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# Leonardo and the Whale

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## Abstract

Around 1480, when he was 28 years old, Leonardo da Vinci recorded what may have been a seminal event in his life. In writing of his travels to view nature he recounted an experience in a cave in the Tuscan countryside:

Having wandered for some distance among overhanging rocks, I can to the entrance of a great cavern... [and after some hesitation I entered] drawn by a desire to see whether there might be any marvelous thing within..."

[*excerpt*]



## Keywords

Leonardo da Vinci, fossils, whale

## Disciplines

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## Comments

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**Leonardo and the Whale**
Kay Etheridge

**Introduction**

Around 1480 when he was 28 years old, Leonardo da Vinci recorded what may have been a seminal event in his life. In writing of his travels to view nature he recounted an experience in a cave in the Tuscan countryside:

> *Having wandered for some distance among overhanging rocks, I came to the entrance of a great cavern…*[and after some hesitation I entered] *drawn by a desire to see whether there might be any marvelous thing within…*[1]

On the next folio he described what appears to have been a fossil whale embedded in the walls of a cave:

*O powerful and once-living instrument of formative nature, your great strength of no avail, you must abandon your tranquil life to obey the law which God and time gave to creative nature. Of no avail are your branching, sturdy dorsal fins with which you pursue your prey, plowing your way, tempestuously tearing open the briny waves with your breast.*

*Oh, how many a time the terrified shoals of dolphins and big tuna fish were seen to flee before your insensate fury, as you lashed with swift, branching fins and forked tail, creating in the sea, mist and sudden tempest that buffeted and submerged ships…*

*O Time, swift despoiler of created things, how many kings, how many peoples have you undone? How many changes of state and circumstances have followed since the wondrous form of this fish died here in this winding and cavernous recess? Now unmade by time you lie patiently in this closed place with bones stripped and bare, serving as an armature for the mountain placed over you*.[2]

The physical proximity of these two entries on adjacent folios and the fact that both are dated to 1480 has caused some scholars to link them, but they may have been two separate experiences. The chronology of entries in the notebooks is unclear to say the least, but the last line on Folio 156 r seems to indicate the fossilized bones of a giant sea creature found in a cave. The word fossil is used in this essay in the contemporary sense, representing petrified remnants or traces of once living organisms. The term was not in use until the early 17th century, and even then it signified anything that was "dug up" (Latin: *fossilis*). Further evidence that Leonardo was describing fossilized remains may be found in a nearby passage in Codex Arundel in which Leonardo refers to "two lines" of shells in the earth; these were undoubtedly layers of fossil shells. In this entry he wrote:

*From the two lines of shells we are forced to say that the earth*
[was] *submerged under the sea and so the first layer was made; and then the deluge made the second.*[3]

In this early writing (also *circa* 1480) Leonardo followed the common assumptions of his time and attributed the layering of fossils to the Biblical deluge. But the studies of geology and fossils that he made over the course of the next three decades ultimately led him reject this conventional wisdom in unequivocal terms. Indeed, Leonardo's interest in fossils and his seemingly prescient grasp of what is now known as

[1] Codex Arundel, f. 155 r
[2] Codex Arundel, f. 156 r
[3] Codex Arundel, f. 156 v

