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Historical Geoanthropology in Venice

by
Pietro Daniel Omodeo and Sebastiano Trevisani

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Historical Geoanthropology in Venice *

Pietro Daniel Omodeo and Sebastiano Trevisani **

This essay deals with the natural-artificial reality of the lagoon of Venice, as a paradigmatic case that can contribute to an understanding of the broad cultural dimension of the Anthropocene. Indeed, we here deal with the low amplitude background signal of anthropogenic geomorphological and geoenvironmental agency. This should not be confused with the stratigraphic meaning of Anthropocene, since geologists are working towards the validation of the Anthropocene hypothesis by detecting specific markers which, from our perspective, correspond to high-intensity signal peaks at a geochemical level. Our geo-anthropological case, the geomorphology of Venice, has particular historical and symbolic relevance. Its environment has been transformed by humans and the elements over millennia to such an extent that it is impossible to neatly separate human agency from natural causes. We here discuss the entanglement of environmental factors, socio-economic drivers, and cultural-political elements of Venice as a paradigm of geo-anthropological processes in general.

The current search for stratigraphic markers by the Anthropocene Working Group is a decisive phase in whether the Anthropocene will be agreed as a new

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** Department of Philosophy and Cultural Heritage, Ca' Foscari University of Venice (*pietrodaniel.omodeo @ unive.it*); University IUAV of Venice (*strevisani @ iuav.it*).

epoch.[1] The identification of such markers would permit the geological community to establish the Anthropocene's lower boundary, in accordance with methodological requirements. This sought-after geological record, which would 'prove' the Anthropocene hypothesis, ought to be a ubiquitous and lasting signal of human impacts on our planet, especially at an atomic and molecular level (Zalasiewicz et al. 2019). As such, stratigraphers deem it necessary for distinguishing from more localized or less enduring anthropogenic signals of low amplitude, against which a global break of major stratigraphic significance possibly occurred in the middle of the twentieth century during the Great Acceleration (Steffen 2015).

The semiotic distinctiveness of markers/signals/documents—even symptoms—goes to the heart of various approaches that have emerged from academic communities and public debates in a productive but sometimes messy manner.[2] Exchanges have taken place between groups who embrace different 'styles of thought' or reasoning, motivated by diverse concerns and agendas (Fleck 1935, and Hacking 1991). The natural archives of earth scientists and the paper archives of historians offer different entry points into the past at a time when the interconnection between 'natural history' (Pliny's *historia naturalis*) and a 'history of deeds' (Tacitus's *historia rerum gestarum*) ought to be unified by the research program that calls for the establishment of the Anthropocene 'paradigm' (Kuhn 1957 and 1961).

Such a convergence of disciplines raises many questions, doubts, and concerns. It is part of an 'environmental turn' in the humanities and social sciences, which infringes a well-established separation between the realms of natural necessity and spiritual freedom.[3] The 19th-century neo-Kantian division of

[1] The Anthropocene Working Group is a special subcommission on Quaternary Stratigraphy of the International Commission of Stratigraphy: see `http://quaternary.stratigraphy.org` accessed 28 October 28 2022.

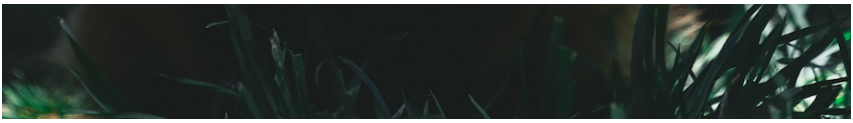
[2] We would like to acknowledge Jürgen Renn for this semiotic insight, which he presented in the concluding session of the conference on *Anthropogenic Markers: Historical and Material Contexts of a Twentieth-Century Transition in Earthly Matters* (Haus der Kulturen der Welt, 22-24 September 2021).

