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Water and the (Infra-)Structure of Political Rule: A Synthesis

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ABSTRACT: This synthesis paper engages with the key messages which emerge from across the eight papers in this special issue. It situates them in the context of Wittfogel's hydraulic hypothesis and its legacy. The paper seeks to synthesise the insights of the papers with the aim to reinterpret the relationship between water, infrastructure and political rule and to provide a stimulus for further research.

KEYWORDS: Water, infrastructure, political rule, hydraulic society

INTRODUCTION

Karl August Wittfogel published his most important book *Oriental despotism. A comparative study of total power* in 1957. The book centres on the hypothesis of a relationship between the presence of irrigation systems and the emergence of centralised political authority. In a nutshell, Wittfogel with his 'hydraulic hypothesis' postulated that large-scale irrigation systems – under certain conditions – lead to centralised coordination and administrative bureaucracies, which, in turn, result in greater political integration. He thus posited that irrigation may be a major factor to account for the emergence of centralised political authority, and, possibly, of autocratic government and despotism. He termed the particular form of the resulting polity a 'hydraulic society' (Wittfogel, 1957).

Is Wittfogel's work an anachronism which has no importance to contemporary water debates, especially during times when grand theories are no longer adequate to explain the world? Or was his original statement of a 'hydraulic society' visionary and still pertinent, if faulty for an overly deterministic interpretation of human-environment relations? Scholars in water studies tend to disagree considerably over the answers to these questions. As stated in the introduction, the objective of this special issue has not been to accept, refute or ignore Wittfogel's important statement on a general interrelationship between large-scale irrigation systems and forms of rule. Rather, we take Wittfogel's observations on politics, power and central authority in relation to water as the starting point for exploring conceptual and empirical links between water, infrastructure and rule.

The relationship between modes of water governance and forms of rule is a long-standing debate in the social sciences (Steward, 1955a; Butzer, 1976; Worster, 1985). Wittfogel's (1957) postulated relationship between large-scale irrigation systems and the emergence of centralised bureaucracies, and possibly authoritarian rule, provided a critical impetus to this debate. While Wittfogel's hypothesis of such a 'hydraulic society' was met with much critique (see for example Millon et al., 1962; Mitchell, 1973; Peet, 1985a; Lees, 1989), his observation of a possible relationship between political organisation and water management has informed and is still informing much research in the field of water (Boomgaard, 2007; Fontein, 2008; Davies, 2009; Palerm-Viqueira, 2009; Stride et al., 2009; Akhter and Ormerod, 2014; Banister, 2014; Linton and Budds, 2014; Wheeler, 2016). At the same time, new concepts which do not draw on Wittfogel's work to explain this relationship have emerged and shape research on water. With this special issue, we have not only taken stock, but also compared and

contrasted recent approaches in the social sciences which address the nexus of water, infrastructure and rule.

This synthesis paper draws on the eight papers which present empirical case studies relevant to the relationship between water, infrastructure and political rule, seeking to explore this relationship conceptually with political economy, political ecology, socio-technical approaches, socio-material approaches and discourse analysis. The aim of this paper is to compare and contrast these conceptual approaches for their understanding of the relationship between water, infrastructure and political rule. On the basis of these case studies, the paper seeks to further the conceptual exploration of this relationship by developing on a number of key themes which emerge from the papers.

After this introduction, I discuss Karl Wittfogel's original statements on the relationship between water, infrastructure and political rule in section 2. In section 3, I present the main points of critique of Wittfogel's statement, and explore trajectories of his thoughts in water studies. In section 4, I examine how the papers in this special issue have conceptualised water, infrastructure and political rule. In section 5, I explore the conceptual approaches which the papers adopt for their salient points in explaining the relationship between water, infrastructure and political rule. In section 6, I attempt to develop a research agenda for the relationship between water, infrastructure and political rule as inspiration for future research. In section 7, a short conclusion is offered.

WITTFOGEL'S HYDRAULIC HYPOTHESIS

In *Oriental Despotism*, Wittfogel explores a geographical relationship. He is interested in a particular type of environment and the socio-political consequences which arise from the form of human labour required for rendering this environment habitable, economically viable and politically governable. The focus of his enquiry is on dry environments, which he classifies as 'arid landscapes' (the desert) and 'semiarid landscapes' (the steppe) (Wittfogel, 1957: 19). Yet, Wittfogel also considered humid environments, and considers all three types of landscapes as a potential basis for the development of 'hydraulic societies'. Wittfogel's empirical analysis draws on historical evidence from a number of case studies, the most important of which are China, India, Japan and Egypt. Some of these case studies were long-term research interests throughout his career, on which he published repeatedly (Wittfogel, 1931, 1938, 1953a, b). However, it is only with *Oriental Despotism* that he links the different strands of thought into a coherent argument with a wider scope (compare also Ulmen, 1978).

Following Wittfogel, a specific view on human agency underlies the emergence of centralised authority in an irrigation system. He argues that:

If irrigation farming depends on the effective handling of water, the distinctive quality of water – its tendency to gather in bulk – becomes institutionally decisive. A large quantity of water can be channelled and kept within bounds only by the use of mass labor: and this labor must be coordinated, disciplined and led. Thus a number of farmers eager to conquer arid lowlands and plains are forced to invoke organisational devices which (...) offer the one chance of success: they must work in coordination with their fellows and subordinate themselves to a directing authority (Wittfogel, 1957: 18).

