Essay

Toward a Sociology of Water: Reconstructing the Missing "Big Picture" of Social Water Research

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Abstract: In recent years, significant advancements have been made in the field of social water research. This is especially reflected in the emergence and consolidation of three influential theoretical approaches in hydrology, human geography, and anthropology: socio-hydrology, hydrosocial theory, and the multiple ontologies of water, respectively. While the present paper acknowledges the great merits of each of these perspectives, it starts from the identification of two important shortcomings in current social water research: the dispersion of the literature in distinct disciplinary sub-fields and the lack of specifically sociological approaches to hydrosocial issues. Accordingly, the aim of this paper is twofold: to offer a "big picture" of current social water research from a sociological–theoretical perspective and to initiate a fruitful conversation between sociologists and social water researchers from other disciplines.

Keywords: socio-hydrology; hydrosocial theory; ontologies of water; sociology of water; modern water

1. Introduction

In recent years, a number of water-related problems and challenges have intensified globally: extreme droughts and floods, worsening water pollution, massive lack of access to clean water, etc. In this context, the idea of a "global water crisis" has gained increasing traction in the public sphere, especially in media [1], scientific [2], and governmental [3] discourses. Not surprisingly, this situation has led to an increased interest in scientific research about water issues in both the Global North and the Global South.

When analyzing the causes and effects of this crisis and seeking horizons for its solution, the different disciplines involved in the study of water phenomena seem to agree on a crucial point: the understanding and adequate explanation of these issues requires the thematization of an aspect of water generally neglected by classical hydrology, namely, *its complex relationship with human societies*. This explains the emergence and recent consolidation of novel influential paradigms such as "socio-hydrology" [4], "hydrosocial" research [5], and the study of "water ontologies" [6] in the fields of hydrology, human geography, and anthropology, respectively.

On the one hand, there is a growing awareness that contemporary water-related challenges are not of purely natural origin, but have primarily *anthropogenic* and *sociogenic causes*. This conviction derives, in large part, from the widespread acceptance of the "Anthropocene" thesis, employed in the international scientific community to explain the current deepening climate crisis [7]. According to this widespread thesis, the global "Great Acceleration" of industrial production, initiated around 1950, gives rise to the emergence of a new geological epoch. The Holocene is succeeded by the Anthropocene, an era in which humans have become a "global geophysical force" capable of drastically modifying environmental conditions [8] (p. 614). In this context, the classical hydrological conception of the 'water cycle' as a purely hydro-natural process now gives way to the notion of a "human-modified water cycle" [9] (p. 225) or even to the more radical idea of a "hydrosocial cycle" [5].

On the other hand, there is also agreement that neither the harmful *effects* of the water crisis nor the 'unequal distribution' of these effects on populations [2] can be adequately understood from a purely natural-scientific framework. An adequate study of the consequences of the global water crisis requires the combination of classical natural science strategies with theoretical–methodological approaches from the social sciences [10,11]. We are dealing with problems that are *both social and natural*, as they intertwine water-ecological phenomena with economic, political, and cultural ones. To do justice to the socio-natural character of contemporary water-related dilemmas, new hybrid concepts, like those of "hydrosocial territory" [12] and "waterscape" [13] (p. 445), are starting to gain momentum.

Against this background, it is understandable why recent theoretical developments in social water research have been so prolific and fruitful. Our starting point in this paper, however, is the identification of two important shortcomings in this nascent field, which, in our view, preclude the full realization of its great potential. The first deficit is that the theoretical literature on the social dimensions of water tends to be extremely dispersed, being produced simultaneously and independently within different scientific disciplines—especially, but not only, human geography, anthropology, and hydrology—whose dialogue is not very fluid. Although valuable efforts to connect these different discipline-bounded discourses on water and society have been made [10,11,14,15], they usually remain partial, covering only specific aspects of this multifarious research field. The second deficit, in turn, is the almost complete absence of *sociological* approaches to hydrosocial issues. (Two exceptions are the works of Willems [16,17] and Oncini & Forno [18]). This, of course, is more the responsibility of sociologists themselves than of water researchers from other disciplines. However, it ends up being detrimental for social water research in general, as the latter could significantly benefit from the distinctive theoretical, methodical, and methodological contributions of sociology.

In this paper, we will attempt to palliate these two deficits at once by offering a *sociological–theoretical* take on the current theoretical developments in social water research. We start from the premise that sociological theory, with its long tradition of systematic ontological, epistemological, and axiological reflection on social reality and its focus on offering a "*big picture*" of complex sociocultural contexts [19] (pp. 7–23), can help us obtain a systematic overview of the existing literature on hydrosocial issues. At the same time, however, we think sociologists have much to learn from this nascent research field, which is why we propose establishing a continuing dialogue of "mutual enlightenment" between both parties [20] (p. 220).

The aim of this paper is thus twofold: to offer a comprehensive overview of current social water research from a sociological–theoretical perspective and to initiate a fruitful conversation between sociologists and social water researchers from other disciplines. To achieve this goal, we will proceed in five steps. First, we will contrast two influential paradigms in social water research, namely, socio-hydrology and hydrosocial theory. Second, we will sketch the main features of the ontologies of water approach, mainly developed in the field of anthropology. Third, we will address the core political issues and dilemmas implied in social water research. Fourth, we will discuss some of the insights sociological theorists can glean from social water researchers. Finally, we will show three possible contributions of sociological theory to current approaches on the relationship between water and society.

The present paper focuses primarily on the approaches of socio-hydrology, hydrosocial theory, and the multiple ontologies of water. It should be noted, however, that there are also discussions on water-related topics in the humanities, especially in philosophy [21–23] and literature studies. Within the latter discipline, the field of the 'blue humanities' has emerged, which mainly addresses topics related to oceans and seafaring [24–31]. Importantly, in the natural sciences, (socio-)hydrology is not the only discipline engaged with the relationship between water and human societies. There are also approaches like that based on the concept of social–ecological systems (SES) [32–35] which are now applied to water-related questions. In this connection, contemporary studies in the field of limnology should also be mentioned [36,37]).

