Did Leonardo See the Light?

Marinus Anthony van der Sluijs

> "*But why should these rough drafts of letters be regarded as anything else than what they actually and obviously are?*"[1]
> — Jean Paul Richter (1883)

Abstract. The notebooks of Leonardo da Vinci contain drafts of a letter to an Egyptian official. These imply that the author travelled to Armenia and witnessed a natural disaster there. They also highlight the extraordinary height of Mount Taurus, which allegedly caused its summit to be illuminated by the sun hours before sunrise and after sunset, making it look like a comet. Another letter, to a friend, seems to reference the natural disaster again. Scholars generally consider the letters to be fiction, with input from Aristotle and other authors for the description of the mountain. Sunlight on the peaks so deep into the night is physically impossible.

This article revives an old hypothesis that the letters are genuine. It proposes a likely date and reconstruction of the events as well as an identity for the official. Against this background of historical plausibility, it deduces that Leonardo really had seen a mysterious night light in the area, which he only afterwards tried to understand in terms of Aristotle's text. It is argued that this light was not an exaggeration of Alpenglow or moonlight, but rather the oldest known observation of the *Gegenschein* by centuries. The pertinent Aristotelian passage can be connected with the zodiacal light, which is the better-known cousin of the *Gegenschein*.

The Armenian Letters

Buried in the voluminous notebooks of Leonardo da Vinci (1452-1519) are incomplete drafts of a letter to an unnamed '*diodario*' of Syria, lieutenant of the sultan of Egypt. They purport to recount the author's experiences in Armenia, including the collapse of a mountain in the Taurus range with

[1] Jean Paul Richter, *Scritti letterari di Leonardo da Vinci = The Literary Works of Leonardo da Vinci*, vol. 2 (London: Simpson Low, Marston, Searle & Rivington, 1883), p.382.

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concomitant flooding and snow cover. Various drawings of the scene accompany the text (Fig. 1).



Figure 1. Mount Taurus, allegedly so high that people east of it can see its summit lit to their west hours before sunrise and people west of it can see it lit to their east hours after sunset, such that it resembles a comet of variable shape. Sketch and accompanying text from Leonardo da Vinci's notebooks. *Codex Atlanticus* (late 16th century), 393*v*. Richter, *Scritti*, p.388/89 pl.117 bottom right.

Another letter, to an unknown recipient, seemingly deals with the same disaster.[2] Compared to that calamity, however, the drafts to the dignitary allocate much more space to a peculiarity of the mountain: Taurus' vertiginous height allegedly exposed it to sunlight for many more hours than the rest of the world. As Leonardo put it:

> *Questi corni son di tanta altura che par che tocchino il cielo, chè nell' universo non è parte terrestre piv alta della sua cima; e senpre 4 ore inanzi dì è percossa dai razzi del sole in oriẽte; e per essere lei di pietra biãchissima, essa forte risplende, e fa l'ufitio a questi Ermini come farebbe vn bel lume di luna nel mezzo delle tenebre; e per la sua grande altura essa passa la somma altezza de' nuvoli per spatio di 4 miglia;*
>
> *e per linia retta questa cima è ueduta di grã parte dell'occidente alluminata dal sole dopo il suo tramontare insino alla 3ª parte della notte; ed è quella che appresso di voi ne' tempi sereni abbiamo già giudicato essere vna cometa, e pare a noi nelle tenebre della notte mvtarsi in varie figure, e quãdo diuidersi in due o in 3 parti, e quãdo lũga e quãdo corta; e questo nascie per li nuvoli che nel orizzonte del cielo s'interpongono infra parte d'esso monte e il sole, e per tagliare l'uno essi razzi solari, il lume del monte è interrotto con vari spati di nvvoli, e però è di figvra uariabile nel suo splendore.*
>
> These peaks are of such a height that it seems they touch the sky, for in the world there is no part of the earth higher than its summit; and always 4 hours before daytime it is struck by the rays of the sun in the east; and being of the whitest stone, it shines strongly, and fulfills the function to these Armenians that a beautiful light of the moon would in the midst of the darkness; and by its great height it surpasses the utmost level of the clouds by a space of 4 miles; and in a straight line this peak is seen from a great part of the west to be illuminated by the sun after its setting until the 3rd part of the night; and it is this which with you in calm weather we previously supposed to be a comet, and appears to us in the darkness of night to

[2] *Codex Atlanticus* (late 16th century AD), 393*r*-*v*, 573*v*, ed. Richter, *Scritti*, pp.381-94; Edward MacCurdy, *The Notebooks of Leonardo da Vinci*, vol. 2 (London: Jonathan Cape, 1938), pp.533-36, 539. H. Anna Suh helpfully marked the exact position of the text on the manuscript pages in *Leonardo's Notebooks* (New York: Black Dog & Leventhal Publishers, 2005), pp.244-48.

> change into various shapes, and to sometimes divide into two or 3 parts, and sometimes long and sometimes short; and this is caused by the clouds that on the horizon of the sky interpose between part of this mountain and the sun, and by cutting off some of these solar rays, the light of the mountain is intercepted by various intervals of clouds, and is therefore of variable shape in its splendour.[3]

In the margin Leonardo scribbled the outline for a book, incorporating the same information:

> *Perchè il monte risplende nella sua cima la metà o'l 3° della notte, e pare vna cometa a quelli di ponente dopo la sera, e inãti dì a quelli di leuãte. Perchè essa cometa par di uariabile figura in modo che ora è tonda or lunga e or diuisa in 2 or in 3 parti, e ora vnita, e quãdo si riuede.*
>
> Why the mountain shines at its summit half or a 3rd of the night, and looks like a comet to those of the west after eventide, and before day to those of the east. Why this comet appears of variable shape in such a way that it is now round, now long, and now divided into 2 parts, now into 3, and now united, and when it is seen again.[4]

One write-up of the letter brings in the Caucasus:

> *Questo monte Tavro è quello che appresso di molti è detto essere il giogo del Monte Cavcaso, ma, avẽdo voluto ben chiarirmi, ò voluto parlare con alquanti di quelli che abitano sopra del Mar Caspio, i quali mostrano che quel sia il uero Mõte Caucaso, che, benchè i mõti loro abbino il medesimo nome, questi son di maggiore altura, e però cõfermano, perchè Caucaso in lingua Scitica vuol dire somma altezza, e in vero non ci è notitia che l'oriẽte nè l'occidente abbia monte di si grande altura; e la pruova, che così sia, è che li abitatori de' paesi, che gli stanno per ponẽte, vedono i razzi del sole che allumina insino alla 4ª parte delle maggior notti grã parte della sua cima, e'l simile fa a quelli paesi che gli stanno per oriẽte.*

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[3] Leonardo to the *diodario*, 9-18, ed. Richter, *Scritti*, pp.387-88. All translations are mine, except where indicated otherwise.

[4] as above, 45-52, ed. Richter, *Scritti*, p.389. Thereza Wells, in *Leonardo da Vinci: Notebooks* (Oxford University Press, 2008), p.249, paraphrased the last few words as "and sometimes invisible and sometimes becoming visible again".

> This Mount Taurus is that which with many is said to be the ridge of Mount Caucasus, but, wishing to be very clear about it, I desired to speak to some of those who live at the Caspian Sea, who point out that it must be the true Mount Caucasus, that though their mountains bear the same name, these are of greater height, and therefore confirm it, because Caucasus in the Scythian language means supreme height, and in truth we have no information that either the east or the west has a mountain of such great height; and the proof that this is so is that the inhabitants of the lands that are to its west see the rays of the sun which illuminates a great part of its summit up to a 4th part of the greatest nights, and the same goes for those lands that are to its east.[5]

'Greatest nights' (*maggior notti*) evidently means the longest nights of the year.[6] Leonardo appears to have ascribed a stable duration of 4 hours to the effect, converting to half of the night at the summer solstice, a third at the equinoxes and a quarter at the winter solstice. This presupposes 16 hours each for the longest day and night at mid-Turkish latitudes – not that far removed from the real value of approximately 15 hours.[7]

In keeping with its unrivalled elevation, Taurus was reputed to cast an enormous shadow. At noon, this amounted to 12 days' going north in mid-June and a month's in mid-December.[8] Leonardo put a figure of about 10 miles on Taurus' height.[9]

The aim of this article is to explain the surprisingly drawn-out light. Substantial unpacking will be required to this end, particularly when it comes to distinguishing between Leonardo's sources and any observations he himself may have made.

Ancient Sources

It was the German art historian Jean Paul Richter (1847-1937; Fig. 2) who introduced these 'Armenian letters' to the public in 1881.[10]

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[5] as above, 66-71, ed. Richter, *Scritti*, p.390.
[6] Richter, *Scritti*, p.390.
[7] Compare Francesco Paolo di Teodoro, 'Stupenda e dannosa maraviglia', *Achademia Leonardo Vinci* 2 (1989): p.124.
[8] Leonardo to the *diodario*, 72-75, ed. Richter, *Scritti*, pp.390-91.
[9] as above, 12, 84-87, ed. Richter, *Scritti*, pp.388, 391-92.
[10] Jean Paul Richter, 'Lionardo da Vinci im Orient', *Zeitschrift für bildende Kunst* 16 (1881): pp.133-41; 'La Question orientale dans la vie de Léonard de Vinci', *La Chronique des arts et de la curiosité* 11 (1881): pp.87-88.



Figure 2. Jean Paul Richter (1847-1937), first editor of Leonardo's notebooks, who argued that Leonardo's journey to the East was real. http://www.emmabandrews.org/project/items/show/118

He had travelled in the area himself[11] and was convinced of the letters' historicity, ruling out that Leonardo had copied sections from a friend.[12] Almost immediately, several of his peers reacted receptively,[13] but dissent arose as well. Gilberto Govi (1826-1889) made light of the letters as the preliminary work for a fictional romance in epistolary form that at best integrated transcriptions from unidentified contemporary geographers or

[11] Richter, *Scritti*, p.387n8.
[12] Richter, 'Lionardo': p.138.
[13] *e.g.*, Mary Margaret Heaton, 'Leonardo da Vinci in the East', *The Academy* 19.462 (1881): pp.194-95; Charles Ravaisson-Mollien, 'Les Écrits de Léonard de Vinci', *Gazette des Beavx-Arts* 23 (1881), pp.225-48, 331-49, 514-35; republished as *Les Écrits de Léonard de Vinci* (Paris: A. Quantin, 1881).

travellers.[14] Two years later, Richter released the comprehensive edition of the notebooks cited above, with an English translation and commentary. His stance had not changed and he reaffirmed it the year after in a riposte to a nameless English detractor.[15]

Regardless, the scepticism grew that same year when Douglas William Freshfield (1845-1934) – who had scaled Mount Elbrus in the Caucasus – asserted Leonardo's reliance on classical sources.[16] Of these, he only named Ptolemy and Aristotle. As the philosopher had it:

> The Caucasus is the largest mountain, both in extent and height, towards the summer sunrise. A proof of its height is the fact that it is visible both from the so-called Deeps and also as you sail into the lake; and also that its peak is sunlit for a third part of the night, both before sunrise and again after sunset.[17]

Freshfield was doubtless spot-on in pointing out Leonardo's literary debt to this passage for the curious light effect, down to its duration. The words 'towards the summer sunrise' (*pròs tèn héō tèn therinḗn*) are a parochial indication of place, correctly situating the Caucasus east-northeast of Greece. The 'Deeps' (*bathéōn*) were the 'deeps of Pontus' (*bathéa tou Póntou*).[18] The lake is either Lake Maeotis, now the Sea of Azov, or the Caspian Sea.[19]

Freshfield adduced also the overlap between Taurus and Caucasus in ancient authors. He refrained from names again, but they include Arrian,

[14] [Gilberto] Govi, 'Brani de' manoscritti di Leonardo da Vinci', *Atti della R. Accademia dei Lincei*, 5.10 (278) (1881): p.223; 'Alcuni frammenti artistici, letterari e geografici di Lionardo da Vinci', *Atti della R. Accademia dei Lincei*, 5.13 (278) (1881): pp.312-13.
[15] Jean Paul Richter, 'The Proposed Reproduction of the MSS. of Leonardo', *The Academy* 25.614 (1884): pp.102-103.
[16] Freshfield, in Charles William Wilson, 'Notes on the Physical and Historical Geography of Asia Minor, Made during Journeys in 1879-82', *Proceedings of the Royal Geographical Society and Monthly Record of Geography* 6.6 (1884): p.323.
[17] Aristotle, *Meteorology*, 1.13 (350a28-33), tr. adapted from Henry Desmond Pritchard Lee, *Aristotle: Meteorologica* (London: William Heinemann, 1952), pp.96-97.
[18] Aristotle, *Meteorology*, 1.13 (351a13).
[19] Lee, *Aristotle*, pp.97, 101n*b*.