[3] In spite of many authoritative attempts to overcome it, beginning with a criticism of the neo-Kantian distinction between the *Naturwissenschaften* and the *Geisteswissenschaften*. A philosopher who deserves more attention in the current epistemological debate is the pragmatist John Dewey, whose philosophy anticipated many of today's geoanthropological concerns. Cf. Dewey 1958.

academic labour between *Naturwissenschaften*—the natural sciences, which offer explanations—and *Geisteswissenschaften*—the humanities, which offer value-oriented interpretations (Wallerstein 2007)—no longer holds true because the *stage* of human *acting* has proven to be part of the *play* itself, if we follow the theatrical metaphors of social constructivists and cultural historians of knowledge (Shapin and Schaffer 1985). At the level of philosophical anthropology, a different understanding of freedom, responsibility, and action is required in the light of such an environmental turn. On the other hand, the sought-after evidence for the Anthropocene calls for scientific explanations of the geological record that include sociology and history. Although this kind of inclusion of the human sciences in the study of the Earth system sounds promising, methodological doubts emerge because it is hard reconcile the qualitative approaches, historical contingencies, and terminological controversies typical of the humanities with the empiricism of the natural sciences (Bonneuil and Fressoz 2017, especially part 3; Haraway 2016; Moore 2016).

The anthropization of the Earth has to be framed in terms of the structures of human societies: the emergence of capitalism as an economic, political, and cultural formation; the function of technology in the material and intellectual reproduction of societies; developments in the history of science and technology as major forces of world transformation (Renn 2020). Between the semiosphere of the humanities (Lotman and Clark 2005) and the geosphere of the Earth sciences, there is an intense interaction between human labour (the technosphere or the ergosphere) and ecological processes (the biosphere). From the viewpoint of the life sciences, one could speak of the ecological construction of an anthropic niche that has expanded to encompass the entire planet. However, this planetary enlargement has also led to a 'metabolic rift' between societal processes and natural cycles, one that constitutes a threat of extinction to many life forms on Earth, including humanity (Foster 2022). From the viewpoint of the environmental humanities, it is essential to consider the historical dimensions of processes of globalization and natural-cultural dynamics, the scale of which used to be limited to local settings. In particular, environmental history can bring clarity to the fuzziness of the Anthropocene boundary so that there is a well-defined sense of the background signal in relation to which golden spikes need to be detected. What is more, environmental history aims to move from signals to causes and from causes to reflection as a means of critically en-

gaging with the present and fostering future-oriented choices, individually and collectively. In sum, this important task entails bringing together the humanities and the natural sciences, along the lines of the post-Enlightenment impetus for critique and the use of reason as the main constituents of ethics, politics and culture (Elkana and Krois forthcoming; Jaeggi and Wesche 2009).



1. The Fuzziness of the Anthropocene Boundary from the Viewpoint of Environmental History: The Case of Venice

The definition of the Holocene/Anthropocene boundary has strict stratigraphic requirements to do with individuating a distinctive boundary in the geological record, marked by a pervasive and ubiquitous high-amplitude spike representing human action in the geosphere. The formal definition of this new geological epoch would encapsulate an unprecedented level of human impacts: the Anthropocene is a clear warning about humankind's relationship with the planet.

For other disciplines, there is a fuzziness regarding the boundary of the new epoch (Edgeworth et al. 2015). The signal of human interference should be analysed comprehensively, ranging from low-amplitude and geographically fragmented intensities some millennia ago (e.g., fires, agricultural terracing) to the ubiquitous high amplitude intensities of recent times (e.g., industrial production, land-use changes). This fuzziness is also dictated by the fact that humans are right in the midst of the geological time in question. To acknowledge the fuzziness of the boundary is a natural process for disciplines such as history, archaeology, environmental geology, geomorphology, and ecology. Multiple questions arise: How did this signal evolve in time and space? How are the characteristics of the signal related to social systems? What should be the indices of human interference across the planet? The wider perspective at stake

here comprises a novel transdisciplinary framework for investigating human interactions with the environment.

French historians from the Annales school have emphasized the importance of taking into account the material dimensions of history, not least environmental factors. Fernand Braudel's magisterial *La Méditerranée et le monde méditerranéen à l'époque de Philippe II* (1949) called attention to the centrality of geography and territory in relation to cultural developments.[1] Indeed, the Mediterranean Sea connected people much more than it divided them, constituting a unique physical and cultural space that fostered the circulation of people, goods and ideas (Aymard 1977).[2] Braudel regarded Venice as a jewel in the crown of Mediterranean wealth resulting from converging global factors, especially long-distance trade guaranteed by maritime hegemony. The Mediterranean basin served the interests of Venetians, who came to transform coastlines and their lagoon basin, whose present land- and waterscape are the result of centuries of engineering, policies and scientific efforts to do with understanding natural processes and employing technology to determine the territory's configuration. Such collective intentionality is an emblematic case of natural conditions associated with a specific form of water civilization.