2. Socio-Hydrology and Hydrosocial Theory: Two Paradigms for Conceptualizing the Water–Society Relationship

2.1. Socio-Hydrology

Socio-hydrology is a relatively new but flourishing "sub-field" within hydrological science [11] (p. 2). It emerged not until 2012 with the publication of a seminal paper by Murugesu Sivapalan, Hubert Savenije, and Günther Blöschl entitled "Socio-hydrology: A New Science of People and Water" [4] (pp. 1443–1448). One year after that, the International Association of Hydrological Sciences (IAHS) allocated to socio-hydrological research a leading role in its official scientific program for the whole decade 2013–2022: "*Panta Rhei*: Change in Hydrology and Society" [15] (p. 2). As its name indicates, this program focuses on an issue generally neglected by classical hydrological research, namely, the "connection between water and humans" [38] (pp. 1260, 1265), or, more precisely put, "the two-way feedbacks between human and water systems" [9] (p. 226).

The rapid emergence and consolidation of socio-hydrology can be attributed to the significant impact of the "Anthropocene" discourse on both public opinion and the scientific community. Not coincidentally, the inaugural paper by Sivapalan et al. [4] begins with a quotation from "Welcome to the Anthropocene", an article published in *The Economist* in March 2011: "Humans have changed the way the world works. Now they have to change the way they think about it, too" [39]. In the same vein, the second most-cited paper on socio-hydrology characterizes this sub-discipline as a "water sustainability science for the Anthropocene" [9].

Put simply, socio-hydrology translates the Anthropocene thesis into the field of hydrological research. Having been recognized as a "global geophysical force" [8] (p. 614), human societies must also be acknowledged as a crucial influencing factor in *how water works*, that is, in "water cycle dynamics" [4] (p. 1274). As the IAHS scientific program for 2013–2022 states: "Societal actions are now conditioning hydrology in many countries at a tremendous and increasing rate" [38] (p. 1259). This occurs in various ways: through the industrial pollution of water bodies, the construction of dams and river rectification, the massive use of water for drinking, food or energy production, and so forth [9] (p. 225) [4] (p. 1274).

The "human-modified water cycle" [9] (p. 225), so the argument goes, gives rise to a number of complex and unprecedented hydrological phenomena—for instance, the so-called "virtual water trade", "efficiency", and "peak-water" paradoxes [9] (p. 228)—which cannot be accounted for within the framework of classical hydrology. The latter has always systematically ignored the "human factor", focusing instead on the analysis of an "idealized" water cycle completely free of anthropogenic influence [4] (pp. 1271–1272). Socio-hydrology, understood as a "new interdisciplinary but quantitative science of people and water", arises as a corrective to this situation [4] (p. 1271). Seeing human beings and their societies as an "endogenous part of the water cycle", this novel way of doing hydrology aims to understand, explain, and predict the "co-evolution of human-water systems" in real-world settings [4] (pp. 1272, 1274).

It is crucial to note that socio-hydrology is conceived from the outset as an applied or "use-inspired scientific discipline" [9] (p. 225). Socio-hydrologists do not see the study of the human-modified water cycle as an end in itself but rather as a means to "underpin sustainable water management" [4] (p. 1271). In this sense, the unprecedented hydrological problems typical of the Anthropocene, such as massive droughts or floods due to climate change, are treated as "water sustainability challenges" that should be technically addressed to ensure human well-being, socio-economic development, and the preservation of ecosystems [38] (p. 1258).

Not coincidentally, in its socio-hydrologically oriented scientific plan for 2013–2022, the IAHS sets as one of its key missions "to advance the science of *hydrology for the benefit of society*", especially for those regions of the world suffering from "severe water problems". Importantly, socio-hydrologists begin with the premise that "water security", including access to potable water and protection against "water-related disasters" and "water-borne

pollution", plays a crucial role in ensuring the "peace and political stability" in contemporary societies [38] (pp. 1257f. Emphasis added).

On the one hand, societal processes such as growing urbanization and the constant increase in industrial production cause "a significant stress on water systems", resulting in a range of complex and unexpected water-related challenges [38] (p. 1259) [9] (p. 225). On the other hand, these very phenomena make societies ever more "dependent on water" [38] (p. 1258), which leads to a vicious circle of sorts.

Against this background, the definition of the socio-hydrology research program offered by Sivapalan et al. [9] (p. 226) becomes understandable. Drawing strongly on Earth System Science (ESS) [15] (p. 5), socio-hydrology conceptualizes the water–society relationship in terms of *systems theory*. Human society and water are considered as two 'systems', whose constant interaction gives rise to a socio-hydrological 'supra-system', as it were, with new "emergent" properties not contained in either of the two [4] (p. 1272). More precisely, using classical system science vocabulary, socio-hydrologists characterize this interactive relation as the "co-evolution of coupled human-water systems" [4] (p. 1271) or the "two-way feedback between human and water systems" [9] (p. 225).

Importantly, as with every inter-systemic relationship in systems theory, that between water and humans is here conceived as essentially *external*. Even if they are 'coupled', water and society constitute ultimately two separated, independent systems with their own specific properties, which exist as such *prior* to their mutual relationship [11] (p. 4) [40] (pp. 6–7). In this sense, Sivapalan et al.'s [4] (p. 1272) statement that socio-hydrology "treats people as an endogenous part of the water cycle" is not fully accurate. As we shall see, this external way of understanding the water–society relation sharply contrasts with that of hydrosocial theory, which sees it as an *internal* one [15] (pp. 6–7) [11] (p. 4). This crucial social-ontological difference is reflected in the very names of the approaches: while socio-hydrology usually separates the social and the hydrological by a hyphen, hydrosocial does not [15] (pp. 6–7).

2.2. Hydrosocial Theory

In contrast to the natural-scientific character of socio-hydrology, hydrosocial research stems from a social-scientific background, namely, within the field of critical human geography [11] (p. 6). This specific tradition in geographic research, paradigmatically represented by authors like Noel Castree and David Harvey, is characterized by two salient features: a deep commitment to social justice and left-wing politics, and a strong philosophical–theoretical foundation that mainly draws from Marxist and post-structuralist sources [41] (p. 123). It is therefore not surprising that the hydrosocial paradigm primarily focuses on the critical analysis of unjust power relations related to water [10] (p. 1443) [5] (p. 178).

Strictly speaking, hydrosocial research arose as a distinct paradigm in the last decade with the publication of two special issues in prominent journals. The most notable of them is the 2014 themed issue of *Geoforum* on "The Hydrosocial Cycle", edited by Jessica Budds, Jamie Linton, and Rachael McDonnell [42]. However, as opposed to socio-hydrology, this research field did not emerge abruptly with the advent of the Anthropocene. Even though critical hydrosocial studies were decisively boosted by the current "water global crisis" [43] (p. 6), they have a long pedigree. They can be traced back to a tradition of critical research on the relationship between nature and society in general [44] and that between water and society in particular [13] within critical human geography and the closely related field of political ecology [10] (p. 1443).

