

Rethinking Leonardo for the Anthropocene

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Modern man should be a synthesis of those traits that are ... presumed as national characteristics: the American engineer, the German philosopher, the French politician, recreating so to speak, the Italian man of the Renaissance, a modern type of Leonardo da Vinci who has become a mass-man or collective man while nevertheless maintaining his strong personality and originality as an individual.²

In this letter to his wife “Julca,” penned in 1932 while he was imprisoned in Fascist Italy, antifascist political intellectual Antonio Gramsci (1891–1937) reflected on how to best raise their children and the type of person that they wanted them to become. He reminded his wife how she had considered naming their second son “Leo” instead of Delio, a name that, as an abbreviation for “Leonardo,” now seemed like a good omen. Gramsci described Leonardo da Vinci as a symbol of the practical, theoretical, and ethical-political aspects of his epoch. He thought that the Renaissance already bore all features of modernity, without, however, reaching the ‘division of intellectual labor’ that would cleave a rift between different groups of intellectuals and professionals. Engineers, philosophers, politicians, and—one might add—scientists and researchers, often seem to represent two divergent and incommensurable “cultures,” according to Charles Percy Snow’s popularization of the notion that the methodologies of the *Naturwissenschaften* (natural sciences) and *Geisteswissenschaften* (sciences of the spirit) are fundamentally irreconcilable. At the same time, the necessity of bridging

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² Gramsci, *Letters from Prison*, vol. 2, ed. Frank Rosengarten, trans. Raymond Rosenthal (New York: Columbia University Press, 2011), 194–95.

the gap between nature and culture, humanities and natural science, has never seemed so pressing. Understanding their interrelations is important for developing adequate intellectual and practical responses to the contemporary challenges of environmental politics, in which geological and historical time overlap. Rethinking Leonardo da Vinci today means taking a privileged historical and historiographical point of view on our technological, scientific age, the state of humanity today, and the future of our planet, because all of these topics are entangled with one another in the work of the Renaissance artist and scientist. The unity of intellect and craft that Leonardo embodies is exemplary of what Jürgen Renn recently called the “ergosphere” when discussing one of the most important factors in the current manmade technological transformation of the Earth: human labor. It should be placed at the center of thought on technological development, particularly in its interactions with forms of knowledge and epistemic ideals and practices.

The aesthetic grace of Leonardo da Vinci’s depictions of nature—the backgrounds of his master paintings and the meticulous drawings in the preserved codices—has a significance that goes beyond mere visual pleasure. The Renaissance’s naturalism was enormously important for the development of a practice-oriented scientific culture rooted in empirical observation. A broad range of research on the practical foundations of science has highlighted this insight, research that spans from Marxist sociology to newer scholarship on practical knowledge in the history of art and science. For instance, in his historical-materialist work on the Renaissance, Lucio Lombardo Radice wrote that the demands of realism in painting and sculpture necessitated deeper knowledge of anatomy and perspective. This forced artists in Italian workshops in the fifteenth century to engage with the study and practice of medicine and mathematics. In turn, they made their own contributions to these disciplines, thus furthering their development. Mechanics, ballistics, military architecture and hydraulics, geology, and landscape engineering were the fields that Leonardo excelled in, and he did so without ever abstracting science from its practical, transformative context. At the same time, his

practice was always guided by the steady hand of certain, rational knowledge. “Those who are in love with practice without knowledge,” he remarked, “are like the sailor who gets into a ship without rudder or compass and who never can be certain where he is going.”

Fig. 1: Leonardo’s self-presentation to Ludovico Sforza. *Codex Atlanticus*. Biblioteca Ambrosiana, Milan, fol. 1082r (CR#: 07.02.02.02).

Leonardo described knowledge—of which mathematics is the prime example of uppermost certainty—with a military metaphor: “Science is the captain, and practice the soldiers.” The comparison was not simply grasped out of thin air. It derived directly from the artist-scientist’s own biography, life experience, and decisions having served ambitious men like Ludovico il Moro (Ludovico Sforza) and unscrupulous condottieri like the Duke of Valentinois, Cesare Borgia, who provided the model for Machiavelli’s “Prince.” In his famous letter to the Duke of Milan, Ludovico Sforza, in which he laid out his resume (Fig. 1), Leonardo almost exclusively focused on presenting his skills in military technology, while relegating to the margins those applicable to civilian ends. As for his artistic projects, they only received cursory mention. Leonardo promised Ludovico il Moro that he would reveal to the duke his “secrets,” which, he boasted, were superior to “common” inventions. He was talking about bridges, scaling ladders, cannons, methods capable of “destroying every fortress or other stronghold,” mortars, covered vehicles, techniques for sea battles, ways of constructing subterranean passages without making noise. “In short,” he concluded, “as the variety of circumstances dictate, I will make an infinite number of items for attack and defence.” Compared with all of this weaponry, the things that Leonardo could have accomplished in times of peace seemed hardly worth the mention. He limited himself to general remarks about being able to construct “both public and private buildings,” conduct “water from one place to another,” and sculpt

statues, in particular a bronze horse that would “be to the immortal glory and eternal honour of the auspicious memory [...] of the illustrious house of Sforza.”³

