

Water or Wind? Leonardo da Vinci's drawings Windsor 12377–12386 reinterpreted

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In memoriam Gunter Schweikbart

In the following, a reinterpretation of Leonardo da Vinci's drawings Windsor 12377–12386 is attempted.² The drawings are very famous. They are traditionally regarded as visions of the apocalypse, as representations of the Flood, as images of the end of the world. In contrast, it will be stated here that both the apocalypse association and the deluge thesis are mistaken. These drawings present not apocalyptic, but scientific visions, and not the Flood, and not even water is their subject, but something completely different, namely wind and storm.³

1. Visions of the end of the world? Representations of the Flood ?

Traditional interpretations believe that these sheets do not offer representations of ordinary natural phenomena, but that excellent events are meant or that what is depicted is to be understood "symbolically." Clark, who prescribed this view almost canonically,⁴ went so far in 1935 as to suggest that Leonardo was "obviously untrue to natural appearances", he even declared that the scientist Leonardo must have been ashamed of these representations,⁵ for he had shown strictly "impossible phenomena."⁶ His aberration could only be explained by the fact that the drawings were not to be understood as naturalistic, but as "symbols of universal destruction", as "visions of the end of the world."⁷ The view propagated by Clark culminated in Gantner's monograph in 1958 (*Leonardo's visions of the flood and the downfall of the world*). The title of the book once again articulated the two main theses of conventional interpretation: that the sheets provide representations of the Flood and the end of the world.

However, objections also appeared on the agenda. As early as 1946 Popham, in his edition of Leonardo's drawings, left aside the stereotype of the end of the world, and instead of talking of a deluge, he spoke only of "floods." In 1980 Perrig tried to put a definite end to both: to the end-of-the-world-thesis, as well as to the Flood-assumption. For the end of the world, Perrig aptly stated, fire is missing, and for the Flood the rain is missing. As an alternative, Perrig suggested that the drawings deal with the formation of rivers by the bursting of underground water veins – what the drawings depict (quasi in a sequence of snapshots) is, according to him, a vein explosion with its consequences.⁸ Much had already been gained with this demystification, but the decisive step had yet to be taken.

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² It is a coherent group of ten drawings of approximately the same size. Most of them are executed in black chalk and were probably made in Rome between 1514 and 1516. For more details see Clark 1968, 53.

³ I thank my art-historical teacher Gunter Schweikbart for his advice and encouragement in the first elaboration of my proposition in 1982. After reading my essay he said that at first he thought it was water as well as wind, but in the end, to his own surprise, he saw only wind and not a single drop of water any more.

⁴ For the history of interpretation see the detailed studies by Fehrenbach 2001 and 2013.

⁵ So Clark in the Windsor catalogue with reference to drawing W 12380 (Clark 1935, 47; and still unchanged in the "revised edition" of 1968, 54).

⁶ Clark 1982, 11.

⁷ Ibid.

⁸ Perrig's proposal, however, is untenable. He tacitly disregards six drawings from the series because they obviously do not fit his thesis. Instead, he takes the group's only non-autographed drawing (W 12381) as his starting point. Furthermore, Perrig's general thesis that, according to Leonardo, large rivers are products of explosion cannot be proven from Leonardo's writings (cf. Fehrenbach 2001, 36, note 16).

Even if one no longer wanted anything to do with the apocalypse and the Flood, one still remained unanimously in the belief that these drawings were depictions of water and of water movements. One believed to see brooks, streams, swirls, spouts, waves, billows, crests, spray (and what else Neptune and the imagination might suggest).

Everyone knows that Leonardo was very interested in water and its dynamics.⁹ As much as he was fascinated by questions of anatomy or perspective or the problems of light and shadow, his greatest research interest was clearly in the behavior of water. In this context it is not surprising that Leonardo also turned to the theme of the Flood (as the most bombastic aquatic theme, so to speak) in his writings and that he indicated how he thought a Flood should be depicted.¹⁰ But one has to be doubly careful here.

Firstly, Leonardo has been extremely critical of the Flood in his theoretical texts. He declared the biblical narrative unsustainable, because if the water had stood 15 cubits above the highest mountains worldwide, it could not simply drain off afterwards, as the Bible claims, but could at most go back by evaporation – only if the Flood, unlike the Bible says, affected just part of the earth, then a normal drain would have been possible. In this question, Leonardo says, one should not flee into belief in miracles, but trust the natural arguments.¹¹ Moreover, Leonardo repeatedly opposed the thesis that shells, which can be found at great heights today (for example in the Dolomites), were washed up there by the Flood – no, this phenomenon can simply be explained by an uplift of the seabed (and modern geology proves Leonardo right). So the scientist Leonardo had little use for the Flood story.

Second, Leonardo's alleged deluge drawings fundamentally disagree with his own description of how he imagines a deluge. In his description Leonardo places the greatest emphasis on the activities of animals and people in the face of an increasing catastrophe. But the alleged Flood drawings do not show a single animal or human.

How could it happen that this discrepancy was completely overlooked? This oddness is only surpassed by the fact that one was ready to speak of a flood, although no rain can be seen at all. Should, in the end, the water view altogether be just a fantasy?

2. Wind, not water

This is indeed the case: Not only is the rain necessary for the Flood missing, but what seemed to the beholders to be water is not water at all. What is actually depicted is *wind*.

Before this will be exemplified in the individual drawings, one has to ask how it is possible that something that Leonardo meant as a representation of wind could be taken as a representation of water. The explanation can be found in Leonardo himself.

Without doubt he was not only interested in the representation of water, but also of atmospheric phenomena, in the representation of air, wind, storm and the like. But all this is much more difficult to represent than water. The atmospheric phenomena can be distinctly experienced sensually, but they are difficult to grasp; our eyes can hardly hold on to them, and artistically it is extremely intricate to visualize them, to capture them on canvas or to put them on paper. Leonardo was highly aware of this difficulty. How can one make the incomprehensible tangible? "Wind itself is not visible," he wrote.¹² But then he gave yet two instructions on how the undertaking to depict atmospheric phenomena can succeed.

First, he says, one cannot show wind directly, yet one can show it by its effects. About this indirect method, he writes under the heading *How to depict a storm*: "If you wish to represent a tempest, consider and arrange well its effects as seen, when the wind, blowing over the face of the sea and earth, removes and carries with it such things as are not fixed to the general mass. And to represent the storm accurately you must first show the clouds scattered and torn, and flying with the wind, accompanied by clouds of sand blown up from the sea-shore, and boughs and leaves swept along by the strength and fury of the blast and scattered with other light objects through the air.