Karl Wittfogel's seminal study on the connection between socio-political power and water control, "Die Theorie der orientalischen Gesellschaft" from 1938 [45], is usually referred to as an important ancestor of current hydrosocial research [5] (p. 173) [10] (p. 1445). However, the crucial antecedents of the paradigm are two contemporary geographers: Karen Bakker and Erik Swyngedouw. The former was perhaps the first to speak systematically about "hydrosocial" relations [46]. The latter, combining elements from Marxist dialectics and Actor-Network Theory (ANT), developed the fundamental

premises of hydrosocial theory in his groundbreaking study on the "production of the Spanish waterscape" [13].

The notion of the "hydrosocial cycle", developed at length by Linton and Budds [5], can be considered the key concept of the paradigm [15] (p. 6). This novel notion implies a 'social-theoretical' revision of the fundamental notion of hydrology, that of the 'water cycle'. Arguably, this reformulation is more radical than that attempted by socio-hydrology, as it delivers what the latter promises but fails to achieve because of its system-theoretical framework: conceptualizing human society as an "*endogenous* part of the water cycle" [4] (p. 1272. Our emphasis). Drawing on dialectical thinking and ANT, hydrosocial research accounts for the relationship between water and society as a truly "internal" one. Here, the water cycle appears not as an enclosed natural system externally modified by society but as a *socionatural* "hybrid" mediated through and through by the latter [5] (p. 178).

In turn, hydrological knowledge is not conceived of as a neutral scientific description of the 'natural' workings of water but, rather, as a socio-culturally constructed idea of water, which is the dominant one in Western modern societies: "modern water" [43]. Hydrosocial theorists show that modern hydrology's key concept, the 'water cycle', is a very recent invention that was not presented until 1931 by the American hydrologist Robert Horton [5] (p. 171). (As for the account of water as H_2O, on which the idea of the water cycle draws, it originated in the 18th century in the chemical laboratory of Lavoisier [43] (p. 4)). Far from being a pure natural-scientific notion, the notion of the 'water cycle' is intimately connected to, and promoted by, a very specific power project typical of 20th century Western societies, namely, the efficient instrumental management of "water resources" by state water agencies [5] (p. 171).

The conception of the hydrosocial cycle starts from an ontological account of water and its relationship with society that differs significantly from that promoted by socio-hydrologists. As mentioned above, the latter understands water as a closed natural system able to interact or even co-evolve with social systems. In contrast, hydrosocial research argues that water *itself* essentially possesses a "social nature", as it necessarily "internalizes and reflects social and power relations" [5] (pp. 170–178). Importantly, within this framework, water and society are seen as "internally", rather than "externally", related. In external relationships, such as those between co-evolving systems, the related entities exist as "pre-given entities" prior to the relation, while in internal ones they constitute themselves thanks to the relation [5] (p. 173). The internal nature of the water–society relation in hydrosocial theory is reflected by the systematic omission of the hyphen between the terms 'hydro' and 'social' [15] (p. 7).

More precisely, this ontological account of water is based on a "relational-dialectical approach" [5] (p. 171), which draws heavily from ANT and Marxist dialectics. Following Latour [47], hydrosocial research embraces the notion of "hybridity", calling into question Western modernity's dualistic tendency to treat natural phenomena, in this case hydrological ones, and social processes as two ontologically separated realms. The sharp separation between water and social reality, so the argument goes, constitutes a discursive fiction—albeit one fraught with important material consequences [48] (p. 4). Especially in the modern context, water manifests itself always already as a "socio-natural hybrid": from desalinated water to boiling water in a house kitchen, it is impossible to think of an instance of water that does not combine natural and social moments [43] (pp. 34, 36) [5] (p. 174). For example, in modern large cities, water is intricately woven in complex 'networks' or 'assemblages' of internal relations with diverse social, natural, discursive, and material phenomena such as pipelines, government infrastructures, water pollution, recreational practices, discourses about city identity or river restoration, and so on [13] (pp. 447–448).

The hydrosocial cycle concept combines Latour's account of hybridity with the Marxian analysis of the *dialectical* relationship between nature and society throughout human history [48] (p. 6). Seen this way, society and nature, in this case water, are not self-sufficient entities but dependent "moments" within an "overall process of mutual becoming" [43] (p. 27). They both participate in a "historical-geographical" process of "hybridization", the

"production of socionature" [13] (pp. 447, 448), which, like every dialectical process, has a cyclical character. Society modifies water, and human-modified water in turn gives shape to society, which modifies the waterscape again, and so on. Accordingly, Linton and Budds define the hydrosocial cycle as a "socio-natural process by which water and society make and remake each other over space and time" [5] (p. 175).

3. Ontologies of Water

The two paradigms for the analysis of the water–society relationship presented above respond critically to the classic hydrological conception of water as a purely natural phenomenon. Socio-hydrology retains water as an independently identifiable entity that interacts externally with society in complex ways, while hydrosocial theory replaces this ontological assumption of separation with an ontology where water is inherently social. Both perspectives, however, share the common ground that their conception of the relationship between water and society is realistic, thus formulating one single ontology that is appropriate for the world as a whole.

Against this notion, in 2015, Julian Sebastian Yates, Leila M. Harris, and Nicole J. Wilson introduced the term "multiple ontologies of water" in a gray paper, subsequently published as an article in 2017 [6]. The three work in environmental science and have a background in human geography, political economy, and development research. They draw inspiration from diverse sources, including geography, anthropology, and cultural history, to develop this concept. It is essential to note, however, that the term "multiple ontologies of water" was not originally coined by them. It first appeared in 2012 in a special issue of the journal *Social Studies of Science*, entitled "Water Worlds", which was edited by Jessica Barnes and Samer Alatout [49].

In what follows, we will reconstruct the fundamental elements of the concept of multiple ontologies of water from the aforementioned special issue; examine the systematic elaboration of this notion by Yates, Harris, and Wilson; and explore the connections between the synchronous perspective of multiple ontologies of water and the diachronic perspective of a modern ontology of water, as presented by Jamie Linton. Taking as a starting point the discussions on multiple and modern ontologies in the field of anthropology, we will show that there are currently three different approaches to water ontologies within the debate. By undertaking these tasks, we seek to provide a comprehensive understanding of the concept of multiple ontologies of water and its significance for social theory.