Pliny, Solinus, Orosius, Jordanes and Isidore.[20] Other inspirations, in Isidore, may have been Olympus rising above the clouds and Athos casting a fabulously long shadow.[21] The latter two claims were repeated in John Mandeville (AD *c*1360),[22] with Athos replaced by Caucasus in some versions[23] and by Atlas (*athlas*) in the Italian versions.[24] Mandeville also featured the Caucasus as "the highest in the world",[25] though the Milanese edition of 1480 merely read 'one of the highest mountains of the world' (*uno de li piu alti monti del mondo*).[26] Aristotle, Pliny, Isidore and Mandeville were all in Leonardo's personal library.[27] Of Mandeville, he owned the Italian edition of 1480. Proclus the Successor (AD 412-485) could have been another influence. A prominent Neo-Platonist, this author cited Aristotle to the same effect in his discussion of the location of Atlantis:

> For there is a story that Heracles after crossing a great deal of desert land came to Mount Atlas, whose size recorded by those who wrote *Ethiopica* was big enough to touch the ether itself and to cast a shadow to a distance of nine hundred kilometres. For from the ninth

[20] Arrian, *Indica*, 2.1-5; Pliny, *Natural History*, 5.27 (97-98); Solinus, *Collection of Curiosities*, 38.10-12; Orosius, *Histories against the Pagans*, 1.2.37,44; Jordanes, *Getica*, 7 (54-55); Isidore, *Etymologies*, 14.8.2-3.
[21] Isidore, *Etymologies*, 14.8.9-10; compare Pomponius Mela, *Description of Lands*, 2.2 (30).
[22] 'John Mandeville', *Travels*, 3, tr. Iain Macleod Higgins, *The Book of John Mandeville with Related Texts* (Indianapolis, IN: Hackett Publishing Company, 2011), pp.12-13.
[23] British Library, MS. Egerton 1982, tr. Charles W. R. D. Moseley, *The Travels of Sir John Mandeville* (London: Penguin Books, 2005), p.49; Bodleian Library, MS. Rawlinson D.99, ed. Malcolm Letts, *Mandeville's Travels*, vol. 2 (London: The Hakluyt Society, 1953), pp.422-23.
[24] 'Johannes de Mandauilla', *Tractato de le piu marauegliose cosse* (Milan: Magister Petrus de Corneno, 1480), p.a6 *v*. Compare Francesco Zambrini (ed.), *I Viaggi di Gio. da Mandavilla*, vol. 1 (Bologna: Gaetano Romagnoli, 1870), p.22.
[25] 'John Mandeville', *Travels*, 27, tr. Higgins, *The Book*, p.152.
[26] 'de Mandauilla', *Tractato*, p.m3 *r*. Compare Zambrini, *I Viaggi*, vol. 2, p.135.
[27] Romain Descendre, 'La Biblioteca di Leonardo', in Sergio Luzzatto and Gabriele Pedullà (eds.), *Atlante della letteratura italiana*, vol. 1: Amedeo de Vincentiis (ed.), *Dalle origini al Rinascimento* (Turin: Einaudi, 2010): pp.1, 3-4; Wells, *Leonardo*, p.313; Giorgio Castelfranco, *Studi Vinciani* (Rome: De Luca Editore, 1966), pp.148-49. For Mandeville, see also Matthew Coneys, *Mandeville in Italy* (doctoral dissertation; University of Warwick, 2016), pp.78, 123, 189.

> hour of daylight the sun is hidden by it until it has completely set. And it is nothing amazing, for even Mount Athos, the Macedonian mountain, casts its shadow as far as Lemnos, which is a hundred and thirty kilometres away.
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> Not only did Marcellus, who wrote the *Ethiopian Inquiry*, report that Atlas was the only mountain that big, but Ptolemy too says that the Mountains of the Moon have an enormous height, and Aristotle says the Caucasus is illuminated by the sun's rays for the third part of the night after sunset and the third part before sunrise.[28]

Leonardo could have discovered this passage through fellow townsman Marsilio Ficino (1433-1499), who is known to have acquired a copy of the work for his revived Platonic Academy. The two were definitely acquainted with each other through the powerful Medici family.

The light's similarity to a comet is absent from these sources, but in 1989 di Teodoro traced this element to *La composizione del mondo colle sue cascioni* (*The Composition of the World with its Causes*).[29] This was the first scientific treatise in an Italian vernacular, completed in 1282 by the monk, craftsman and scientist Restoro d'Arezzo. He had written:

> *E già vedemmo, stando lo sole quasi a mezzo virgine, aparire in oriente e·lla nona ora de la notte uno grandissimo vapore, quasi enfiambato, come una grandissima montagna, e avea grandi ragi o vòli crina, la quale era chiamata cometa …*
>
> And we have indeed, when the sun stood almost in the middle of Virgo, seen a very great vapour appear in the east at the ninth hour of the night, almost aflame, like a very great mountain, and it had great rays or volutes of hair, which was called a comet …[30]

[28] Proclus, *Commentary on Plato's Timaeus*, 1.181, tr. Harold Tarrant, *Proclus: Commentary on Plato's* Timaeus, vol. 1: *Book 1: Proclus on the Socratic State and Atlantis* (Cambridge University Press, 2006), pp.280-81.
[29] di Teodoro, 'Stupenda': p.124.
[30] d'Arezzo, *La composizione del mondo colle sue cascioni*, 2.7.5.4, ed. Alberto Morino, *Restoro d'Arezzo* (Florence: Presso l'Accademia della Crusca, 1976), p.191.

The object was the Great Comet of 1264 (C/1264 N1).[31] It was shortly followed by a second comet, which graced the western sky after sunset.[32] Di Teodoro passed over that part of Restoro's chapter, but as a complement to the eastern comet it underscores the parallel with Leonardo's theme.[33]

There is no denying Leonardo's dependence on most of these sources, but what does that prove? Even for a real letter it would surely be forgivable that he should have drawn on them without attribution, especially in draft or if he were writing from memory. Even in real life people's past reading colours their perceptions. And enough remains unaccounted for to warrant the impression of some direct observation: the tectonic troubles; the interview with the Caspians; the mountain's very white stone (*pietra biãchissima*), which is clearly limestone;[34] and the light's Protean propensity. One translation reads: "it is this which among you in calm weather has formerly been thought to be a comet".[35] That obnubilates the use of the first person plural (*abbiamo*): 'it is this which with you in calm weather *we* previously supposed to be a comet'.[36] Even so, the consensus since Govi and Freshfield has been that the man never set foot in Armenia and was just indulging in "imaginative word

[31] Enrico Narducci (ed.), *La Composizione del mondo di Ristoro d'Arezzo* (Rome: Tipografia delle Scienze Matematiche e Fisiche, 1858), p.132n1. Gary W. Kronk (*Cometography*, vol. 1: *Ancient-1799* (Cambridge University Press, 1999, pp.218-22) gives sources on this comet other than Restoro.
[32] d'Arezzo, *La composizione*, 2.7.5.8-9, ed. Morino, *Restoro*, p.192.
[33] For other signs that Restoro impacted Leonardo, see, *e.g.*, Domenico Laurenza, 'The Books of Nature', in Carlo Vecce (ed.), *Leonardo and his Books* (Florence: Giunti Editore, 2019): p.57; Martin Kemp, *Leonardo da Vinci: The Marvellous Works of Nature and Man* (Oxford University Press, 2006), pp.84, 99-101, 308; Claire Farago, 'The Codex Leicester', in Carmen C. Bambach (ed.), *Leonardo da Vinci: Master Draftsman* (New York: The Metropolitan Museum of Art, 2003): p.197; 'Eight Double-Sided Sheets from the Codex Leicester', in *idem*: pp.620-21; Webster Smith, 'Observations on the *Mona Lisa* Landscape', *The Art Bulletin* 67.2 (1985): pp.188-90, 198; Antonina Vallentin, *Leonardo da Vinci: The Tragic Pursuit of Perfection* (tr. Ernest Walter Dickes; London: W. H. Allen, 1922), pp.203-205, 341; Mario Baratta, *Leonardo da Vinci ed i problemi della terra* (Turin: Fratelli Bocca, 1903), *passim*.
[34] Richter, *Scritti*, p.388n11.
[35] MacCurdy, *The Notebooks*, p.534; *cf.* Wells, *Leonardo*, p.249.
[36] So Edward McCurdy, *The Mind of Leonardo da Vinci* (New York: Dodd, Mead & Company, 1928), p.233; Suh, *Leonardo's Notebooks*, p.244.

painting".[37] Robert Payne, indeed, went so far as to write the putative novel.[38]