In this quotation, Wittfogel speaks both of the nature of water and human nature. First, water is a substance with certain biophysical properties: it is a mobile, fluid and fugitive natural resource with an inherent uncertainty about its quantity and location. For irrigation, distinct quantities at specific times and locations are needed. These quantities which tend to be 'in bulk', as Wittfogel says, are the starting point for his reflections. Second, he contends that successfully establishing and running an irrigation system requires cooperation on a large scale (Wittfogel, 1957: 22-26). In particular, it necessitates a large workforce to achieve its labour-intensive construction, operation and maintenance as well as ensuring the cooperation over long distances within an irrigation system. Yet, many people at hand are not sufficient for granting success. They need to be coordinated, disciplined and led. While Wittfogel is

not explicit about this, I would argue that his ideas resonate with a Hobbesian view and understand conflict in irrigation systems as a natural condition. For Wittfogel, centralised authority thus emerges from the need to control conflict that is understood to be inherent and notorious to irrigation systems at a certain scale (compare also Millon et al., 1962; Lees, 1989). Third, central to Wittfogel's idea is the transformative process through 'mass labour', thus the prevalence of large populations which can be drafted into a workforce through cooperative, but probably also coercive measures, and which are willing to comply and subject themselves to authority.

In Wittfogel's understanding, both cooperation and the division of labour produce hierarchical leadership. Hydraulic leadership, in turn, tends to transform into political leadership, no matter whether non-hydraulic leaders initiated or captured the incipient hydraulic 'apparatus', or whether the leadership of this apparatus expands its power to other public functions. To his mind, the origins of a hydraulic society are thus multiple rather than single. However, what unites them is that the resulting regime is shaped by the specific form of governance and social control which hydraulic agriculture requires (Wittfogel, 1957: 27). Under certain conditions, this constellation has the potential to turn into autocratic rule which Wittfogel terms 'despotic'. This implies the emergence of a ruler who has the power to take all major decisions, and is a consequence of a "cumulative tendency of unchecked power", understood as the absence of outside control and internal balance (Wittfogel, 1957: 106-107). The power of the despot is total, and he rules with physical and psychological terror over those submitted to him (Wittfogel, 1957: 137-138).

Central to Wittfogel's argument is that irrigation systems may, but do not have to, take the road of state control and authoritarian government:

Too little or too much water does not necessarily lead to governmental water control: nor does governmental water control necessarily imply despotic methods of statecraft. It is only above the level of an extractive subsistence economy, beyond the influence of strong centers of rainfall agriculture, and below the level of a property-based industrial civilization that man, reacting specifically to the water-deficient landscape, moves towards a specific hydraulic ordering of life (Wittfogel, 1957: 12).

In this statement, Wittfogel argues that a hydraulic society emerges first at the nexus of a particular evaluation of nature (water-deficient), second, at a specific institutional scale (above the level of subsistence economy and below industrial civilisation) and a third, in distinctive system of political economy (neither purely extractive nor property-based).

First, as Wittfogel (1957: 15) asks, "[m]ust the hydraulic potential be actualised?" His answer to this questions clearly is 'no'. He talks of a 'stimulating contradiction' inherent to a potential hydraulic landscape: on the one hand insufficient rainfall or none at all, but on the other hand accessible sources of water supply from adjacent regions. However, whether or not humans decide to engage in irrigated agriculture is entirely their choice, and such a decision does not necessarily follow a historical trajectory. And yet, if they do decide to take this road, they will have to bear the socio-political consequences, as increased material security due to large-scale irrigation might come with the price of greater political, economic and cultural submission (Wittfogel, 1957: 17). Changing the environment implies here, as Wittfogel's argues with reference to Karl Marx, also changing humans (Wittfogel, 1957: 11).

Second, Wittfogel distinguishes between two forms of irrigation: 'hydroagriculture' and 'hydraulic agriculture'. Hydroagriculture is a farming economy that involves small-scale irrigation, whereas hydraulic agriculture involves large-scale governmental works of irrigation and flood control. It is the latter that Wittfogel terms 'hydraulic society' or 'hydraulic civilisation'. Hydroagriculture increases food supply, but does not produce the patterns of organization and social control that characterise hydraulic agriculture. Whether or not a hydroagricultural society takes the road to a hydraulic one depends on a number of conditions, but again, is by no means decided by, "(...) a unilinear cause dictated by unavoidable necessity" (Wittfogel, 1957: 18).

Third, Wittfogel sees hydraulic societies emerging from a particular political economy to be found in the 'Orient'. One of his main arguments is that hydraulic societies have 'weak' property rights as a consequence of inheritance laws (Wittfogel, 1957: 78, 228-229), its bureaucracies are managerial and acquisitive (Wittfogel, 1957: 67) and its rulers exert strong control over the workforce which mainly consists of peasants (Wittfogel, 1957: 48). Wittfogel draws an interesting analogy between modern economies based on 'heavy industry' and hydraulic societies based on 'heavy water works', using 'heavy' in the sense of comprehensive. He argues that these two productive forms differ: while he expects modern heavy industry to be directed by private owners or managers, heavy water works in turn are essentially directed by governments due to the specific physical properties of water as 'raw material', its protective functions and installations, its spatially expansive operations, and its decentralised and only seasonally mobilised workforce. Hydraulic governments, however, are likely to engage in other, non-hydraulic enterprises which supplement the agrarian economy proper (Wittfogel, 1957: 29).

To summarise the key points relevant for this special issue, Wittfogel asserts that it is from water's biophysical properties that institutional consequences such as hierarchical leadership and, in turn, centralised authority arise (Wittfogel, 1957: 18). He stresses the specific qualities of water: water is heavy and follows the law of gravity, water is mobile, and water is at the same time 'bulky' as it gathers unevenly in a landscape (Wittfogel, 1957: 15). He understands water as political in the sense of linking and ordering human beings along spatial and social topographies, which require and reinforce centralised and hierarchized political control. But water does not only take the form of a material substance. It is an economic resource for agricultural development, which is contested, controlled and sometimes fought about. It is also a threat to people's safety to which hydraulic societies respond with protective measures and constructions (Wittfogel, 1957: 24-26, 42).