3.1. The Emergence of the Multiple Ontologies of Water Approach

Alatout, who had already been working with a notion of "multiple waters" prior to 2012 [50], employed the term as a heuristic perspective to interlink the different papers contained in the special issue on "Water Worlds" mentioned above. These articles covered a wide range of topics from swamp drainage in 19th-century California and irrigation pumps in Egypt to dam construction in Southeast Asia and North Africa. All of them shared a common focus on struggles surrounding water infrastructures, and Barnes and Alatout [49] aimed to interpret these struggles as conflicts between different ontologies of water.

Although the term 'multiple ontologies of water' was not explicitly mentioned in any of the individual articles of the special issue, the core elements of the concept were present. Patrick Carroll sheds light on the historical development of water ontologies by highlighting that "'[w]ater', in a very real (if constructivist) sense, emerged as an object of government through a historical process" [51] (p. 510). Ashley Carse points to the ontological root of water-related conflicts when she illustrates that "these conflicts become cultural, rather than strictly political-economic" [52] (p. 557). In turn, Karen Bakker, who contributed a theoretical article to the issue, links the debate to theories of socio-nature and emphasizes that "the innovation of the concept of materiality [. . .] is an acknowledgement that the 'things' (pumps, dams, canals), which make a difference for the way social relations unfold, are not merely pre-given substrates that enable and constrain social action; rather, they are themselves historically and geographically produced" [53] (p. 621).

Barnes and Alatout's idea of multiple ontologies of water was fruitful in connecting these different elements. Multiple ontologies, each linking humans, artifacts, and other socially relevant types of materiality like water, give birth not only to different worldviews but also to different worlds. And they even produce conflicts between these worlds that are ontological, rather than just conflicts about rights, land, or resources.

3.2. Defining the Multiple Ontologies of Water

The most cited article on 'multiple ontologies of water' is, as mentioned, "Multiple Ontologies of Water: Politics, Conflict Implications for Governance" by Yates, Harris, and Wilson. The authors draw from the special issue by emphasizing their focus on "political-ontological friction" and examine various ontologies of water, as well as Bakker's onto-epistemological decentering of humans and the recognition of the materiality and agency of water [6] (p. 798). They distinguish their perspective on the different worlds that are constituted by different ontologies explicitly from Steinberg and Peters' "wet ontologies" [54], which propose water as a metaphor for a postmodern approach to ontologies. Steinberg and Peters' approach could be placed within the mentioned 'blue humanities', as they also speak mainly about oceans and try to understand them not in terms of territories but as a dynamic "volume of vibrant matter" [54] (p. 256).

Yates et al. also draw from the "ontological turn" [6] (p. 809) but, above all, from Mario Blaser's work [6] (p. 799). His studies, which focus on environmental policy and indigenous interests and rights in South America, play a central role in this connection [55]. Yates et al. apply Blaser's ideas to water conflicts in British Columbia, Canada. They combine this anthropological perspective with references to other anthropologists' and geographers' research on the relationships of indigenous groups with animals, plants, and landscapes. They also draw on the works of Annemarie Mol on modern medicine [56]. Mol's work, which addresses Western modern ontology, allows them to link the anthropological discourse on non-Western ontologies of water with studies exploring the "understanding of the nature of water and human-water relations" [6] (p. 798).

These studies criticize and historicize the dominant perspective on water in modernity, introducing concepts such as "modern water" [43] and the mentioned "hydrosocial cycle" [5,57]. Their objective is to explore "whether the water of scientists, engineers, and government agencies reflects just one possible reality of water. If so, what might it mean to take seriously diverse waterworlds, and what might this lend to our analyses and explanations of water politics and governance?" [6] (p. 800).

In recent years, the concept of multiple ontologies of water, as developed by Yates et al., gained some prominence in the field of social water research. Building upon this paradigm, different water-related topics have been addressed [58–61]. This new research follows the framework set by Yates et al., but links anthropological concepts of multiple ontologies, especially those from Blaser and Mol, with ideas related to hydrosociality and hybrid water, as well as with Linton's account of 'modern water'.

3.3. Modern Water and Its Genealogy

From a different angle, Jamie Linton's book *What is Water? The History of a Modern Abstraction* from 2010 lead to a similar notion of multiple ontologies of water [43]. As a geographer, Linton is mainly influenced by Harvey's relational dialectics and Swyngedouw's concept of hybrid waters [62] (p. 7). Linton takes this notion as a basis to critically reevaluate the modern idea of water as a singular and uniform substance. To be sure, Linton is not the first one to point out the historicity of modern concepts of water. Twenty-five years before him, Ivan Illich wrote his essay "H_2O and the Waters of Forgetfulness" [63], where he reconstructs the transformation of water since Greek and Roman antiquity. He concluded that "H_2O is the new stuff, on whose purification human survival now depends. H_2O and water have become opposites: H_2O is a social creation of modern times" [63] (p. 68). Since then, a range of publications have touched on the topic of modern water [13,64–68], but Linton is the first one that analyzes the construction of modern water by natural sciences

not only as the emergence of a new, "dominant epistemology" but a "dominant ontology" of water [43] (p. 178).

This perspective allows him also to radicalize Illich's claim: H_2O and thereby modern water is not the opposite of water but rather of the "reality of various waters" in which "premodern societies typically lived", as Graeme Wynn [69] (p. XI) puts it in the foreword of Linton's book. Linton therefore understands the "history of a modern abstraction" that is told by Illich and others as the emergence of a novel ontology, in which water is "deliberately non-social and non-historical in a way that the waters of other places and times are not" [43] (p. 74). What this perspective offers is a Foucault-inspired genealogical critique of the idea of 'modern water'. A genealogical critique [70] aims to reconstruct the power-related history of those things that generally appear as not having a history at all, such as 'sexuality', 'the body', or 'water', thereby revealing their contingent and thus modifiable nature [43] (p. 8).