[37] Kemp, *Leonardo*, p.145. *E.g.*, Gabriel Séailles, *Léonard de Vinci: L'artiste & le savant* (Paris: Librairie Académique Didier Perrin et C^{ie}, 1892), pp.525-28; *Léonard de Vinci: Biographie critique* (Paris: Librairie Renouard, 1903), p.43; Adolf Rosenberg, *Leonardo da Vinci* (Bielefeld: Verlag von Velhagen & Klasing, 1898), p.42, translated by J. Lohse as *Leonardo da Vinci* (London: H. Grevel & Co., 1903), p.48; Eugène Müntz, *Leonardo da Vinci: Artist, Thinker, and Man of Science*, vol. 1 (London: William Heinemann, 1898), pp.82-85; Sigmund Freud, *Eine Kindheitserinnerung des Leonardo da Vinci* (Leipzig: Franz Deuticke, 1910), pp.61-62, translated by Alan Tyson as *Leonardo da Vinci and a Memory of his Childhood* (New York: W. W. Norton & Company, 1964), pp.89-90; Ettore Verga, review of Carl Brun, 'Die Orientreise Leonardos' (1913), *Raccolta vinciana* 9 (1918), pp.34-36; Vallentin, *Leonardo*, pp.118-20; Rachel Annand Taylor, *Leonardo the Florentine* (New York: Harper & Brothers, 1928), pp.551-52; Franz Babinger and Ludwig Heinrich Heydenreich, 'Vier Bauvorschläge Lionardo da Vinci's an Sultan Bajezid II. (1502/3)', *Nachrichten der Akademie der Wissenschaften in Göttingen*: *Philologisch-historische Klasse* 1 (1952): pp.1-2; Giuseppina Fumagalli, *Leonardo: Omo sanza lettere* (Florence: Sansoni, 1952^2), pp.16, 171-72n1, 172-73n2; Castelfranco, *Studi Vinciani*, pp.137-38, 148-49, 152; Vasily Pavlovich Zubov, *Leonardo da Vinci* (tr. David H. Kraus; Cambridge, MA: Harvard University Press, 1968 [1962]), pp.242-44; Giovanni Ponte, *Leonardo prosatore* (Genoa: Tilgher-Genova, 1976), pp.113-17; Carlo Pedretti, *The Literary Works of Leonardo da Vinci …: Commentary*, vol. 2 (Berkeley, CA: University of California Press, 1977), pp.291-92; Robert Payne, *Leonardo* (Garden City, NY: Doubleday & Company, 1978), pp.256-58; Ernst Hans Gombrich, *New Light on Old Masters*, vol. 4 (Oxford: Phaidon Press, 1986), pp.77-86; di Teodoro, 'Stupenda'; Carlo Vecce, 'Scritti di Leonardo da Vinci', in Alberto Asor Rosa (ed.), *Letteratura italiana. Le Opere*, vol. 2: *Dal Cinquecento all'Ottocento* (Turin: Einaudi, 1993): pp.103, 123; Wells, *Leonardo*, p.248; Paul Strathern, *The Artist, the Philosopher, and the Warrior* (New York: Bantam Books, 2009), pp.230-31n†, 233; Filomena Calabrese, 'Leonardo's *Profezia*', *Quaderni d'italianistica* 32.2 (2011): pp.91-92, 98; Marco Versiero, *I Diluvi e le profezie* (Novara: DeAgostini, 2012), pp.12-13, 22, 24-25; Marina della Putta Johnston, 'Leonardo da Vinci: Scriversi come uomo di scienza', *Mnemosyne* 9 (2014): pp.33, 37-42, 45-46; Coneys, *Mandeville*, pp.78-79; Joost Keizer, *Leonardo's Paradox* (London: Reaktion Books, 2019), pp.151-61.

[38] Robert Payne, *The Deluge: A Novel by Leonardo da Vinci* (New York: Twayne Publishers, 1954).

Getting the Story Straight

This verdict relieved scholars of the duty to find a realistic physical explanation for the marvel of the light, but even their attempts to catch Leonardo's drift on its own terms were riddled with problems.

Fumagalli reckoned that Leonardo set the 'novel' in prehistory to explore a 'bold geological speculation' (*ardita speculazione geologica*) about outburst floods from a once larger Black Sea. The flooding, snow and destruction of the city in the outline would be "solo l'annuncio di un cataclisma maggiore", to wit, the final drainage that formed the circum-Pontic lowlands.[39] It must have evaded her that no one would project a sultan or *diodario* into such a hoary past. And the text does introduce a 'new prophet' (*novo profeta*) pronouncing on why 'this destruction is done' (*questa ruina è fatta*), but without intimation of further tragedy to come.[40]

Zubov – or the man who translated his book from Russian into English – messed up Taurus' altitude. There was no fault with the translation he cited for the lower half: "fifteen miles with a height of about five in a straight line."[41] That is to say, the hike up to that point covered a distance on the ground of some 15 miles, with an altitudinal gain of about 5 miles.[42] But in Zubov's book this is mangled into "fifteen miles of height vertically",[43] resulting in a total height of 30 miles instead of 10.

That aside, Zubov's take on the plot is as contrived as Fumagalli's. He gleaned that Leonardo tried to make sense of the puzzling glow first as a comet and then as sunlight constrained to a mountain top. So far so good, but he seems to treat it as some star of Bethlehem inspiring the journey to Armenia – from Syria – in the first place; upon arrival, the protagonist would not only have learned the truth about that spectacle, but also have run into the "destructive flood" as "mountain waters burst" through Taurus.[44] At the outset of the first fragment, Leonardo promised the *diodario* to relate "first the effect and then the cause" (*primo l'effetto e poi la causa*).[45] Zubov equated the 'effect' with the comet-like "unusual

[39] Fumagalli, *Leonardo*, pp.172n1, 172-73n2.
[40] On this prophet, see the appendix.
[41] MacCurdy, *The Notebooks*, p.536, translating "15 miglia, che sono circa a 5 · miglia d'altezza per linia retta", ed. Richter, *Scritti*, p.392.
[42] Compare di Teodoro, 'Stupenda': p.125.
[43] Zubov, *Leonardo*, p.248.
[44] Zubov, *Leonardo*, pp.245-49.
[45] Leonardo to the *diodario*, 4 (*cf.* 56-58, 60-61), tr. Richter, *Scritti*, p.386 (*cf.* 389-90).

illumination" and the 'cause' with the mountain itself. Styling the whole tale "hyperbolic", he reduced the disaster to mundane geological processes and accordingly toned down the meaning of Leonardo's *accidẽte* by translating "unforeseen event". This is not a tenable approach. Leonardo's storyline for the book shows that the 'effect' was the fall of the mountain, with the flooding, while one draft of the letter reveals the 'cause' to be "the true form of the Taurus Mountain" (*la vera figura di Tavrus Mõte*).[46] What he had in mind was perhaps a structural instability related to the mountain's continuous exposure to thunderbolts, at the level of clouds, for these left the rock "all riven and full of huge débris" (*tutto fracassato e pien di grã ruine*).[47] There is no textual proof either that investigation of the 'comet' was the purpose of coming to Armenia, even if the first observation of it had been in Syria, which is itself uncertain.

Gombrich's analysis echoes Zubov's. Omitting Aristotle, he voiced a hunch that reading Isidore and Mandeville had stimulated Leonardo "to speculate on the appearance of such a mountain at night and on the possibility that its summit might be taken for a comet of changing shape", which had then driven him to write fiction.[48] Gombrich did passingly contemplate Leonardo searching for the "real causes" of "a natural disaster",[49] but nevertheless settled on a 'cause' in the light reflecting off the mountain and an 'effect' in its resemblance to a comet.[50] Whilst he conceded that this scenario "still hangs in the air", it contravenes subtleties in Leonardo's text, as argued.

Keizer, to his credit, picked up on the mountain's ceaseless 'erosion' by thunder and lightning as the likely core of Leonardo's theory. Unfortunately, he muddied the waters by identifying this process as the "recent disaster" and soft-pedalling the flooding and blanketing in snow as nothing more than 'prophecies' deduced from the geology, which were to be elaborated in the forthcoming novel.[51] In the letters, the catastrophes undeniably are a recent historical reality. Moreover, again unconscious of the Aristotelian passage, Keizer gathered that the sun irradiates Taurus from the east and clouds refract that light to viewers in the west: "If you looked at the peaks from the west, you would find it radiating light a couple of hours before sunrise. Clouds rising up against the mountains refracted

[46] Leonardo to the *diodario*, 29, 65, tr. Richter, *Scritti*, pp.388, 390.
[47] Leonardo to the *diodario*, 77, tr. Richter, *Scritti*, p.391.
[48] Gombrich, *New Light*, p.87, *cf.* 81.
[49] Gombrich, *New Light*, p.87.
[50] Gombrich, *New Light*, p.81.
[51] Keizer, *Leonardo's Paradox*, pp.152-53, 156.

the peaks' reflection."[52] This distorts Leonardo's "careful scientific description", which keeps all morning light to Taurus' east and all evening light – which Keizer ignored – to its west. As a more trifling point of critique, it is silly to characterise 15th- or 16th-century Armenia as being "at the eastern end of the known world".[53]

The Armenian fragments deserve a fairer hearing than these strained and predominantly uniformitarian efforts. For all one knows, Leonardo had witnessed genuine devastation, which could fuel 'bold geological speculation' in his later years. The 'book' would be his full report to the *diodario* on its cause, to be illustrated with the sketches.[54] He remained vague about the order and catalyst of the collapse and flooding, but could have linked them with Taurus' great height through the thunderstorms halfway up, which subjected the upper segments to constant erosion. Without a shadow of a doubt, Leonardo meant the summit's protracted visibility to be recurrent due to the staggering height alone, just as Aristotle had done for the Caucasus.

As for the comet, the surface reading is the most parsimonious one: that it was Leonardo's first assessment of an arresting glow he observed in actual history. A comet cannot appear in front of a mountain, so the illuminated top will be an explanation – lifted from Aristotle – that he retrospectively pondered. All he ever saw, in this context, would have been the original light suggestive of a comet, in an unknown location, and the Taurus with its ordinary properties. A comet is a far cry from a luminous peak, but the cognitive leap would have been smaller if he had come across Restoro's record of the mountain-shaped comet seen at successive sunrises. That comet had been on the same side of the sky as the sun, but the simile could have sparked Leonardo's recollection of the way the sun shone on the Caucasus according to Aristotle. Outstanding questions are now: What phenomenon had that been? Had Leonardo really been in the region? And if so, what for? What was the 'comet' he watched there? And why his second thoughts on its identity?

Alpenglow?

Still unaware of the classical input, Richter believed that Leonardo was writing solely from his own observations. He reasonably fingered an earthquake as the underlying cause of the various disasters.[55] The

[52] Keizer, *Leonardo's Paradox*, p.152.
[53] *contra* Keizer, *Leonardo's Paradox*, p.151.
[54] McCurdy, *The Mind*, pp.234, 238.
[55] Richter, *Scritti*, pp.386n3, 388-89n30, 389n40.

innocuous nightly glow, meanwhile, reminded him of a familiar optical phenomenon:

> The description of the curious reflection in the evening, resembling the 'Alpine-glow' is certainly not an invented fiction, for in the next lines an explanation of the phenomenon is offered, or at least attempted.[56]

The Alpenglow is a roseate light crowning mountains when the sun is just below the horizon.

Vigen Gaikovich Khechoomian (1916-1975) was an Armenian historian patriotically inclined to set store by Leonardo's narrative. Though cryptically expressed, at least in the translation, his argument was that the artist was referencing the twilight (մթնշաղ *mtʻnšaġ*) as seen by him during a trip to Mount Ararat in June and locally counted as a part of the night.[57] Reading between the lines, Khechoomian, too, must have thought of the Alpenglow, but as lengthened first by being localised on the highest mountain and second by being timed at the summer solstice, when the twilight is the longest of the year. If Leonardo professed that the striking light pattern on Taurus appears year-round (*senpre* – 'always'), he might have done so in error, based on his limited data set. However, Khechoomian was – like Richter – oblivious to Leonardo's use of Aristotle, who implies that the effect manifested throughout the year. On top of that, the annual variation of the twilight in Armenia is only about 2 minutes for civil twilight to 33 for astronomical twilight – nothing to write home about.