In Wittfogel's 'hydraulic society', political rule is explained as domination. The notion of power which underlies his work is likely to draw on a Weberian idea: the ability to exert control over and limit the freedom of others. Wittfogel subscribes to a state-centric perspective, and assumes a central, hierarchical core of the state from which power emanates and control is exerted. Infrastructure is the least explicitly conceptualised category in *Oriental Despotism*, yet large-scale constructions are the central precondition for the development of a 'hydraulic society'. Wittfogel (1957: 42) speaks of "great builders" who acquired considerable technical skills and experience with different types of materials through the construction of hydraulic infrastructure. These skills were also applied to other types of constructions serving transportation, but also representational and even spiritual requirements which emerged with political and economic growth. His understanding of infrastructure is thus largely functional, but with multiple purposes ranging from technical to aesthetic (Wittfogel, 1957: 42-45). Having summarised Wittfogel's ideas, I discuss next how his work has been received by the academic community.

WITTFOGEL'S LEGACY: CRITICISM, ENGAGEMENT, IGNORANCE

Oriental Despotism is a book which did not go unnoticed. A quick Google Scholar search lists more than 3800 citations of the book. Wittfogel's ideas were controversially discussed throughout the next decades after its publication (Leach, 1959; Millon et al., 1962; Mitchell, 1973; Hunt, 1988) and continue to be referred to today, even if often in passing. Some scholars endorsed Wittfogel's framework and found it productive for explaining their empirical findings (Sanders and Price, 1968; Sidky, 1997). A much larger group of publications critically engage with and/or question the idea of the 'hydraulic society' on empirical, theoretical, positional or ideological grounds. I would suggest that not only endorsement, but also critical engagement and disagreement with Wittfogel's work sparked important debates and further development in water studies. To adequately situate the impact of his work, I proceed by identifying the four main points of critique of *Oriental Despotism* through a review of

literature. I then outline trajectories in water studies where Wittfogel's publication has led to a productive engagement through adaptation and further development.

The first point of critique is *empirical* and challenges Wittfogel's statement that irrigation systems lead to the emergence of centralised governance and even despotic power due to its inherently conflictive nature. This statement has been examined through a large number of contemporary and historical studies in different social and ecological settings (for an overview see Mitchell, 1973; Radkau, 2012: 107-153). Findings tended to agree that authoritarian forms of political rule could be observed in irrigation economies, but criticised Wittfogel's argument of scale (Hunt, 1988), variables and historical causality (Mitchell, 1973) as not conclusive. Scholars also questioned that conflict was an inevitable social response to water distribution in irrigation systems (Millon et al., 1962: 495; Lees, 1989). As archaeologist Davies (2009: 31) succinctly puts it, "[W]hat he [Wittfogel] got wrong was not that the requirements of irrigation management might lead to new forms of authority (...). Rather, what he misunderstood was that these forms of authority should be, in any way, hierarchical, or, to use his term, 'despotic'". In sum, empirical research suggested that a relationship between irrigation and political rule was likely to exist, but does not have to be authoritarian in form (see also Lansing, 1991; Mosse, 2003).

The second main point of critique is *theoretical* and challenges Wittfogel for his assumptions about human-environment relations, more specifically for the environmental determinism which underlies the relationship between a state of the environment (arid or semiarid, in some exceptions humid) and a form of society ('hydraulic') (Peet, 1985b, 1988). Accounts framed by environmental determinism are understood to be problematic as they have the tendency to simplify complexity, limit contingency, and often morally evaluate societal outcomes (Livingstone, 2011). While scholars recognised that Wittfogel relativised this picture with his distinction between hydraulic and hydroagricultural activities (Price, 1994), determinism is perhaps the most frequently voiced criticism of his work. It is interesting to note that this determinism is mostly understood to be environmental (e.g. Gestwa, 2000: 13; Banister, 2014: 205; Swyngedouw, 2014: 68) rather than technological (e.g. Engels and Schenk, 2015: 25-26).

The third point of critique is *positional* and questions Wittfogel's argument for its ethnocentric and Orientalist assumptions. At the basis of *Oriental Despotism* is a fusion of geographical and institutional characteristics of irrigation economies, interpreted through the lenses of Marx's 'Asiatic mode of production'. From his European/American vantage point, Wittfogel (1957: 2-3, 8) interprets the phenomenon of 'hydraulic societies' as 'oriental' based on insights from selective case studies situated in the 'Orient'. Scholars in the field of area studies were quick to point out Wittfogel's underlying assumptions of Euro-American cultural and political superiority, as well as his stereotypical ideas about Asian political and economic systems. They rejected *Oriental Despotism* for its incorrect evidence and interpretation of the empirical cases (e.g. Mote, 1961; Meisner, 1963; Levada and Kosambi, in Shabad, 1959). Moreover, scholars also questioned the value of the Asiatic mode of production which served as a guiding concept for Wittfogel's work (Bailey and Llobera, 1979).

The fourth point of criticism is *ideological* and questions the validity of *Oriental Despotism* for the political beliefs which underlie Wittfogel's work and, in some cases, his personal political stance. Wittfogel's political convictions changed throughout his life from being a supporter to an outspoken critic of communism. In particular, he became highly critical of the Soviet Union as a socialist state after his emigration to the USA (Ulmen, 1978; Peet, 1985a). On the one hand, scholars interpreted his work as a covert critique of Stalinist totalitarianism under the heading of 'oriental despotism', a bias resulting from what John Protevi (2007) terms Wittfogel's "libidinal investment" in anti-communism. On the other hand, it was criticised for Wittfogel's ideologically interpreted failure to scientifically engage with totalitarian regimes in the Western world (e.g. Nazi Germany) or capitalist systems such as the USA (Worster, 1985: 28-29). Scholars also noted Wittfogel's problematic involvement in Cold War politics in academia in the USA by publically testifying against scholars with alleged sympathies with the Soviet Union (Smith, 1987; Price, 2008).