⁹ An external evidence: In Lücke's edition of Leonardo's diaries and notes, the chapter "The Nature of Water" is by far the largest (and there is, in addition, much talk of water, hydraulics, etc. in other chapters). Gombrich points out that a compilation of Leonardo's texts entitled *Del Moto e Misura dell'Acqua* was already published in the 17th century, comprising nine books with a total of 566 paragraphs, and that a modern collection of Leonardo's notes on water contains 990 notes, although it is limited to manuscripts A to M at the Institut de France (Gombrich 1987, 55).

¹⁰ Cf. Richter I 352–357 [607–609].

¹¹ Cf. Richter II 186 [986].

¹² "l uēto per sé no si uede" (Richter I 354 [608]).

Trees and plants must be bent to the ground, almost as if they would follow the course of the gale, with their branches twisted out of their natural growth and their leaves tossed and turned about."¹³

So an indirect representation of wind – a representation by means of its effects – is possible. The objection that in this way one would not represent the wind after all, but only other things, goes nowhere. It is part of the nature of the wind that it is "itself [...] not visible," but only becomes visible through "the motion of the things carried along by it."¹⁴ So a representation of the wind by its effects is absolutely adequate to the phenomenon.

Secondly, Leonardo advocates an analogy between the movement of water, which can be observed, and the movement of wind, which is not visible as such. From this he derives the methodical maxim of conceiving wind representations according to the model of water movements. In the context of Leonardo's interest in the flight of birds, this reads as follows: "In order to write the true science of the flight of birds through the air it is necessary first to give the science of winds, which we will prove by the motion of water within itself; and the understanding of this science will lead to the required knowledge."¹⁵

What does Leonardo mean by "motion of water within itself"? Leonardo has dealt with this phenomenon on a broad basis. In numerous theoretical considerations and highly famous drawings, he has shown the movements caused by the impact of water on dormant waters¹⁶ or the interruption of the water flow by an obstacle.¹⁷ The movement patterns that Leonardo found and impressively demonstrated are famous: pigtails, swirls, vortices, and spirals.¹⁸

And now his thesis is that the movements of air in air (e.g. the entering of wind into calm air zones or into other wind streams) have the same structure as the movements of water in water and therefore can be represented according to the model of water movements.¹⁹

¹³ "Se tu uoi figurare una fortuna, cōsidera e poni bene i sua effete; Quādo il uēto, soffiādo sopra la superfite del mare e della terra, remove e porta cō seco quelle cose, che nō sono ferme colla vniuersale, massa, e per bē figurare, questa fortuna, farai ī prima li nuvoli spezzati e rotti dirizzarsi per lo corso del uēto, accopagnati da l'arenosa polvere leuata da liti marini, e rami e foglie leuati per la potētia del furore del uēto sparse per l'aria: e ī compagnia di quelle molte altre cose leggieri, li alberi e l'erbe piegate a terra, quasi mostrarsi volere seguire il corso de' vēti coi rami storti fori del naturale corso e cō le scōpigliate e rouesciate foglie" (ibid., 351 [606]). – Cf. also the particular remarks on the effect of wind on branches, leaves and trees ibid., 298 [470–473].

¹⁴ "l' uēto per sé no si uede"; "il moto dell cose da lui portate è sol quel che par l'aria si uede" (Richter I 354 [608]).

¹⁵ "Per dare vera scienza del moto delli uccelli in fra l'aria, è necessario dare prima la scienza de' venti, la qual proverem mediante li moti dell'acqua in sé medesima, e questa tale scienza sensibile farà di sé scala per venire alla cognizione de' volatili in fra l'aria e 'l vento" (Solmi 1979, 91 [LVI]).

¹⁶ Some examples: W 12660 v, W 12661, W 12662 r.

¹⁷ On this, too, a small selection: W 12660 v et r, W 12579 r. – And here are some text samples: *Vortex*: "The vortices are always a mixture of two masses of water, namely the incident and the reflected one. All water that slows down in the currents of the rivers behind the objects in these currents finds an exit only in contact with the mentioned currents. The vortices that turn back are always those of the fastest water. But the vortices facing the direction of escape of the river are those of the water, which slows down in the course of the river. Here the law of waters does not fail in relation to their vortices, because the water, which slows down, reverses and forms the vortices in the opposite direction to its movement, as happens with the vortices of the faster water. Therefore, these vortices, both those in slow and those in fast water, mix and double their power. But this is not entirely true, because the slow vortex becomes faster as it mixes with the fast vortex, and the fast vortex becomes slower as it grasps the slow vortex and mixes with it" (Lücke, 534 f., Ms F 66 r) – *Formation and cutting of waves*: "If the larger of the two unequal cylindrical waves develops earlier than the smaller, then the smaller cuts the larger and goes beyond it. This happens because the larger one, which was created first, becomes wider and lower, while it is opposite to the smaller one. Since the smaller one is therefore high when it encounters the other, it hits the lower part of the larger one, and since it finds no obstacle as high as it is, it rushes over the other one, comes crashing down on the opposite side and continues its initial run" (ibid., 543).

¹⁸ On the comparison of whirling water with pigtails: "Observe the movement of the mirror of the water, which behaves in the same way as the hair, which has two movements. One follows the weight of the strand, the other follows the contour of the winding. Thus also the water has its whirling twists, which on the one hand follow the main current, on the other hand the falling and reflex movement" (ibid., 580).

¹⁹ Heydenreich has pointed to a sketch in Ms E 42 v, where above water waves that strike sea cliffs, air currents can be recognized which are used by seagulls for landing and take-off. For landing, they profit from air currents that rise on the side facing away from the waves and then move apart in counter-rotating vortices, so that a buoyancy-free vacuum is created between them, into which the seagulls descend. Conversely, they use the air currents rising on the surf side like wings to ascend. Heydenreich draws attention to the fact that in this "inconspicuous sketch" the per se invisible lines of force of the wind flow are depicted in the manner of water currents and thus made visible – a drawing technique "which is of decisive importance for the interpretation and full understanding of Leonardo's last graphic creations" (Heydenreich 1943, 283 f.).