The Alpenglow is quite a stretch for what Leonardo and Aristotle alike were describing anyway. Its hue might be likened to a reddish moon, but the comparison of the Taurus light to 'a *beautiful* light of the moon' (*vn* bel *lume di luna*) calls for a white colour – as does the repeated allusion to the limestone. Furthermore, sunrays do not strike even the highest peaks through any significant portion of the night, whether 'night' be defined as the period between civil, nautical or astronomical twilights. It has been calculated that the Caucasus would have to be 5,760 km high in order to meet Aristotle's description (Fig. 3).[58]

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[56] Richter, *Scritti*, p.388n14.
[57] Vigen Khechoomian, 'Leonardo da Vinci in Armenia' (1968), *The Armenian Review* 24 (1971): p.51.
[58] John Lewis Heilbron, *Galileo* (Oxford University Press, 2010), p.111.

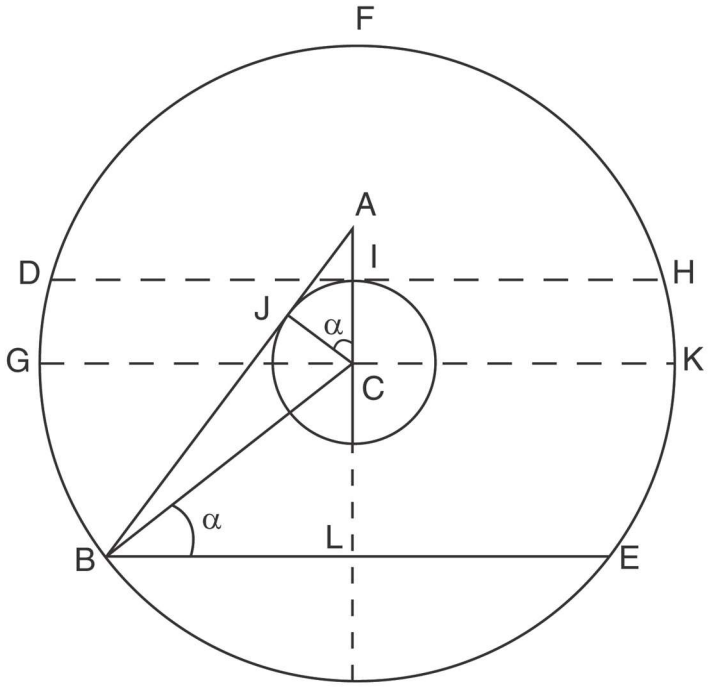


Figure 3. Diagram for calculating how high Mount Caucasus (AI) would have to be in order to receive the light of the set sun (B) when it has completed one third of its nocturnal path. α = ∠GCB = 60° = ∠GCK/3. Not to scale. © Heilbron, *Galileo*, p.111 fig. 4.1.

One classicist admitted defeat: "There is obviously something wrong with the text".[59] How Leonardo, at home in geometry, could have reconciled the summit's shining so deep into the night with a paltry height of 10 miles is anyone's guess, not to mention the long noon shadows, in relation to the solar elevation angles possible in Armenia.

Richter surmised that the 4 hours were counted from the first lighting up of the peak to when "the sun's rays penetrate to the bottom of the valleys",[60] as opposed to astronomical sunrise. However, it would take a second mountain between the Taurus and the sun to overshadow such a valley. There is no sign of that and the valleys in the Armenian plateau are

[59] William Arthur Heidel, *The Frame of the Ancient Greek Maps* (New York: American Geographical Society, 1937), p.78n175.
[60] Richter, *Scritti*, p.388n9-10.

themselves 800 to 2,000 metres above sea level, so that the difference might fall well short of 3 to 4 hours. Besides, even in valleys daytime is apparent from the brightness of the sky overhead.

Moonlight?

Moonlight could not be behind the enigmatic show of light on the Anatolian mountains either. When above the horizon, the moon shines on all things equally, like the sun. An effect from below the horizon would be more in line with Leonardo's statement that the light 'fulfills the function … that a beautiful light of the moon would in the midst of the darkness'. The conditional mood 'would (fulfill)' (*farebbe*) suggests that the moon is not up when the light materialises. Moonrise and moonset do come with a sort of twilight analogous to solar dawn and dusk, but that is again brief, is weak especially when the moon is new or crescentic, and occurs at any time of the night or day, varying with the lunar cycle. This is incompatible with the steady light that, in Leonardo's words, strikes 'always 4 hours before daytime' (*senpre 4 ore inanzi dì*). Would such an obvious agent confuse a keen observer like Leonardo anyway?

Zodiacal Light?

Were the prolonged impressions of dawn and dusk just extreme exaggerations of Alpenglow? Or should one consider a more fundamental question: were they really seen from afar to begin with? Reading closely, Aristotle only explicitly distanced observers from the mountain for the daytime settings on the water, not for the nocturnal visibility.

The case of the Caucasus is comparable to that of three other mountains: Casius (Jebel al-Aqra' or Kel Dağı), on the Syrian-Turkish border; Ida (Kaz Dağı), in northwestern Turkey; and Athos, in northeastern Greece. On the tops of these, according to ancient reports, the day broke hours earlier than down below. Most sources were discussed elsewhere,[61] except

[61] Ponte (*Leonardo*, p.116n45) and di Teodoro ('Stupenda': pp.124-25) addressed only material on Casius, as an additional influence on Leonardo. Supplement that with Marinus Anthony van der Sluijs, 'Ancient Reports of the Zodiacal Light as Viewed from Mountain Tops', *The Observatory* 143.1293 (2023): pp.57-60 and, for Casius: Mela, *Description of Lands*, 1.10 (61) (confused with the Arabian Casius); Ammianus Marcellinus, *Deeds*, 22.14.4; Martianus Capella, *On the Marriage of Philology and Mercury*, 6 (666); anonymous, *Augustan History*: *Life of Hadrian*, 14.3.

for Strabo averring of Athos that "those who live on the crest see the sun rise three hours before it rises on the seaboard."[62]

In the extended twilight experienced up these peaks van der Sluijs recognised the zodiacal light, a phenomenon well known to astronomers.[63] First observed systematically by Cassini in the early 1680s,[64] it is sunlight reflected off a cloud of minute dust particles in the inner solar system. These particles straddle the ecliptic, defined as the plane of the earth's orbit around the sun. Consequently, the light is concentrated in the zodiac as seen from Earth and this gives it its name. At middle latitudes, it typically appears as a tilted cone above the horizon in the direction of the sun that persists for some hours not long before sunrise in autumn and after sunset in spring – the so-called 'false dawn' and 'false dusk'. It is common knowledge that the purity of air and the absence of light pollution up in the mountains are highly conducive to seeing this feeble light. Ignorant of its true nature, of the earth's size and of the distance to the sun, someone beholding it from the top of a mountain could infer that not the rarefied air but the mountain's height alone facilitated its appearance.

In hindsight it should not take a genius to see the connection between the zodiacal light and the classical testimony regarding these mountains, considered on its own. What Leonardo evinced, however, was illumination of the mountain's apex as seen from a distance, bright enough to act like moonlight but fuzzy enough to be mistaken for a comet. This cannot have been a misrepresentation of the zodiacal light, as that stretches all the way down to the horizon and is at its brightest there. The directions would be wrong, too: the evening zodiacal light appears in the western sky, but an observer would have to look east to see a mountain top still lit by the set sun. Did Leonardo paint himself into a corner by misinterpreting Aristotle to the effect that people at ground level could also see the extended sunlight? Or, if his text was pure fiction, had he perchance misconstrued Arab folklore? Islāmic cosmographers were well aware of the 'false dawn' and even involved the Caucasus in their explanation of it – as recently as the late 18th century.[65] Yet whereas Leonardo firmly located the Caucasus

[62] Strabo, *Geography*, 7 fragment 33, tr. Horace Leonard Jones, *The Geography of Strabo*, vol. 3 (London: William Heinemann, 1924), pp.354-55.
[63] van der Sluijs, 'Ancient Reports': pp.58-59, 61-62.
[64] [Giovanni Domenico] Cassini, 'Nouveau phenomene rare & singulier d'une lumiere celeste, qui a paru au commencement du Printemps de cette année 1683', *Journal des Sçavans* 11.11 (1683): pp.121-32.
[65] Edward Scott Waring, *A Tour to Sheeraz, by the Route of Kazroon and Feerozabad* (London: T. Cadell and W. Davies, 1807), p.107.

in Armenia, they relegated it to the earth's distant rim and endowed it with an aperture through which the sun's early rays fleetingly produce the full classic pyramid of light. And where does Restoro's comet come in? It rose in the east before dawn, but a sunlit mountain should at that hour be to the west again.

At the end of the day, the most elegant hypothesis is that articulated above: that Leonardo was conflating the ancient sources with observations of his own. What could he have seen? Arguably, something has been overlooked so far.

The Oriental Question Revisited

Did Leonardo visit the East (fig. 4) after all?



Figure 4. Map showing the Mamlūk sultanate (green; left) and the Aq Qoyunlu confederation (yellow; right) in 1478. Adapted from Sémhur/ArabLeague/Rowanwindwhistler
(Wikimedia: Map_Aq_Qoyunlu_1478-es)

A fresh case can be made even without utilising every viable strand of Richter's argument. There is no pressing reason why the Florentine could not have been writing from personal experience to a real official, as first claimed by Richter. The known details of his life provide a narrow window for such an excursion: on 28 September 1481 he was still in Florence, working on an *Adoration* commissioned by the convent of San Donato at Scopeto, which he never finished, and – having been born on 15 April 1452 – the move to Milan when 'he was 30 years old' (*haueua 30 annj*) must

have occurred before 14 April 1483.[66] Nothing is on record for the period in-between.

Richter cast Leonardo as an engineer in the service of the Mamlūk sultan al-Ashraf Qā'itbāy (*c*1417-1496).[67] Based in Egypt but of Circassian birth, this great patron of art and architecture had undertaken an inspection tour of the fortresses in Palestine and Syria between 9 September 1477 and 9 January 1478, going as far north as Rumkale in the Euphrates valley on 19 October 1477.[68] In 1919, an intractable Armenian writer signing off as 'Mardig' published a short but spirited defence of Richter's position.[69] Decades later, Khechoomian painted a mostly credible picture of

[66] For these bracketing events, see 'the anonymous Gaddiano', *Codice Magliabechiano* (Florence: Biblioteca Nazionale, XVII, 17; AD *c*1540), 'Lionardo da Vincj', 8, ed. Carl Frey, *Il Codice Magliabechiano cl. XVII. 17* (Berlin: G. Grote'sche Verlagsbuchhandlung, 1892), p.110; Ravaisson-Mollien, 'Les Écrits': pp.240-48, 331-49, 514-24 = *Les Écrits*, pp.16-52; Rosenberg, *Leonardo*, pp.33-37, 42-43, tr. pp.36-40, 47-48; Verga, review of Brun, p.35; L. Beltrami (ed.), *Documenti e memorie rigvardanti la vita e le opere di Leonardo da Vinci in ordine cronologico* (Milan: Fratelli Treves Editori, 1919), p.9; Taylor, *Leonardo*, pp.551-52; Kenneth Clark, *Leonardo da Vinci: An Account of his Development as an Artist* (Cambridge University Press, 1939), pp.34-36, 183; Castelfranco, *Studi Vinciani*, p.209; Cecil Gould, *Leonardo: The Artist and the Non-Artist* (Boston: New York Graphic Society, 1975), p.51; Charles Nicholl, *Leonardo da Vinci: Flights of the Mind* (New York: Viking, 2004), pp.168-69, 176-77, 197; Wells, *Leonardo*, p.xlii; Bulent Atalay and Keith Wamsley, *Leonardo's Universe* (Washington, DC: National Geographic, 2008), p.104. Compare the estimated dates for Leonardo's Armenian stay in Richter, 'Lionardo': pp.139-40; 'La Question': p.88; *Scritti*, p.382; Heaton, 'Leonardo': p.195; Mardig, 'Leonardo da Vinci in Asia Minor', *Ararat* 6.65 (1919): p.395; and McCurdy, *The Mind*, pp.230-31, 241, 254.