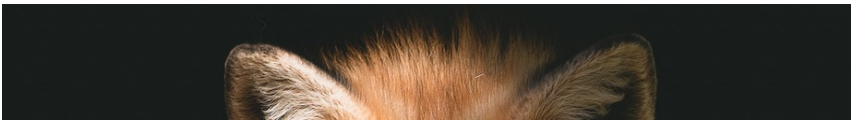
The city of Venice is an expansive archive of environmental proxy data that includes urban features, artistic documents, antiquarian books, and political-administrative sources (Trevisani and Omodeo 2021), though retrieving data from historical records is not straightforward. Pioneering work has been done by Dario Camuffo and his research group regarding the reconstruction of temperatures in the Mediterranean Sea over five hundred years, combining data from instrumental observation and historical sources for times before standards of measurement were established (2010). The same group derived evidence of extremely cold winters in the Venetian lagoon from rare printed sources, archival documents and paintings (Camuffo et al. 2017a). A daring proposal of theirs has to do with proxies for sea levels in the Venetian lagoon from 1350 to 2014, relating early-modern depictions of green algae to the height of stairs leading to palaces along the Grand Canal (Camuffo et al. 2017b).

[1] Another classic treatment is Febvre 1922.

[2] Today's migration of workers between the Indian subcontinent and the British Islands is reminiscent of this. See Della Puppa and Morad 2019.

One of the main difficulties for the correct use of art and architecture as sources is adequately evaluating their material and cultural contexts, as scientific concepts and units of measurement have changed with time. For example, it is not easy to use current metrics in relation to archived measurements of river flows: the late Renaissance mathematization of the principles of water flow according to the Galilean school of thought measured quantity by means of Euclidean geometrical proportions that took into account river sections (or canal sections) and velocities in a manner that does not correspond simply to a modern flow rate (Castelli 2004; Omodeo et al. 2020). An interdisciplinary method is thus required, incorporating proficiency in archival, philological and historical research as a counterpart to the work of natural scientists and engineers. Explorations of these materials also benefit from bespoke tools within the rapidly growing field of the digital humanities, e.g. the comparison of corpora of texts (Zamani 2020) and the automatic extraction of information by means of artificial intelligence.

The archaeology of the Venetian lagoon constitutes another fundamental field of inquiry into the anthropization of the territory. After the pioneering works of the generation of Wladimiro Dorigo and Ernesto Canal (Dorigo 1983; Canal 2013), new scholarship has been investigating the antiquities of the lagoon with a glance that brings together archaeology, longue durée history and cultural anthropology. In particular, the inter-pollination of archaeological and archival research has made possible new inquiries into ancient movements of populations and processes of urbanization. As Maddalena Bassani has programmatically stressed in her recent work on the *Antichità lagunari* ("Lagoon Antiquities"), "an interdisciplinary approach, that brings together literary, archival and documentary sources with archaeological excavations on land and underwater, and benefits from the contribution of geoenvironmental geology, stratigraphy and sedimentology, is the most suitable research perspective to reconstruct, as accurately as possible, the anthropic dynamics of the Venice before Venice" (Bassani 2012, 32; see also Bassani 2022).



2. The Hydromorphological Structure of the Venetian Lagoon: Rivers and Human Agency

Venice's geomorphology has particular historical and symbolic relevance: the environment has been transformed by humans and the elements over millennia to such an extent that it is impossible to separate the effects of human action from those due to natural causes, rivers and the sea.[1] Rich documentation since the Middle Ages allows for a fine-tuned comprehension of economically and politically minded decisions beginning in the late fifteenth century that aimed at reshaping the environmental niche geologically (minimising sedimentation), biologically (agricultural uses of water, industrial exploitation, fishing) and culturally (navigable infrastructures within the urban aesthetic). Indeed, early modernity is a moment of geo-anthropological transition, in which major river diversions determined the present state of affairs—the Venetian environment's path dependency is clear.

The relationship of the lagoon's hydromorphology to natural and cultural factors is documented from the early days of the Magistrate of the Waters. This long-lived role was established on a permanent basis around 1501 and abolished in the times of the Napoleonic conquest. It was then resumed at the beginning of the twentieth century but eventually suppressed in 2014 in the wake of scandals linked to the movable dams of the MOSE project ("*Modulo sperimentale elettromeccanico*"). Initially, a commission of 'water savants' (*Savi alle acque*) were in charge of all matters linked to water policy in the three main areas of the lagoon, the coast and the rivers (Zorzi 2008; Ventrice 2008).[2] The Magistrate of the Waters benefitted from the advice of experts called 'proti', including one mathematically trained superintendent. Among them, Cristoforo Sabbadino is the best known Renaissance water practitioner. He produced treatises in Italian (at a time in which Latin was the language of the learned elites) and many accurate accounts of hydrology, tides and water politics, as well as cartographic works. He forcefully advocated for preserving the Venetian lagoon by diverting rivers—a measure aimed to avoid the sedimentation of sediment.