In spite of these points of critique – in some cases perhaps because of it – Wittfogel's work has continued to serve as a point of reference in water studies from which inspiration for new conceptual developments were drawn. In view of this criticism, however, his conceptual framework was rarely applied to empirical contexts without adaptations (for recent applications see Evers and Benedikter, 2009; Harrower, 2009). Rather, I suggest that both Wittfogel's work and its reception have mapped out the conceptual and empirical terrain for further work. In the following, I outline three trajectories in water studies which I understand as having been inspired by Wittfogel's reflections, and which inform ongoing research in water studies.

A first point of continuity with Wittfogel is research on *hydrosocial relations*, and more concretely, the hydrosocial cycle. It connects to Wittfogel's dialectical understanding of a changing human society in a changing nature as a continuous process. With the hydrosocial cycle, scholars acknowledge this idea, but question that humans and nature are separable and single-standing entities. Rather, it postulates that water and society are internally related and co-constitutive of each other (Swyngedow, 2009; Linton, 2010). The hydrosocial cycle has become an influential concept in water studies and informs much recent research in geography and political ecology (e.g. Special Issue in *Geoforum* edited by Budds et al., 2014; Schmidt, 2014).

A perhaps lesser known strand of engagement with Wittfogel's work in water studies is *geophilosophy*, having its origins in Gilles Deleuze and Félix Guattari's work *A Thousand Plateaus* (2004 [1980]) via Mark Bonta and John Protevi's (Bonta and Protevi, 2004; Protevi, 2007) interpretations. Deleuze and Guattari made reference to Wittfogel briefly in relation to bureaucracies and rhizomatic structures (Deleuze and Guattari, 2004 [1980]: 21) and the state's striating of smooth spaces through irrigation systems (Deleuze and Guattari, 2004 [1980]: 400-401). Protevi develops this argument into a 'hydro-bio-politics' of water by drawing on further works by Deleuze (1994 [1968]) and Deleuze and Guattari (1994). These works inspire post-structuralist notions of water (e.g. Chen et al., 2013; Banister, 2014).

The third trajectory is *new materialism* (Cool and Frost, 2010) in water studies and other fields. Research in this field stresses the importance of water's materiality in relation with the human body or human-made structures (Orlove and Caton, 2010: 403). It connects to Wittfogel's work through its (historical) materialism inspired by Marxist theory, but also through contemporary and later conceptual developments in cultural ecology (Steward, 1955b), cultural materialism (Harris, 2001[1979]), and material culture studies (Gell, 1998, in Strang).¹ Currently, discussions on water's materiality are particularly prevalent in anthropology (Rasmussen and Orlove, 2016), connecting to another long-standing strand of research in the discipline on irrigated agriculture (e.g. Mitchell, 1976; Lansing, 1991; Ilahiane, 1996; Mosse, 2003).

It is important to stress that these outlined trajectories do not stand isolated, but mutually inform each other. For example, Deleuze and Guattari's work on geophilosophy was close to and shared common ideas with cultural ecology, and also engaged with materialist philosophies (Bonta and Protevi, 2004: 167). In accordance, Banister (2014) seeks to productively combine geophilosophy with the hydrosocial cycle. Interestingly, Wittfogel has received little to no attention in socio-technical and engineering approaches to water management. This seems counter-intuitive, as technology was a key variable in the relationship which he established. In a next step, I shift my attention from Wittfogel's work and its reception in the individual papers of this special issue.

¹ In-text citations without year make reference to the individual papers in this special issue.

UNDERSTANDING WATER, INFRASTRUCTURE AND POLITICAL RULE

In this section, I explore the eight papers of this special issue for their understanding of the central categories of the relationship which it addresses: water, infrastructure and political rule. For all of the papers, *water* is a substance with physical properties, but at the same time there is more to it. The paper by Mohamud and Verhoeven insightfully demonstrates the symbolic power of water and its intrinsically politicised nature in discourses of modernity and nation-building related to large-scale water (and land) development projects. Controlling and harnessing the physical properties of water for the purposes of economic development and human improvement serve to discursively justify political hierarchies, to forge collective ideologies and to mobilise public support. The papers by Mollinga and Veldwisch, and Janáč and van der Vleuten investigate water as a natural resource which acquires value (economic, but also cultural and symbolic) in a specific historical and societal context. Yet their analyses show that this value is far from one-dimensional, but rather characterised by multiple functionalities of water over time and space (i.e. agriculture, drinking water, navigation etc). These functionalities may reinforce, but sometimes also contradict each other, especially when mobilised in political hierarchies and negotiation of economic and political priorities. Moss demonstrates that specific water paradigms (e.g. saving water) relating to water's value may have semantic stability throughout different political regimes, yet in content vary considerably over time. Several papers explore water's 'more-than-biophysical' characteristics ontologically by questioning the nature-society dualism. Loftus et al., and Rodina and Harris postulate that water and society are co-constitutive. Ertsen, Moss and Strang conceive of water as being part of an assemblage, a socio-material configuration with interacting human or non-human, material or discursive 'things' in which relations, rather than entities, are foregrounded.