[67] Richter, 'Lionardo': p.139; 'La Question': p.88; *Scritti*, pp.382, 385n1, 386n5.

[68] Abu'l Baqā' ibn al-Jī'ān (d. 1480), *al-Qawl al-Mustaẓraf fī Safar Mawlānā al-Malik al-Ashraf* (*The Elegant Report Recounting the Voyage of Our Lord the Esteemed Monarch*), tr. Mrs Robert Llewellyn Devonshire, 'Relation d'un voyage du Sultan Qâitbây en Palestine et en Syrie; Traduit de l'arabe', *Bulletin de l'Institut Français d'Archéologie Orientale du Caire* 20 (1922): p.16; Muḥammad ibn-Ṭūlūn (1475-1546), *I'lām al-Warā bi-Man Wulliya Nā'iban min al-Atrāk bi-Dimashq al-Shām al-Kubrā* (*History of the Turkish Governors of Damascus in Syria*), tr. Henri Laoust, *Les Gouverneurs de Damas sous les Mamlouks et les premiers Ottomans (658-1156/1260-1744): Traduction des annales d'ibn Ṭūlūn et d'ibn Ǧum'a* (Damascus: Institut Français de Damas, 1952), p.33.

[69] Mardig, 'Leonardo': pp.394-97.

Leonardo's contact with Armenian expats back home and his pursuits in Anatolia.[70] There, a sizeable Italian population had been present from the 14th century. The Persianate Aq Qoyunlu administration was in control of eastern Armenia. It was on uneasy terms with the Mamlūks, despite a joint cause against Ottoman expansion, but the Italians maintained friendly relations with both. In February and March 1474, Giosafat Barbaro (1413-1494) passed through the Taurus region as a Venetian envoy to the ruler of Aq Qoyunlu. He found that Corycus, today's Kızkalesi, 'was ruined in great part' (*in gran parte era ruinato*), its sights 'destroyed by the Ottoman' (*distrutti per lo Ottomanno*).[71] The stretch east of Adana, subject to the sultan, looked no better:

> *Lascio di dire le uille & castelli rotti, che si ritrouano per insino allo Euphrate; per non hauer cosa mòlto memorabile.*
>
> I will omit mentioning the broken manors & castles that are found as far as the Euphrates; for there is nothing very memorable about them.[72]

Khechoomian's contention was that the sultan, in the wake of his survey, initiated a programme of repairs, putting Leonardo to work on these ravaged fortifications along the border between Syria and Armenia.

Leonardo's letter states that the mission began 'in the city of Calindra, close to our borders' (*nella città di Calindra, vicina ai nostri confini*), which 'is situated on the shores of that part of Mount Taurus that is divided by the Euphrates and faces the peaks of the great Mount Taurus to the west' (*è posta nelle spiaggie di quella parte del mõte Tavro, che è diuisa dall' Eufrates e riguarda i corni del grã Mõte Tavro per ponẽte*).[73] Calindra, which Keizer dismissed as "an imagined city",[74] is bound to be Celenderis, a port some 70 km west of Corycus. Under that name it is shown on the first map of Asia in Ptolemy's *Geography*.[75] A Latin edition of that was in

[70] Khechoomian, 'Leonardo': pp.3-16, 46-52.
[71] Giosafat Barbaro, 'Viaggio … in Persia', ed. anonymous, *Viaggi fatti da Vinetia, alla Tana, in Persia, in India, et in Costantinopoli* (Venice: Aldvs, 1543), pp.28*v*, 29*r*.
[72] Barbaro, 'Viaggio', p.30*v*.
[73] Leonardo to the *diodario*, 6-9, ed. Richter, *Scritti*, p.387.
[74] Keizer, *Leonardo's Paradox*, p.152, *cf.* 151; Dietrich Seybold, *Leonardo da Vinci im Orient: Geschichte eines europäischen Mythos* (Cologne: Böhlau Verlag, 2011), p.317.
[75] *e.g.*, https://commons.wikimedia.org/wiki/File:Tabula_Prima_de_Asia.jpg.

Leonardo's possession.[76] By then, the city had belonged to Cilician Armenia and it is now Aydıncık. This is the identification that Richter put forward in his original article on this subject and he then sensibly translated: "liegt am Strande an jenem Teile des Taurusgebirges, welcher vom Euphrat geteilt wird".[77] The words *nelle spiaggie* unquestionably indicate a position on the shore, but in his definitive edition Richter downplayed this clue by translating "at the base" and backed away from the link with Celenderis.[78] He probably did so under the impression that Leonardo was situating Calindra close to the Euphrates, which Celenderis is not.[79] Di Teodoro came down on the same side, homing in on a 'Cholmadara' – or 'Choldamara' – far inland in Commagene, north of Syria, as on Ptolemy's fourth map of Asia.[80] The conundrum is solved if the 'part of Taurus' at issue was not a small area, but one of the respective geographical ranges of that name – the Central Taurus, which does have Celenderis at its western shore and is intersected by the Euphrates at its eastern extremity.

Leonardo seems to position this part 'to the west' (*per ponẽte*) of another one: the *great* Taurus, so called because it contained the lofty peaks with the alluring night light.[81] The highest points of the Taurus – Uludoruk Dağı at 4,135 m, Cilo Dağı at 4,116 m and others – are indeed all in the Eastern Taurus range; the Central Taurus attains its greatest height in Mount Erciyes, at 'only' 3,916 m. These peaks had not yet been scaled,[82] let alone their exact altitudes measured, but Barbaro's journal, too, notes the 'highest and jagged mountains' (*mõti altissimi, & asperi*) in Taurus'

[76] Descendre, 'La Biblioteca': p.4.
[77] Richter, 'Lionardo': p.137; *cf.* 'La Question': p.87. The same identification was made in Freshfield, in Wilson, 'Notes': p.323; Edmondo Solmi, *Leonardo (1452-1519)* (Florence: G. Barbèra, 1900), pp.44; *Leonardo da Vinci. Frammenti letterari e filosofici* (Florence: G. Barbèra, 1904 [1899]), p.326n*; McCurdy, *The Mind*, pp.233, 249-51, 254; MacCurdy, *The Notebooks*, p.526n1; Fumagalli, *Leonardo*, p.173n4; Khechoomian, 'Leonardo': pp.11-13. See also Payne, *Leonardo*, p.258; *The Deluge*, p.14.
[78] Richter, *Scritti*, p.387n7, but compare 386n5.
[79] Richter, 'Lionardo': p.137.
[80] di Teodoro, 'Stupenda': pp.122-23.
[81] MacCurdy (*The Notebooks*, p.534; *cf.* McCurdy, *The Mind*, p.232) translated *piaggie* correctly, but otherwise differed: "This city is situated on the sea-coast of that part of the Taurus range which is separated from the Euphrates and looks westward to the peaks of the great Mount Taurus." *Cf.* Khechoomian, 'Leonardo': p.11; Wells, *Leonardo*, p.249.
[82] Compare Leonardo to the *diodario*, 93-94, ed. Richter, *Scritti*, p.392.

easternmost section.[83] Perhaps Leonardo figured that the unremitting erosion of the limestone rocks by lightning that was still going strong in the Eastern Taurus had in the Central Taurus already created a much less elevated karst-like topography vulnerable to further collapse, as he could personally vouch for.

The natural upheaval related in the letters was almost certainly a major earthquake causing flooding and avalanches – or what Leonardo called a 'devastation of snow' (*Ruina di neve*).[84] He gave the locale of the flooding as 'western Armenia' (*Erminia occidentale*).[85] Richter inadvertently translated "Eastern Armenia" in his standard edition, thereby misleading many.[86] His candidate for the earthquake was one that struck Aleppo in 1484,[87] but apart from the late year there is no evidence that it did much harm.[88] An earthquake associated with a tsunami struck Rhodes and Antalya on 3 May 1481, but also caused limited damage and would be too early; Leonardo mentioned it in a different text.[89] Khechoomian was taken in by Richter's mistranslation, but still perceived that the culprit had to be the destructive earthquake that, on the authority of Armenian chroniclers, afflicted the region of Erzincan at the very end of the year 931 of the Armenian era, which must be November 1482.[90] Though the locals of that town were no strangers to earthquakes with landslides and overflowing of the Euphrates' banks, this occasion stood out for its tragic death toll of

[83] Barbaro, 'Viaggio', p.32*v*.
[84] Leonardo to the *diodario*, 32, ed. Richter, *Scritti*, p.389; *cf.* to the unknown addressee, 10, p.393. See Mardig, 'Leonardo': p.397; McCurdy, *The Mind*, pp.237-38; MacCurdy, *The Notebooks*, p.533; Zubov, *Leonardo*, p.249; Pedretti, *The Literary Works*, p.293; Payne, *Leonardo*, p.257; Wells, *Leonardo*, pp.248, 252.
[85] Leonardo to the *diodario*, 36, ed. Richter, *Scritti*, p.389.
[86] *e.g.*, Mardig, 'Leonardo': p.396; Khechoomian, 'Leonardo': pp.15, 47, 49; Payne, *Leonardo*, p.256; Gombrich, *New Light*, p.79; Suh, *Leonardo's Notebooks*, p.245. The translation in Richter, 'Lionardo': p.136 was accurate.
[87] Richter, 'La Question': p.88; *Scritti*, pp.388-89n30.
[88] Emanuela Guidoboni and Alberto Comastri, *Catalogue of Earthquakes and Tsunamis in the Mediterranean Area from the 11th to the 15th Century* (tr. Brian Phillips; Rome: Istituto Nazionale di Geofisica e Vulcanologia, 2005), p.798.
[89] Guidoboni and Comastri, *Catalogue*, pp.777-83; McCurdy, *The Mind*, p.245.
[90] Khechoomian, 'Leonardo': pp.15-16, 46-49. Khechoomian (p.49) gave Hovhannes Daranaghetzi as a source, but this being Hovhannes Draskhanakerttsi (*fl.* AD 920) it must be an error for the anonymous chronicler of Sivas, cited in Guidoboni and Comastri, *Catalogue*, pp.788-89, along with other primary sources.

