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LEONARDO DA VINCI ON NATURE: KNOWLEDGE AND REPRESENTATION

1. The subject of this book, *Leonardo da Vinci on Nature*, requires some preliminary remarks. On the one hand, these remarks refer to the image of Leonardo in the history of culture, and on the other, to the state of studies concerning his thought. There is, of course, a relationship between these two fields, even if this link is strangely weak in Leonardo's case, much weaker than for most Italian Renaissance authors. Leonardo's public image, given over to the myth of the 'genius' and nowadays marketed in countless ways, is powered by a current of popular belief which is now unstoppable. This revolves around certain mythologems that are the fragmented residues of interpretations set out in different periods of Leonardo's critical reception. This image therefore mingles – just like a museum of fossils – relics from different periods and various backgrounds: from the 'magician' to the technician able to anticipate almost all modern inventions, from the fanatic worshipper of science to the esoteric painter of symbols and hidden truths, with all possible variations in between. Collective efforts that have attempted to reconcile scientific rigour with general interest, such as the recent exhibition on *The Mind of Leonardo. The Universal Genius at Work*¹, have not decisively broken up this rich stream of mythical images, which therefore become increasingly distanced from the mainstream flow of studies concerning Leonardo².

¹ Cf. *The Mind of Leonardo. The Universal Genius at Work*, ed. by P. Galluzzi, Firenze 2006.

² F. Capra's book is one of the most recent examples of the 'mythical' use of Leonardo, attempting to give a coherent presentation of his thought as the anticipation of a 'holistic' science, *The Science of Leonardo: Inside the Mind of a Great Genius of the Renaissance*, New York 2008, translated into five languages.

For all the reasons just given, a theme such as *Leonardo on Nature* is thus highly ambivalent and can result in more than one misinterpretation. From the point of view of Leonardo's public image, talking about 'nature' means being caught in a dilemma with no way out. On one hand, we are dragged towards the nineteenth-century celebration of the struggle against nature, i.e., a 'technical' idea which is not only out of step with Leonardo's time, but now found completely obsolete when bearing in mind the changes undergone not just by the debate on technology during the twentieth century, but also by its own reality³. On the other hand, we fall into the acritical exaltation of 'nature' as a mystical-religious reservoir of all meaning and value; a representation which in fact is not particularly different from a simple anthropomorphic reflection.

2. This is precisely the alternative that has gradually been neutralised, i.e. proved false and lacking any historical basis, over the course of interpretations of Leonardo's thought concerning nature. This can be appreciated if we briefly consider the main studies concerning Leonardo's natural philosophy written since the beginning of the twentieth century. In 1905 Edmondo Solmi, in his *Nuovi studi sulla filosofia naturale di Leonardo da Vinci*⁴, albeit within a comprehensive approach of a positivistic character, identified *analogy* as the key to accessing the method used by Leonardo to study the work of nature. This led him to postulate a necessary connection between the concept of 'spirit', optics and the theory of light, acoustics and mechanics⁵. In fact, Solmi's reputation is due principally to his scholarly research concerning Leonardo's 'sources'⁶, while this hermeneutic proposal remained

³ Just think of the way in which ecology has emerged as the science controlling the community/environment cycle, beyond and against the various 'green' ideologies. We confine ourselves to mentioning three studies: L. Trepl, *Geschichte der Ökologie. Vom 17. Jahrhundert bis zur Gegenwart*, Frankfurt am Main 1987; P. Acot, *Histoire de l'écologie*, Paris 1988; F. Dagognet, *Nature*, Paris 1990.

⁴ E. Solmi, *Nuovi studi sulla filosofia naturale di Leonardo da Vinci: il metodo sperimentale, l'astronomia, la teoria della visione*, Mantova 1905. This book contains three studies: «Leonardo da Vinci e il metodo sperimentale nelle ricerche fisiche» (pp. 7-74), «Leonardo da Vinci astronomo» (pp. 75-136), and «Leonardo da Vinci e la teoria della visione» (pp. 137-218).

⁵ Cf. Solmi, 1905 (as in n. 4), pp. 147-157.

⁶ His essays, published in 1908 (*Le fonti dei manoscritti di Leonardo da Vinci. Contributi*, Torino 1908 [Supplement to the *Giornale storico della letteratura italiana*]) and in 1911

buried in the pages of a marginal book for a long time with practically no influence within the history of interpretation. However, the idea that the code and the style of thought peculiar to Leonardo should be identified in the specific manner of using the analogy between natural phenomena of different order and scale – which Solmi called the «theory of undulations»⁷ – grasps a point that subsequently, even though in an independent manner from Solmi's interpretation, has gradually been confirmed.

In the large work by Lynn Thorndike concerning *Magic and Experimental Science*, the chapter devoted to Leonardo (*The 'Magician' of the Renaissance*) depicts a path that goes from natural magic to an approach that Thorndike broadly defines as Aristotelian, and more particularly as physical and materialistic⁸. This is an interesting chapter⁹, but quite below the expectations legitimately raised by the overall discussion of this monumental work, which in most places draws a structural analogy between optics, magic-astrology and the study of natural laws, in authors ranging from the ninth to the fifteenth centuries¹⁰. De facto, Solmi's insight recognized the presence of a much older metaphysical approach within Leonardo, but one which was still very much alive in the fifteenth century, which considered light as a primary phenomenon in the production of natural reality and an example in terms of studying the laws that governed it. Thorndike was not unaware of the presence of this background in Leonardo's thought¹¹, but

(«Nuovi contributi alle Fonti dei Manoscritti di Leonardo da Vinci», in: *Giornale storico della letteratura italiana*, LVIII, 1911, pp. 297-358), are now collected in id., *Scritti vinciani*, Firenze 1976.

⁷ «The theory of the undulations in Leonardo is a wonderful example of what analogy can do in science» (Solmi, 1905 [as in n. 4], p. 155).

⁸ L. Thorndike, *A History of Magic and Experimental Science*, Vols. v-vi: *The Sixteenth Century*, New York 1941, Vol. V, p. 36.