Solmi has placed this analogy recipe under the significant heading "One must pass from the known to the unknown."²⁰ The invisible (the natural movements of air) is to be conceived according to its visible analogue (the natural movements of water). This is what Leonardo does. And this, of course, is also the reason why Leonardo's depictions of wind could give the *impression* that they depict water – so that his wind studies could be misinterpreted as deluge drawings.

In fact, it was precisely those flow-like vortices that can be found in all of the drawings in question that prompted the interpreters to see the usual and familiar, i.e. to water, instead of perceiving what Leonardo had actually depicted: wind.²¹ – Two final remarks before turning to the drawings in detail.

Leonardo himself described exactly how the wind causes the formation of vortices. They arise when the wind encounters an obstacle. This can be mountains, but also other winds. When a fall wind glides down a mountain flank, waves are formed. In them, the wind moves away from the mountain, but at the same time rises again due to the wave movement, until it encounters an oncoming wind section, which it first compresses before being itself turned downwards again.²² In general, when different winds meet, the weaker one is thrown back, but cannot move back in a straight line, because trying to do so it encounters the resistance of the subsequent packages of its own wind configuration. This way vortices emerge when wind hits obstacles and especially when different winds collide.²³ These are exactly the vortices one sees in the drawings.

And how does wind arise and where does it come from? According to Leonardo, winds originate in the wake of meteorological differences between heat and cold. Mist, which rises and gets on a cold layer, condenses to clouds. The reduction in volume associated with this condensation causes suction to the air underneath, and this prompts these air masses to start moving – this is how wind often originates. Conversely, however, wind can also arise when clouds get into a warm zone and dissolve; as a result (because the clouds were condensation products) a volume expansion ensues, which now sets the surrounding air in motion – which in turn leads to wind.²⁴

So, according to Leonardo, winds always come from clouds. Therefore, if one wants to represent winds, it is best to show clouds too. The wind bursts out of them. However: an untrained, a conventional observer will always think of rain when something bursts out of clouds. This explains the conventional misinterpretation of Leonardo's drawings: because something bursts out of clouds, one thinks it must be rain – and if it bursts particularly strongly, one thinks it must be extremely strong, proverbially: deluge-like rain.

3. The drawings in detail

Let us now look at the drawings in detail.²⁵

²⁰ "Bisogna passare dal noto all'ignoto" (Solmi 1979, 91 [LVI]).

²¹ Even astute and keenly observing Gombrich calls "the most striking feature in Leonardo's so-called Deluge drawings [...] the way the falling waters curl back as if they formed vortices in the air" (Gombrich 1969, 198).

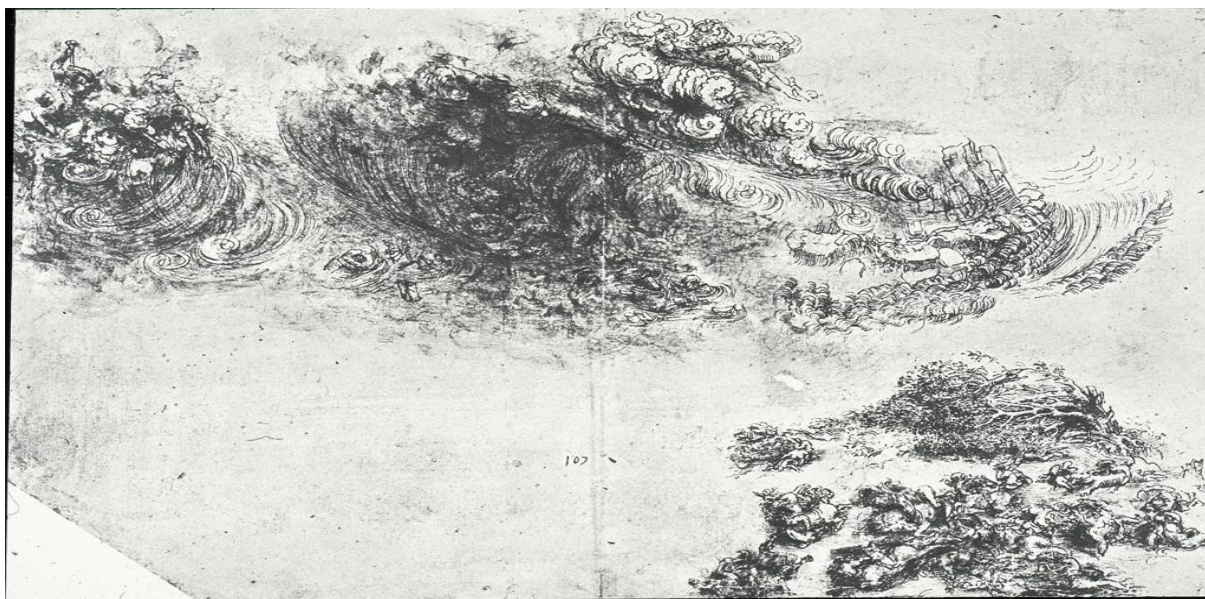
²² "Quel vento che discende rigando le parte de' monti, che si inclinano al mare, penetrano al fondo e fanno l'onde coi lor lati simiglianti alla ispiaggia donde discendano, e però tali onde spesso sono di stretti e profonde intervalli, come dissi nel libro del moto delle acque. E questa tal fortuna poco dura dopo la percussione di tal vento, perché, poi che ha percosso, risale in aria insino che ritrova l'altro vento e, in quello percosso, lo condensa e di novo ripiglia il salto in basso a similitudine de' fiumi che percotan le rive" (Marinoni VI 203, fol. 493 v [180 v-a]). Significant in this description is again the parallel to Leonardo's description of the reflex movements of water (cf. Lücke 598–600, CL 29 r).

²³ "Le revertigini ovver retrosi de' venti nascono ne' venti che s'aprano nell'abbracciamento delle montagne ovvero di qualche edificio, e poi nel ricongiugnarsi si per<c>otano con impeto; e lor moti refressi non son fatti per linia retta, perché è impedito nella sua propria sfera, dove si move, da materia simile a sé, la quale ha forza d'impedire il retto impeto e piegarlo; onde tal vento, non potendo distendersi, va consumando il suo impeto con mo<to>" (Marinoni VI 204, fol. 493 v [180 v-a]).