3.4. Three Different Approaches to the Notion of Multiple Water Ontologies

To systematize these approaches to the notion of multiple ontologies of water and connect them with the discussions about hydrosociality, it is helpful to take a step back and look at the context of debates around ontologies and the 'ontological turn'. Broadly speaking, the ontological turn is a reaction to the dominance of semiotic concepts of culture and the consequent disregard for the material in humanities and the social sciences. This led to the emergence of theoretical frameworks like Science and Technology Studies (STS) and the so-called 'new materialisms', as well as to the 'ontological turn' in a more narrow sense within anthropology [71] (p. 4f.).

Scholars such as Bruno Latour, Philippe Descola, and Viveiros de Castro aimed to conceptualize differences between worldviews not in the vocabulary of cultural relativism or ideology, but with the notion that the ways in which entities—people, animals, plants, things, and ideas—connect to each other constitute different worlds. They characterized the Western modern ontology as a product of a specific way of connecting and disconnecting these entities. This debate was further systematized by Blaser [55], as he focused on the political dimension of the multiplicity of ontologies. Multiple ontologies allow us to see that "what appears from a modernist perspective as 'resources' are entities to which indigenous and other place-based peoples are related in diverse ways" and therefore "conflicts are becoming very visible as ontological conflicts" [55] (p. 891). Blaser also points to an important difference within the ontological turn. While Latour [47] criticizes modern ontology for its separation of nature and culture and its ignorance of the interconnectedness of all entities, De Castro and Descola take a more symmetrical perspective. Descola [72] describes four main types of ontology, and Blaser points out that Latour's relational ontology simply corresponds to one of Descola's three non-modern ontologies [55] (p. 888).

The existing approaches to multiple water ontologies can be sorted in accordance with Blaser's distinction. All of them diverge from the dominant ontology of hydrology, also adopted by socio-hydrology, which conceives the relationship between society and water as an external interaction between two distinct entities. Hydrosocial theory, Linton's account of 'modern water', and most of the articles on multiple ontologies of water [49,53,58,59,64,73] are based on the certainty that there is one correct ontology of water, and that this ontology is relational, thus implying that the world is full of hydrosocial hybrids.

On the other hand, some works on multiple ontologies of water [6,49,52,61] are closer to Descola's approach and argue that there are actually different worlds, each with its own correct ontology. They propose that ontological conflicts do not occur between the right and the wrong ontology, but rather when these worlds start to overlap and collide because they cannot coexist.

A third, less popular way of conceiving multiple ontologies of water, presented, for example, by Mikko Joronen and Jouni Häkli [74], stands outside the ontological turn. It abstains from ontological assumptions and instead re- and deconstructs ontological perspectives in a critical manner, drawing inspiration from Jacques Derrida. Within this strand,

one can also include newer works that critically reflect on the ontology of hydrological research [60].

Importantly, the theoretical differences between these approaches are partly due to political issues. While Joronen and Häkli take a more restrained stance when it comes to social critique, the positions that tend toward a relational ontology more often take the perspective of an internal critique of Western modernity. On the other hand, the Descolian perspective is evident in articles that formulate their viewpoint from a stance closer to indigenous interests and struggles.

4. Politics of Water

Both hydrosocial theory and the concepts of multiple ontologies of water discussed above take political positions on the water-related social realities they address. Accordingly, many advocates of these paradigms criticize the lack of normative 'reflexivity' typical of technocratic approaches to water such as socio-hydrology. Far from being normatively neutral—so the argument goes—all forms of water-related scientific and technical knowledge are politically motivated and shaped by complex power relations. Even the seemingly indisputable criterion of 'sustainability', adopted as self-evident by socio-hydrologists, involves axiological–political commitments that should be made visible and justified [15] (p. 8).

In this sense, hydrosocial researchers and proponents of the multiple ontologies approach aim to explicate and problematize water-related political decisions and conflicts that usually remain taken for granted in hydrological and socio-hydrological research. And they themselves take a critical stance towards the dominant, technocratic, and self-proclaimed apolitical hydrological concepts. The debate about 'waterscapes' started with the aim "to address central concerns in political ecology such as 'who controls, who acts and who has the power'" [75] (p. 3), waterscapes being understood as both materialized power and political materiality. In turn, connected notions like the 'hydrosocial cycle' and 'hydrosocial territories' were developed to analyze water policies and water politics [75]. These concepts take a structural perspective towards politics, often explicitly related to critical theories of capitalism.

In contrast, the debate around multiple ontologies of water, initiated by Alatout [50], focuses more on actor motivations and political narratives. His initial research on the topic of multiple waters examined the interconnection of scientific 'facts', political programs, cultural motives, aspirations, and ideologies. He historically reconstructs these phenomena in the context of the disputes over water abundance and scarcity during the Zionist immigration to the Mandate of Palestine and later in the State of Israel. Alatout's aim was to "demonstrate that there was nothing predetermined about the way things unfolded" [50] (p. 978). The criticism he formulates is that political decisions could be presented as technical necessities as long as "the ontological distinction often assumed between scientific [...] and political [...] fields of practice" is maintained [50] (p. 959). Against this depoliticization of water politics, Alatout emphasizes that ontologies are always political. Within this line of work, the special issue from 2012 cited above mainly addressed conflicts between state actors and the population in the context of dam constructions, drainage projects, or irrigation infrastructures.

The main exception was Karen Bakker's participation in the same special issue. While she also conducted research on "hydrodevelopment" [76] (p. 209) in the Mekong Delta, her work on water privatization dates back as far as twenty years and is associated with a critique of neoliberalism [77]. Rooted in this critique, which departs from the "entanglement of markets and nature" [78], instead of the connection between the state and 'nature', she employs the term "neoliberal natures" [78] in line with Castree [79] as a way to articulate a critique of the modern ontology of water.

Other branches of research in the politics of water examine the entanglement of water concepts and ontologies not primarily with the state or capitalism but with other structural categories of modern societies. A relatively small field of research focuses on a critique of gender-differentiated relationships to water. For example, Jacob Bull explores

how masculinities are shaped, reproduced, and stabilized through fly fishing [80], while Astrida Neimanis takes the opposite path by exploring female subjectivities through the fundamental hybridity of human existence as a "body of water" [81] (p. 34). These and some other scholars demonstrate a connection between the modern-natural scientific ontology of water, and its strict separation from the social, with modern notions of patriarchal gender identities. They aim to make an alternative ontology of water fruitful as a contribution to reimagining gender relations [82–84].