⁹ Thorndike, 1941 (as in n. 8), Vol. v, pp. 16-36.

¹⁰ Cf. L. Thorndike, *A History of Magic and Experimental Science*, Vols. i-ii: *During the First Thirteen Centuries of Our Era*, New York 1923, Vol. 1, pp. 642-646 (al-Kindi), Vol. II, pp. 258 (Pseudo-Aristotle), 443-444 (Grosseteste), 454-446 (Witelo), 667 (R. Bacon). Cf. also L. Thorndike *A History of Magic and Experimental Science*, Vols. iii-iv: *Fourteenth and Fifteenth Centuries*, New York 1934, Vol. III, pp. 598-599 (Matteo Guarimberto from Parma, xv cent.).

¹¹ Thorndike, 1941 (as in n. 8), p. 24: «In Leonardo's discussion of perspective the same conception of pyramids of rays is prominent which had appeared far back in Alkindi and Roger Bacon and often in the interim».

he was far from being able to deduce all its conclusions. After him, Graziella Federici Vescovini and David Lindberg undertook further studies of this tradition, which may be grouped under the idea of an ontological concept of perspective¹², and it was finally studied once again in relation to Leonardo by Romano Nanni, who spoke of a kind of «radial ontology»¹³.

Studies concerning Leonardo from the opposite aspect, i.e. that of mechanics, gradually reached the same conclusion. The book by Cesare Luporini on *La mente di Leonardo*, published in 1953, which in many ways was already dated, clearly identifies precisely in connection with a pertinent reference to Solmi's old book both the organic link between the fields of optics and mechanics and more generally the function which this analogy holds in Leonardo's thought «not just as an instrument of discovery, in order to establish new connections, but also to discard the appearance or limit its scope where it proves to be completely or partially untenable within the critical process»¹⁴. These suggestions would subsequently be resumed but not connected to previous studies by Kenneth Keele and Martin Kemp¹⁵. It is mainly thanks to the success of Kemp's book (published in 1981) that the link between perspective and mechanics, and between art and science, is today considered as the consolidated basis for studying Leonardo's thought.

¹² Cf. G. Federici Vescovini, *Studi sulla prospettiva medioevale*, Torino 1965, pp. 40, 45; D.C. Lindberg, *Theories of Vision from Al-Kindi to Kepler*, Chicago/London 1976, p. 19 (where both Thorndike, and Federici Vescovini are quoted).

¹³ R. Nanni, «Astrologia e prospettiva: per lo studio dell'immagine della scienza nel *Paragone delle arti* di Leonardo», in: *Raccolta Vinciana*, xxvii, 1997, pp. 13-81: 72.

¹⁴ C. Luporini, *La mente di Leonardo*, Firenze 1953, pp. 168-169. Cf., now, regarding analogy, A. Nova, «Valore e limiti del metodo analogico nell'opera di Leonardo da Vinci», paper presented at the symposium *Leonardo da Vinci: metodi e tecniche per la costruzione della conoscenza. Dal disegno, all'arte, alla scienza*, organized by P.C. Marani, Milano, May 13-14, 2015.

¹⁵ Cf. K.D. Keele, «Leonardo da Vinci's Physiology of the Senses», in: *Leonardo's Legacy*, ed. by C.D. O Malley, Berkeley/Los Angeles 1969, pp. 35-56; id., *Leonardo da Vinci's Elements of the Science of Man*, New York/London 1983; M. Kemp, *Leonardo da Vinci: The Marvellous Works of Nature and Man*, London/Melbourne/Toronto 1981. Cf. also K.H. Veltman, *Studies on Leonardo da Vinci I. Linear Perspective and the Visual Dimension of Science and Art*, München 1986.

3. Talking about *Leonardo on Nature* these days therefore means a confrontation with the problems that we have briefly tried to illustrate. In this light, ‘nature’ is never, in Leonardo’s scripts, a purely passive and mechanical substrate, to be addressed from a superior technical point of view given as a distinguishing feature of human civilisation (as subsequent science in the seventeenth century would do); nor can it take on the wraparound traits of a mystical background, where differences end up vanishing or recurring esoterically (as would still happen in many Neoplatonic texts of the 16th century). The elements of magic and astrology present in Leonardo – as in many of his contemporaries – do not equate with irrationalism, nor with an arid rationalism. They are part of a comprehensive reference system with which Leonardo – not alone in this, either – tries to build an approach able to lead the most varied and disparate natural phenomena back to a *common measure* of readability. What is special in the case of Leonardo, is, if anything, the way in which research concerning him has gradually recognised the dual intertwining between art and science, and between theoretical knowledge and its technical and operational translation (with a strong emphasis on the issue of calculation and measurement). All of this, though, does not exclude the possible philosophical or metaphysical significance of his thought in any way, provided one does not succumb to a narrow and impoverished notion of what constitutes ‘philosophy’ and its history.

We can symbolically date the beginning of the focus on the peculiarity of Leonardo’s approach to nature, as a consequence of the traits that bind him to a longstanding tradition, to Ernst H. Gombrich’s essay *The Form of Movement in Water and Air*¹⁶. The importance of this paper can hardly be exaggerated, given that it opened up, in a single stroke, the *dossiers* of the mingling between aesthetic and scientific research, and those of the relationship between knowledge of reality and its visual representation within the sphere of research on Leonardo, two themes that have since occupied an ever-expanding space in the discussion concerning Leonardo and some of his contemporaries¹⁷.

¹⁶ E.H. Gombrich, «The Form of Movement in Water and Air», in: *Leonardo’s Legacy*, 1969 (as in n. 15), pp. 171-204.