²⁴ "Convertansi li elementi l'uno nell'altro, e quando l'aria si converte in acqua pel contatto ch'ell'ha colla sua fredda regione, allora essa attrae a sé con furia tutta la circostante aria, la quale con furia si move a riemp<i>ere il loco evacuato della fuggita aria, e così si move successivamente l'una quantità dirieto all'altra insino a tanto che hanno in parte equalato lo spazio donde tale aria si divide: e questo è il vento. Ma se l'acqua si converte in aria, allora l'aria che prima occupava il sito dove discorre il predetto accrescimento, è necessario che con fuga e impeto dia loco alla nata aria: e quest'è il vento" (Marinoni VI 63, fol. 461 r [169 r-a]).

²⁵ The Windsor sequence of the drawings is not to be considered canonical. For methodological reasons the sheets are treated here in a different order.

W 12376



Let us begin with drawing W 12376, which does not belong to the actual series W 12377–12386, but is conventionally attributed to it as the opening sheet. This has, while formal reasons speak against it,²⁶ an interpretative reason. Since it was thought that the series as a whole represents the Flood and since Leonardo's most detailed vision of it ("Diluvio e sua dimostrazione in pittura"²⁷) focuses in particular on how animals and humans fare in the Flood, it was believed that this sheet, as it shows animals and humans (which is not the case with all the other sheets of the series) should be put in front of the series as the opening sheet.²⁸ Of course, the drawing still could not fulfill more than a fig leaf function – this single sheet cannot hide the fact that nothing of animals and humans is found on all subsequent drawings, so that they do not at all coincide with Leonardo's vision of the Flood.

The real irony, however, is that this sheet (just for another reason) actually fits in perfectly with the following series, and this also in an opening function. The drawing clearly represents a storm – and so do all subsequent drawings. While the alleged opening function for Flood representations fails in respect of all subsequent drawings, the opening function for storm representations proves itself on each of them. The peculiarity of drawing W 12376 is that storm is shown there in such concrete form that anyone can see that it is a storm. In contrast, the following sheets show storm as it were in a more abstract and imaginative, less narrative, less manifest manner. W 12376 follows Leonardo's instruction exactly that storm cannot be depicted as such, but can only be made recognizable by its effects. The following sheets, on the other hand, go beyond this view. They increasingly try to portray the dynamics of the storm as such. This is why W 12376 provides the ideal introduction to the series: this drawing strikingly shows that it's all about wind and storm.²⁹

Let us move on to a detailed examination. In the upper part the formation of wind is shown twice, on the left by a group of wind-generating creatures, on the right by an Aeolus blowing the wind trombone. The air current then drives counterrotating bands of clouds upwards, while downwards it comes upon a massif, on the other side of which, weakened accordingly, it appears again and pulls out into the foreland.

²⁶ The format of this drawing is more than three times as large as the drawings in the series, and the technique is also different. The drawings of the series are mainly executed with black chalk (only W 12379 and W 12390 differ slightly), but W 12376 shows pen and ink on black and somewhat white chalk.

²⁷ Richter I 352–344 [608].

²⁸ Hohl was probably the first to point out that only in drawing W 12376 elements of the Flood program are realized (Hohl 1967, 54).

²⁹ In this respect, the traditional placement of the drawing is completely correct. One may assume that the older connoisseurs – at a time that did not yet indulge in apocalypse- and deluge-ramblings – simply saw in the subsequent sheets what is to be seen: storm.



In a separate scene at the bottom right, the effect of a storm (perhaps, as if a detail # were enlarged out, of the storm blowing over the foreland) on a group of riders and on the vegetation is shown. Everything is torn to the ground, nothing – not even the horses, let alone the people – is able to hold itself upright. Two trunks have already been broken, the main trunk will soon be completely uprooted, and the people who are still crouching and clinging to the bushes will soon be flung through the air with them. The hurricane's violence is irresistible. He makes his mark on everything, bends everything in his manner, makes himself the master of everything.

W 12379



Stylistically and in its descriptive approach, the drawing *W 12379* is the closest to the previous one.³⁰ On the upper right one sees the wind bursting out from under a cloud layer and forming vortices. On the left is shown how the wind presses down bushes and forces its form on them. On the right one can see its effect on shrubs and high grass. The emphasis is on the fact that the wind, which in itself is incomprehensible, forces everything solid into its own form. The sheet is, as already mentioned, still similarly narrative as *W 12376*: while on the one hand one sees, in the upper part, the formation of the wind with its vortex forms, the effect of the wind on bushes, shrubs and grasses is shown in the two lower parts. The drawing is, in comparison to the following ones, still focusing on the effects and relatively narrative, not yet turning to a representation of the atmospheric conditions as such.

³⁰ Here again ink is used in addition to the black chalk, which can be found in the other drawings.

W 12378

This sheet shows the effect of the storm on inorganic nature, on rocks. In the left part Leonardo demonstrates how the storm unfolds a layer-like rock formation. He drives the layers apart by blasting them at their attachment points. He expands cracks into chimneys and thus, from the seemingly compact mass of the massif, makes appear individual towers which then may endure or, forced by the storm into its rotational movement, collapse. One might well assume that Leonardo tries to illustrate here how he imagines the emergence of certain formations in the Dolomites, so that his depiction concerns the historical evolution of morphological traits. The drawing does not represent a momentary view, but rather depicts a process that extends over a long period of time – Leonardo's depiction has an almost cinematographic character. What is special is that the storm is attributed not only the strength to impose its form and rhythm on the vegetation, but even to force hard rock into its typical form. Individual towers appear completely turned into the gigantic vortex shape of the storm – until they are overturned and collapse. The events on the right lower side, on the other hand, are more undramatic, here we only see the vortices occurring when the wind hits the ground.

W 12377

Sheet W 12377 is similarly arranged. Again winds marked by volutes (vortices) break out of the cloud zone. But they cross various rock formations with apparently less dramatic consequences. On the left we see how the wind laps around a hill and forms several plait-like waves on the ground, before it finally spreads into the foreland in softer waves. On the right Leonardo becomes again narrative: a tree tilts in the wind and shows the play of its leaves.