geomorphology have been well documented.[4] However, the influence on Leonardo of this early encounter with a "wondrous form" has not been fully examined, and there is skepticism among some scholars as to whether it actually took place. The passage has been interpreted by some as a poetic reference to Ovid or Seneca, both of whom wrote of caves. Seneca even wrote of subterranean fishes, although a biologist might recognize these creatures as some type of living cave fish, which inhabit pools and streams that sometimes occur in caverns beneath the earth. However, cave fish are quite small and clearly not what Leonardo described as "powerful and once-living." He may have drawn on classical or other sources for his description of the animal's behavior; we have no evidence that Leonardo ever observed a living whale. Yet what seems a poetic turn of phrase describing the whale's "insensate fury" as it churns the water around it is not necessarily apocryphal, and Leonardo may have learned of whale behavior from those who made their living on the sea. Several species of whales do "lash" or slap their fins or tails on the water as a form of communication, and at least some species (*e.g.* humpback whales) use tail slaps to frighten fish into a tight school for easier hunting. Leonardo very likely read of whales in his study of natural history, as many classical accounts exist. Aristotle wrote about whales, describing both the appearance and behavior of more than one type, as did Pliny the Elder, whose *Natural History* was owned by Leonardo. Pliny described killer whales creating waves by "blowing and thrashing" and credited them with sinking a boat in a battle with Emperor Claudius in the harbor of Ostia.[5] Pliny provided evidence of the Romans' fascination with the size of these "monsters," describing a skeleton over 12 meters long with a spine half a meter thick brought from Israel in 58 B.C. by Marcus Scaurus to be exhibited in the capital.[6] Whales and dolphins had in fact been a source of wonder and fascination around the Mediterranean from at least the Archaic period, and even beyond Greece literary and iconographic traditions featured cetaceans in a variety of forms from fabulous to relatively naturalistic.[7]

It is certainly possible that Leonardo's description of the cave and the wonder within was colored by his reading of the classics, both poetry and natural history, but it is essential to consider his work from multiple angles and from a variety of disciplines. I propose that Leonardo did enter one of the many caverns that punctuate the Tuscan landscape and there saw something marvelous that would stay with him for the rest of his life, shaping both his art and his investigations of nature. The evidence lies in Tuscan geology and paleontology, but also in Leonardo's writings, drawings and paintings.

**The Evidence**

The appearance of whales in the valleys and hills of Italy may seem a bit more fantastic than sightings along the coastline, but 200 million years ago most of the country was covered by the early Jurassic sea. The geological strata that Leonardo's fossils occupied were formed by sedimentation over eons, a concept that he visualized and described, even though it seems unlikely that he fathomed the time scale involved. A mere five million years ago much of the Italian peninsula was still submerged, and the Apennines and environs would have comprised most of the dry land in northern Italy. It is not surprising that Italy is rife with marine fossils, and indeed prehistoric whale bones from Italian deposits have been documented and studied for at least 200 years. By the 19th century at least forty fossil whale finds had been discovered in the area around Asti and Turin,[8] and dozens more had been unearthed in Tuscany and further south.[9] Areas in Emilia Romagna were in

[4] See for example David Alexander, "Leonardo Da Vinci and Fluvial Geomorphology," *American Journal of Science* 2 (1982): 735–55. Geomorphologists study how physical and chemical processes shape the earth's surfaces.
[5] Pliny the Elder, *Natural History*, Book IX, v, translated by Harris Rackham (London: William Heinemann, 1949).
[6] *Ibid*., IX, iv.
[7] A fascinating account of this history may be found in John K. Papadopoulos and Deborah Ruscillo, "A Ketos in Early Athens: Archaeology of Whales and Sea Monsters in the Greek World," *American Journal of Archaeology* (2002): 187–227.
[8] Alessandro Portis, "Catalogo Descrittivo Dei Talassoterii Rinvenuti Nei Terreni Terziari Del Piemonte E Della Liguria," *Memorie Della Reale Accademia Delle Scienze Di Torino* 2 (1885): 247–65.
[9] Michelangelo Bisconti, "Taxonomy and Evolution of the Italian Pliocene Mysticeti ( Mammalia , Cetacea ): A State of the Art" 48 (2): 147–56. This account of progress in fossil whale studies credits the rich fossil finds from Italy in the construction of baleen whale phylogeny. Bisconti reviews the record of fossil whale finds in Italy from the 19th century, although clearly the history is much longer.