¹⁷ Cf., to obtain a first impression in relation to Leonardo, the studies collected in *Leonardo da Vinci and Optics. Theory and Pictorial Practice*, ed. by F. Fiorani & A. Nova, Venezia 2013. More generally cf. M. Krieger, «The Ambiguities of Representation and

In particular, two important and markedly different books – published in the same year – by Frank Fehrenbach and Daniel Arasse¹⁸, are hardly conceivable without the distant stimuli born from that essay by Gombrich, stimuli – whether shared or not – which prompted scholars to work on Leonardo with a new awareness. In fact, neither the connection between art and science (whether or not mediated by analogy), nor that between knowledge and representation is immediate or obvious. This forces us to explore a whole range of issues – from the Renaissance system of the arts to the visual appropriation of reality, from the link between vision and perspective projection to that between ‘paradigms’ (in the sense of Thomas Kuhn) and perceptual experience, etc. – for which Leonardo has, over the years, become a unique testing ground, one might even say an almost perfect ‘case study’. Finally freed from the issue of the lack of impact of Leonardo’s inventions and research on the history of technology and science (but studies on the circulation of the *Treatise on Painting* and the *Leicester Codex*, to take two examples, have started to place this matter on a new basis as well)¹⁹, the discussion regarding *Leonardo on Nature* today develops in very different directions, but all – we believe – united by this renewed critical awareness of the dual relationship between art and science, representation and knowledge²⁰.

4. The fact that in recent decades a series of parallel systematic research

Illusion: An E.H. Gombrich Retrospective», in: *Critical Inquiry*, XI, 2, 1984, pp. 181-194. And Gombrich’s reply: E.H. Gombrich, «Representation and Misrepresentation», in: *Critical Inquiry*, XI, 2, 1984, pp. 195-201.

¹⁸ F. Fehrenbach, *Licht und Wasser. Zur Dynamik naturphilosophischer Leitbilder im Werk Leonardo da Vincis*, Tübingen 1997; D. Arasse, *Léonard de Vinci. Le rythme du monde*, Paris 1997.

¹⁹ As regards the first point, we refer to the fundamental studies by R. Nanni: cf. «Luce e ritratto nel *Trattato della pittura di Leonardo da Vinci*», in: *Leonardo da Vinci and Optics*, 2013 (as in n. 17), pp. 217-246; but also, more generally, «Il concetto di Rinascimento e Leonardo: Febvre, Garin, Panofsky», in: *Leonardo «1952» e la cultura dell’Europa nel dopoguerra*, proceedings of the International Conference (October 29-31, 2009), ed. by R. Nanni & M. Torrini, Firenze 2013, pp. 3-76. Concerning the second point, see now the essay by D. Laurenza contained in this volume: «Leonardo’s Theory of the Earth: Unexplored Issues in Geology from the *Codex Leicester*».

²⁰ A significant example in this sense is the collection of essays *Natur im Übergang*, ed. by F. Fehrenbach, München 2002.

has begun concerning Leonardo's language is not without significance. In this regard, Carlo Pedretti noted in 1995:

As Kenneth Clark wrote exactly thirty years ago: 'It is not an exaggeration to say that the Treatise on Painting by Leonardo da Vinci is the most precious document in the history of art'. We can today add that art historians are no longer sufficient: it takes language historians in order to prove this²¹.

Before Pedretti, contributions concerning Leonardo's language were scarce. In 1982 Maria Luisa Altieri Biagi recorded the «poverty of literature in the field of the history of the language» regarding Leonardo and consequently noted: «the problem of the study of Leonardo's own language is rather distressing»²². Altieri Biagi framed this poverty within the more general «lack of research tools (starting with the documentation provided by our historical vocabularies, notoriously inadequate concerning the 'langue' of technique and science)»²³, and as one of the very few exceptions she cited the study by Paola Manni, *La terminologia della meccanica applicata nel Cinquecento e ai primi del Seicento* dated 1980²⁴.

Among the many merits of the much missed Romano Nanni, we can certainly recall that of having promoted a series of important studies in this area. With the support of Paola Manni, of Marco Biffi and of other scholars, this isolation (to quote Altieri Biagi again: «there is no work so singular that it cannot be placed within a literary and linguistic convention»²⁵) which Leonardo had experienced for so long in terms of the history of language, finally ended; an isolation that was born in part from the above-mentioned lack of interest in technical vocabularies among Italian linguists, and in part from the preconceived notion concerning Leonardo's 'splendid isolation'. The *e-Leo* project (*Archivio digitale di storia della tecnica e della scienza*)²⁶ is now flanked by a series of studies that begin to

²¹ *Libro di pittura. Codice Urbinate lat. 1270 nella Biblioteca Apostolica Vaticana*, ed. by C. Pedretti & C. Vecce, Firenze 1995, pp. 78-79.

²² M.L. Altieri Biagi, «Considerazioni sulla lingua di Leonardo», in *Notiziario vinciano*, VI, 2, 1982, pp. 11-29: 12.

²³ Ibid.

²⁴ Ibid.

²⁵ Ibid.

²⁶ Cf. <http://www.leonardodigitale.com/>.

establish some lynchpins²⁷. One of these is the standardisation, carried out by Leonardo, of a broad technical terminology alongside and in addition to the assimilation of the pre-existing technical terminology through the study of specialised lexica (the *De Re Militari* by Roberto Valturio translated into vernacular by Paolo Ramusio, the *Vocabulista* by Luigi Pulci, and the *Novellino* by Masuccio Salernitano²⁸). Leonardo's language is therefore full of first records: not because he invented new words (although he did that, too), but because, for the first time, he 'regulated' some 'entries' that had enjoyed «a previous vitality within those environments where for centuries craftsmanship knowledge was essentially transmitted orally»²⁹.