18,000 to 32,000 human lives. The Armenian seismologist Arkady Stepan Karakhanian (1951-2017) also felt that Leonardo was "an eye-witness of the 1482 catastrophic earthquake", leaving his "detailed description of this event."[91] The collapsing mountain and disruption of the Euphrates find a precedent in the events of August 817, as narrated in the chronicle of Michael the Syrian (d. 1199):

> … there was a great and very terrible earthquake: the mountains cracked, the springs dried up. At Agoursa, a village in the region of Claudia, a great mountain fell into the Euphrates, obstructed it and suspended its course for a whole day. At Ṭema'în the spring was dried up, and in several places abundant springs sprang up.[92]

Claudia or Claudias was a fortress just southeast of Malatya, known earlier as Claudiopolis.[93]

Erzincan is at the western boundary of Armenia in its greatest historical extent, though a long way from Aydıncık. Leonardo's draft included a remarkably serviceable sketch map of the Upper Euphrates basin, on which this town can be pinpointed with confidence (Fig. 5). It sits on the northern edge of a shaded area that, in all likelihood, represents the flooded zone.[94] Malatya, at the centre of that zone, could be the city where Leonardo was stationed during the cataclysm. Observing the light effect only in the evenings, as his text signals, he would have pictured the wondrously bright pinnacles somewhere east-northeast to southeast, in the Eastern Taurus. He thus seems to have travelled from Aydıncık along the western fringes of the Armenian highlands and Aq Qoyunlu territory. There are no grounds for supposing with Khechoomian that he continued further east than Erzincan.[95] His enquiry with inhabitants of the Caspian shore rings true, but need not have taken place near the Caspian Sea itself. The information

[91] Arkady Stepan Karakhanian, 'Active Faults of the Armenian Upland', in Valerio Spagna and Enrico Schiavon (eds.), *Scientific Meeting on the Seismic Protection* (Venice: Dipartimento per la Geologia e le Attività Estrattive, 1995): p.91. Compare the original but uncritical ideas in Hüseyin Doğan, *Hidden Secrets in Mona Lisa: Islamic Codes of Da Vinci* (place and publisher not stated, 2016), pp.29-32, 66-69.
[92] Michael the Syrian, *Chronicle*, 12.8 (497-498), tr. (to French) Jean-Baptiste Chabot, *Chronique de Michel le Syrien*, vol. 3 (Paris: Ernest Leroux, 1905), p.34.
[93] *e.g.*, Thomas Alan Sinclair, *Eastern Turkey: An Architectural and Archaeological Survey*, vol. 4 (London: The Pindar Press, 1990), pp.63, 200.
[94] Richter, *Scritti*, p.391n77.
[95] *contra* Khechoomian, 'Leonardo': pp.49, 51-52.

he obtained from them, possibly far from their homes, cannot be right at any rate. Reaching 5,137 m, Mount Ararat (Ağrı Dağı) well surpasses the 4,135 m of Uludoruk Dağı.

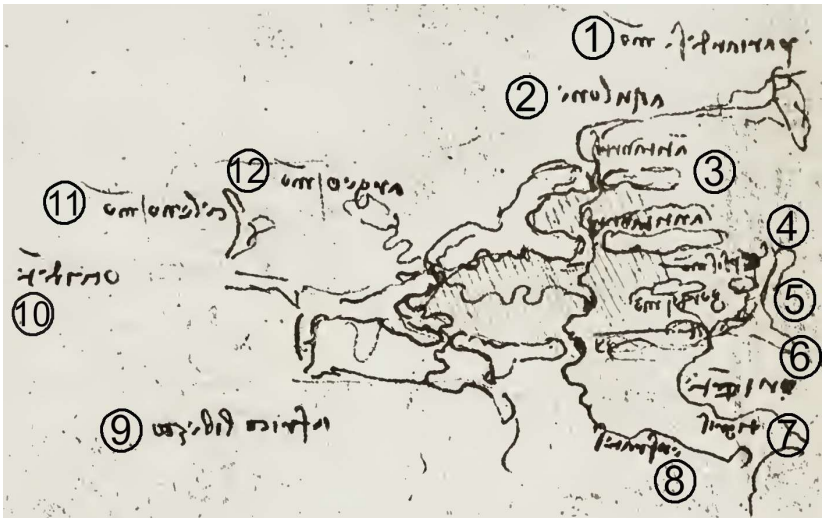


Figure 5. Sketch map of the basin of the Upper Euphrates and Tigris. From Leonardo da Vinci's notebooks, *Codex Atlanticus*, 393*r*. Richter, *Scritti*, p.392/93 pl.118 top. The shaded area would be the flooded one. Added numbers: 1. *pariardes mõ*. = Paryadres (Pontic) Mountains; 2. *aquilone* = north; 3. *antitaurus* (twice) = Antitaurus; 4. *...psis mõ* = Thospitis Mountains (?), near Lake Van; 5. *gordis mõ* = Gordyaean Mountains, eastern Taurus; 6. *oriẽte* = east; 7. *tigris* = Tigris; 8. *eufrates* = Euphrates; 9. *africo libezco* = southwest; 10. *occidẽte* = west; 11. *celeno mõ* = Celaenae Mountains (Sultan Dağı), near Dinar; 12. *argeo mõ* = Mount Argaeus (Erciyes Dağı), near Kayseri. Erzincan is at the northern limit of the shaded area, just south of the western part of the gorge.

What are the odds that the Tuscan engineer should have invented or borrowed from an unknown author the graphic account of a real crisis that happened in a year for which his own activities are entirely unknown? This very convulsion of nature may have cut his assignment short to mere months, as Richter's champion Edward Alexander Coles McCurdy (1871-1957) eloquently speculated.[96] This could be so even if the drainage of the flood water 'through the cutting of Mount Taurus' (*per la tagliata di mõte*

[96] McCurdy, *The Mind*, pp.238-39, 251, 254.

Tavro) – listed in the synopsis for the planned book – was Leonardo's own handiwork. Some had suggested as much, be it as real[97] or a flight of his mind.[98] Richter's solution was simpler: that the 'cutting' was the famous gorge enabling the Euphrates to flow south through the Central Taurus or Anti-Taurus.[99] Located south of Erzincan, this is clearly depicted in the sketch map.

The drafts express Leonardo's worry that his superior lose patience with him for procrastination.[100] That would be true to form, though a perfectionist streak may have played a part. The *diodario* may or may not have withdrawn his favour in the end. Keizer opined that "no modern scholar has ever managed to figure out who he was" because Leonardo "made up the rank of the lieutenant".[101] The office in question was the *dawādār* (دوادار, literally 'holder of the inkwell') or executive secretary.[102] The term is often conveniently used for what was actually the 'grand *dawādār*' (*dawādār kabīr*), who answered directly to the sultan. For example, Barbaro talked about the 'grand *dawādār* of the sultan' (*diodar grando del Soldan*),[103] but also labelled him just 'the *dawādār* of the sultan' (*el diodar del soldan*).[104] Leonardo, by contrast, wrote to a '*dawādār* of Syria'. A critic of the idea that he was in Armenia objected that there was no such thing as a *dawādār* of a specific region.[105] He slipped up, however,

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[97] Mardig, 'Leonardo': p.396; compare Khechoomian, 'Leonardo': p.47.
[98] Payne, *Leonardo*, p.256 (*cf. The Deluge*, p.11); Gombrich, *New Light*, pp.86-88; compare Keizer, *Leonardo's Paradox*, p.156.
[99] Richter, *Scritti*, p.389n36; compare Zubov, *Leonardo*, p.245.
[100] Heaton, 'Leonardo': p.195; Richter, *Scritti*, p.382.
[101] Keizer, *Leonardo's Paradox*, p.152.
[102] So already Richter, 'Lionardo': p.136; *Scritti*, p.385n1; Ravaisson-Mollien, 'Les Écrits': p.333n3 = *Les Écrits*, p.26n3; Henry Yule (1820-1889), in Freshfield, in Wilson, 'Notes': p.323; Solmi, *Leonardo*, p.325n**.
[103] J. Barbaro to the Doge (27 April 1473), ed. Enrico Cornet, *Lettere al Senato Veneto di Giosafatte Barbaro ambasciatore ad Usunhasan di Persia* (Vienna: Libreria Tendler & Comp., 1852), pp.26, *cf.* 27-30.
[104] J. Barbaro to the Doge (9 and 13 April 1473), ed. Cornet, *Lettere*, pp.14, 16, *cf.* 15, 17.
[105] Seybold, *Leonardo*, pp.96-97, 99-100, 213. Seybold found an exception in the diary of Marino Sanuto the Younger (1466-1536), which mentions "cazar el diodar de la Soria" in a quoted letter from Alexandria dated 30 December 1497 (ed. Federico Stefani, *I Diarii di Marino Sanuto*, vol. 1 [Venice: Tipografia del Commercio di Marco Visentini, 1879], p.911). However, the context demonstrates that that concerns *el diodar grando* (see also pp.878, 886) and the words should mean 'to drive the *dawādār* from Syria'. The subject is the

for a local governor (*nā'ib*; Fig. 6) frequently had his own *dawādār*. Examples abound in the Syrian annals of ibn-Ṭūlūn,[106] but are also in the diary of the sultan's northern tour. During a stopover in Damascus on 11 December 1477, the sultan promoted one Jamāl al-Dīn, '*dawādār* of the governor of Syria', to the position of *ustādār* ('chamberlain') of the Ghors.[107] These Ghors were the Jordan valley. The diary names the *amīr* Jānībak al-Īnālī Qulaqsīz as the 'governor of Syria' himself.[108] The ensuing mention of the *amīr* Yalbāy al-Mu'ayyadī as '*dawādār* of Syria'[109] is best understood if this person was the new incumbent replacing Jamāl al-Dīn. 'Syria' was presumably interchangeable with 'Damascus' in these titles, for ibn-Ṭūlūn has this same Jānībak as governor of Damascus from 1473 to 1479.[110]



Figure 6. Anonymous, *The Reception of the Venetian Ambassadors in Damascus* (1511), probably painted in the workshop of Gentile Bellini (1429-1507). The seated character with the curious headdress is the *nā'ib* or governor of Damascus. Louvre, Paris. (Wikimedia: Anonymous Venetian Orientalist Painting, The Reception of the Ambassadors in Damascus)

rebellion of grand *dawādār* Āqbirdī min 'Alī Bāy (*c*1449-1498), a relative of Qā'itbāy.

[106] ibn-Ṭūlūn, *I'lām al-Warā*, tr. Laoust, *Les Gouverneurs*, *passim*.

[107] ibn al-Jī'ān, *al-Qawl al-Mustaẓraf*, tr. Devonshire, 'Relation': p.26.

[108] as above, tr. Devonshire, 'Relation': pp.8, 22, 25-27.

[109] as above, tr. Devonshire, 'Relation': p.27.

[110] ibn-Ṭūlūn, *I'lām al-Warā*, tr. Laoust, *Les Gouverneurs*, pp.32-33.

Leonardo's designation 'lieutenant of the holy sultan' (*locotenẽte del Sacro Soltano*)[111] accords with the rôle of 'viceroy' or 'vice-sultan' (*nā'ib al-salṭana*). As one scholar explained:

> *Nā'ib* could mean, loosely, any person appointed to represent another in any kind of matter. But it was more commonly used for men nominated to official positions, with an implication of subordination to a superior authority. It thus meant lieutenant, vicegerent or deputy. In the Mamluk state, the title *nā'ib al-salṭana* was applied to the Sultan's deputy and chief administrator …, and to provincial governors acting in his name in Egypt, Syria and Palestine.[112]

On a straightforward reading of the letter, Leonardo identified the '*dawādār* of Syria' as a *nā'ib al-salṭana*. The rationale may have been that the *dawādār* of a governor also represented the sultan. Qā'itbāy's travelogue qualifies someone as '*dawādār* of the sultan in Aleppo', alongside the 'governor of Aleppo' himself.[113] There was also a '*dawādār* of the sultan in Damascus', at least in 1464 and 1500-1501.[114] What is more, a *dawādār* could fill in for an absent governor, as in 1497 and 1498.[115] If Leonardo composed the letter soon after the earthquake of 1482, the ruling governor of Damascus and viceroy of Syria (*nā'ib al-salṭana bi-l-Shām*) was *amīr* Qijmās al-Isḥāqī. Coming from Egypt not long before, he was well respected even by the sultan and died in 1487.[116] His *dawādār* must have been his emancipated slave Shādbak Khāzindār, who was killed in action in June 1484.[117] Was he Leonardo's erstwhile master?