Gramsci’s reading of the work that Leonardo had performed in the service of force and power took a different direction than the praise contained in the introductory quote above. In a letter to his sister-in-law Tatiana Schucht, he interpreted it as a sign of Italian intellectuals’ deep-rooted tendency to sway between opportunism and cosmopolitanism, writing: “it was a matter of indifference to Leonardo whether he sold the designs for the fortifications of Florence to Duke Valentino. The Communes were thus a particularistic [*sindacalista*] state, which did not succeed in transcending this phase and becoming an integral State as Machiavelli vainly urged.”⁴ Eugenio Garin (1909–2004), historian of the philosophical culture of the Renaissance, offered a more conciliatory, if also more abstract, assessment of Leonardo’s accomplishments, writing that he had “above all the merit of having lived both the arduous and wonderful history of his time in heroic harmony.” Cesare Borgia’s patronage of Leonardo came at a time when the prince was at the height of his political powers: he ruled over central Italy, which he, in the name of his father, Pope Alexander VI, ravaged with fire and fury from Urbino to Romagna to Tuscany. Did this patronage cause a scandal? What about Leonardo’s work for a foreign king who got him to spend the last years of his life in France? In his willingness to serve the powerful without many qualms, Leonardo himself displayed a certain Machiavellianism.

Indeed, Leonardo knew Machiavelli. The two Tuscans frequented one another during the most heated period of the Italian Wars in the late fifteenth century. Perhaps they first met in Urbino, just after Borgia took it over. More than just one of the most important military cities of the time, Urbino was also a center of cultural-scientific blossoming: Baldassare Castiglione later penned his

³ Leonardo da Vinci, Letter to Ludovico Sforza, in *Leonardo on Painting*, ed. and trans. Martin Kemp and Margaret Walker (New Haven, CT: Yale University Press, 1989), 251–253.

⁴ Antonio Gramsci, *Selections from the Prison Notebooks*, ed. and trans. Quintin Hoare and Geoffrey Nowell Smith (New York: International Publishers, 1971), 56. Translation slightly revised.

codification of court etiquette there; moreover, it was home to the school of Federico Commandino, which produced research on mathematics and engaged with the work of Archimedes; and Guidobaldo del Monte, one of Galileo's early benefactors, authored notable studies on mechanics as one of the Commandino school's members.

Leonardo did his most intensive work for Borgia between July and September 1502. In a letter granting him safe passage in order to inspect the fortifications, Borgia commanded that Leonardo be provided "with as many men as he requisitions" and called him "our most eminent and well-beloved familial friend, the architect and engineer general Leonardo Vinci."⁵ Some documentation of this debated period of Leonardo's life is preserved in a small codex held in Paris as "MS L." It begins with a remark about Leonardo's search for a translation of the work of Archimedes, the great mathematician and military engineer of Antiquity. Alongside various technical projects, it contains drawings of fortifications and notes about mapping Borgia's territory. The notes allow us to reconstruct Leonardo's travels from Urbino, where he inspected the city's defenses, to Cesena and Porto Cesenatico, and finally western Tuscany.

Later biographies—and particularly those whose authors who were close to the House of Medici, such as Vasari's *Lives* (CR# 10.02.03.01-e)—left out Leonardo's compromising relationship with Borgia. But considering the fact that others, beginning with Machiavelli himself, saw Borgia's undertakings as the Renaissance's greatest attempt to overcome Italy's fragmentation and realize a political system that transcended the peninsula's many city-states and communes, it is possible to interpret Leonardo's work for Borgia in a way that differs both from its suppression in the Medici-friendly narratives as well as from Gramsci's criticism of it. For historians of science, Leonardo's emphasis on military technology in his letter to Ludovico il Moro might be read as an index of the primacy of the political over the economic in his work, if we assume (again drawing on Machiavelli)

⁵ Quoted in: Walter Isaacson, *Leonardo da Vinci* (New York: Simon & Schuster, 2017), 339–40.

that the Italian wars of the fifteenth century were an—albeit failed—attempt at state building. The *socio-economic roots* of modern science have been uncovered by historians, and particularly those of the “externalist” school of the history of science who, in the 1930s and 1940s, drew on Soviet scholar Boris Hessen (1893–1936), the politically-minded neo-positivist Edgar Zilsel (1891–1944), and the Polish “Frankfurter” Henryk Grossmann (1881–1950). In this light, Leonardo’s case invites us to focus on the *political* dimensions of science in the Renaissance. At the same time, it is worth noting that Leonardo lived during an age when the logic of profit had not yet come to dominate everything in society, including war, thus leaving open considerable room for the relative autonomy of different spheres of activity.