Whilst shifting from one field to another, Leonardo refines words, pushing them towards a more general or a more precise meaning; and at the same time the epistemic technical and craftsmanship matrix from which he starts is redefined by contact with the great models offered by tradition: the fourteenth century *perspectiva*, the physics of *impetus*, the *scientia de ponderibus*, etc. The result is both a language and a model of science that are at the same time highly sensitive and unstable³⁰. A further result is an

²⁷ Cf. P. Manni, «Riconsiderando la lingua di Leonardo. Nuove indagini e prospettive di studio», in: *Studi linguistici italiani*, xxxiv, 1, 2008, pp. 11-51; ead., *Percorsi nella lingua di Leonardo: grafie, forme, parole*, (xlviII Lettura Vinciana – 2007), Firenze 2008; M.R. D'Anzi, «Appunti sul lessico anatomico di Leonardo da Vinci», in: *Leonardo da Vinci's Anatomical World: Language, Context and «Disegno»*, ed. by A. Nova & D. Laurenza 2011, pp. 43-60; ead., «Il lessico anatomico di Leonardo da Vinci e la tradizione medica in volgare: continuità e discontinuità», in: *Volgarizzare, tradurre, interpretare nei secc. XIII-XVI*, ed. by S. Lubello, Strasbourg 2011, pp. 209-221; *Glossario Leonardiano. Nomenclatura delle macchine nei Codici di Madrid e Atlantico*, ed. by P. Manni & M. Biffi, Firenze 2011; R. Nanni, *Leonardo da Vinci e le «arti meccaniche»*, with contributions from M. Biffi, F. Giusberti, A. Neuwahl, D. Russo, Milano-Vinci 2013; M. Quaglino, *Leonardo «trattatore della luce»: prime osservazioni sul lessico dell'ottica nei codici di Francia*, in: *Studi di lessicografia italiana*, Vol. xxx, 2013, pp. 93-132; *Glossario leonardiano. Nomenclatura dell'ottica e della prospettiva nei codici di Francia*, ed. by M. Quaglino, Firenze 2013; M. Biffi, «Alcune prime osservazioni sulla lingua artistica di Leonardo», in: *Studi di Memofonte*, 10, 2013, pp. 183-205.

²⁸ Cfr. A. Marinoni, «Saggio sugli appunti grammaticali e lessicali di Leonardo da Vinci», in: Leonardo da Vinci, *Scritti letterari*, ed. by A. Marinoni, new enlarged edition, Milano 1974 (1952), pp. 227-238; C. Vecce, *Leonardo*, Roma 1998, pp. 99-101.

²⁹ P. Manni, «Introduzione», in: *Glossario Leonardiano. Nomenclatura delle macchine nei Codici di Madrid e Atlantico*, 2011 (as in n. 27), p. XXI.

³⁰ Regarding the composite character of Leonardo's language, with «particularly daring forms of coexistence between 'high' and 'low', courtly and popular», cf. Manni, 2008 (as

unusual discrepancy between Leonardo's not only linguistic but also methodological and metaphysical approach and the epistemological ideal that he always strove to achieve: while the order is always partial and surfaces from zones of disorder that cannot be deleted (and that, on the contrary, nurture this order from the inside) in the former, the latter instead reflects an idea of accuracy and completeness that, given the circumstances, it is impossible to draw on³¹. This is due, at least in part, to the unique blend of varying knowledge located in Leonardo's 'science', which was born as a type of re-transfer into nature of Alberti's perspective³², and it is thanks to this step that perspective regains its 'cornerstone' status in natural philosophy without losing (at least in Leonardo's intentions) the accuracy that he had achieved thanks to the transformation given by Alberti.

5. On the basis of these considerations, we can confirm the importance in Leonardo's thought of the dual link *art-science* and *representation-knowledge*. The ambiguity of perspective, which he understood as the science of representation, which is connected to painting but simultaneously returned to its status as natural philosophy and returned to the theory of vision, constantly keeps both levels in play: nature understood in its most profound reality, almost as a fact that affirms its power in relation to the observer, and art as interaction with this profound reality, but also emulation, competition and, in some respects, its reduction on the basis of precise conventions, i.e. a 'language', which is verified by the effects it produces in the audience of the visual show staged in the painting.

in n. 27), pp. 49-51. Regarding the tension between orality and writing in the 'words' of Leonardo cf. C. Vecce, «Parola e immagine nei manoscritti di Leonardo», in: *Percorsi tra parole e immagini, 1400-1600*, ed. by A. Guidotti & M. Rossi, Lucca 2000, pp. 19-35.

³¹ Leonardo's conception of nature is much more dramatic than Ficino's *concordia discors*, with which, in any case, he maintains a clear link. Cf. S. Toussaint, «Leonardo filosofo dei contrari», in: *Leonardo e Pico. Analogie, contatti, confronti*, ed. by F. Frosini, Firenze 2005, pp. 13-35. But now compare Toussaint's contribution in this volume («L'autore e la natura. Alberti, Leonardo e Michelangelo») with a strong critical view.

³² For this thesis cf. A.M. Brizio, «Razzi incidenti e razzi refressi», (III Lettura Vinciana – 1963), in: *Leonardo da Vinci letto e commentato. Letture vinciane I-XII (1960-1972)*, ed. by P. Galluzzi, Firenze 1974, pp. 63-77; F. Frosini, «Leonardo da Alberti a Bacone (e oltre)», in: «Tutte le opere non son per istancarmi». *Raccolta di scritti per i settant'anni di Carlo Pedretti*, ed. by F. Frosini, Roma 1998, pp. 145-158.

These two axes can perhaps be taken as the coordinates framing the relative positions taken by the authors of the contributions hosted in this volume. These are divided into four sections, focusing, respectively, on the confrontation between humanity and nature; on the theoretical and philosophical issues arising from the attempt to ‘think’ nature; on the interweaving of philosophical, scientific, technical and artistic themes that occurs in the comparison between painting as a language and painting as the direct expression of natural dynamics; and finally on the relationship between the theoretical and the artistic dimensions, which stems from the task of reproducing and studying natural reality. Of course, the order we propose is partly arbitrary, given that, in reality, all these issues circulate in varying degrees in the majority of the texts collected here. There are, however, differences of emphasis and approach between the various texts, which we believe substantiate this subdivision.