The occasion when the restless polymath first observed the 'comet' with the *dawādār* in 'calm weather' could have been some weeks or months prior to the earthquake of 1482. Conjecturing freely, however, one cannot help wondering whether it might instead have been when the sultan was in Syria. Leonardo's whereabouts are again undocumented for that period.

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[111] Leonardo to the *diodario*, 1-2, ed. Richter, *Scritti*, p.385.
[112] Ami Ayalon, *Language and Change in the Arab Middle East* (New York: Oxford University Press, 1987), p.75.
[113] ibn al-Jī'ān, *al-Qawl al-Mustaẓraf*, tr. Devonshire, 'Relation': p.20.
[114] ibn-Ṭūlūn, *I'lām al-Warā*, tr. Laoust, *Les Gouverneurs*, pp.30, 69, 74, 76.
[115] as above, tr. Laoust, *Les Gouverneurs*, pp.40-41.
[116] as above, tr. Laoust, *Les Gouverneurs*, pp.34-36; *cf.* Daisuke Igarashi, 'The Waqf-Endowment Strategy of a Mamluk Military Man', *Bulletin of SOAS* 82.1 (2019): pp.27, 31, 47-48.
[117] Igarashi, 'The Waqf-Endowment Strategy', p.52.

Having been acquitted of sodomy the year before, he left Verrocchio's studio sometime in 1477 and opened his own later that year or in 1478, but there is ample scope for some intervening months abroad. Nor is it inconceivable – given the tense geopolitical situation in the Orient in that period – that he operated there as a spy under cover of his engineering commitments. That could have been why he kept silent about these adventures upon his return to Italy, along with the eventual fiasco.

These more radical thought experiments may be brushed off, but any lingering doubt that a sojourn in the Levant suited Leonardo's character should be dispelled by a Turkish rendition of a letter that turned up at the State Archives in Istanbul's Topkapı Palace in 1952 – long after Richter had gone to press. Arriving from Genoa in 1502 or 1503, the letter is an application for an engineering post submitted by the 'infidel named Lionardo' (*Lionardo adlu kjâfir*) to Bāyezīd II (1447-1512), sultan of the Ottoman Empire.[118] The concrete building proposals in it cement none other than da Vinci as the author. If he harboured such interests then, why not some twenty years before as well? The association of the Armenian letters with the earthquake of 1482 looks perfectly feasible and provides a compelling setting for his seemingly authentic notes on the shapeshifting comet, which he subsequently reinterpreted as the mountain's acme. What could he have seen, right across no less from the direction where the zodiacal light would be? No comet is known for the period 1481-1488.[119]

The *Gegenschein*

The iconic eastern and western pyramids of the zodiacal light are closely related to some other types of nighttime glow that could rise to the challenge. The zodiacal band is sunlight reflected off dust outside the earth's orbit that forms a narrow band along the ecliptic. If one of the pyramids is also visible, the band appears as a dimmer extension of it. Backscattering off that same interplanetary dust is the cause of a bulge of

[118] Topkapı Museum, E 6184, in Babinger and Heydenreich, 'Vier Bauvorschläge': pp.1-20; Ponte, *Leonardo*, p.114; 'Attorno a Leonardo da Vinci: L'attesa popolare del Sofì di Persia in Venezia e Firenze all'inizio del Cinquecento', *La Rassegna della letteratura italiana* 81.1-2 (1977): p.19; Pedretti, *The Literary Works*, pp.212-14, 292; Payne, *Leonardo*, pp.178-80; Vecce, 'Scritti': p.103; Nicholl, *Leonardo*, pp.353-56; Atalay and Wamsley, *Leonardo's Universe*, pp.198-99; Strathern, *The Artist*, pp.224-33. See also Edmondo Solmi, 'Leonardo da Vinci e la repubblica di Venezia; Novembre 1499 – Aprile 1500', *Archivio Storico Lombardo* 10.20 [35] (1908): pp.352-53.

[119] Kronk, *Cometography*, p.289.

concentrated light in the band, enhanced enough to often be visible when the band is not. Some 10° wide, this diffuse oval is called the *Gegenschein*, which is German for 'countershine' or 'counterglow'. Situated exactly at the antisolar point (ASP), its position changes with the sun's invisible passage below the horizon.

Naturally, these features are most conspicuous in a clear, moonless sky. They are not as elusive as is widely believed, however. Although it has been dubbed the stargazers' Holy Grail owing to such a reputation, "there are really very few things in the sky that are easier to see than the gegenschein", assured Edward Emerson Barnard (1857-1923), who was an early expert on it.[120] Once identified, this glow is quite easy to follow across the sky and to correlate with the sun's hidden movement. Best seen around midnight, when it is highest in the sky, in months when it is not in front of the Milky Way, notably the late autumn and late winter of either hemisphere,[121] it "does not seem to be extremely far away" and varies in shape from "small and somewhat elongated" to "very large and round".[122] This metamorphosis involves a seasonal component,[123] but also a noteworthy daily variation. As a Russian specialist attests: "Perhaps one of

[120] Edward Emerson Barnard, 'The Gegenschein or Zodiacal Counterglow', *Popular Astronomy* 7.4 (64) (1899): p.174, *cf.* 176-77; 'The *Gegenschein* or Zodiacal Counterglow', *The Astronomical Journal* 17.403 (1897): p.151.
[121] Michael Maunder, *Lights in the Sky* (London: Springer-Verlag, 2007), p.127; James Bailey Kaler, *The Ever-Changing Sky* (Cambridge University Press, 1996), p.375; Stephen J. Edberg and David Howard Levy, *Observing Comets, Asteroids, Meteors, and the Zodiacal Light* (Cambridge University Press, 1994), pp.154-57.
[122] Barnard, 'The Gegenschein', *Popular Astronomy* (1899): pp.175, 171.
[123] M. Ishiguro *et al.*, 'High-Resolution Imaging of the Gegenschein and the Geometric Albedo of Interplanetary Dust', *The Astrophysical Journal* 767.75 (2013): pp.1, 6, 11; Barnard, 'The Gegenschein', *Popular Astronomy* (1899): pp.171, 179; 'Periodical Changes in the Form of the *Gegenschein*', *The Astronomical Journal* 20.472 (1899): pp.131-32; 'The *Gegenschein*', *The Astronomical Journal*: pp.151-52; 'The Gegenschein or Zodiacal Counter Glow', *Popular Astronomy* 1.8 (1894): pp.340-41; 'Observations of the *Gegenschein* or Zodiacal Counterglow, Made at the Lick Observatory during September and October, 1893', *The Astronomical Journal* 13.308 (1893): pp.169-71; 'Observations of the Zodiacal Counterglow, or *Gegenschein*, Made at Mt. Hamilton during the Years 1888, 1889, 1890, 1891', *The Astronomical Journal* 11.243 (1891): pp.19-20; 'Observations of the Zodiacal Counterglow', *The Astronomical Journal* 7.168 (1888): pp.186-87. Graphics are in Hiroyoshi Tanabe, 'Photoelectric Observations of the Gegenschein', *Publications of the Astronomical Society of Japan* 17.4 (1965): p.358 fig.6, *cf.* 360.

the most reliable facts regarding the gegenschein is its changeability: its shape, size, and brightness all vary from night to night, and also during a single night."[124] These rapid fluctuations "can all be explained as an effect of solar corpuscular streams", meaning the solar wind.[125]

Together with the zodiacal light and band, the *Gegenschein* will in antiquity have made up the scattered 'flames' seen to give way to the rising sun from the heights of Ida.[126] It also seems to be what Leonardo initially mistook for a comet, variously round and long. The occasional bi- or tripartition he reported may have been due to: portions of the zodiacal band appearing alongside it; fine internal structure from asteroidal dust bands, revealed in it when the sky was exceptionally transparent; or a "*nucleus* of greater brightness", which "is a small definite circular spot of about 2° in diameter, … only to be detected under favorable atmospheric conditions."[127]

Because the *Gegenschein* "has the appearance of a nebula and similar size of a comet, it was often mistaken for one."[128] That is what occurred when Barnard first saw it: "In 1883 about October 1st the writer in seeking comets at Nashville, Tennessee, one night happening to look up to rest his eyes, saw a faint hazy glow near the constellation of Pegasus. This was thought to be a bit of local haze, though it seemed abnormally permanent. The next night it was seen again and was therefore no ordinary haze. A few nights' location of its position showed that it was moving along the ecliptic eastward about one degree a day. Could it be an immense comet? It was certainly no ordinary meteorological phenomenon. The positions obtained were sent to an eminent astronomer with the suggestion that it might be some extraordinary kind of comet. He wrote back that I had discovered the

[124] Lev Mironovich Gindilis, 'Absolute Spectrophotometry of the Gegenschein Continuum' (tr.), *Soviet Astronomy* 6.1 (1962): p.67.
[125] Gindilis, 'Absolute Spectrophotometry': p.76; *cf.* 'The Gegenschein as an Effect Produced by the Scattering of Light from Particles of Interplanetary Dust' (tr.), *Soviet Astronomy* 6.4 (1963): pp.540-41.
[126] van der Sluijs, 'Ancient Reports': pp.61-62.
[127] Henry Carvill Lewis, 'Note on the Zodiacal Light', *The American Journal of Science*, 20.120 (1880): p.443. *Cf.* Ishiguro *et al.*, 'High-Resolution Imaging'; Robert Bruce Bousfield, 'The Zodiacal Band', *Monthly Notices of the Royal Astronomical Society* 94 (1934): pp.833, 834 fig. 4; Barnard, 'Observations' (1893): p.170; 'Observations' (1891): p.20.
[128] Maunder, *Lights*, p.127.

Gegenschein."[129] The astronomer was Lewis A. Swift (1820-1913).[130] By suspecting a comet at first, Leonardo would thus be in good company.

If the *Gegenschein* is a form of reflected sunlight, what is the reflecting surface? The answer of the American anomalist Charles Hoy Fort (1874-1932), in his inimitable way, was a giant solid and mostly opaque shell around the earth:

> That the sky is a matrix, in which the stars are openings, and that, upon the inner, concave surface of this celestial shell, the sun casts its light, even if the earth is between …[131]

That may have been no more than a *jeu d'esprit* on Fort's part, but a canvas of some sort *would* be needed for someone clueless about the cosmic dust. Anaximenes of Miletus (*c*585-*c*525 BC) had, in fact, theorised a solid starry sphere and classicist Peter James Bicknell (1938-2001), following Fort's logic, posited in earnest that seeing the *Gegenschein* had been the philosopher's motivation.[132] There is no record of that, but Leonardo could have come to look at this comet-like light through a similar lens by factoring in the Caucasus – whether or not Restoro's mountain-shaped comet triggered this flash of insight. Assuming that Aristotle had described the scene remotely, not from the summit, Leonardo must have imagined that he had seen the mountain's crest towering in the distance, receiving the sun's light even in the depth of the night. Maybe the crest had been so indistinct in the daytime as to go unnoticed then, but the ghostly white sheen of the 'comet' tellingly tallied with Taurus' abundant ridges of white limestone.

