front entrance, facing the riverside boat-slips (*tha*), became backdoors.

Meanwhile, the Chao Phraya irrigation system brought water to most parts of the delta. However, the new infrastructural regime also diverted drainage into lower-lying places and exacerbated flooding there (Takaya 1987). The huge amount of water required for irrigation at the highest altitudes increased inundation elsewhere. Farmers responded by returning to traditional floating rice varieties able to keep pace with rise of water in the flooding season (Molle et al. 1999).

In his *Ethics*, Spinoza (1959: 49) wrote that: "bodies are reciprocally distinguished with respect to motion and rest, quickness and slowness, and not with respect to substance." Thus, the bodies of floating rice are distinguished by their ability to keep up with the quickness of water flows (Morita 2016). In turn, delta infrastructure dreamed up by a Dutch engineer shaped these flows. Moreover, this infrastructure, too, is a complex set of bodies, distinguished by their capacities to respond to the delta environments. And of course farmers and politicians also engaged in processes of ongoing and reciprocal adjustment to the shifting demands of amphibious and terrestrial delta ontologies.

Despite the rapid development of terrestrial irrigation, however, amphibious forms of agriculture *also* resurfaced in the period up to the 1990s. In places where traditional floating rice varieties are used, and which depend on intensive labor for harvesting, dikes around paddy field keep large amount of water *within* the fields. Meanwhile, at the upper parts of the irrigation tract, dikes are built to *prevent* floodwater from entering into the

paddy. These areas have turned to the use of high yield short stem rice varieties developed by International Rice Research Institute (as part of the Green Revolution), and to mechanized harvesting (Molle et al. 1999).

We Do Not Yet Know What a Delta Can Do

In this paper we have characterized two contrasting delta ontologies: one terrestrial and one amphibious. Since both were and are composed of incongruent relations and travelling comparisons, this contrast does not correspond to the conventional dichotomy between universal Western science and particular regional cosmologies. According to Wolters, the galactic polity emerged out of complex trading patterns between dispersed settlements, which preceded Hindu-Buddhist cosmology. Due to the freedom of the single ocean and frequent travel between the scattered kingdoms of the region, the galactic pattern eventually became 'a regional universal.' Thus, traders and diplomats were able to witness the *same political and cosmological order* in numerous locations.

At the same time, Western scientific and engineering knowledge depended on travels that allowed for observations of *similar landforms* all over the world. Thus, the proper name for the Nile Delta became a general noun through comparison with Indian deltas, made possible by Greek military expeditions. Much later, Dutch reclamation efforts traveled across Europe. The delta infrastructures that British and Dutch empires developed in Indian and Java were very different from 'indigenous' European ones.

Homan van der Heide's Chao Phraya irrigation scheme is emblematic of knowledge modified by comparison. Before arriving in Thailand, he had traveled to Egypt, Japan and Italy to study their systems (Brummelhuis 2005). His assessment of the potentials of the

Chao Phraya relied on a constant comparative endeavor drawing on his travel experiences. In the *General Report for Irrigation and Drainage* (Homan van der Heide 1903), he cited multiple sources, from the William Willcock reports on the British modernization of Egyptian irrigation to Tokyo University's *Bulletin of the College of Agriculture*. Meanwhile, King Chulalongkorn read foreign texts on irrigation and canal systems, which led him to invite Homan van der Heide to his court. For *both* the king and the engineer, delta flows thus operated as what Stefan Helmreich (2011: 132) has called a 'theory machine', "an object in the world that stimulates a theoretical reflection." Or, more precisely, several incongruent ones.

In the context of such entangled histories of agency, Helmreich urges that attention to incongruent knowledges and practices must "constantly cut across and complicate our descriptive paths" (Helmreich 2011: 134). Following this advice, we have described a process of transformation that has shaped Western theories and practices of hydrology and geomorphology, Thai farming practices, and galactic cosmologies at once. Centrally, it has also created the Chao Phraya delta as an ontological palimpsest, part terrestrial, part amphibious, neither quite nature nor quite culture.

Helmreich (2011: 136) makes the additional intriguing suggestion that the capacity of water to operate as a theory machine "depends on how quickly one frames it moving, flowing, with respect to 'culture'" a formulation that resonates with Spinoza's argument that bodies are differentiated by motion and rest, quickness and slowness. We would only add that it also depends on which direction bodies like water and land are seen to be moving in. In terms of delta infrastructures, at least, it matters a great deal whether land is imagined to extend into the sea or vice versa.

The flow of water is thus not neutral. Nor, of course, is knowledge of it (Strathern 2004). Although Homan van der Heide's Chao Phraya scheme was shaped by unpredictable encounters with several deltas, his fundamentally Western imagination remained intact. While he had no compunction about pushing for irrigation and land reclamation schemes in Thailand, no Thai engineers were invited to the Netherlands to extend the sea into the land. Perhaps, however, as Europe itself becomes increasingly amphibious and prone to flooding such invitations might yet be forthcoming.

By the turn of the 21st century, the Chao Phraya delta seemed almost fully terrestrial. However, the huge floods of the 00s made visible their co-existence with half-forgotten amphibious infrastructures. In 2006, the Royal Irrigation Department diverted waters into low-laying tracts in the Ayutthaya province to prevent the flooding of Bangkok. Announcing a call for 'volunteers' who would offer their land to retain excess floodwater, the irrigation department proceeded to divert water to the Western lowlands of Ayutthaya and Suphanburi during the night, leaving farmers on top of their houses, in a veritable lake of floodwater (Lebel 2009: 286). Paradoxically, this maneuver simply foregrounded the resilience of supposedly outdated 'traditional' buildings and infrastructures, making clear that the safety of Bangkok's terrestrial infrastructure is entirely dependent on amphibious retention zones. The huge floods of the 00s thus brought to light some almost forgotten layers in the Chao Phraya delta palimpsest, making visible also some rather strange inversions of terrestrial and amphibious infrastructures. Indeed, it is tempting to say that the floods generated its own infrastructural comparisons (Morita 2014) and found the terrestrial ones wanting.

The occurrence of increasingly severe floods raises important questions about how

to ‘reconcile’ terrestrial and amphibious infrastructure. These are questions about forms of knowledge, culture and politics to be sure but mostly about the making of new delta worlds, in which water, people, and other beings, can find ways of living together. As Spinoza might say, we do not yet know what a delta can do, or what people can do with a delta, but finding out is an issue of increasing urgency.

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[1] Following the convention in Thailand (and in Thai studies), Thai people are cited by first name.

[2] "Floating buildings could help Thais tackle the flooding crisis." *The Guardian* February 14, 2012.

[3] http://asitespecificexperiment.wordpress.com/2011/05/12/amphibious-house/.

[4] In Thailand there are hardly any ceremonies without the symbolic or actual use of water.

Parades on water or boat races often pertain to seasonal and Buddhist ceremonies (Sumet and Fuller 1988).