In the two texts collected in the first section (*Man and Nature*), a critical eye is turned to Leonardo’s writings on the basis of a double demarcation line: his relationship with the preceding culture and the way in which through this relationship, the confrontation of man (who is also the ‘author’ of a text) with nature is established, a confrontation that is always simultaneously emulation, challenge, and imitation. The texts by Leonid M. Batkin and Stéphane Toussaint diverge widely in both their results and their approach, but one aspect which undoubtedly unites them is the identification of Leon Battista Alberti as an exceptional reference point. As is well known, direct references to Alberti are scarce in Leonardo. Batkin, however, demonstrates that in reality, all the theory and poetics of Leonardo’s painting are thought of as a heated debate with Alberti.

Batkin (*Leon Battista Alberti e Leonardo da Vinci sul gesto in pittura*) deals with the study of «gestures in painting» within his culturological approach to the Renaissance world, particularly regarding issues of individuality and personality. Batkin argues that the way the ‘gesture’ is encoded in its pictorial expression is not the feature of a unique and immeasurable personality, in the full modern sense of the term. It «leads, on the contrary, to the Whole. The gesture as an ‘element of everyday life’ is mediated by ‘nature’ as it is by the worldly and universal, everyday life. The ‘alphabet’ is not psychological, but has a naturalistic value». Nature is expressed by the gestures of the characters, but not immediately: when studying a «repertoire of gestures [...] the painter not only looks every

time, but also thinks of a possible twist, of a combination of movements, of their amplitude etc. for a given representation, depicting them as the plastic expression of a universal individual». It is in the 'folds' of this combinatory method, aimed at delineating universal man, that Batkin believes the origin of the passage towards modern individuality is hidden, and which is therefore, first and foremost, the individuality of an *author*. «Leon Battista Alberti already knew the unprecedented innovative value of his treatises and his instructions, and therefore also the value of himself as their author. Leonardo feels his superiority in everything even more acutely and openly he is exalted by the passion of observation, the pride of mastering the most hidden secrets of the art and the invaluable combination of 'universality' and 'uniqueness'».

This, which is Batkin's arrival point, is the starting point of the critical review conducted by Toussaint (*L'autore e la natura. Alberti, Leonardo e Michelangelo*). In this regard, however, he first states the need to distance oneself from Leonardo's self-representation: «After all, critique, even the fiercest, ended up putting back into circulation Leonardo's self-promotion, with very few amendments – *omo senza lettere* smarter than the humanists – without being weighed down by the sources and implications, including sociological, of his cultural inferiority complex». In particular, Toussaint focuses on Leonardo's ambiguous relationship with Alberti: «The influence this model had on Leonardo was very strong, and the sincerity of the *omo senza lettere*, an enemy of humanists, therefore, allows suspecting some duplicity». If, on the other hand, we move on to consider testimonies *about* Leonardo, beginning with Vasari, we realise how hard, if not impractical, the prospect of becoming an 'author' was for Leonardo. The «obsessive pictorial imitation of the 'natural'» and «the proximity to the animal world» indicate the presence in Leonardo of «a deep impulse: the total identification with nature, mistress of thought and life. Between the divine predestination and the worship of nature, there is no room, in Leonardo's *Life*, for the erudite culture which forged humanism». This total identification was born in Leonardo – according to Toussaint – precisely from the consciousness of the defeat which will hit him as he is unable to master the language: that language which in the fifteenth century is the fundamental dimension (as the study of *humanitas*) in order to access culture and which «at the time had to be the Latin language». The solution devised by Leonardo – his radical naturalism and empiricism – is merely the other face of

this defeat: «for his insoluble epistemological drama, Leonardo promises gnosiology and provides nothing more than genealogy».

6. The second section (*Thinking Nature*) collects contributions that may be conventionally defined as «philosophical». In a less generic way, should this term not have a very different meaning traditionally, we could say that here the focus consists in Leonardo's 'ontology', i.e. the way in which the concept of 'nature' is configured in his thinking in relation with the 'deep' layer, which constitutes reality in general. Once again, there are no unequivocal results, although a common thread may be found in the ambivalent and conflicted idea of nature and therefore of reality. This issue is explained in a particularly clear way by Romano Nanni (*Catastrofi e armonie*), whose conclusion (Leonardo, although placed «in the middle of the Renaissance», is «as much an a-humanist, as he is an a-Christian») can usefully be placed in comparison with that of Toussaint given above. Nanni reconstructs Leonardo's thought by organising it around the catastrophe/harmony duo and following it through three successive 'stations' dated, respectively, to the 1480s, the period from the 1490s to the first decade of the sixteenth century, and the years 1513-1515. Nanni demonstrates how Leonardo's image of nature constantly oscillates between these two dimensions, which in any case complement each other perfectly, and how his attitude changes in relation to the conceptual instruments he possesses at each moment in order to rationally 'master' this ambivalence. This is the context within which he interprets Leonardo's mathematical processing of the spiral, which at one point becomes the image of the destructive violence of water (the storm water «eddies», «retrosi», depicted in his series of drawings of the Deluge) and together, inextricably, the result of a mathematical knowledge, that is – in a contradictory manner – a form of rationalisation of the catastrophe: «On one hand the representation of disasters, by virtue of the mediation of the *retroso* aesthetics, the spiral aesthetics, is governed by an ordered framework, whose foundations are regulated by constant mathematical proportions, establishing an emotional distance between a possible direct experience of dreadful nature, and its visual contemplation, which can be appreciated as harmony and almost as grace. On the other hand, here harmony is all on nature's side, and on the side of the scientific and artistic representation by the subject». What Nanni called «the science of *retrosi*» thus becomes an actual conciliation between the destructive im-

pulse, the natural law and even an idea of beauty, in the sense that there is no chaos in its purest state within the «flood» itself, but nonetheless a constant unfolding of a series of measurable laws perceived as visual harmonies.