[1] This applies to many civilizations. See for instance Amrith (2018).

[2] The State Archive of Venice holds a great number of documents relating to the activities of the Magistrate of the Waters. See Da Mosto 1937, 155-157.

He also brought about strict regulations on human activities that could alter the lagoon, e.g. agricultural activities in the wetlands. His *Discourses on the Venetian Lagoon* (*Discorsi per la laguna di Venetia*),[1] a Renaissance masterpiece of practice-oriented science, the enumerates natural and human factors threatening the city's surroundings, above all rivers and the sea. As for the anthropic component, he perceives various degrees of responsibility:

If one attentively considers the ruin of this lagoon produced by people, one will judge [the human impact] to be as significant as that of rivers and the sea. Three kinds of people are responsible for this great evil: first, lords and powerful men; second, engineers; third, individuals pursuing their own interests. (Sabbadino 1930, 31)[2]

Sabbadino was technically minded but not a technocrat: he saw politics as a major territory-shaping factor. In particular, he held powerful people responsible for transformations of water flows in terms of both effective and unfortunate decisions. Accordingly, the Venetian lagoon's delicate and dynamic environment is apt for perceiving the complexity of the 'archaeosphere' (Edgeworth et al. 2015) on the basis of this living archive of continuous management and exploitation of water.

At the margins of the lagoon and the Adriatic's coastlines, fluvial processes have always interacted with tidal and marine processes, increasing the complexity of morphologies and hydrodynamics in the Venetian area. During the long history of local urbanization (Ammerman et al. 1999; Gelichi 2010; Zezza 2010; Canal 2015; Fontana et al. 2017), a succession of technological interventions deeply affected the morphologies of the lagoon and surrounding areas, including the alluvial plain. Centuries ago, the city's diversion of major rivers flowing into the lagoon had profound impacts on geomorphological and ecological equilibria (Omodeo et al. 2020). The remnants of river deltas have lately been reshaped by tidal currents and transformed into salt marshes (Bondesan et al. 2004). The expansion of the city centre (*centro storico*) in correspondence of

[1] In spite of its scientific value, the manuscript was not printed at the time, probably because it was considered politically sensitive. Its first publication was provided by Sabbadino 1930.

[2] "Chi bene considera la ruina, che hano data gli homeni a questa laguna, non la gidicarà minor di quella, che le ha data gli fiumi et il mare. Tre conditione de homeni sono state, che ha causato questo grandissimo male. Gli primi sono stati gli signori et homeni potenti, gli secondi li inzegneri gli terzi li particulari per il bene proprio".

tidal morphologies is an example of the pervasiveness and complexity of human impacts on the geosphere: the hazard of tidal surges, locally referred as 'acqua alta', is partially a direct consequence of humans altering the lagoon (D'Alpaos 2010).

Understanding geoanthropological interactions requires a multiscale approach in time and space. For example, an environmental history of early debates about the diversion of rivers should not be limited to an analysis of the lagoonal environment; rather, it should take into consideration the overall drainage basins of the rivers, given that land-use practises and modifications at a distance from the lagoon could have had an impact on sediment dynamics. Another example would be the management of the surge hazard, in which natural and anthropic processes interact at multiple spatiotemporal scales (Pirazzoli and Umgiesser 2006). Human interventions in the lagoon's hydrodynamics are just one part of the picture. At the local level, groundwater exploitation in the 1960s and 1970s increased the land subsidence rate (Tosi et al. 2009; idem 2012; Camuffo et al. 2017b). On a global scale, we must keep in mind rising sea levels due to anthropogenic climate change.