Precursors to these investigations are ecofeminist approaches that also explore the connection between water and feminine subjectivities [85] and criticize, with reference to dam construction projects, that "gendered, cultural assumptions about water, power, and human relations have led to creating a water-power infrastructure that perpetuates environmental sexism, environmental racism, and environmental classism" [86] (p. 157). The linkage between water-related infrastructure projects and global racism, particularly in the context of (post-)colonialism, is a central focus of criticism within the field of multiple ontologies of water. This criticism analyzes hydrology itself as "colonial hydrology" [87] and "hydroimperialism" [88] to reveal the close connection between the modern scientific ontology of water, the state, and racism in colonial and imperialist infrastructure projects.

The central role infrastructures play in this entanglement is addressed by authors who focus on the "politics of technology" [89] in dam construction projects. Technology, as a mediator between nature and humans [90], is inherently political because it is constitutive for the poles of mediation. From this perspective, water technology is always "poliTechnics of water" [91]. In the "political ecologies of water" [92], technology occupies a central position between material substances, human actors, and cultural concepts, embodying a materialized ontology in this sense.

The discussion of the politics of water is thus structured along different dimensions: (national) state-configured power, economy with a focus on neoliberalism, the gender relation—or more precisely the water-relation of genders—, the convergence of racism and modern water ontology—particularly in the context of (post)colonialism and imperialism—, and the politicality of water-related technologies. The focal points for most of these aspects are the research on dam construction projects in former colonies and the privatization of access to drinking water in Europe, as well as in South America and countries like India.

A gap between the ways in which the addressed political issues are perceived can be identified when the socio-hydrology paradigm is compared with hydrosocial research and the multiple ontologies of water approach. Socio-hydrology is conceived as a 'use-inspired' science that should serve as the scientific basis for integrated water resources management (IWRM) [15] (p. 3), which ultimately aims at achieving 'sustainability' in water governance. Put differently, according to their proponents, socio-hydrological research can contribute to the successful technical management of the novel water sustainability challenges of the Anthropocene [9].

Importantly, the 'technocratic' orientation of the socio-hydrology program, shared with ESS, has been subjected to extensive criticism. The goal of technically solving water sustainability problems through an 'engineering approach' is not as "self-evident and unproblematic" as it may seem at first sight. Rather, it promotes an untenable "post-political" narrative that not only involves unreflected normative positions but also obscures the role of power struggles and inequalities in both the construction of the status quo and the definition of management goals [15] (pp. 3, 5).

In contrast, hydrosocial research and most authors in the field of the multiple ontologies approach exhibit a strong concern for addressing water-related inequity and injustice issues [10] (p. 1443). This is not surprising, as they both can be said to belong to the multi-paradigmatic group of contemporary 'critical theories', broadly understood as an umbrella term that refers to all research approaches rejecting social-scientific 'value neutrality' and instead aiming to criticize social suffering and injustice from the perspective of an 'emancipatory interest' [93] (p. xi) [94] (p. 2) [95] (p. 159). Like all forms of critical theoretical inquiry, they

assign a central role to developing "self-reflection" [95] (p. 159) in both scientific researchers and lay agents as a necessary condition for achieving social emancipation.

5. Toward a Sociological Theory of Water: Contributions of Water Social Research to Sociology

The reconstruction of current social water research presented in this paper has made evident that sociology in general and sociological theory in particular practically do not participate in this nascent field. As shown, the key works currently dealing with the water–society relationship stem from hydrology, human geography, and anthropology—and, to a limited extent, from history, political science and STS. Within mainstream contemporary sociological theory, neither water in particular nor material natural substances in general play a prominent role. Although the global ecological crisis often forms the backdrop of discussions, the subject matter of sociological–theoretical thinking is usually defined as 'the social', manifested in discourses, affects, subjects, and life forms [19] (pp. 59–63), or in actions, situations, and orders of justification [96]. Even in approaches in which materiality and the societal relationship with nature play a decisive role, 'the material' remains systematically undetermined [97].

The potential of water for stimulating social theoretical reflection is enormous. As anthropologist Stefan Helmreich claims in regard to sea water, "water" is a "theory machine", that is, "an object in the world that stimulates a theoretical formulation" [98] (p. 132). According to him, "Water is not one thing" but holds different meanings for various sciences: for "natural science, water's effects depend on its state (solid, liquid, gas), on its scale (from molecular to oceanic), and on whether it is fresh or salty, still or turbulent, deep or shallow. For interpretative social sciences, water can be sacred substance, life, refreshment, contaminant, grave" [98] (p. 133). Helmreich emphasizes that the specific materialities as well as social embeddings of water are crucial for understanding what water is. If one follows these reflections, sociological theory can learn much from the bulk of social water research reconstructed above. Theorizing in sociology should start paying more attention to the specifics of materialities and the way in which they are mediated and entwined with the social.

Bakker spells out the socially effective material properties of water in a broader context, by looking at it as a "non-substitutable flow resource essential for life and ecological health" [78] (p. 617). The specific materiality of water itself makes it essential to industrial as well as agricultural processes and human life itself. Simultaneously, the high solubility of substances in water, its fluidity, and the challenges it presents for containment and singularization, decisively shape the social interactions with it.

In relation to the "flow", Bakker underscores the relevant juridical and political characteristics of water, stating that it "transgresses geopolitical boundaries, defies jurisdictions, pits upstream against downstream users, and creates competition between economic sectors, both for its use and for its disposal (invoking intertwined issues of water quantity and quality)" [53] (p. 616). The necessity of water for various uses and its challenging singularization make it an "uncooperative commodity" [99] (p. 132), requiring state-funded infrastructures. Water's high solubility makes it "a vessel of toxicity, water carries pollutants and chemicals across cellular and bodily boundaries, confounding assumptions behind juridical allocations of responsibility over the intoxication of people's bodies" [14] (p. 409). This deepens the importance of the connection between human metabolism and water, rendering water "biopolitical in the Foucauldian sense: modern governments seek to optimize both water resources and our individual water-use practices in order to secure the health and productivity of the population" [53] (p. 619). Water thus becomes a, if not *the*, central interface between the social and the natural-material components of the human world.

Building on these core features of water's materiality and its significance for social analysis, the multiple ontologies of water approach emphasizes "water's multiple materialities" [49] (p. 2263). Sociology can learn from this idea. Considering 'materiality' alone, as some contemporary sociological theorists do, is insufficient because "to talk of

the materiality of water is problematic" [100] (p. 2263). Rather, sociologists have to understand the particularities of the specific materialities they deal with and their significance depending on their social meaning, as anthropologists do. "Water", for instance, should be seen "as multiple, never singular. Entangled, never isolated. Material, only artificially abstracted" [14] (p. 415).