Whilst the alternative with which Nanni works is the one between the composition of an 'order' and its catastrophic dissolution, the contribution by Fabio Frosini («*Mistioni*» e «*termini*», ovvero dell'«*accidentale*» in *natura*) stands instead on the line of distinction between these two moments, on the assumption that the entire movement of Leonardo's thought leads towards neutralising this alternative, i.e., towards developing a concept of nature and life subjected to permanent character changes, not just cyclical, but open and constructive. The key words used by Frosini in this study are «*termini*» (limits) and «*mistioni*» (mixtures). He shows how they move from an initial incompatibility to a structurally entwined position. In particular, after the notes concerning the «being of nothing» («*essere del nulla*»), the «*limits*» become a threshold devoid of reality, «an oscillating field, in which the logics mingle inextricably». Therefore, the dichotomy between nature and accident also tends towards evanescence: «civilisation is an occasional interruption of nature, but it is nature which takes on the aspect of 'historicity' which places it in a continuing relationship with the sphere of civilization». Towards the end of the first decade of the sixteenth century a number of texts show – according to Frosini – «the assimilation [...] of the concept of 'accidental' with that of 'mixture'», so that from this height the distinction between simple bodies (determined naturally) and accidental compounds «is not [...] ontological but morphological: i.e. it passes through forms of different levels and origin – natural and artificial, ancient and recent, relatively stable and relatively ever-changing – which, however, *all* belong to the same level of reality: that of more or less mobile and changing 'compounds'». These findings have an ethical-political aspect because it is precisely within the 'mixtures' that the 'divinity' of man (the great humanist *topos*) is proven: civilisation 'expresses' nature through language, machines and institutions.

The Lucretian background of this idea is suggested by Frosini at the end of his essay. This issue, however, receives monographic attention in Alison Brown's contribution («*Natura idest?*» *Leonardo, Lucretius, and Their Views of Nature*). Brown reconstructs this issue with all its implications, starting with the presence of Lucretian themes in Florence, both through the fif-

teenth century and at the beginning of the following century. Whilst being aware of the risk of exaggerating – as there is only one explicit reference to Lucretius’s great ancient poem by Leonardo, and even this is known only through a second-hand source –. Brown believes we can speak of undeniable Lucretian «echoes», particularly in the ambivalent concept of nature, the description of the storms and the fury of the elements, the idea of a language organically linked to natural processes (within the general ‘primitivist’ background of the many visual and verbal descriptions made by Leonardo), and finally – and this is perhaps the most important point of the entire essay – the elaboration of the concept of the «being of nothing», in particular of the «punctus» as the equivalent of «nothing». «We know [...] that the mathematical concept of the *punctus* was associated with Lucretius’s atom in Florence in the 1490s from the interesting marginalia in a Lucretius (Laurenziana pl. 35, 32) that have been ascribed to Machiavelli’s teacher Marcello Adriani and his pupils». In his notes on «the being of nothing», Leonardo switches from an Aristotelian view of the point as infinitely divisible to a notion of the ‘indivisible’ point, similar to the one now shown and therefore connected to the concept of the ‘atom’. «It is unnecessary», Brown concludes, «to insist on a Lucretian origin for Leonardo’s changing views on the *punctus*, which in their later version seem to be linked to his study of optics. Nevertheless, they strikingly reflect the contrast drawn by the marginalia between the *punctus* as a mathematical or imaginary point that is infinitely divisible (Leonardo’s starting point) and the atomist view of it as a unity that cannot be divided, a contrast that Leonardo worked through before reaching his equally Lucretian conclusion that the huge number of atoms (‘indivisible parts’) in the sun’s rays was a source of vivifying energy. So Lucretius may help to explain some of the ambiguities of Leonardo’s late thinking».

7. The third section (*Science, Art and Languages in, beyond and against Nature*) is devoted to illustrating the relationship between painting and nature. Running through this relationship – as is apparent from all the contributions collected here – is an internal tension between the great classical model of imitation and a controversial scheme in which art and nature oppose one another in a dramatic challenge. Nevertheless, there is a continuity between these different options given by the profound correspondence between nature as a generator of energy, strength, and even violence, and

the images, which according to Leonardo should aim to incorporate the same power and violence present in natural images even when they are reproduced artificially. Carlo Vecce focuses on this complex interplay of referrals (*Leonardo e il 'paragone' della natura*), stating that a double comparison is in fact present in this 'comparison' of the arts: of painting, which goes beyond nature, but also of the painter who competes with it. The painter thus lies ambiguously inside and outside nature, celebrating time as an expression of nature but also aiming to capture it in the painted image. These paradoxes are all reflected in the double image of nature as 'mother' and 'stepmother', harmonic and terrible, and in the notion of time as creator but also destroyer. Leonardo never wrote of the 'comparison' between painting (and the painter) and nature; if he had, he would have noted that, «if nature has to obey the laws of necessity, the painter goes beyond those laws, triumphing over necessity and time (or at least creating a momentary illusion of triumph). His record mainly consists in preserving the (artificial) simulacrum of beauty, whose (natural) archetype is destroyed by time or by death». The painter is therefore able to stop «the universal story of abuse of one organism over another, in an endless cycle of transformation and metamorphosis which involves all forms of nature», but this interruption stands within the grounds of that 'illusion' which constitutes the meaning of civilisation.

This gap between nature and civilisation, between a reality that imposes itself through its own strength and a set of meanings subject to dispersion and a multiplicity of interpretations, is the starting point of the essay by Frank Fehrenbach (*The Cycle of Images*). He notes that unlike words, images are not subject to a 'code': images, in fact, are immediately 'imprinted' in the first faculty of perception ('imprensiva', a new faculty introduced by Leonardo). Hence the idea that images have a 'cyclical' aspect, since they move from nature to knowledge and vice versa, thanks to images produced artificially. Where artificial images reach a high degree of illusion, they can therefore enhance and strengthen nature: «the simulacra produced by the painter are nature's transient emanations made durable, and enhanced in beauty and expressive qualities». According to Fehrenbach, this is where the function of painting within the space that unites but also divides and opposes nature to civilisation, derives from: «Painting, triggered by the power of nature to impress or imprint its own images in the mind of man, emerges as a 'second nature', an expression of the first nature's longing to

maintain the existence of every product, suspending the fugacity of time. While the first nature struggles to overcome death through procreation, *pittura* (painting) ‘doesn’t have children’ (‘non partorisce figliuoli eguali a sé’); she is the promise of a life in time without death».