W 12380

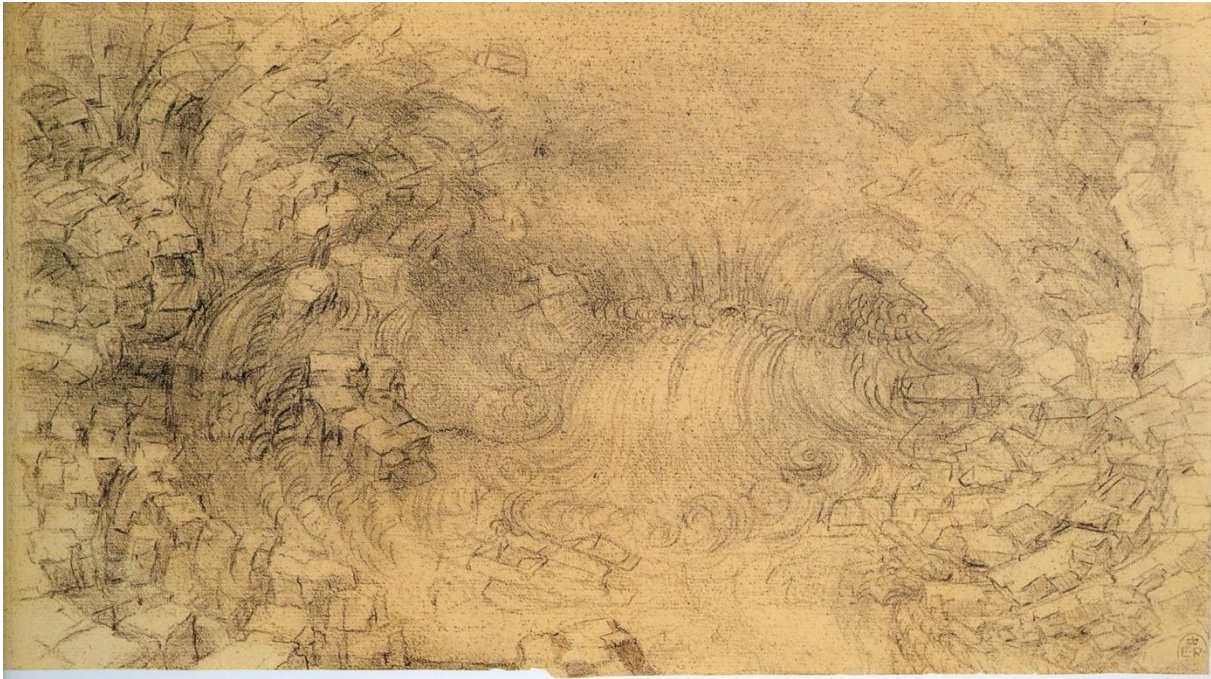


Similar to W 12378, but more schematized, this sheet also shows how rock pillars are pressed into the movement of the wind and thus brought to collapse. Already the mountain formation at the back right shows on its left side (and even more clearly do so the square towers behind the storm's incursion) how structured the mountain massifs susceptible to this phenomenon are. On the left of two rock columns remain only the bottom cuboids, while the rest, turned in an arch and split up, has already fallen to the ground. In addition, in this renewed depiction of a geological process one can see how other columns of rock are being split up in an arch, while some have already been torn down and collapsed, which, as a secondary effect, creates a new centre of explosive air mass propagation, which is then given special attention in the drawing.³¹ Again air waves spread pressure-like, yet in well-ordered (quite schematic) arrangement of successive vortex-packets, towards the front rather in horizontal direction, towards the right however ascending. A landscape stretching over the entire foreground is still completely untouched by the events, as its vegetation reveals. As far as the wind representation is concerned, the sheet has the character of a schematic drawing. Any pathos of horror is far away, Leonardo only wants to show the form and structure of the geological and atmospheric events. Not a tragic sense, but scientific spirit determines the drawing.³²

W 12381

³¹ Before turning to the alleged 'Flood drawings', Gantner discusses in his book five sheets with bursting rocks (W12387, 12389, 12394, 12396, 12397). Indeed, drawings W 12378–12381 (especially W 12380) recall the theme of bursting rocks. But Gantner speaks with respect to those comparative drawings of "eruptions" and "explosions" and concludes: "There can be no doubt that the secret force that bursts all these rocks from within the earth [...] must be the heat, i.e. a hidden fire" (Gantner 1958, 190). However, doubts are allowed. Because there is absolutely nothing to see of fire. And W 12387 is thematically quite similar to the middle scene of W 12380. Here, too, the visible consequences of a rock fall are depicted: air and dust masses, which emerge through the impact and which, the further they move away from their starting point, assume the spiral shape typical for Leonardo's wind representations.

³² By the way: "della pioggia" can be read at the top of the drawing, and some hints for representation follow. But the factual drawing does not match this heading. Indeed, the title was already on the sheet before the drawing was made. In the drawing absolutely nothing of water is to be seen. Perrig pointed this out convincingly (Perrig 1980, 77, note 66). Cf. on controversial aspects Fehrenbach 2001, 36.



Similar to the previous three drawings, W 12381 is also about wind and rock. This is the only non-autographed drawing of the series. It is usually regarded as a copy by Leonardo's pupil Melzi after a lost drawing of his master. On its left it shows again cube-like rock formations seen from above, as we already know them from W1378 and W 12380, and on the right it shows such forms one more time. But this time the wind does not come, as usual, from above, from a cloud zone, but from a crevice or a mountain yoke in the middle of the drawing, forming its first vortex there and then partly flowing upwards, but above all downwards, where it merges, hitting the rock formations on the right and left, into the spiral forms that have become common to us in the meantime.