Fig. 2: The “Imola Plan,” Leonardo da Vinci.

Leonardo’s work in cartography has particular significance in this regard. Leonardo never separated it from military ends. The Imola Plan (Fig. 2) is a precise representation of the northernmost outpost of the provinces under Borgia’s control. In his maps of papal territories and central Italy, he included not only the conquered regions, but also the targets of expansion. His maps of the Chiana Valley, for instance, including the map held by the Royal Library of Windsor (12278r), concentrate on an area that gained in geopolitical significance after the Aretine rebellion against Florentine rule in June 1502. But Leonardo also had grand ideas about reshaping the territory and was thus highly interested in studying the basin of the Chiani river that runs through the region. This coincidence of Leonardo’s occupation with both cartography and hydrology precluded a clear distinction between military mapmaking and civilian waterworks. He dreamt of redirecting the Chiani—the path of which had been changed by humans since Etruscan and Roman Antiquity—in order to increase the volume of the Arno river in Florence. Roger Masters’s *Fortune Is a River* (1998) narrated in literary form the attempt to change the Arno’s course during the lengthy war between Pisa and Florence, which would have had the dual purpose of cutting Pisa off from an important water

supply while connecting Florence with the Mediterranean. But the failure of his exceptionally expensive project of constructing a dam, financed by the Florentine Republic, brought Leonardo into conflict with the gonfaloniere Piero Soderini.

Abb. 3: Leonardo da Vinci. 5 August 1473. Arno Valley Landscape. Gabinetto Disegni e Stampe degli Uffizi, Florence. Inv.: 8 P r (CR #02.02.02.02). [Alternative: Leonardo da Vinci. ca. 1513–1518. *A Tempest*. Royal Library, Windsor. Inv.: RCIN 912376 (CR #06.02.02.03).]

Leonardo's beautiful drawings of the Arno Valley (CR#02.02.02.02) and flowing rivers (Fig. 3), which strengthen the image of Leonardo as an artist and philosopher of variety, are not separable from his work as a hydraulic engineer. The advice he gave Ludovico il Moro on how to improve the canal system in Milan is one prominent example. Another is when, anticipating a possible invasion, Leonardo proposed that the Republic of Venice construct mobile barriers along the Isonzo River. "My most illustrious lords," Leonardo wrote in March or April 1500 to the government of Venice, "as I have perceived that the Turks cannot invade Italy by any part of the mainland without crossing the river Isonzo, and although I know that it is not possible to devise any means of protection which shall endure for any length of time, I cannot refrain from bringing to your notice the fact that a small number of men aided by this river might do the work of many, seeing that where these rivers ... [section missing]." ⁶ For those same Turks, Leonardo would later design a futuristic bridge to cross the Bosphorus, connecting Asia and Europe; the draft can be found in the Paris Codex MS L from Leonardo's time working for Borgia (CR#11.02.01.07, neu: 115). Was he imagining a U-turn in technology and politics when he promised his services to the Sultan after having been in the employment of the Serenissima, the Most Serene Republic of Venice? Indeed, that there was a political motivation behind Leonardo's work as a technical advisor cannot be denied. Similarly undeniable is how his work in landscape engineering and his creation of what then must have seemed

⁶ Jean Paul Richter, ed., *The Literary Works of Leonardo da Vinci* (Berkeley: University of California Press, 1977), 197.

fantastic inventions presage the technical sublime of Americanism and the Anthropocene, while his plan to construct mobile barriers around Venice anticipates today's experimental electromechanical modules to protect the city from high tides, known under the pseudo-Biblical acronym MOSE (from the Italian: MOdulo Sperimentale Elettromeccanico). Leonardo's century also witnessed less spectacular, but deeply innovative largescale public works projects, such as the construction of irrigation canals that radically altered Italy's landscape, particularly in Lombardy under the Sforzas, but also in Venice and Tuscany.