These reflections naturally lead to consideration of the shallow subsoil and geomorphology of the area. Venice is located on top of more than 1 km of sediments (Zecchin et al. 2017; Massari et al. 2004). The upper part of this 'critical zone' – e.g., its first 15-30 m, ranging from the Pleistocene to the present – is a heterogenous archive of processes that formed the Venetian landscape. The presence of diverse materials and ages emerge evidently in archaeological remains (Ammerman et al. 1999; Gelichi 2010; Canal 2015; Fontana et al. 2017, Madricardo et al. 2021). In the city centre, the uppermost sedimentary unit has very heterogeneous anthropic content, recording a long and complex urbanization of salt marshes and mudflats (Ammerman et al. 1999; Gelichi 2010; Canal 2015). The ground at the top of this unit is on average 1.3 metres above sea level, with an almost flat topography.

By contrast, the lower surface of this unit, perched uneasily on Holocene lagoonal sediments, has a complex morphology, with a highly variable depth, ranging from 1.5 metres to 7 metres below ground level (McClennen et al. 1997). The depths of the lower surface correspond to filled-in tidal channels and woodpile foundations of structures such as buildings and bridges (Gottardi et al. 2013; Camuffo et al. 2017). On the alluvial plain, the anthropic unit is vertically and

laterally in contact with Pleistocene and Holocene sediments of fluvial and tidal environments.

A quick look at the geomorphological map of the area is sufficient to perceive the dynamic complexity of the Venetian landscape (Bondesan et al. 2004), not least extensive inland fluvial paleochannels and bygone fluvial deltas. Similarly, Roman settlements and roads highlight prolonged anthropization (Ninfo et al. 2009), and buried lagoonal channels in areas subjected to land reclamation are another instance of human interference.

3. Water as a Socio-Economic Resource, Science as a Land-Transforming Force

The relationship between the Venetian lagoon, the Mediterranean and surrounding rivers has always been economically driven in a broad sense; the economic motivations behind the transformation of the territory relate to both production (goods, labour, transportation) and reproduction (the basic needs of life). Water, as an infrastructure for transportation, was the environmental precondition for Venice's maritime pre-eminence during the Middle Ages up to the early-modern shift of European global commerce from the Mediterranean Sea to the Atlantic Ocean. The state-run shipyard (*Arsenale*) reminds us of the medieval and early-modern centrality of maritime technologies for Venice, including a military dimension (Davis 1991; Renn and Valleriani 2001; Zan 2019). The still-functioning shipyards bear witness to the economic importance of access to the sea and concomitant exchanges. The Petrol Channel (*Canale dei petroli*) connecting the industrial area of Marghera to the open sea was excavated in the 1960s in response to the growing needs of the harbour and chemical industry (Dorigo 1973, 231, 275n1).[1] It deeply changed the currents in the lagoon and their force.

As for the relevance of water in terms of 'economic reproduction', i.e. sustaining life at its most basic level, the scarcity of drinkable water on the island of Venice has been a constant problem, as summarized in an oft-quoted statement by the Renaissance historian Marin Sanudo: "[the city] is in the water but has

[1] On the topic of Marghera, see Giani and Peron 2018.

no water“ (“è in aqua et non ha aqua”) (Sanudo 1980, 37-38). Until extensive consumption from aquifers became technically reliable in the nineteenth century, Venice depended on an extensive system of cisterns and wells to collect rainwater (Gentilcore 2021, 3-4). Water sources may have existed in ancient times on the islands where Venice stands today, but there is no historical record of this. For this reason, naturalists and archaeologists were very surprised when a submerged source of freshwater in Cannaregio was discovered in the seventeenth century during excavations for canal maintenance (Luzzini 2019).

Agricultural uses of water and fishing constitute two often-neglected but significant aspects of the economic interests that guided the hydromorphological transformation of the territory. Much can be rediscovered about the usage of water thanks to archival documentation concerning local manufacturing and various forms of labour in the preindustrial age. Documentary evidence of water labour is still to be fully assessed, though some progress is evident in cases like a recent online database of early-modern internship contracts (Bellavitis et al. 2017). Documents preserved in the State Archive of Venice indicate a large number of water-based professions, ranging from artisanal work (especially textile production) to transport, including drinkable water being brought from rivers by watermen (‘acquaroli’). As far as the prominence of fishing is concerned, the Venetian authorities considered it crucial to have price controls on fish to guarantee a certain kind of social order, as reflected in centuries of legislative measures (Rivoal 2015). Indeed, the reproduction of fish in the lagoon and the Adriatic was of vital importance: fishing techniques and scheduling were closely regulated as a means of guaranteeing the city’s prosperity.