The understandings of *infrastructure* show considerable variation throughout the papers. Mollinga and Veldwisch as well as Janáč and van der Vleuten adopt a socio-technical notion of infrastructure with a focus on systems rather than artefacts. The technical nature of engineering blueprints and design principles for water systems is negotiated in a context of economic priorities, environmental feasibility and political visions at different levels ranging from local to transnational. For Mohamud and Verhoeven, infrastructure is discursive. In their analysis, the Merowe Dam represents a projection site for the symbolic, both for references to the sublime and as a narration of (high) modernity through which national and transnational ideologies are reconciled. Moss deconstructs the strategic nature of planners' discourses of infrastructure which entailed making wildly inaccurate predictions of future water demands to justify investments for maintenance and expansions.

As Wittfogel already noticed, infrastructure reorganises not only temporal and spatial configurations, but also has the potential to alter social and political relations. Rodina and Harris, as well as Loftus et al., adopt a more instrumental approach to infrastructure for exploring shifts in physical access, metering and billing regimes for drinking water. They conceive of it as a material 'mediator' through which changes in subjectivities and power constellations are effected. In the paper by Rodina and Harris, in-house metered drinking water taps serve to legitimise state institutions and, at the same time, to hold accountable citizens through service delivery. For Loftus et al., in-house meters, together with billing of utilities for water, put into place a disciplinary regime which governs subjects' behaviour through financialisation beyond the public domain into their private realm.

Ertsen, Moss and Strang adopt a socio-material perspective on infrastructure which gives weight to the interaction of its material aspects with other elements in a configuration or an assemblage. On the one hand, such a perspective counters discourses of apparent stability and highlights the inherent contingency of water infrastructure. Moss demonstrates that the seeming resilience of infrastructure trajectories to political change is in fact constantly destabilised and restabilised through adaptation, resistance and change. Ertsen suggests that colonial irrigation depicted as a smooth process is better understood as the 'hard work' of assembling stubborn, restive and unruly things with contingent

outcomes. Strang argues from a socio-material perspective that infrastructure embeds and expresses past and present power relations and social structures in material form. Infrastructure is thus both a materialisation of past ideologies and practices, and the material condition to exert power and (physical) control to allocate water.

The papers also demonstrate a wide range of ideas of *political rule*. Several papers address specific regime types and/or breaches across different regimes. Both Ertsen, and Mollinga and Veldwisch situate their cases of canal irrigation in the historical context of British colonial rule in Sudan and India. They demonstrate how the development of irrigation systems served both political control and economic interests. Mollinga and Veldwisch use a comparative case from Soviet Central Asia with similarities for the primacy given in the Soviet Union to cotton production in a centrally planned economy. Mohamud and Verhoeven demonstrate that large-scale water projects are also vital to post-colonial nation states which seek to build a coherent imaginary of nationhood, development and modernity for internal or external legitimacy. At the same time, these cases point to the importance of international and transnational contexts (e.g. Islamism, or the disintegration of the Soviet Union) for negotiating nation-building through infrastructure development. Moss and Janáč and van der Vleuten show the surprising path dependency of infrastructure planning and building throughout Central Europe's changing regimes and borders during the 20th century.

In terms of political actors, Mohamud and Verhoeven focus on national elites' discursive strategies aiming to establish political domination through the fusion of ideology and water management. Janáč and van der Vleuten foreground 'system builders' and their interactions with 'big politics' in the form of governments and public sectors. In line with Moss, they show how individuals or groups of planners and engineers lobby for their infrastructure visions by strategically reframing and tailoring them to changing political elites and ideologies. In the papers by Mollinga and Veldwisch and by Ertsen (quasi-) colonial administrations seeking to implement projects through specific governmental agencies or private companies were confronted with complicated processes of translation and aligning stakeholders. Rodina and Harris emphasise citizenship as a political subjectivity which is shaped not by 'big politics', but rather through everyday practices and narratives surrounding technology for access to drinking water. In the focus of two other papers are the effects of forms of governance which operate through market forces or property regimes such as privatisation beyond a nation context, resulting in disenfranchised (Strang) or disciplined political subjects (Loftus et al.).

For Mohamud and Verhoeven, power operates through discursive hegemony by monopolising a specific understanding of the Merowe Dam through constant tactical and strategic reframing to bring into line allies or exclude competitors, and selective tweaking and bending of ideologies to fuse them into a coherent imaginary. In Moss and Janáč and van der Vleuten, planners and engineers strategically reinforce their political influence by couching their visions in technological expertise and system requirements (technical feasibility, future projections, cost recovery, maintenance needs) and thereby create a compelling argument in societal contexts where hard sciences and engineering are dominant forms of knowledge. In Loftus et al., and Rodina and Harris, capillary and networked power produce subjectivities, but at the same time also subject them to forms of political rule. Moss, Strang and Ertsen also foreground other forms of power which unmask and contest hegemonies. They demonstrate that the materiality of water and infrastructure develops its own form of power when entering into relation with other 'things' in a configuration. This relational power manifests itself in contingent outcomes of water master plans through resistance or re-configuration. Such power also explains the considerable stability and path dependency in water systems through the inflexible physical properties of infrastructure (Strang).

In conclusion, notions of water, infrastructure and political rule vary considerably among papers as a reflection of the different conceptual frameworks, the epistemological and ontological positions that authors adopt, as well as the centrality they bestow or the preference they give to explaining one or two out of the three categories. In all of the papers, the three categories are conceptualised in a

relational form rather than as a singular entity which is isolated from the other two. In a next step, I seek to systematise these relationships which have become visible in this section by focusing on the conceptual frameworks through which they are invoked.