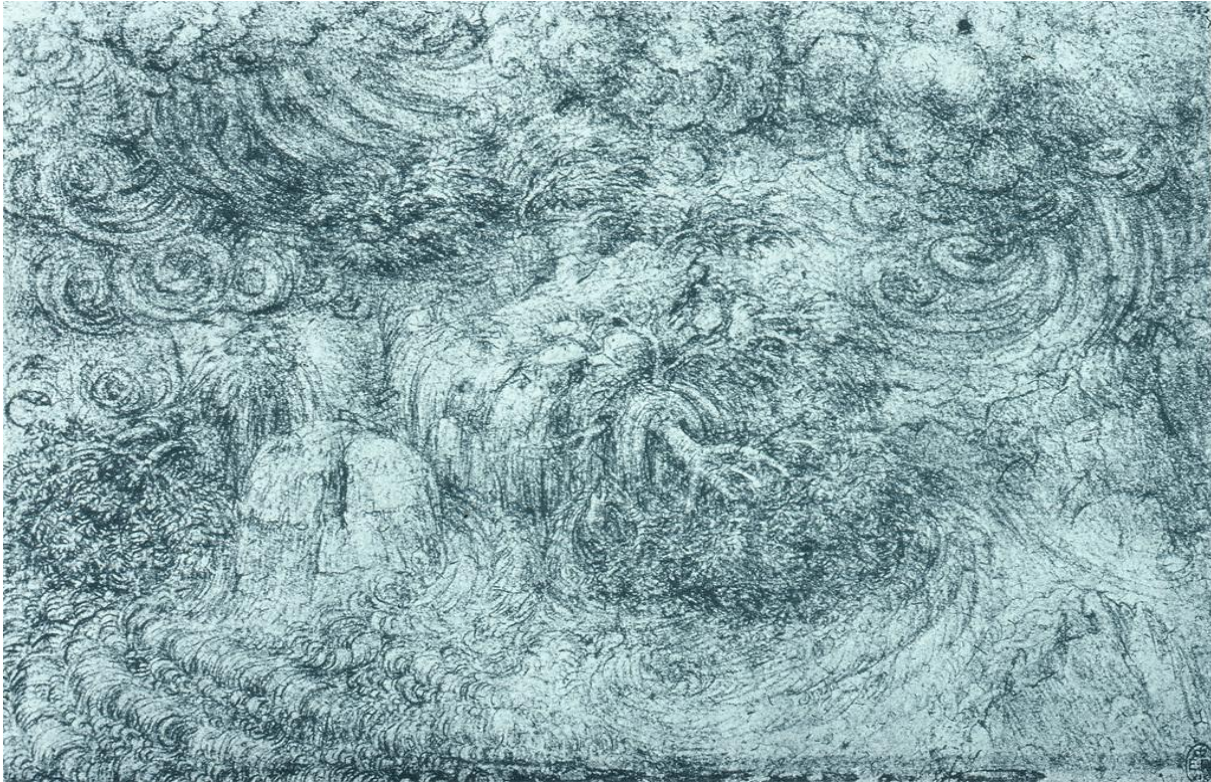
W 12382



From this drawing onwards the representational arsenal changes: rocks fade into the background, vegetation moves into the foreground – until in the end none of this will play a role anymore, because wind and storm will be

depicted purely as such. In W 12382 wind bursts one more time out from clouds downwards, then moves sideways and rises again in gigantic volutes.³³ In the middle the already known impact of the wind on pieces of rock with the common spiral and vortex formation takes place. To the left, the wind plunges into the depths and forms a series of smaller vortices when hitting the plain, until it meets a hill covered with vegetation in the foreground and sweeps over it, while on the right a mixture of buildings, stones and bushes is exposed to the wind.

W 12386



Once again, the storm scenery spans the entire space between heaven and earth. In the upper area the volute-like circles dominate, and in the lower area there are on the left smaller air vortices and on the right rather plait-like air packets.³⁴ In the middle we see in dramatic representation how the storm attacks a group of trees. On its left side, the storm flows like a cataract. In the middle it tears up the group of trees, uprooting its front part and forcing it into the depths.³⁵ On the right side it extends into the valley and then divides itself on a massif.

W 12385

³³ Curiously, Clark writes: "the huge spouts of rain no longer aim at the earth, but curl upwards in great volutes" (Clark 1935, 48). Did one ever see rain turn skyward?

³⁴ Cf. Leonardo's remark that spirals form where the wind meets dense air masses, while in the case of thinner air, softer courses form: "ogni mobile seguita il suo mo[to] per la via più breve e fugge l'impedimento over è piegato dall'impedimenti: adunque il vento s'incurva nel penetrare l'aria grossa e si piegha all'aria più sottile" (Govi VIII [Ms K] 47, fol. 112 v).

³⁵ See Leonardo: "I have seen motions of the air so furious that they have carried, mixed up in their course, the largest trees of the forest" (Richter II 323 [1338]). "Ho veduto movimēti d'aria tanto furiosi, che ànno acconpagnati e misti col corso suo li grandissimi alberi delle selue" (Ms F 37 v).



Again we see (it is almost tiring) in the upper zone the usual cloud sheep as well as wind volutes and wind curls. At the same time, on the left from the upper edge of the drawing to about the middle, there is a row of block-like structures, which one probably should interpret as town. The wind blows over them, then moves in the front to the left and in the middle around various hills, also hitting bushy vegetation, and on the right it finally climbs up a hill on which there is a castle. Where the wind takes its way around the hills, one sees the well-known plaited figures, as Leonardo usually drew them in his water studies. But in the meantime no one will be deceived any more, but, being familiarized with Leonardo's special view by the previous drawings, immediately take these wave-like movements as representations of wind flowing through the country. Finally, the scene at the bottom right may teach the last water addict a better lesson. What he might at first be tempted to interpret as water can, as it gradually rises up the castle-crowned hill, only be wind, which breaks on the incline and due to the pressure of the subsequent wind parts is pushed up in ever new packages.

W 12384



In this sheet, finally, all representational clues have vanished. One only sees the usual clouds, gigantic wind twists (volute) and smaller rows of vortices. But what's new here are the lightning bolts. They are represented in

serpentine. One might ask whether this does not contradict our perception. Presumably not. It is contrary only to our accustomed representation pattern of lightning, according to which lightnings are not wave-shaped but zigzag-shaped.³⁶ In this drawing however, the bolts of lightning correspond to the wave-like pattern of wind. The form of the wind dominates everything – not only the clouds and the earthly formations, but also the lightning.

W 12383



The last drawing to be discussed is W 12383. It is the most abstract of them all. While before Leonardo has mostly shown the effects of the wind on mineral and vegetal nature, here he remains completely in the atmospheric range. He shows turbulences and superimpositions of different air flows, and he exploits artistically the difference of flow structures close to the sky or to the earth. Huge volute circles burst out of the clouds and turn into themselves. Below one can see several vortex chains, but also flatter wind currents and small vortex bulges that spread one after the other – the entire arsenal of Leonardo's morphology of wind phenomena.

4. Making the invisible visible

One last question remains: how can Leonardo see and depict all these atmospheric phenomena – while, according to his own words, wind is invisible?