1995 designated as comprising the Piacenzian Geological Reserve, and the richness of Pliocene marine fossils in the region have led to some to call it *il golfo delle balene*, the gulf of whales. A paper summarizing whale fossils housed in Italian museum collections documents many specimens that were found within a relatively short distance of Florence, Leonardo's home until 1491.[10] A fossil whale was excavated in 1995 near Empoli, just 10 km south of Leonardo's birthplace in Vinci,[11] and Cetona, a Tuscan town visited by Leonardo later in life, is now home to a museum housing regional fossils. Leonardo would not have seen an articulated skeleton such as the ones on display in modern museums (Figure 1), but it is possible that his great fish, "unmade by time" appeared something like the whale excavated in Orciano Pisano (Figure 2).[12] In addition to fossilized whale remains embedded in the earth, Leonardo very probably had other opportunities to view such giant bones, as they have been long been used as ornaments and even structural parts of buildings across the Mediterranean. Even today, a whale's jawbone hanging on the exterior of a house about 16 km west of Florence gives the town its name, La Lisca (the fishbone).[13] A lunette by Gustav Utens (*c.* 1599) displays a very similar whale jawbone on the stable façade of Villa Cafaggiolo, about 25 km north of Florence (Figure 3). The villa was used by the Medici from the middle of the 15th century, and could very well have been visited by Leonardo. What may be the same whale jawbone is still on view today, mounted on a building in the nearby village of Cafaggiolo (Figure 4); this building is from the estate of the Castello di Cafaggiolo.[14]

The prevalence of caves in the Tuscan landscape near Vinci would seem to make it more likely than not that a curious young Leonardo explored at least one of these. Grotta Giusti is a sizeable cave located 16 km north of Vinci, and the hills in this area are home to many more caverns. All of this geological and paleontological evidence indicates that a subterranean encounter with ancient whale bones was not beyond the realm of possibility for a well-traveled and intensely observant young man in 15th century Italy. But how might this experience have influenced Leonardo's scientific investigations and led to innovations in the composition of his artworks?

**Influence on Leonardo's scientific interests**

Leonardo's known writings are peppered with references to what we now recognize as fossils, and these writings are often in conjunction with his musings on the formative changes in the earth's surface. His curiosity about these subjects is documented in notebook entries made as a young man of less than thirty, apparently piqued by the remains of marine organisms such as the fossil whale and the shells that he found far from the sea in both distance and height. In the Codex Arundel entry above regarding the "two lines of shells," he reasoned that the first layer was deposited in the seabed. But at the time when he made this observation the Mediterranean coastline was kilometers away, so Leonardo recognized that the face of the earth was not static as was generally believed, but had changed. His youthful explanation for the upper layer of shells was deposition by the Biblical deluge; however, another journal entry dated to within two years of the above appears to posit different forces behind the burial of large objects such as the walls of a lost city. He wrote:

*For do you not perceive how, among the high mountains, the walls of ancient and ruined cities are being covered over and concealed by the earth's increase? Nay, have you not seen how, on the rocky summits of the mountains, the live stone itself has in course of time swallowed up by its growth some column which it*

[10] Silvia Danise and Stephano Dominici, "A Record of Fossil Shallow-Water Whale Falls from Italy," *Lethaia* 2 (2014): 229–43.
[11] Giovanni Bianucci, "A New Record of Baleen Whale from the Pliocene of Tuscany (Italy)," *Atti Della Società Toscana Di Scienze* (1995): 101–4.
[12] Stephano Dominici, Elisabetta Cioppi, Silvia Danise, Ubaldo Betocchi, Gianni Gallai, Francesca Tangocci, Gigliola Valleri, and Simonetta Monechi, "Mediterranean Fossil Whale Falls and the Adaptation of Mollusks to Extreme Habitat,." *Geology* 9 (2009): 815–818. The names place names Cetona and Orciano are tantalizingly suggestive; both *cetus* and *orca* are Latin words for whale.
[13] Francesca Fiorani drew my attention to this whale bone during the 2012 NEH Summer Institute in Florence that inspired this essay (Leonardo da Vinci: Between Art and Science).
[14] Nicholas Redman, *Whales' Bones of France, Southern Europe, the Middle East and North Africa*. (Teddington: Redman Publishing, 2014):106.