Leonardo's work in geology was closely intertwined with these developments. A century ago, Giuseppe De Lorenzo described Leonardo's engagement for the Florentine Republic in a way that has passed the test of time. In his book *Leonardo Da Vinci e la geologia*, he writes of the period between 1503 and 1506: "And so, while he was in the city painting *The Battle of Anghiari* and the *Mona Lisa* and advising where to best place Michelangelo's *David*, on the countryside, he was devising his flying machines and flights from Monte Cerere and designing hydraulic works for the Duke of Valentinois [Cesar Borgia] and the canalization of the Arno. At the same time, he was absorbed in viewing fossils and geological terrain, which brought him back to ruminations on the transformation of the Arno Valley and the ancient geological relations between the Apennines and the adjacent seas." Of all the preserved manuscripts, the Codex Leicester is the one that is most helpful for exploring the relationship between Leonardo's interests in hydraulics and geology. It contains "paleographic" reflections about the Arno Valley and its formation by the river's sediment deposits (Codex Leicester, fol. 9r). These reflections fit into his studies on water management. Leonardo analyzed the distribution of fossil shells in order to chart how the coastline looked in the distant past (CR#06.02.02.03, neu: 61; 06.02.02.02, neu: 60; CR Essay Schneider). Thus, he researched the history of the earth by observing fossils; he grappled with hydrography, the complex composition of soils, and the formation of mountains and plains through fluvial processes. Water

appeared to him as our world's primary instrument of transformation ("Water is the driving force of nature," we read in Codex K, fol. 2r). It erodes mountains and moves minerals. Over the long term, it creates global imbalances between land and water that rearrange landscapes and cause disasters. Pierre Duhem (1861–1916), a major French scholar of Leonardo's work and reception, saw in his treatment of such "petits mouvements de la terre"—small tremors of the earth combined with shifts in their cosmological centers of gravity—an anticipation of the theory of terrestrial motion developed by Nicolaus Copernicus (1473–1543) soon thereafter. The cosmic perspective aligned with Leonardo's fascination with the Earth in its historical and spatial, geological and astronomic aspects, as expressed in the *Codex Atlanticus* (fol. 365v): "The knowledge of past times and of the places on the earth is both an ornament and nutriment to the human mind."

For Leonardo, the world is a coherent whole. Man is everything's measure—or, as the neo-Platonists of the fifteenth-century "Accademia Fiorentina" would have said, the *nexus rerum universalis*, the universal nexus of all things. Donning his anatomist's hat (Manuscript A, fol. 55v), Leonardo reflected on the microcosm, a topic beloved by Marsilio Ficino (1433–1499) and other admirers of Plato's *Timaeus*:

Man has been called by the ancients a lesser world, and indeed the term is rightly applied, seeing that if man is compounded of earth, water, air and fire, this body of the earth is the same; and as man has within himself bones as a stay and framework for the flesh, so the world has the rocks which are the supports of the earth; as man has within him a pool of blood wherein the lungs as he breathes expand and contract, so the body of the earth has its ocean, which also rises and falls every six hours with the breathing of the world; as from the said pool of blood proceed the veins which spread out their branches throughout the human body, in just the same manner the ocean fills the body of the earth with an infinite number of veins of water. In this body of the earth there is lacking, however; the sinews, and these are absent because sinews are created for the purpose of movement, and as

the world is perpetually stable within itself no movement ever takes place there, and in the absence of any movement the sinews are not necessary; but in all other things man and the world show a great resemblance.⁷

In sum, Leonardo's geo-anthropology grew out of his belief in human faculties and his desire to change the world through science and technology, both of which he placed at the service of politics. This was part of a philosophical naturalism that viewed man and earth, life and the cosmos as cohering, connected beings, both in a material sense and in a structural-functional sense. In particular, Leonardo's holistic conception of the inseparable unity of nature and culture can offer a fruitful perspective on today's pressing questions about the identity of the *anthropos* as a being that defines a geological age. So, too, can his a priori rejection of the division between eye and hand, theory and practice. His practice had at least two aspects: the *poiesis* of technological invention and the *praxis* of collective action.

In the twentieth century, Machiavelli's masterwork, *The Prince*, was read as a political theory of collective subjectivity, because political action in contemporary society can only take the form of mass action. Similarly, the artist, inventor, and scientist, the ideal unity of which was embodied by Leonardo, can and must be understood in a non-individualist sense. A statement by Gramsci, this time from his *Prison Notebooks* (XI §34), provides one such reading:

One might say that the typical unitary process of reality is found here in the experimental activity of the scientist, which is the first model of dialectical mediation between man and nature, and the elementary historical cell through which man puts himself into relation with nature by means of

⁷ *Leonardo da Vinci's Note-books*, edited by Edward McCurdy (New York: Empire State Book Company, 1923), 93–94.

technology, knows her and dominates her ... Scientific experiment is the first cell of the new method of production, of the new form of active union of man and nature.⁸

The scientist of Leonardo's type is the molecular agent of macroscopic, technological, and scientific transformations at the intersection of ergosphere, technosphere, and the many other spheres of the system in which we live.

⁸ Gramsci, *Selections from the Prison Notebooks*, 446.