In the drawings discussed, Leonardo goes beyond a limit that he himself has formulated. That the wind as such is not visible, but only recognizable by its effects, no longer applies in these late drawings, is exceeded in them. It is precisely the fact that storm can now be *seen* as a state of motion in the air, as a specific atmospheric event, that makes these drawings so special. Leonardo shows us the movements and the flow behavior of the wind. How can this be? Fehrenbach thought that these vortex winds are air masses whose degree of density has become so high as a result of the absorption of other substances (water and dust) "that their course becomes visible."³⁷ However, this does not apply to these drawings. They do by no means represent something simply visible. They rather make something invisible visible. Just not a freely imagined invisible, but an invisible, whose characteristics were made accessible through scientific exploration.

For Leonardo, not only science, but also art and especially drawing is research. Painting represents things that could not be visualized in any other way, and it aims to expand the limits of what can be perceived beyond the usual. In the drawings discussed, the connection between scientific view and artistic presentation is particularly close. Let's just remember Leonardo's aforementioned water studies. There he showed patterns of movement that are not alien to our familiar gaze, but unfamiliar in the details and the precision that Leonardo gave them.

Gombrich has aptly described this with reference to drawing W 12660 v: "It is clear as daylight that we are not dealing here with a 'snapshot' of the impact of water on water, but with a highly complicated diagram explaining

³⁶ In fact, even linear flashes without branches have an irregular wavelike rather than a zigzag shape.

³⁷ Fehrenbach 1997, 316.

Leonardo's ideas about such an impact. No waterfall or vortex allows us to see streamlines so clearly, and the foam bubbles are never distributed so regularly in turbulent water.³⁸ Leonardo not only writes down his scientific findings, he also makes them clear to himself in drawings. Theory and perception merge here and fertilize each other.³⁹ That the drawings have a scientific character, as one has noticed on several occasions, is one thing, but is not everything. The drawings are not merely illustrations of scientific findings, but means of generating scientific and visual insights. Only by drawing can Leonardo fully make clear the structures of water – pigtailed, vortices, whirls, spirals – to himself.

The same applies to the representations of wind. In his drawings Leonardo seeks to exhibit the structures of wind – its typical patterns of movement and flow. He had already done this with respect to water, and water was, as explained before, a model for him to understand wind. But the wind drawings are even more daring, even more imaginative than the water drawings. The vortices and swirls of the water can be seen, those of the wind can only be guessed. But Leonardo thinks, imagines and peers himself into the play of the winds so far that he believes to be able to make it visible.⁴⁰ His drawings present diagrams of wind courses that are scientifically correct but are hidden from normal perception. But the scientifically and theoretically educated eye sees differently and perceives more than the physical eye. And Leonardo's claim and unique achievement is to share with us his radar-like vision of wind movements and flow patterns. What we see in these drawings is, although a natural phenomenon, not simply to be seen in nature, but here brought out into its full visibility. Leonardo develops a presentiveness aiming at the inner structure of phenomena which goes beyond the standard perceptiveness. The scientist Leonardo has gone beyond the dogma of simple visibility. He depicts what is not simply visible, but only opens up for scientific insight and imagination.

Leonardo's method is thus reminiscent of an older and a newer authority: of Aristotle, of whose truly ingenious descriptions of nature it was said that they combined empiricism and speculation in a unique manner – Aristotle, being a true "secretary of nature," had dipped his reed pen simultaneously into nature as well as into reason;⁴¹ and of Goethe, of whom Hegel said: "Experience depends on the sense with which one approaches reality. A great sense makes great experiences and discovers in the colorful play of appearance that which matters."⁴²

5. Vision

How can it be that for a long time even the best art historical minds considered what Leonardo meant as wind to be water? How could they go astray to such an extent?

Actual historical reasons (the catastrophes of the World Wars) certainly played a role. The human gaze is not innocent, it is influenced by cultural circumstances. And the first half of the 20th century has understandably increased the tendency to see disaster scenarios and extermination processes.⁴³ But I want to bring another reason to the fore. Leonardo's way of seeing is unusual. He does not simply depict nor does he construct out of free imagination; he rather, starting from the perception of phenomena, imagines the inner lawfulness from which phenomena are built – and that is what he depicts. This applies to his portrayals of water and mountains and plants as well as to his representations of wind. Leonardo portrays the phenomenon of wind by imagining the laws that produce it. He lets the apparition emerge from its laws.

There can be no doubt that Leonardo starts from the concrete phenomena and does not try to represent platonic ideas, but the actual reality of the phenomena. Everything he represents is eminently phenomenally saturated and perception-based. So are his representations of winds. His recording of atmospheric structures is based on experience. We all know from physical experience a variety of characteristics of wind: its wave character, its repeated strengthening and weakening, as well as the properties of slipstreams or – finer – the fact that in the area of slipstreams, refractive effects occur and gentler, rotating side currents are being formed.

³⁸ Gombrich 1987, 57, similarly 66.

³⁹ Cf. Gombrich 1969, 174.

⁴⁰ "[...] ces *Déluges* manifestent combien l'analyse scientifique permet à Léonard d'*imaginer* ce qu'il observe" (Arasse 1997, 111).

⁴¹ Flashar 1983, 410.

⁴² Hegel 1986, 87 [§ 24, addition 3]).

⁴³ Clark wrote in 1949 that only the war had really opened the view for the pessimism of the 'deluge drawings' (Clark 1950, 46). Gantner supposed: "Perhaps it really took the apocalyptic events of our century and the revolutionary developments of modern art to open our eyes to a use of forms that undertakes to portray the unheard of, indeed the actually unrepresentable" (Gantner 1958, 202).

And even optically we are familiar with the flow structure of the wind from a series of effects, just think of the dance of leaves in the autumn wind or of whirled up dust or, on a large scale, of whirlwinds;⁴⁴ or also of how it can be observed on small sand formations that wind achieves the same effect as water: a clearly emerging wavelike or (on a large scale) a dune configuration. All of Leonardo's atmospheric structures are phenomenally secure. But Leonardo goes beyond the mere depiction of the visible. He shows the apparitions together with their laws. In his drawings he makes the event of a storm develop itself by depicting the flow structures from which wind results. His drawings are eminently comprehensible.⁴⁵

That's what makes these drawings so eminent. Therefore, however, they also demand an eye that is equal to their peculiarity. It takes a look that can grasp the dual structure of lawfulness and appearance, that is capable of seeing phenomena build up from their inner condition and become manifest precisely through it, while they are usually invisible. The simple view, however, the usual view will fail here, will go astray. It will interpret forms, which it knows as features of water, as water, whereas Leonardo used them very differently: as the structural forms of quite another phenomenon, the wind.