To point out the specific anthropological approach to water, Ben Orlove and Steve Caton characterize water as a "total social fact" [101] (p. 402), a term from Marcel Mauss. 'Total social fact' means that water is relevant in all social spheres due to its specific materiality. They argue that water's molecular properties, such as transparency, incompressibility, chemical neutrality, etc., give it distinctive characteristics, making both quantity and quality crucial matters [101] (p. 403). They conclude that it is necessary to reconstruct 'waterworlds' as totalities of connections between social and material elements, a perspective that is also partially shared by hydrosocial theory.

This intertwining between materiality and sociality is also presupposed in the "hybrid" or "socionatural" concepts developed by hydrosocial theory [5,13,53,102]. With these notions, social water research has evolved from a pure natural account of the water cycle towards a socio-material theory, as reflected paradigmatically in the notion of a 'hydrosocial cycle'. We argue that these ideas could operate as a corrective to the 'purely social' concepts of society predominant in mainstream sociological theory.

A final point for sociological theory to learn important lessons from social water research is to be found in the latter's refined analyses of social conflicts. True, sociologists have developed many conflict theories [103]. However, we think they can glean significant insights from social water researchers' detailed theoretical reflections on the material foundations of hydrosocial conflicts and their ontological connotations.

6. Three Contributions of Sociological Theory to Social Water Research

As should be clear by now, the relationship between water and society is a complex one that involves different layers of analysis. One of the main obstacles to comparing the manifold theoretical approaches presented above and establishing a dialogue between them is that they do not always operate on the same argumentative level, and when they do, they sometimes hold antagonistic positions on similar issues. Our argument is that sociological theory offers a rich set of conceptual distinctions that could help clarify the theoretical import of each of these approaches and thereby overcome this obstacle. Specifically, we are referring to the distinctions between '*social theory*' and '*theory of society*', '*understanding*' and '*explanation*', and '*value-freedom*' and '*value-partisanship*'. As we shall demonstrate, these conceptual distinctions offer useful theoretical coordinates to organize the debates in the field of social water research and avoid getting lost in its complex landscape.

6.1. Social Theory and Theory of Society

In recent years, a useful conceptual distinction has gained relevance, especially in the field of German-speaking sociology, namely, that between 'social theory' [*Sozialtheorie*] and "theory of society" [*Gesellschaftstheorie*]. These two modes of sociological–theoretical reflection have coexisted since the inception of the discipline in the works of Karl Marx, Émile Durkheim, and Max Weber, but can—and should—be analytically distinguished. Generally speaking, *social theory* constitutes a mode of sociological–theoretical reflection that deals with the analysis of the defining features of social reality *as such*, attempting to answer the *ontological* question of *what is social reality*. In contrast, *theory of society* focuses on the analysis of the key structures and processes typical of *modern* societies; that is, of those capitalistic, technified, rationalized, secularized, and socially differentiated societal formations that started becoming prevalent worldwide since the 19th century [104] (pp. 8–10) [105] (pp. 19–21).

It is useful to classify the different approaches in social water research along this distinction to clarify their respective theoretical scope and limits. This makes it possible to establish an order in the often-disorganized debates within social water research. A

social-theoretical account of water, i.e., one concerning the essential nature of the relationship between water and society, can only be meaningfully refuted, criticized or corrected with *social-theoretical* arguments. The same applies to *societal-theoretical* accounts of water, which address the specific modulations and configurations of water in modern social formations. Importantly, in some of the approaches in social water research presented above, social-theoretical and societal-theoretical arguments coexist. We believe that analytically distinguishing these two different argumentation lines within each of these perspectives is crucial for fully understanding their respective theoretical significance.

The socio-hydrology [4,9], hydrosocial theory [5,57], and the ontologies of water [6] approach can be understood primarily as *social-theoretical* efforts, as they attempt to define *ontologically* the essential features of the water–society relation. As shown, each of them does so by drawing on very different theoretical frameworks. While socio-hydrology uses a system-theoretical account—albeit not in the sociological, Parsonian–Luhmannian sense [106] (pp. 173–193)—, hydrosocial theory combines motifs from ANT with ideas from Marxist dialectics. The water ontologies approach, on its part, draws on different sources from the contemporary 'ontological turn' in social and political theory, like Descola's, Viveiros de Castro's, and Latour's works.

As mentioned above, Linton, one of the key proponents of hydrosocial theory, also offers an account of 'modern water'. This account can be considered the paradigmatic example of a *societal-theoretical* approach to water, which can—and should—be analytically distinguished from the social-theoretical perspectives just discussed. Linton's idea of 'modern water' provides conceptual resources for analyzing the specific instrumental–technocratic use and configuration of water prevailing in modern societies. In turn, the multiple water ontologies approach also provides important societal-theoretical contributions besides its social-theoretical ones. The political conflicts it analyzes, namely those between the dominant 'reifying' ontology of water in modernity and particular indigenous water ontologies, can be seen as a structural feature of modern societal formations [40]. Establishing a dialogue between these water-related societal-theoretical perspectives and contemporary sociological theories of modernity and late modernity, like Reckwitz and Rosa's [19], could be useful for complementing and nuancing the former.

6.2. Understanding and Explanation

The second crucial sociological–theoretical distinction we want to introduce is of *epistemological–methodological* nature. We are referring to that between 'explanation' [*Erklären*] and 'understanding' [*Verstehen*], which goes back to the classical works of Droysen [107] and Dilthey [108]. Generally speaking, explanation and understanding are two different strategies to make sense scientifically of social reality, which are associated to two rival epistemological traditions in the history of the social sciences. For simplicity reasons, these two traditions might be called "positivism" and "hermeneutics", respectively. The former, classically championed by Mill and Comte, defends a naturalistic position: the social sciences should follow to the letter the methodological pattern of the natural sciences, namely, *quantitative causal explanation*. The latter, classically advocated by Dilthey, Simmel, and Weber, opts for 'methodological dualism', emphasizing that social researchers should develop *interpretive-understanding* methods that align with the meaningful nature of their objects [109] (pp. 3–23).