The idea of a natural force or power that is repeated, grows and is transformed (in a certain sense inverting itself) into the painter’s work, as already assumed in Fehrenbach’s essay, lies at the centre of the contribution by Francesca Borgo (*The Impetus of Battle: Visualizing Antagonism in Leonardo*). The underlying issue here is the relationship between terminology and the problems of the *impetus* (i.e. of the mechanics) and terminology and the problems of painting. To this end, Borgo formulates an expanded conception of *impetus* that goes far beyond the technical meaning of *vis impressa*, embracing the phenomenon of the *afterimage* as the ability of the work of art to ‘attack’ the viewer, thereby transmitting a kind of *vis impressa*. Borgo identifies a precise path within this crossroad that leads from motion in the mechanical sense to the typical ‘animation’ of painting. «Impetus, therefore, performs painting’s most crucial task, that of apparent enlivenment and animation; painted images are expressive of living things without having life in themselves». Impetus in painting would therefore be that ‘accidental liveliness’ which is added to the images, and which would give them that momentary vividness that mechanical impetus transmits to dead things by putting them in motion. However, «being accidental and not natural, this fictive vivacity can only be achieved by means of violence, intended, in accordance with the Aristotelian tradition, as the application of a force that causes an object to move in an imposed way that counteracts its natural inclination. It follows that in enforced, violent movements – when the impetus is at its greatest – the painter finds an opportunity to convey great animation: for example in battle scenes, where motion is particularly dynamic». The greatest example of this pictorial challenge is the struggle for the banner in the *Battle of Anghiari*, in which different forces support and ‘block’ each other. In this way, the painter gains the effect of interrupting the self-destructive fugacity of the force: «The image embodies impetus’s fundamental quality, creating a juncture where both stability and instability, the conservation of motion and its undoing, paradoxically coincide». Thanks to the mediation of the narrative embedded in the figurative language of the pictorial composition, the impetus of the artist’s mind is added to that present in the bodies in action. «In a scene of

uttermost destruction, the representation of violent motion testifies to the animating power of painting. Fighting figures are enlivened by the most extreme 'vivacità accidentale'; only on the verge of death do bodies come fully to life».

The scene of the struggle for the banner in the Battle of Anghiari is also the focus of the essay by Michael Cole (*Leonardo contro Natura*), which reinterprets a series of notes by Leonardo concerning centres of gravity and crossbows as the explanation of the basic theories of the situation depicted in the scene. According to Cole, it is «precisely in the project for the Battle of Anghiari that we see Leonardo develop the theories conceived while studying mechanical motion in a figurative direction, towards a reflection in images». The peculiarity of these reflections lies in the fact that, as emphasised also by Borgo, here the violent motion «is no longer equivalent to the discharge of a force» but, on the contrary (as in the case of loading a crossbow) «the compression of a form which therefore allows giving power to its own action». Cole notes that Leonardo pushes violence towards a form of paronomasia, as this term shifts through quite distinct fields, such as mechanics or depicting human bodies. The latter thereby become a prime example of visualising «deviations from the natural order».

8. The fourth and last section (*The Form of Movement in Water and Earth*) is devoted to illustrating themes of geology and cosmology in their relationship with the problem of scientific and artistic representation. Domenico Laurenza (*Leonardo's Theory of the Earth: Unexplored Issues in Geology from the Codex Leicester*) presents some preliminary conclusions that he reached during a new overview of the *Codex Leicester*, which he is carrying out together with Martin Kemp and which will lead to a new critical edition. Laurenza's main argument is that the *Codex Leicester* represents an early beginning of the modern 'theories of the earth' that would arise only in the late seventeenth century. Laurenza was driven to this conclusion by the fact that, in contrast to the Aristotelian approach, which postulates the presence on earth of only local changes and therefore the eternity of the planet, «the *Codex Leicester* contains striking and laborious demonstrations of how the earth possessed a history comprising both local and global changes that occurred over extended time spans». Moreover, «on a global scale, according to Leonardo, dry land in the northern hemisphere had not existed forever, but emerged from the waters because of a cata-

strophic event in a very remote era and then continued to change in a less catastrophic way. In both cases, marine fossils embedded in mountains, correctly interpreted by him as the remains of animals, provided evidence of these changes». Laurenza postulates that the theories presented in the *Codex Leicester* contain an echo of stories originating from exploration trips to the West Indies, which had shown the presence of a much larger quantity of land area than acknowledged since ancient times. «Leonardo was acquainted with members of the Vespucci family, not least Agostino, Amerigo's cousin, who was an administrator involved in Leonardo's work in the Florentine Council Hall. Leonardo's figure of the earth with nearly all its circumference occupied by dry land on folio 36r may well be one of the first geological representations of the globe to accommodate what was then known about the New World».

Leslie A. Geddes also pays special attention to the relationship between water and land («*Infinite Slowness and Infinite Velocity*»: *The Representation of Time and Motion in Leonardo's Studies of Geology and Water*), and like Laurenza, she locates an 'historical' conception of the earth in Leonardo. But while Laurenza focuses on the relationship between the two elements – earth and water – on the geological scale, Geddes focuses on their punctual interaction: this is how a water flow in the long run forms rocks, which are subject to a continuous transformation. This transformation, however, originates in the contact between two seemingly opposing elements: «Leonardo's studies of rock formations record his observations and interpret water's incremental contouring of the land. In contrast, water flow is fleeting and ephemeral». Leonardo is thus compelled to deal with speed at the two opposite edges of the infinite: the infinite slowness of rock transformation and the infinite speed of water producing shapes and forms, in both cases going beyond the scope of what it is possible to perceive. This poses problems for him, both as concerns the awareness of the phenomena and as concerns their representativeness – problems that are expressed both in verbal terms and in terms of the pictorial expression of nature. Therefore, when studying rocks belonging to his graphic work, Leonardo tries to fix in an image a kind of 'arrested motion', and when studying the flow of water, as it is impossible to see what is represented (because it is too fast), he visualises and stops an 'instant' of the motion. This cognitive supremacy of the image is reversed, however, in other cases, such as in the *Codex Leicester*, where a study concerning the materiality of the

page and the probable sequence of its compilation reveals that, where an image is the primary and spontaneous form used by Leonardo to approach a particular problem, this is also marginal, as, once it is established as the first point of inquiry, it is then overcome by written reasoning.