CONCEPTUALISING WATER-INFRASTRUCTURE-POLITICAL RULE RELATIONS

In this section, I focus on the salient points which the different conceptual approaches adopted by the papers in this special issue offer for explaining the relationship between water, infrastructure and rule. For this purpose, I distinguish between five different conceptual frameworks, namely political economy, (urban) political ecology, socio-technical approaches, socio-material approaches, and discourse analysis. For some papers, I base my classification on the authors' own statement regarding their conceptual framework. For other papers, I take the liberty to offer my own interpretation of the sources they draw upon. It is important to note that some of the papers draw on more than one of these frameworks. They could, obviously, be interpreted differently and classified otherwise. What is more, the approaches themselves mutually inform each other by drawing on similar strands of thought which may question the very classification (e.g. political economy and political ecology). In the following, I explore each of the approaches and present an overview in Table 1.

Table 1. Approaches to water, infrastructure and political rule.

| | Water as... | Infrastructure as... | Political rule as... | W-I-P connection | Key concepts |
|----------------------------|---|--|--|------------------------------|---|
| Political Economy | Resource | Economic and symbolic structure | State and elite supremacy | Political and economic power | Hegemony, economic production, state- and nation-building, ideology |
| Political Ecology | Relationship produced / co-constituted by society | Material mediator between water and politics | State-society relations, governance | Hydro-social relations | Inequality, justice, scale, governance, subjectivity |
| Socio-technical approaches | Multi-purpose / multi-functional substance | Technology | National and transnational regimes | System (-building) | Design, regime, builders, agency |
| Socio-material approaches | Matter | Physical artefact | Relationship between 'things' which exert agency | Assemblage / configuration | Relationality, contingency, objects, non-humans, agency |
| Discourse analysis | Text | Discursive and non-discursive construction | Power-knowledge relationship | Discourse | Statements, power, social construction, ideology |

Source: own compilation

Political economy approaches analyse the relationship between water, infrastructure and political rule for its mutual constitution and interdependencies of political and economic processes and systems. Theoretically, the field draws on Marxist and post-Marxist critiques of capitalism and uneven development (Harvey, 1982). Mohamud and Verhoeven through their political economy analysis explore how national economic priorities of large-scale hydro-agricultural development enabled by massive infrastructure investments become intertwined with the elite's struggles for political power and ideological projects of state- and nation-building. In Loftus et al., the metering and billing practices for drinking water in the South East of England are part and parcel of shifts in the political economy and governance arrangements and the political rule of finance. In conclusion, political economy approaches explore the relationship between water, infrastructure and political rule for the production, distribution and consumption of (material and immaterial) resources across scales within specific political-economic systems.

Political ecology examines the relationship between water, infrastructure and political rule for political struggles and inequalities which emerge from environmental transformations. Research on water from a political ecology perspective often draws on the concept of hydrosocial relations (Swyngedouw, 2004; Budds and Sultana, 2013; Linton and Budds, 2014) which assume the co-construction of water and society. Within this field, urban political ecology (Heynen et al., 2006) more specifically engages with the production of nature, including water, through processes of urbanisation, with a focus on forms of rule, their contestation and unequal distribution across scales. Loftus et al., through the lens of an urban political ecology approach explore the disciplinary effects of metering and billing in the provision of drinking water through which rescaling of governance is produced, thereby extending control over water consumption behaviour into the private domain. Rodina and Harris show how drinking taps in private houses not only facilitate improved access to water, but also reveal their dividing character for fostering inclusion (for those who have in-house taps) and exclusion (for those who do not have in-house taps) with regard to citizenship. Political ecology, then, enables us to analyse the relationship between water, infrastructure and political rule in terms of how political struggles and inequalities are part of the production and transformation of water-society relations.

Socio-technical approaches analyse the relationship between water, infrastructure and political rule through the mutual constitution of its social and technical dimensions. These approaches focus on technology, but at the same time offer a more-than-technical understanding of the relationship through exploring actors, institutions, resources, norms and politics, often brought into conversation through the notion of the system. Socio-technical approaches draw on the Social Construction of Technology (Bijker et al., 1987; see also Mollinga and Veldwisch), the Large Technical Systems school (see Janáč and van der Vleuten), and also on the anthropology of technology (Star, 1999; Harvey, 2012). By drawing on a socio-technical approach, Mollinga and Veldwisch's paper explores how the design of irrigation systems, taking shape by balancing technical principles, political-economic systems and geomorphological characteristics, express and facilitate particular forms of political rule. Janáč and van der Vleuten foreground the agency of engineers in system building who wed their own technical priorities strategically with political priorities ranging from the local to international level in a changing Central European context. In a similar vein, Moss explores how water planners successfully pursue an 'infrastructure logic' which serves to technically ensure and discursively justify the primacy of safeguarding the hardware part of the system. To summarise, socio-technical approaches through their focus on the social nature of the technical enable us to analyse the relationship between water, infrastructure and political rule as spatial, temporal and societal systems of engineering knowledge and practices.

Socio-material approaches examine the relationship between water, infrastructure and political rule with a focus on materiality. They draw on a range of inspirations including actor-network theory (ANT) (Latour, 2005) material culture studies (Winner, 1980), assemblage thought (Deleuze and Guattari, 2004 [1980]) and new materialism (Bennett, 2010). Epistemologically and ethically, socio-material

approaches decentre the primacy of an anthropocentric standpoint and include the perspective of non-humans and objects through the focus on physical artefacts and their attribution with relational/agentive properties. This is often combined with analytically privileging fluidity over determinacy. Ertsen shows how the building and operation of the Gezira irrigation scheme in Sudan is not a smooth enterprise, as dominant colonial discourses suggest, but is better understood as a difficult process in bringing together wilful and uncooperative subjects and objects. In a similar vein, Moss productively combines discourse analysis with a socio-material perspective to reveal the restive destabilisation and restabilisation of infrastructural assemblages underneath the smooth surface of rhetoric. Strang directs attention to the historical momentum in material and social relations, which can be read chronologically to identify long-ranging changes of water governance. To conclude, socio-material approaches with a focus on materiality's relational properties and/or agency enable us to analyse the relationship between water, infrastructure and political rule as a contingent assemblage or configuration of 'things', including humans and non-humans.