*supported, and stripping bare as with shears, and grasping it tightly, has left the impress of its fluted form in the rock?*[15]

Interestingly, this Codex Atlanticus entry shares the same folio as another description of a whale:

*Oh, how many times were you seen through the waves of the swelling and great ocean, like a mountain that conquers and overwhelms, with your bristles*[16] *and black back moving through the waters of the sea with your heaving and imposing carriage.*[17]

The above series of entries show that before he was 30, Leonardo was beginning to consider the stratification of the earth's surface, an exercise that would occupy him for decades, as would his curiosity about the shells and bones of fish he found in sedimentary layers far from the sea. Begun in the early 16th century, *Codex Leicester* contains numerous entries that we would today relate to geology and paleontology. For example, Leonardo described the "cutting of Colle Gonzoli, which has been made precipitous by the action of the Arno wearing away its base" and revealing layers of fossil shells deposited in the mud of the sea.[18]

Leonardo's writings show that he came to understand how fossils were formed, and it seems likely his artistic training in bronze casting bronzes paved the way for this scientific breakthrough. Perhaps too his preparatory work for the unrealized Sforza monument led him to visualize and describe how casting could be directed by nature to form objects embedded in the earth.[19] Leonardo described the process by which cast fossils of fish bones were molded as accurately as if he had seen it happen millions of years earlier:

*All the creatures that have their bones within their skin, on being covered over by the mud from the inundations of rivers which have left their accustomed beds, are at once enclosed in a mold by this mud. And so in course of time as the channels of the rivers become lower, these creatures being embedded and shut in within the mud, and the flesh and organs being worn away and only the bones remaining…. the water runs away so that it* [the mud] *dries and becomes first a sticky paste and then changes into stone, enclosing whatsoever it finds within itself, and itself filling up every cavity; and finding the hollow part of the mold formed by these creatures… this paste as it dries becomes stone which is devoid of weight, and preserves the exact shapes of the creatures which have there made the mold, and encloses their bones within it.*[20]

The above description is echoed in several places, particularly in the Codex Leicester. Leonardo also mentioned the "bones of fish" and the "bones of great fish" several times in his writings on fossils. In addition to the easily recognizable fossils from fish and marine shells, he also made note of smaller and less obvious traces of ancient organisms, including the fossilized holes made by marine worms. He wrote that "The hills around Parma and Piacenza show abundant mollusks and bored corals still attached to the rocks."[21] On the next folio he wrote that "Between one layer and the other there remain traces of worms that crept between them when they had not yet dried."[22] Leonardo also made a drawing that appears to show the patterns generated by

[15] Codex Atlanticus, f. 715 r (Hoepli 254 r-a).
[16] Aristotle wrote correctly of some baleen whales as lacking teeth in their mouth and instead having hairs similar to pigs' bristles (Papadopoulos and Ruscillo, "A Ketos in Early Athens, 105-106). Possibly as a result of this, many Renaissance depictions of whales and dolphins sprouted fearsome bristles.
[17] Codex Atlanticus, f. 715 r (Hoepli 254 r-a). The whale description is written upside-down on the folio with respect to the entry on the buried city.
[18] Codex Leicester, f. 8 b [R 987].
[19] A few decades later Bernard Palissy (French, 1510-1590) came to a similar conclusion about the organic nature of fossils based on his work with life-casting. Hanna Rose Shell, "Casting Life, Recasting Experience: Bernard Palissy's Occupation between Maker and Nature," *Configurations*, 2004: 1-40.
[20] Codex F, f. 79 v.
[21] Codex Leicester, f. 9 r.
[22] Codex Leicester, f. 10 v.