Epistemological–methodological discrepancies in the way water-related phenomena are addressed constitute one of the main reasons for the differentiation between the approaches in social water research. We believe that the classical sociological distinction between understanding and explaining remains relevant and particularly useful for making sense of these divergences. Arguably, in this respect, there are *three kinds* of perspectives in the field of social water research: those that follow a positivist-explanatory strategy, those that proceed in a hermeneutic-understanding way, and those that attempt to blend both methodologies.

Socio-hydrology uses a *positivist* approach to the study of the interaction between water and human systems [10] (p. 1443). This is not surprising, as this field is completely dominated by natural scientists, namely, professional hydrologists [11] (p. 4). Following one of the articles of faith of naturalistic positivism, "science is measurement" [110] (p. 188), the advocates of socio-hydrology understand their research field as an essentially *quantitative* one based on mathematical models [4] (p. 1271). (It should be stressed that socio-hydrology is not the only natural-scientific discipline analyzing the interactions between water and human societies. Here, one should also consider the contributions of ecology in general and limnology in particular [36,37]).

In contrast to socio-hydrology's naturalist positivism, hydrosocial research uses a social-scientific approach decisively informed by historical-materialist and post-structuralist premises and opts for *qualitative-understanding* methodologies over quantitative-explanative ones [10] (p. 1443) [15] (pp. 8–9). More precisely, hydrosocial research offers rich qualitative investigations of particular socio-historical cases, which are based on a strong social-theoretical framework [15] (p. 9). Something similar can be said about the ontologies of water approach, whose empirical studies draw strongly from the ethnographic tradition within anthropology [15]. Importantly, there are also some attempts to bridge the gap between explanation and understanding in social research on water, such as that of Rusca and Di Baldassari [11].

6.3. Value-Freedom vs. Value-Partisanship

The last distinction we want to introduce is that between value-freedom and value-partisanship, which goes back to Max Weber's work [111] (pp. 1–50) [112]. This distinction is of an *axiological* nature, as it refers to the two possible normative stances social researchers can take toward their research object. 'Value-free' sociology, advocated by Weber himself and authors like Popper or Albert, deliberately refrains from making value judgments on social reality. In contrast, 'critical' sociology, paradigmatically promoted by Frankfurt School Critical Theory, explicitly rejects value-freedom, taking instead a critical stance toward what it considers 'unjust' or 'alienated' social phenomena [113].

Arguing from a technocratic perspective, socio-hydrology presents itself as a value-free perspective supposedly limited to scientifically diagnosing water sustainability issues and 'solving' them with allegedly politically neutral engineering methods [40]. In contrast, hydrosocial theory, coming from the field of critical human geography, operates decidedly as a critical theory in the aforementioned sense, identifying and normatively questioning issues of injustice and social suffering related to water [15] (p. 6). The ontologies of water approach's analysis of political–ontological conflicts around water can also be said to follow a critical perspective on the negative impacts of the hegemony 'modern water' in specific cultural and territorial settings [40] (p. 55).

In this connection, it is important to note that sociological theory, especially emanating from the Frankfurt School, has classically questioned the alleged normative neutrality of science and technology [114] (p. 83), as defended in the technocratic perspective of socio-hydrology. Scientific research and technological solutions are never as neutral as they aspire to be. Instead, they always presuppose unreflected normative-political stances, which can and should be articulated.

7. Conclusions

Throughout this paper, we have undertaken a multifaceted exploration of social water research, guided by a sociological–theoretical lens. Our endeavor has been twofold: firstly, to provide a comprehensive overview of prevailing paradigms and approaches within the field and, secondly, to foster a meaningful dialogue between sociologists and social water researchers. In the first section, we delineated the contrasting paradigms of socio-hydrology and hydrosocial theory, illuminating their respective conceptual frameworks and methodological underpinnings. In the second section, we delved into the ontologies of water approach, elucidating its origins in anthropology and its implications for under-

standing the entanglements of water and society. In the third section, we engaged with the axiological–political dimensions of social water research, foregrounding the ethical and political commitments inherent in water governance discourse.

After reconstructing the 'big picture' of current social water research, in the fourth section, we explored the ways in which the insights offered by this nascent field can contribute to contemporary sociological theory. In this respect, we emphasized the importance of moving from a general, empty concept of materiality, as is prevailing in current sociological discussions, to a more nuanced and differentiated one that takes into account the specific complexion of particular materialities like water. Finally, in the last section of the paper, we showcased some of sociological theory's potential contributions to water social research. Through key conceptual distinctions, such as social theory versus theory of society, explanation versus understanding, and value-freedom versus value-partisanship, sociological theory provides a framework to navigate the diverse theoretical terrain of social water research. With these conceptual distinctions, sociological theory can foster dialogue, bridge theoretical divides, and deepen understanding between social water researchers.

Moving forward, integrating sociological insights into water social research can enrich analyses, offering holistic perspectives that encompass both the material realities of water and the socio-political contexts in which they are situated. We argue that the project of a sociology of water holds promise in advancing interdisciplinary scholarship and addressing pressing challenges at the intersection of water and society. However, this project remains a desideratum whose realization requires conceptual work in four areas.

First, existing knowledge from debates within the history of sociology must be reframed with respect to water-related issues. We anticipate rich connections between water social research and sociological perspectives like those of Frankfurt School Critical Theory [114] and ecofeminism [115], which have critically engaged with nature and its integration into society. Additionally, we think that insights from sociological debates about Romanticism, as *an alternative modernity within modernity* [97,116], could be helpful in showing that 'modern water' is perhaps the dominant but not the only ontology of water in Western modernity. This can provide a possible foundation for a theory of multiple ontologies of water in modern societies.

Second, sociology possesses a competence in generating diagnoses of the times [*Zeitdiagnosen*]; that is, 'big pictures' that integrate various debates and phenomena into a common framework to address current, pressing issues. Given the context of the Anthropocene, this can be realized with a focus on 'socionatures'. The ubiquity of water as a 'total social fact' provides an ideal basis for such an endeavor.

Third, sociology offers a rich treasure trove of methodologies and methods of empirical social research that need to be made fruitful for social water research. These methodologies can enable nuanced investigations into the social dimensions of water, shedding light on its varied socio-political and cultural implications.

Lastly, if these steps are successfully undertaken, sociology can play a central role in the translation and mediation between different disciplinary perspectives within social water research. By bridging gaps and facilitating dialogue, sociology can assist interdisciplinary collaboration, leading to more holistic understandings of water and its interactions with society.

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