The idea of a dynamic and historical nature is also at the heart of the essay by Alessandro Nova («*Addj 5 daghossto 1473*»: *l'oggetto e le sue interpretazioni*), who consciously moves along the ridge running between the famous 8P sheet of the Gabinetto Disegni e Stampe of the Uffizi and the complex and layered history of its interpretation. By going along this ridge, Nova tries to gradually restore the sheet of paper to the context of its birth and to the role it initially held, thus making visible a level of significance of the 'landscape' depicted in it, which a formalistic approach instead tends to delete. Regarding the relationship between the reality of the depicted landscape and its representation, Nova supports the conclusions of those who believe that it is the result of a complex operation in which elements of observation, conventions and reconstruction are present³³: «Every work of art, and therefore also a landscape portrayed 'from life', always constitutes a rhetorical fiction, an abstraction, especially in this case where the author has relied on a 'plurality of representational scales' and vanishing points. The artist could have changed and perhaps did change his position as he sketched, but in any case he uses a decentred perspective grid to build his image, as can be seen even more clearly if we remove the memorial lettering added by Leonardo after completing the work». Using various techniques was pertinent to the purposes pursued by Leonardo, as it is also true that, once «one has established that every work of art appeals to a specific visual rhetoric, it is nevertheless true that we could be faced by varying degrees of negotiation concerning the perception of the real world or of nature, as Leonardo would have said». Therefore, if 8P is not an isolated and abstract attempt to depict a landscape, but a sheet of paper that is born (like many others) in the world of Verrocchio's workshop, whether real or invented, it should be measured against the interests and roles that Leonardo assigns to that drawing. From this point of view, relying on a judgment by Cesare Luporini concerning the fall «of the border, in Leo-

³³ The reference is to an important essay by R. Nanni, «Osservazione, convenzione, ricomposizione nel paesaggio leonardiano del 1473», in: *Raccolta Vinciana*, xxviii, 1999, pp. 3-37.

nardo, between drawing and painting and, consequently, also of the fall of the relationship between a preparatory drawing and the completed work to be delivered to the customer»³⁴, Nova considers 8P a study of «natural phenomena during their transformation process. What we see before our eyes is therefore the result of a process».

The essay by Rodolfo Maffei (*«Quasi dentatae rotae»: Leonardo disegna la Luna*) is devoted to the relationship between vision and the various processes of visualisation – but from the point of view of the history of science – and concludes this section and the entire volume. In light of the ancient and medieval, the mythical, cosmological and metaphysical conceptions of the moon, Maffei examines in detail the notes that Leonardo makes concerning the nature of the moon during different periods of his work, and in particular those, in some way conclusive, expressed in *Ms. F*. Maffei's approach is not oriented towards verifying whether Leonardo had anticipated later scientific developments or how many. In reality, Leonardo concludes – against the subsequently ascertained thesis – by arguing that the moon is covered by oceans and that lunar spots are due to land surrounded by water. What matters, however, is on the one hand, the basic belief that guides his arguments, and on the other, his manner of debate. Concerning the former, Maffei shows that Leonardo gives the moon the nature of «an earthly body with all the necessary basic prerogatives, including water», thus breaking, in terms of methodology, with all previous traditions, which were then still very much alive. Concerning the latter, Maffei documents how Leonardo makes his argument whilst always keeping an eye on the «physical effects which would ensue from the theory». In reality, Leonardo «refuses to think in those terms» even before accepting or rejecting arguments by scholars such as Albert the Great. He «does not ignore theses and antitheses of medieval astronomy, but refuses to counter-argue from a purely speculative position and looks for concrete evidence». Leonardo's refusal to consider the moon as a rough and coarse surface, sandy and dusty (how Galileo later 'saw' and described it), an hypothesis which he even took into consideration in folio 310v of the *Codex Atlanticus* (c. 1505-1508), and his choice of a moon covered with wavy oceans, certainly does not derive from the fear of going against the authority of

³⁴ C. Luporini, *La mente di Leonardo*, Firenze 1997 (1953: anastatic reprint), p. 124.

those who believed the moon to be a perfect celestial body, but rather – and in this way we return to one of the starting points of this *Introduction* – from «a form of reasoning based on an analogical principle. Because of a comparison with our planet, where he could observe seas and lakes blazing with sunlight whilst this was absorbed by black earth and mountains covered with forests, Leonardo hypothesises an identical structure for the moon, stating that the dark parts – namely the famous spots – consisted of land lapped by shining seas». This analogy, which should be reiterated here, is only possible because of a sharp break from almost all the preceding western cosmology and metaphysics.

* * *

9. The essays collected here do not exhaust the subject of *Leonardo and Nature*, but we will have achieved our purpose if they should help to foster continued interest in one of the central themes of research concerning Leonardo. All that remains at this point is to fulfil the very pleasant duty of expressing our thanks, in particular to Dario Donetti and Francesca Marzullo for their impeccable editorial work; to Linda Olenburg for collecting all the image rights; to Stefano Grandi for the graphics and the layout; to Francesca Fiorani, who contributed to our discussions but could not deliver her written essay; to the chairs of the different sessions, and in particular to Paolo Galluzzi and Lea Dovev; and finally to Maja Haederli, Christine Klöckner and Mandy Richter for their invaluable skill in organizing the practical aspects of the event.