some of these marine organisms (Figure 5).[23] Because of these careful observations and the insights to which they led, Leonardo has been dubbed the father of paleontology by some, and of ichnology (the science of fossil traces) by others. Andrea Baucon wrote that Leonardo was the first to understand and correctly interpret the marks left behind by long dead creatures from the sea, although he adds that he probably did not influence subsequent Renaissance naturalists; these "ichnological" studies by Leonardo were not discovered for centuries.[24] Unlike Baucon, Gian Battista Vai leaves the door open for the possibility that Leonardo's early work in geology and paleontology did influence Renaissance views of fossils, perhaps by verbal reports of his writing.[25]

It is important to note that in his mature writings Leonardo argued frequently, forcefully and logically that the Deluge was not responsible for the layers of fossils readily apparent across Italy. The explanation that he developed for the deposition of ancient whale bones and shells far from the sea is very much in line with today's scientific models of changes in the earth. As for the beliefs of his contemporaries with a more traditional vision, Leonardo mocked such thinking, writing that

*…if you were to say that these shells have been created and are still constantly being created in such places by the nature of the locality and through the potency of the heavens in those spots, such an opinion cannot exist in brains of any extensive powers of reasoning ...*[26].

Leonardo deduced from his observations of fossils and the geology in the areas he explored that the face of the earth had undergone massive changes. He envisioned that in the ancient earth "the peaks of the Apennines stood up in this sea [the Adriatic] like islands surrounded by salt water ….. and above the plains of Italy where flocks of birds are flying today, fishes were wont to wander in large shoals."[27] In making such assertions da Vinci contradicted his more youthful writing about this subject. However, these later convictions would have been seen as heretical, and this is perhaps why his conclusions regarding fossils were not openly disseminated. It has been argued that Leonardo's studies of geomorphology and fossils qualify him as one of the earliest observers of subjects that otherwise received little attention from the scientific community until the 18th century.[28] In fact, prior to the appearance of Charles Lyell's *Principles of Geology* in 1830, deposition by the Deluge remained the common explanation for the distribution of fossils, a premise Leonardo had rejected more than 300 years earlier.[29] By the 19th century both Lyell, and Alexander Humboldt, two of the major proponents of modern geology, knew of Leonardo's writings on these topics; it would be fascinating to know how they responded to his ideas.

**Influence on Leonardo's art**

It is clear that Leonardo sustained an interest in what we now term geology and paleontology throughout his adult life, but how might this and his experience of "something marvelous" within a Tuscan cave have influenced his art? Throughout his career he was influenced by the countryside that he explored, and one of his early drawings depicted the type of geological formations that could include such a cavern (Figure 6). Within a few years before and after the Codex Arundel entries on the cave and on the wondrous "fish," Leonardo painted a number of images in which a grotto or sedimentary rock formations play a prominent

[23] Andrea Baucon, "Leonardo Da Vinci, the Founding Father of Ichnology." *Palaios* (2010): 361–67.
[24] *Ibid*., 366.
[25] Gian Battista Vai, "The Scientific Revolution and Nicholas Steno's Twofold Conversion," *Geological Society of America Memoirs* (2009): 187–208.
[26] Codex Leicester, f. 9 v.
[27] Codex Leicester, f. 10 v.
[28] Although Leonardo drew on the classics in his descriptions of the earth's hydrological cycle, he moved from the theoretical methods of his predecessors to the use of direct observation and deduction (Alexander, "Leonardo Da Vinci and Fluvial Geomorphology").
[29] In Leonardo's time and for almost two centuries after, the two predominant ideas regarding fossils were that they were left from the Biblical deluge or that they were placed by the Creator.