The engineering of the hydrological basin has long meant preserving the lagoon as navigable, especially in the fifteenth century, when Venice took control of large inland territories. Water was considered to be the most effective defence of Venice: its ‘fluid walls’. As early as the fifteenth century, it was recognized that deforestation had consequences on the accumulation of sediments in the lagoon (Appuhn 2009, ch. 2), even as wood from forests was needed for housebuilding and maintenance of the Venetian fleet. The preservation of forests became as important as their utilization, which was strictly regulated. Early-modern Venice is to some extent an example of how to manage resources in a non-destructive manner (Appuhn 2009). Similarly, water-based practices were kept under control, especially in the case of countryside canals (Sereni 2010). In

this context, agricultural and navigational came into conflict because the regulation of waterways was geared towards maintaining Venice's insularity at the expense of other interests. This created tensions between the mercantile elites who lived in the city's centre and landowners whose main interests were in the mainland. Conflictual environmental politics are exemplified by the harsh polemics between the aforementioned Sabbadino and Alvise Cornaro, who was a staunch supporter of land reclamation and intensive agriculture without regard for the lagoon (Fiocco 1965; Puppi 1980).

Measures against water pollution due to manufacturing are especially evident in connection with early-modern textile production, foreshadowing the critical situation in the twentieth century resulting from chemical pollution at Marghera. These large-scale industrial developments had an impact at a geological level because pumping from aquifers for industrial and household usage accelerated Venice's subsidence. Around the time of the high water ("acqua granda") of 4 November 1966, journalists came to denounce the impact of industrially caused subsidence on seasonal high waters (Montanelli 1969), the frequency of which has continued to increase as a consequence of global warming and sea-level rise.

In essence, the crux of Venetian history is water politics. The Magistrate of the Waters, meant to offer technical support for maintaining the territory, had an evident political function, which clearly emerges from documents concerning negotiations and controversies around major interventions. In 1610, political authorities requested an assessment of the consequences of the diversion of the Brenta River for water levels in the lagoon. The Magistrate of the Waters sought expert advice from well known mathematicians (not least Galileo's pupil Benedetto Castelli), from professors in Padua, and from the fishing community (Omodeo et al. 2020). A decree from 1536 reads:

Since no-one better understands the course and movements of the waters of our lagoon than the fishers who travel through it day and night, the Gastaldo [i.e. the leader of

the fishing community] and the school of fishers at San Nicolò shall choose two of the most sensible and practical elderly fishers, or former fishers […]; another person must be chosen by the Gastaldo and the fishers at Sant'Agnese, another by the fishers of Murano, two by those at Burano, and two by those at Chioggia. When matters related to this lagoon are at stake in this College, all eight shall be called to share their opinions and recollections about the subject under discussion, for the benefit of our lagoon. (Scarpa 1996, 28).[1]

17th century documents indicate a convergence of interests among different social groups and institutions. The fishing community requested that the authorities map the lagoon so as to designate public waters for fishing, free from private appropriation for aquaculture. The Senate backed this initiative. In the words of a proclamation dated 7 June 1684:

Notice is hereby given of the intent to accomplish the duties of the Magistrate and the Decrees of the Most Excellent Senate (August 19th and November 13th) that followed the plea of the faithful people of San Nicolò, its leader and associates regarding the demarcation of the boundaries of public waters, out of zeal for the homeland in this most important matter for the lagoon and ports, the fount of its upkeep, wellbeing and freedom. The most excellent lords Andrea Corner (Procurator), Piero Vallier, and Giulio Giustinian (Procurator), the wise men Zuanne Grimani, Marc'Aurelio Soranzo, and Ferigo Calbo (Executors), and all the ministers and experts in the magistracy deliberated on the 15th and 16th of this month with respect to the middle and right channels of the Lagoon, in the vicinity of the ports of Malamocco and Chioggia, in terms of fishing enclosures (active or out of use), lakes and canals inside the sandbars as far as dry land [*Terra Ferma*]. Having taken account of the relevant laws and writings, with a view to a neat distinction between public waters and those claimed by title, particularly on the part of owners of fishing enclosures […], they have decided, in the name of the Lord God, that whoever wishes to advance any claim must present to the Magistrate's notary the reasoning