Discourse analysis addresses the relationship between water, infrastructure and rule through the conceptual notion of discourses, understood as "frameworks that embrace particular combinations of narratives, concepts, ideologies and signifying practices, each relevant to a particular realm of social action" (Barnes and Duncan, 1992: 8). Most discourse theories start from the assumption that language, images, and also practices are constitutive of social phenomena rather than reflecting it. Accordingly, knowledge is not neutral or objective, but its production is a political process informed by existing social orders. Deconstructing discourses may help to unmask how truth claims are produced through specific social and political orders, with the aim to uncover an underlying reality (Fairclough, 1995), or to understand historically shifting statements which produce reality (Foucault, 2010 [1969]). Mohamud and Verhoeven demonstrate how the *Sad Merowe* magazine in text and images emblematically produces a national dam, carefully crafted by elites which succeeded in bridging contradicting ideologies for gaining state power. Moss shows how the idea of water conservation was discursively produced in Berlin throughout a succession of political regimes during the 20th century, with changing meanings, knowledge base and political implications. In sum, discourse analysis helps deconstructing the ways in which the relationship between water, infrastructure and political rule is produced through texts, and how these texts are historically contingent.

In this section, I have examined the contrasting but also complementary explanatory potential that the different conceptual approaches have. The discussion shows that the authors mobilise a wide range of theoretical inspirations to explore this relationship, and demonstrates indeed that the debate has much evolved since Wittfogel's 'hydraulic hypothesis' (compare also the Introduction to this special issue). Several papers have also fruitfully combined two or more approaches (e.g. Moss; Loftus et al.). Privileging one or several approaches implies a selection of the aspects of water, infrastructure and political rule which the papers sought to explain, as summarised in Table 1. Yet the approaches should be understood as complementary, each offering the potential to explore the emergence and transformation of this relationship in empirical cases from different theoretical standpoints. Moreover, the discussion of the papers brings to the foreground a number of themes which seem to be a shared concern. In a next step, I examine the themes central to the relationship which have emerged in this special issue.

RESEARCHING WATER, INFRASTRUCTURE AND RULE

In this section, I attempt to establish a possible agenda for future research on the relationship between water, infrastructure and political rule. My idea is to offer avenues for future studies rather than to attempt to redefine or re-evaluate the relationship between water, infrastructure and rule. Some of the identified themes represent tensions which emerge in or between the papers. Others are thematic and

pertain to central, but often controversial or little discussed aspects of the relationship. I structure the section into six subsections, each engaging with one of the themes.

Obduracy and change

Obduracy and change in the relationship between water, infrastructure and rule remain a challenge. The materiality of infrastructure accounts for inertia of systems throughout time due not only to its 'hard' physical properties, but also to its cost-intensive technical nature. But infrastructure is also constantly altering its form through processes of withering and decay which necessitate maintenance and repair (Graham and Thrift, 2007). Moreover, through its relational properties as an artefact, socio-material configuration of infrastructure may change while its physical form remains the same (Moss). Infrastructure does not grow *de novo*, as Star argues (1999: 389), but "[i]t wrestles with the inertia of the installed base" and is shaped by considerations of "backward compatibility". In this sense, infrastructure is an archive which stores multiple overlaying, while interacting discourses and practices.

Discourses and materiality

The interface between discursive and material dimensions in the relationship between water, infrastructure and rule necessitates further research. Bridging the gap between constructivist and materialist philosophies has proven challenging. But also the status of infrastructure itself is debated, and papers in this special issue foreground both its discursive (Mohamud and Verhoeven) and material (Ertsen; Strang) dimensions. Moss productively combines a discourse analysis with a socio-material approach, and unravels the complex relationships which emerge at their interface. Ertsen suggests that we should think of replacing social structure with infrastructure. The relationship between the two components of infrastructure – the components 'infra' (meaning below, beneath or within) and the component 'structure' – remains intriguing. The two components point to the process of structuring, and yet to something beyond this structure – hence also the title of this paper.

Temporal and spatial reconfiguration

Further research is needed on how changes in the relationship between water, infrastructure and political rule affect temporal and spatial configurations. Wittfogel already noticed in his work that large-scale irrigation systems alter how people in the system relate to each other, and also change the organisation of time through distribution schedules. Yet there are more far-reaching effects to time and space. Despite its often static and place-bound image, infrastructure has a spatial or temporal reach beyond a single event or a one-site practice (Star, 1999: 381). Moreover, the relationship between infrastructure and calculative practices play an important role in modern states (Harvey, 2012). Continuous calculation produces a particular spatial awareness through gridding of time and space (Thrift, 2004). Space and time may expand and shrink throughout historically changing political regimes and infrastructural connections (Moss; Janáč and van der Vleuten). At a smaller scale, temporality is reconfigured through the introduction of night storage as an irrigation technique (Ertsen). Spatial and temporal scales interact in complex ways, and need to be further explored.

Intentionality and contingency

A remaining challenge pertains to the question of intentionality and contingency in the relationship between water, infrastructure and rule. The papers provide evidence for the intentional design of infrastructural systems, even if influenced by political, economic and environmental factors (Janáč and van der Vleuten; Mollinga and Veldwisch), and contingent outcomes of configuration and assemblages of 'things' (Ertsen). Whether papers privilege intentionality or contingency seems to be not so much a question of the empirics, but rather depends on the conceptual frameworks which authors draw on: socio-technical approaches privilege the intentionality, while socio-material approaches have a

preference for explaining contingency. As Moss demonstrates, conversations between these two approaches may offer productive insights for researching the relationship.