compositional role. One of the earliest of these may be in his contributions to Verrocchio's *Baptism of Christ* (Florence, Uffizi, c. 1475), in which naturalistically rendered rocks add an earthy solidity to the painting of the holy figures. According to a geologist, some details in the landscape in this painting depict the way such strata of fractured rocks weather, indicating very close observations by the artist.[30] In the early 1480's Leonardo began the *Adoration of the Magi* (Florence, Uffizi) in which sedimentary rocks also figure in the landscape around the central figures. His unfinished *Saint Jerome* (Vatican Museums, c. 1482) from around the same period is set a landscape made up of sedimentary rocks. Such a composition was traditional for the representation of Saint Jerome and indeed, the use of such geological formations by Florentine painters was well established by the fifteenth century.[31] However, the placement of the Virgin Mary within a grotto was more unusual at this point, and perhaps it is telling that *The* V*irgin of the Rocks* (Paris, Louvre, 1483) was begun within three years of Leonardo's written entry on the cave. Geologist Ann Pizzorusso found the Louvre painting to be highly accurate in its representation of nature but found the later version of the painting (*Virgin of the Rocks*, National Gallery, London) to be lacking in the same features.[32] Andrea Mantegna and others followed Leonardo in placing the Virgin in rocky settings and even grottos, but whether this was by chance or influence is difficult to trace.

Painted almost twenty years later, Leonardo's *Virgin and Child with Saint Anne* (Paris, Louvre, *c.* 1508-1517) displays even more detailed sedimentary rock in the foreground under the feet of the women and children.[33] In the years surrounding the creation of this painting in Milan, Leonardo wrote frequently about the history of the earth, describing in detail the sedimentation processes that built up the layers of rock and led to deposits of fossils. He was in fact mocked at the time by the poet Guidotto Prestinari for wandering in the hills and forests of Val Cava (near Bergamo), seeking "*various monsters and a thousand strange worms…*"[34] Baucon suggests the possibility that fossil tracings of the worms described in Leonardo's writings may be visible on the surface of some of the foreground rocks in the Louvre painting.[35] Whether or not this is the case, a cartoon of *The Virgin and Child with Saint Anne*, which appears to have been started before 1500, leaves us with another potential link to Leonardo's formative experience in the Tuscan countryside. The geological formation in the upper right of the Burlington cartoon does not appear in the later Louvre painting, but close scrutiny of the work reveals a dark area that gives the impression of the mouth of a cave just to the right of Saint Anne's hand (Figure 7). Furthermore, the depiction of the rocky surfaces is oddly particular in this unfinished drawing; it would seem that geological formations were on Leonardo's mind even as he composed a work destined for a patron commissioning a work of religious symbolism.

Leonardo's most mysterious landscape, the backdrop for the *Mona Lisa*, has been identified by various scholars (Carlo Pedretti among them) as the Val di Chiana as seen from a point near Arezzo. The painting was begun around 1503 in roughly the same period that da Vinci was employed by Cesare Borgia as an engineer, and for whom he made a topographical map of the area (Figure 8). In this same decade Leonardo made numerous notebook entries regarding fossils and geomorphology, subjects that surely occupied his thoughts as he surveyed this part of Tuscany. The Arno river valley, like others in Italy, is rich in fossils; documented finds include the bones of whales and even mammoths, as well as innumerable smaller creatures such as mollusks

[30] Vai, "The Scientific Revolution."

[31] David Branagan, "Geology and the Artists of the Fifteenth and Sixteenth Centuries, Mainly Florentine," *Geological Society of America Special Paper* (2006): 31-42.

[32] Ann Pizzorusso, "Leonardo's Geology: The Authenticity of Virgin of the Rocks," *Leonardo* 3 (2012): 197–200. Pizzorusso questioned the attribution of the National Gallery's painting to Leonardo based on the problematic depiction of the rock formations in this painting. I agree that it seems unlikely that Leonardo painted the backdrop in the London painting, as it would have meant abandoning years of accumulated geological knowledge. As of December 30, 2016, the Louvre website referred to the London painting as a "replacement" that "may have been painted by Ambrogio de Predis under Leonardo's supervision." http://www.louvre.fr/en/oeuvre-notices/virgin-rocks.

[33] Vai, "The Scientific Revolution."

[34] Prestinari wrote the poem c. 1490-95. Eodoardo Villata, *Leonardo Da Vinci: I Documenti E Le Testimonianze Contemporanee* (Milan: Castello Sforzesco, 1999), 62-63.