[1] "Perché niuno meglio intende il corso et andamenti de le acque de queste nostre lagune de quello farà li pescadori che il zorno et nocte le practicano però sia preso che per el gastaldo et scuola dei pescadori de San Nicolò sia facta electione de duo dei più sensati vechi e pratici pescadori, o che siano stati pescadori che potranno trovar. Et questo sotto debito de Sacramento; et simile electione far debi de uno altro il gastaldo et pescadori di Sant'Agnese, et di uno altro li pescadori de Muran, et de duo altri quelli de Buran, et duo quelli de Chioza, li quali tuti otto quando se tracterano materia tantum de questa lacuna se debino far intervenir in questo Collegio per haver da loro, le loro opinion et aricordi circa dicta materia fosse proposta per benefitio de questa nostra laguna".

and documentation pertaining to any area within the circumference of the Lagoon [...] within one month, so that [the Notary] may examine them, promptly return them and administer the justice that is due. If these [claims] do not take place, those who have benefitted from [privileges] until now will be considered deprived of all possessions and titles. It is the aim of the Magistrate's Excellencies to determine for each party what is legitimately owned on the basis of precise drawings, featuring Lines and Winds, as well as noteworthy signs. These [technical drawings] shall be kept separately in the Magistrate's Office in the form of a District Register, so that no-one may feign ignorance, nor make up pretexts to enlarge boundaries [of a water enclosure]. Once the public has been separated from the private, may the people of San Nicolò, Chioggia, and all other subjects universally benefit from permitted fishing.[1]

[1] State Archive of Venice, *Compilazione leggi Pesca, Pescaria, Pescatori, Pesce (1314-1786)*, f. 1050r: "Nelli riflessi debiti alla soddisfattione dell'incombenze del Magistrato con la mira d'obbedire alli Decreti dell'Eccellentissimo Senato 19 Agosto e 13 Novembre decorsi seguiti a supplicatione anco del fedel Popolo di S. Nicolò, suo Gastaldo, e Compagni per poner li confini all'Acque Publiche col zelo verso la Patria nella Materia importantissima della Laguna, e Porti, da che dipende la preservatione, salute, e Libertà della medesima. Essendosi sotto li 15 e 16 decorso conferiti sopra loco dal braccio di mezo, e destro della stessa Laguna, et alli Porti di Malamocco, e Chioza, e per le Valli concesse, e per quelle distrutte, per Laghi, e Canali di quelle entro a Barenne anco fino alla Terra Ferma, gl'Eccellentissimi Signori Andrea Corner Procurator, Piero Vallier, e Giulio Giustinian Procurator Savii, Zuanne Grimani, Marc'Aurelio Soranzo, e Ferigo Calbo Essecutori con li Ministri tutti, e Periti del Magistrato havendosi sopra il fatto conosciuto nella Lettura delle Leggi, e Scritture in tali propositi, che per distinguere, e separare affatto l'Acque Publiche da quelle de pretesi Titoli de Privati, e particolarmente de possessori delle Valli di qual si sia sorte uniformandosi però alle Leggi in tal proposito, e massime alla Terminatione 1641 del Colleggio Eccellentissimo delle Valli 11 Giugno, approvata nell'Eccellentissimo Senato detto mese, e riconfermata l'anno 1655 con altra Terminatione pure del Collegio Eccellentissimo delle Valli 1662, 14 Aprile approvata pure 26 Maggio seguente dall'Eccellentissimo Senato, hanno nel nome del Signor Iddio terminato che cadauno che pretendesse qual si sia raggione, Attioni, Titoli, Possessi, Godimenti d'Acque, Valli permesse, e non Pesche vagantive di qual si sia sorte, e beni d'ogni parte, et entro la circonferenze di questa Laguna, longhezze, e larghezza, debba presentar nel termine di mese uno nelle mani del Nodaro di questo Magistrato perché questi essaminati che siano, saranno poi prontamente restituiti et amministrata quella giustitia, che a cadauno indifferentemente si deve, e non lo facendo s'intenderanno decaduti d'ogni Possesso, Titolo, o Godimento ch'havessero fin'hora tenuto. Intendendosi dal Magistrato di loro Eccellenze escorporare ad ogn'uno quello che legitimamente sarà suo con veri e pontuali disegni, con ponervi in esse le Linee, e Venti, col darvi anco qualche segno notabile da doversene tenere pur nel Magistrato registro distinto in forma di circondario o Catastico, onde non si possa pretendere ignoranza da chi si sii, né pretesti imaginabili a dilatatione de Confini, e separato il Publico dal Privato possano li Popoli di S. Nicolò e Chioza e cadauno universalmente de sudditi godere delle Pesche riservate, e permesse".