So my thesis at the end is not only that in all these drawings there is not water, but wind or storm represented, that the water reading is therefore not only interpretatively wrong, but is fundamentally wrong,⁴⁶ that it has misjudged the purely physical facts of the depicted,⁴⁷ but I also claim that Leonardo's drawings represent and demand a special kind of seeing. What we usually take for seeing can be beaten with blindness. This is a lesson of art history which is not only to be applied to art history, but which is also worthwhile to practice in daily life ...

Sources and Literature:

Arasse, Daniel: *Léonard de Vinci. Le rythme du monde* (Paris, 1997).

Clark, Kenneth: *A Catalogue of the Drawings of Leonardo da Vinci in the Collection of His Majesty the King at Windsor Castle*, vol. 1 (Cambridge, 1935).

Clark, Kenneth: *Landscape into Art* [1949] (London, 21950).

Clark, Kenneth: *The Drawings of Leonardo da Vinci in the Collection of Her Majesty the Queen at Windsor Castle*, revised edition with the assistance of Carlo Pedretti (London, 21968), vol. 1.

Clark, Kenneth: *Leonardo da Vinci. Nature Studies from the Royal Library at Windsor Castle* (Florence, 1982), "Introduction", 9–12.

Fehrenbach, Frank: *Licht und Wasser: Zur Dynamik naturphilosophischer Leitbilder im Werk Leonardo da Vincis* (Tübingen, 1997).

Fehrenbach, Frank: "Leonardos Vermächtnis? Kenneth Clark und die Deutungsgeschichte der 'Sintflutzeichnungen'", *Marburger Jahrbuch für Kunstwissenschaft* 28 (2001), 7–51.

Fehrenbach, Frank: "Un nuovo paradigma: il Diluvio", in: *Leonardo '1952' e la cultura dell'Europa nel dopoguerra*, eds. Romano Nanni and Maurizio Torrini (Florence, 2013), 303–320.

Flashar, Hellmut (ed.): "Aristoteles", in: *Die Philosophie der Antike*, vol. 3: *Ältere Akademie – Aristoteles – Peripatos* (Bale/Stuttgart, 1983), 175–457.

Gantner, Joseph: *Leonardos Visionen von der Sintflut und vom Untergang der Welt* (Berne, 1958).

Gombrich, Ernst H.: "The Form of Movement in Water and Air", in: *Leonardo's Legacy: An international symposium*, ed. C. D. O'Malley (Berkeley, 1969), 171–204.

⁴⁴ See Leonardo's description of such a whirlwind (Richter II 323 [1338]).

⁴⁵ In this respect one ought not to agree with Nova, who thought that Leonardo had depicted the movements of wind as "a pure natural phenomenon" (Nova 2007, 84). No, he presented them proceeding from their presumed laws. Nova himself rightly points out that Leonardo has virtually developed an encyclopaedia of graphic, almost stenographic signs for wind (Nova 2009, 58).

⁴⁶ In Perrig's words, it does not pass the "endurance test of perception" (Perrig 1980, 61).

⁴⁷ Certainly it has not completely escaped the attention of all interpreters that wind or storm occurs at least occasionally in these drawings. But they thought that this was only a side effect of the main event and that this one was represented by the Flood and in any case by an aquatic event. So far, no one has come up with the idea that these drawings might not be about water at all, but exclusively about wind. To mention some examples: Clark wrote that in these drawings Leonardo had undertaken "the materialisation of the atmosphere" (Clark 1935, 47) – which however did not have any consequence für his view altogether. Gantner noted that wind and storm occur, but he saw in them only accompanying phenomena of the rainfall, the floods and the diluvian events. More recently Fehrenbach has most clearly recognized that various whirlwinds and storms are depicted, but he also insisted that "flooding processes" play the "central role" in the drawings (1997, 318).

- Gombrich, Ernst H.: "Leonardo da Vincis Forschungsmethode der Analyse und Mutation – Die Formen der Bewegung von Wasser und Luft", in: *Die Entdeckung des Sichtbaren – zur Kunst der Renaissance III* [1976] (Stuttgart, 1987), 55–76.
- Govi, Gilberto (ed.): *I manoscritti dell'istituto di Francia trascritti da Gilberto Govi*, 10 vols. (Rome, 2000).
- Hegel, Georg Wilhelm Friedrich: *Enzyklopädie der philosophischen Wissenschaften im Grundrisse I* [1830], *Werke*, Bd. 8 (Frankfurt/Main, 1986).
- Heydenreich, Ludwig H.: *Leonardo* (Berlin, 1943).
- Hohl, Hanna: *Die Darstellung der Sintflut und die Gestaltung des Elementaren* (Phil. Diss. Tübingen, 1967).
- Lücke, Theodor (ed.): *Leonardo da Vinci: Tagebücher und Aufzeichnungen* (Leipzig, 1940).
- Marinoni, Augusto (ed.): *Il Codice Atlantico della Biblioteca Ambrosiana di Milano. Trascrizione diplomatica e critica di Augusto Marinoni* (Florence, 1975–1980).
- Nova, Alessandro: *Das Buch des Windes – Das Unsichtbare sichtbar machen* (Munich, 2007).
- Nova, Alessandro: "Il vortice del fenomeno atmosferico e il grido metaforico: le *Tempeste* di Leonardo e il *Piramo e Tisbe* del Poussin", in: *Wind und Wetter. Die Ikonologie der Atmosphäre*, eds. Alessandro Nova and Tanja Michalsky (Venice, 2009), 53–66.
- Perrig, Alexander: "Leonardo: Die Anatomie der Erde" in: *Jahrbuch der Hamburger Kunstsammlungen* (1980), 25, 51–80.
- Popham, Arthur E.: *The Drawings of Leonardo da Vinci* (New York, 1946).
- Richter, Jean Paul: *The Literary Works of Leonardo da Vinci*, compiled & edited from the original manuscripts by Jean Paul Richter, 2 vols. [1883] (London, 31970).
- Solmi, Edmondo (ed.): *Leonardo da Vinci – Frammenti letterari e filosofici* (Florence, 1979).