Property relations

Property relations are a key category in human-environment relations and also central to the relationship between water, infrastructure and rule. Wittfogel's analysis argues, albeit in an Orientalist interpretation, that 'weak' property rights are a key element which enables the emergence of centralised rule. Research on irrigation systems demonstrated that changes in infrastructure may also alter property rights on land and water (Coward, 1986, 1990). This happens not only by reconfiguring material access to land and water, but also through changing narratives which legitimise claims (Bichsel, 2009). Property rights are part and parcel of political and economic systems (e.g. Verdery, 2004). The form of property rights matters not only at an abstract level, but also through tangible outcomes. Strang argues that the transfer of ownership and control of water into private hands, in combination with weak regulation, diminishes state power and disenfranchises local populations to the benefit of transnational corporations. Moreover, property relations through mostly anthropocentric conceptualisation are also indicative of how humans relate to non-humans. Property relations may indeed be a key concept in the relationship.

Subjectivities

Lastly, the subjectivities which are produced through the relationship between water, infrastructure and political rule are still little explored. In Wittfogel's 'hydraulic society', large-scale irrigation systems produce rulers and subjects, mediated through a hydraulic bureaucracy. This happens through an accumulation of power at the central and hierarchical core of the system, in turn limiting peasants' economic and political choices. The papers depart from this binary conception and conceptualise subjectivity quite differently. Subjectivity is understood to emerge through calculative practices and disciplinary effects (Loftus et al.), materialised entitlements (Rodina and Harris), socio-material assemblages (Ertsen) and specific knowledge practices (Moss; Janáč and van der Vleuten). Specifically, these knowledge practices point to the subjectivity of engineers, system planners and builders which often powerfully position themselves through the domination of scientific and technical knowledge in many societies, but also through exerting influence on political agendas by foregrounding infrastructure cost recovery, system stability and projective calculations. There is a need to further explore subjectivities in the relationship.

CONCLUSION

I began this paper by mapping Wittfogel's 'hydraulic society' in his influential publication *Oriental Despotism* (1957). This seemed important to me, as I am under the impression that Wittfogel's 'hydraulic society' is often summarily dealt with in recent research without consideration of the precise relationship which he postulated. For example, this is the case for the classification of his work under the heading 'environmental determinism', a concept which has recently regained critical potential in view of the climate change debates and is not always sufficiently explained (Livingstone, 2011). However, my intention is not to advocate for a revival of Wittfogel and to dispense with scholars' criticism which I have presented in a condensed form in section 3. Wittfogel's ideas remain problematic for their empirical evidence, theoretical assumptions, and Orientalist and ideological biases. *Oriental Despotism*, in this sense, must be regarded as an anachronism which today rarely serves as a conceptual framework for empirical analyses.

And yet, Wittfogel's work continues to be cited by scholars. As environmental historians Joachim Radkau (2012: 113) and Frank Uekötter (2013: 480) both quipped, Wittfogel's ghost is "difficult to exorcise". In this reading, getting rid of Wittfogel is not an easy task. While his persistence might be

explained by a number of reasons such as academic citing practices or pathways of scholars' canonisation, I suggest that there is also value in thinking of other motives. Wittfogel's work might be perceived as provocative and discussed controversially, but it also doggedly persistent in debates because he observed a crucial and yet little explained relationship. Moreover, he remains one of the few scholars to date who have dared, by way of systematic exploration, to produce a coherent argument on the nature of this relationship, even if incorrect. With this paper, I argue that rather than trying to get rid of Wittfogel's overall argument, we should look for key insights and possible trajectories which emerge from his work, and which can be brought into conversation with recent approaches to explore water, infrastructure and political rule.

This special issue has demonstrated that today's theorising in water studies has moved far beyond Wittfogel's ideas (compare also the Introduction to this special issue). The individual papers have drawn on political economy, political ecology, socio-technical approaches, socio-material approaches and discourse analysis to explore their empirical case studies. And yet, there is also continuity with Wittfogel in these papers in terms of the questions they raise and the issues they address. How do modern forms of nation-and state-building relate to large-scale waterworks such as dams (Mohamud and Verhoeven)? What kind of relationships exist between large-scale irrigation, drinking water and navigational systems and changing political regimes (Mollinga and Veldwisch; Janáč and van der Vleuten; Moss)? How do the physical properties and agentic qualities of water shape socio-political relations (Ertsen)? What is the relationship between material relations with water and cosmological beliefs? To what extent are property rights over land and water fundamental to the nature of political rule (Strang)? These themes resonate powerfully not with Wittfogel's answers, but with the very questions that he had asked when he wrote *Oriental Despotism*.

This special issue has engaged with important recent conceptual approaches to water, infrastructure and political rule, yet does not claim to be exhaustive. Further research will want to include other relevant fields. In particular, two conceptual innovations seem promising. First, Infrastructure History (*Infrastrukturgeschichte*), a conceptual development in German-speaking historical sciences, produces important work with a focus on historical accounts of infrastructure, domination and power (e.g. van Laak, 2008; Engels and Schenk, 2015). Second, feminist and gender studies offer an important perspective on water, infrastructure and rule through the analysis of inscribed masculinities and femininities in water systems, gendered scientific and technical expertise as well as unequal outcomes for men and women arising from environmental transformation (e.g. Laurie, 2005; Zwarteveen, 2008). There remains much to be done in this field.

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