This passage bears witness to the political dimensions of water negotiations and decisions in early modernity, when several individuals, institutions and communities took part in administering the lagoon as a common good. Such a perspective is a valuable insight into effective democratic approaches to the commons that can serve as a model for managing 'resources'.[1]

Besides economic and political questions, scientific knowledge has played a key role in the transformation of the Venetian waterscape. As the historian of science Boris Hessen emphasises, water was understood in early modernity as multi-layered in social and epistemological terms (Hessen 1931). At a time marked by the expansion of merchant capital and manufacturing, a new class of entrepreneurs emerged, whose interests were connected with the expansion of transport, mainly in the maritime sphere. Simultaneously, agricultural uses of water grew in importance. Given the formula of "economics […] *present[s]* demands, which *pose* technical problems, which *generate* scientific problems" (Freudenthal and McLaughlin 2009, 4), such economic interests entailed technological and scientific advancements: the improvement of vessels, new navigation techniques, the building of canals and locks, greater understanding of fluid dynamics, and more accurate knowledge in the domains of astronomy, geography, mathematics and optics. From this perspective, one can view science as an economic vector and a motor of geomorphological change. There is still much to be said about the large body of scientific sources linked to water management, hydraulics, sea tides, and cartography emerging from the Venetian context as part of the great expansion of knowledge in the locale, which became a major early-modern centre of book printing, in tandem with the flourishing University of Padua.[2] Indeed, highly impressive technological inventions and engineering projects were produced by practitioners like Sabbadino working for the Magistrate of the Waters.

[1] On the complexities of the commons, see Ostrom (1990) and Federici (2004).
[2] In terms of hydraulic publications alone, see Ciriacono 1980.

4. Conclusion: From Anthropogenic Transformation to Anthropocene Globalization

Our consideration of the Venetian context is intended as an exploration of a *glocal* reality that has to be understood from a multiscale and interdisciplinary perspective, particularly in relation to how water-cities are threatened by rising sea levels across the globe.[1] The above discussion of geomorphological politics and resource management in a spatiotemporally limited 'scarcity economy' offers a model for rethinking intertwined environmental, economic, and political questions in a time of increasing globalisation. We want to stress the importance of interdisciplinary research in understanding the sociocultural realities of the Anthropocene: the sort of historical/archaeological records at stake here shed light on how scientific, political and economic interests interacted in terms of adaptation to constantly changing environmental conditions (Mukerji 2009). In the Venetian case, administrative, technical, and political documents are a fruitful archive of data that remains largely unexplored. The cases therein help to foster reflections on environmental politics for our times because they show more communitarian ways of dealing with the territory.

To use a Baconian distinction between the physical and cultural contexts in which we live and act, a critical environment like Venice has to do with both a first-order Nature and a second-order Nature. As pointed out in 1989 by the philosopher Félix Guattari in *The Three Ecologies* (*Les trois écologies*),

> Now more than ever, nature cannot be separated from culture […]. Just as monstrous and mutant algae invade the lagoon of Venice, so […] men like Donald Trump are permitted to proliferate freely, like other species of algae, taking over entire districts of New York and Atlantic City; he 'redevelops' by rising rents, thereby driving out tens of thousands of poor families, most of whom are condemned to homelessness, becoming the equivalent of the dead fish of environmental ecology. (Guattari 2000, 43)

Following Guattari, we can regard environmental problems as the outcome of three interwoven ecologies: the *natural*, meaning the geoenvironmental and biological realm; the *cultural*, concerning social structures and ways of living;

[1] Regarding Venice as a hydropolis, see Finch-Race 2021.

the *immaterial*, ranging from feelings to aesthetics. To that end, Venice epitomizes a natural-cultural nexus.

In Braudel's eyes, the Mediterranean Sea demonstrates over the *longue durée* how material culture (including economics) is strictly dependent on geography, whereas political history is rooted in societal structures and geology, each unfolding according to different temporalities. From Braudel's perspective as a historian, geology constituted an almost immutable precondition of human relations and deeds. Yet, the Anthropocene is a predicament that calls for different areas of scholarship to consider the dialectics of Nature and Culture, which are constantly transforming each other: therefore, the idea of a unidirectional dependency no longer holds. The proposed geological epoch means a revision of history as much as historiography: it is necessary to come to terms with how certain humans' actions have become inscribed in Earth's layers and cycles.

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