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[129] Barnard, 'The Gegenschein', *Popular Astronomy* (1894): p.339; *cf.* 'The Gegenschein', *Popular Astronomy* (1899): p.170; 'Observations' (1888): p.186; 'Gegenschein', *The Sidereal Messenger* 2.8 (18) (1883): p.254.

[130] Lewis A. Swift to Barnard (11 October 1883), in William Sheehan, *The Immortal Fire Within* (Cambridge University Press, 1995), p.69.

[131] Charles Fort, *New Lands* (New York: Boni & Liveright, 1923), p.82. Fort justified the *Gegenschein*'s stellar distance by the then current view that it lacks parallax. Though hard to measure, the *Gegenschein* does have parallax, however –

Robert George Roosen, 'The Gegenschein', *Reviews of Geophysics and Space Physics* 9.2 (1971): pp.281-83; Tanabe, 'Photoelectric Observations': pp. 362-63, 365; Gindilis, 'The Gegenschein': pp.540-41.

[132] Peter James Bicknell, 'Anaximenes and the Gegenschein', *Apeiron* 11.1 (1977): pp.49-52.

Leonardo could have abandoned the comet interpretation upon finding out that the mysterious light was always diametrically opposite the place under the horizon where the sun must be. His expression 'in a straight line' (*per linia retta*) confirms that he was concerned with the antisolar point. In the few hours that he could have tracked the 'antisun', before it faded from view, he potentially saw it move from the eastern side of the sky via the south towards the western side. As the Taurus comprises a whole range of peaks (*Questi corni* – 'These peaks'), such a shift would not baffle him when he began to entertain the mountain scenario. The 'summit' (*cima*) could have had a considerable horizontal extent towards his south. However, he held that 'those of the west' could only ever see the evening reflection and 'those of the east' only the morning reflection. Had he observed the *Gegenschein*'s full movement from east to west, he would have realised that it shines even where no sufficiently high peaks are available to produce the reflection. Apparently, he only saw the pre-midnight manifestation to the east. Perhaps the rising of the moon or a bright planet or star around midnight prevented him from witnessing the post-midnight part; the moon would then necessarily be in its last quarter.

The *Gegenschein* is far larger and fainter than the moon, but as a roundish source of white light it could be said to stand in for it in a truly dark sky. That may have been what Leonardo tried to convey with the words that it 'fulfills the function to these Armenians that a beautiful light of the moon would in the midst of the darkness'. He obviously could not mean that the Armenian sky lacked a moon, while the brightness could hardly match the full moon if the glow were the Alpenglow or a real comet. When he wrote that the light appears 'always 4 hours before daytime' (*senpre 4 ori inanzi dì*), his accurate sentiment may have been that the light technically shines every night, despite being only discernible to us when not outshone.

Leonardo probably did not see the true zodiacal light either, or else its lambent intrusion into the nighttime should have intrigued him more than the *Gegenschein*. If his sightings were all limited to the summer and early autumn, the conditions would have been unsuitable for viewing the evening cone. This is again consistent with the November date of the earthquake, if not also the dates of the sultan's Syrian journey. Moonlight in the hours after midnight could have drowned out the morning cone as well as the *Gegenschein* on its western leg. For example, in Malatya the moon rose around 22.10 on 2 November 1482, around 23.10 on the 3rd and around 0.10 on the 4th. Other nights could, of course, have been overcast.

That the *Gegenschein* is not a play of light on mountains is easily demonstrated by noting stars below it. If this never dawned on Leonardo, it may be because the mountain explanation – as argued – occurred to him some time after the observations, prompted by reading or remembering Restoro and Aristotle.

Upshot

Personal familiarity of Leonardo with the *Gegenschein* and his struggle to decipher its nature have the edge over his creative use of old literature alone. They fit into a broader pattern of astronomical passion. Earthshine is the sunlight weakly reflected off the earth by which the moon's dark limb can be made out around the time of new moon. It was Leonardo who first comprehended this and made a memorable drawing of this light, earning it its modern nickname 'da Vinci glow'. He explored magnifying the image of the moon by assembling lenses into a telescopic arrangement, about a century before Galileo.[133] And he privately queried the earth's immobility, well before Copernicus began to spread such heresy.[134]

This outcome is of no small interest for the history of science. As recently as 2011, an otherwise absorbing monograph dedicated to the 'oriental question' in Leonardo studies answered it in the negative, giving the Alpenglow explanation while leaving the reader in the dark about the classical passages and Armenian writers cited above, the Erzincan earthquake and the zodiacal light complex.[135] It is significant in itself that ancient authors should have unwittingly testified to these fascinating displays in the night sky. But beyond that, the Renaissance luminary who fathomed the earthshine and envisioned the helicopter, submarine, parachute and automobile now also emerges as the first modern European known to have espied the *Gegenschein* – some 370 years before the earliest indisputable reports of this light appeared.[136] The Maestro may not have grasped what he saw, but a highlight it certainly was.

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[133] Alessandro Bettini, 'Did Leonardo da Vinci Invent the Telescope?', *Optics & Photonics News* 33 (February 2022): pp.30-37.

[134] Richard Poss, 'Was Leonardo da Vinci a 'Copernican'? Leonardo's Astronomical Thought in Context', *Culture and Cosmos* 27.1-2 (2023): pp.43-52.

[135] Seybold, *Leonardo*, pp.182 and *passim*.

[136] George Jones, *Observations on the Zodiacal Light* (Washington, DC: Beverley Tucker, 1856), pp.220, 234; Theodor Brorsen, 'Ueber eine neue Erscheinung am Zodiakallicht', *Unterhaltungen im Gebiete der Astronomie, Geographie und Meteorologie* 8.20 (1854): pp.156, 158; *cf.* Marinus Anthony

Appendix: Finding the Prophet

In Leonardo's *précis* for the planned book, a 'new prophet' (*novo profeta*) is 'found' after the inundation of western Armenia and proceeds to show 'that this destruction is done for his purpose' (*che questa ruina è fatta al suo proposito*).[137] It has long been customary to identify this obscure figure with shāh Ismā'īl I (1487-1524), founder of Iran's Safavid dynasty.[138] This cannot be wide of the mark, but would preclude 1482 as the year Leonardo intended. The key is that Ismā'īl's messianic inclination, as the Mahdī expected in Islām, did not originate with him, but had been cultivated by his immediate ancestors.[139] These were Kurds of the mystic Safavid order, within the Ṣūfi Shī'a, who gained a wide following among Turkmen tribes in eastern Anatolia. Ismā'īl's father Shaikh Ḥaydar (1460-1488) led the order, by then militant, from his early teenage years until his death. The lieutenants of *his* father had "foolishly announced the glad tidings of his divinity", as a contemporary Persian historian of the Sunni persuasion lamented. He went on:

> Many people from Rūm, Ṭālish, and Siyāh-kūh (Qarāja-dagh) gathered to him and it is reported that they considered him as their god …[140]

Venetians of the same period also chronicled these developments. One wrote that 'he was considered a saint' (*esser tenuto huomo santo*); [141]

van der Sluijs, 'The Tortuous Discovery of the Gegenschein, False Zodiacal Light & Zodiacal Band – Brorsen vs Jones', *Journal of the British Astronomical Association* 134.1 (2024): pp.55-57; Donald W. Olson, *Investigating Art, History, and Literature with Astronomy* (Cham: Springer, 2022), pp.224-25.

[137] Leonardo to the *diodario*, 33-42, ed. Richter, *Scritti*, p.389.

[138] *e.g.*, Edmondo Solmi, *Le Fonti dei manoscritti di Leonardo da Vinci* (Turin: Casa Editrice Ermanno Loescher, 1908), pp.318-20; Fumagalli, *Leonardo*, p.171n1; Ponte, *Leonardo*, pp.113-16; 'Attorno': pp.5-19; di Teodoro, 'Stupenda': p.125; Seybold, *Leonardo*, pp.100n216, 169-70, 325n430; Versiero, *I Diluvi*, p.24.

[139] Said Amir Arjomand, *The Shadow of God and the Hidden Imam* (Chicago: The University of Chicago Press, 1984), pp.66-84.

[140] Faḍlullāh Khunjī Iṣfahānī *alias* Amīn (1455-1521), *Tārīkh-i 'Ālam-Ārā-Yi Amīnī*, ed. John E. Woods and tr. Vladimir Minorsky, *Faḍlullāh b. Rūzbihān Khunjī-Iṣfahānī Tārīkh-i 'Ālam-Ārā-Yi Amīnī: Persia in A. D. 1478-1490* (London: Royal Asiatic Society, 1992[2]), pp.57-58. Rūm is Anatolia; Ṭālish and Qarāja-dagh are west and southwest of the Caspian Sea.

[141] Giovanni Maria Angiolello (*c*1451-*c*1525), *Breve narratione della vita, et fatti del Signor Vssvncassano*, ed. Giovanni Battista Ramusio, *Navigationi et*

another knew him only as 'a sacred man of Persia' (*uno sancto homo de Persia*).[142] Caterino Zeno (1418-1478), a diplomat who was in the area as Barbaro's predecessor, specifically told of him:

> *Era Secheaidare, come un'Alano, ò Maestro, ò Profeta, come lo uogliamo dire, che predicando nella setta Macomettana nuouo Dogma, & Alì essere stato maggiore, che Omar, haueua molti discipoli, & persone, che fauoriuano la sua dottrina, & perseuerò cosi in questo un tempo, di maniera, che era da tutti riputato Santo, & un'huom quasi diuino.*
>
> Secheaidare was, like an Alan, either Master, or Prophet, as we wish to call him, who, by preaching a new Dogma in the Mahometan cult, & that Alì had been greater than Omar, had many disciples, & people who favoured his doctrine, & so persevered in this for a time, in such a way that he was by all considered a Saint, & a man almost divine.[143]

Captive to the millenarian *Zeitgeist*, Shī'ite survivors of the landslide would have wanted to know what Ḥaydar made of it. Messengers could have sought him out, perhaps somewhere in the Eastern Taurus, and returned with the revelation that the events hastened the Aq Qoyunlu's demise and the Safavids' rise to power. The Mamluks who had flooded western Armenia, so to speak, would be driven back through the Taurus into Syria, leaving the land for the Safavids' taking. Word reached Leonardo, who was still in Armenia and saw fit to work this intelligence into his report to the *dawādār* about the cause of the disaster.

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viaggi …, vol. 2 (Venice: Stamperia de Givnti, 1574), p.71*r*-*v*, tr. Charles Grey, *A Narrative of Italian Travels in Persia, in the Fifteenth and Sixteenth Centuries* (London: The Hakluyt Society, 1873), p.100.

[142] Girolamo Priuli (1486-1567), *Diarii*, for 15 March 1502, ed. Roberto Cessi, *I Diarii di Girolamo Priuli [AA. 1499-1512]*, vol. 2 (Bologna: Nicola Zanichelli, 1937[2]), p.199.

[143] Nicolò Zeno (ed.), *De i Commentarii del viaggio in Persia …* (Venice: Francesco Marcolini, 1558), pp.30*v*-31*r*, *cf.* VIII. Grey (*A Narrative*, p.43) translated *Alano* as "Saint", but the meaning is rather that Ḥaydar's exaltation was in the spirit of barbaric nomads, not orthodox muslims.