[35] Baucon, "Leonardo Da Vinci."

(*e.g.* prehistoric snails and clams). In the miles Leonardo covered in his explorations of this he made many such discoveries, and this in conjunction with his understanding of the ancient earth may have influenced this atypically composed portrait. The *Mona Lisa* is not unusual among his paintings for inclusion of a mountainous backdrop or bodies of water. Yet volumes have been written about the *Mona Lisa*, and the peculiar features of the most distant portions of the landscape have enticed scholars to develop a variety of explanations for the seemingly curved horizon, oddly elevated perspective and the primitive, inundated lands in the distant view. He kept this painting until his death, and some scholars think that he may have continued to work on it for well over a decade.[36] Was Leonardo attempting over the years to portray with paint his vision of an older view of the earth, seen before waters receded, destined to leave behind the traces of ancient life forms? In spite of the painting's modest size, one perceives a landscape of great depth behind the figure. The text above describing the Apennine peaks standing up from the sea like islands seems to be illustrated by the jutting mountains rising from the water in the far distance of the *Mona Lisa*'s landscape. No mountains extant in the Val di Chiana form such shapes. Nearer to the viewer is a body of water, possibly the lake included in his map (Figure 8), but alternatively, perhaps the visual manifestation of an ancient lake that he had imagined, filling the Val d'Arno above Arezzo "for a distance of forty miles."[37] The near landscape is marked by the more recent activities of civilization, but like the primordial earth beyond it, is seen from a bird's eye view, perhaps an allusion to the "flocks of birds" he imagined soaring above the plains where fish once swam.

**Conclusion**

Only a fraction of Leonardo's notebooks are known to survive and scholars continue ponder and reassemble these fragments of his work in much the same way that paleontologists reconstructs the skeletons of fossil behemoths. It is frustrating to consider that a critical piece, perhaps a sketch of the petrified bones of a whale in a cave, was made by Leonardo and then lost to us. The task of interpreting what remains is complicated by an unclear chronology of the extant notebook entries. As described by Carlo Vecce, the entries on various folios reflect an interlinked web of information rather than a linear construction; the folios were later assembled into notebooks in which themes often were revisited, sometimes with obvious links and sometimes not.[38] Like paleontologists we often must date something by what surrounds it or by clues buried in the material itself. The occasional piece of the puzzle that is dateable and intact, such as *The Virgin and Child with Saint Anne,* adds much to our store of information.

A larger and more complete picture of Leonardo's work emerges most readily from the fragments of his writings and images when considered by scholars from a variety of disciplines. We now know that he understood that his homeland was once submerged beneath the sea, and that he was the earliest to describe the effects of this geological history on both the landscape and the traces of creatures left behind in the rocks. As his maps show, Leonardo seemed to visualize his own flight over the landscape and to comprehend the environment in a broader and deeper way than most of his more earthbound contemporaries. But when he did come back to earth, da Vinci could produce his own wondrous creations, blending art and nature in works such as the paintings discussed above. All of these extraordinary artworks were created as he explored the history of the earth. And all of the aforementioned paintings ground the most beautiful forms of life on earth in the historical context of the world around them as only Leonardo understood it. It is intriguing to consider that the

[36] Carmen Bambach, Rachel Stern, and Alison Manges, *Leonardo da Vinci, master draftsman* (New York: Metropolitan Museum of Art, 2003), 234.

[37] Codex Leicester, f. 9 r. In this entry he wrote of two great lakes formed by a ridge of rock "united with Monte Albano" damming the Arno. One lake filled the area later occupied by Florence, Prato and Pistoia and the other flooding the valley north of Arezzo. The description of the Apennines rising from the water is on nearby f. 10 v.

[38] Carlo Vecce, "Word and Image in Leonardo's Writings," in *Leonardo Da Vinci: Master Draftsman*, edited by Carmen Bambach (New York: Metropolitan Museum of Art), 74-75. Vecce's reading and discussion of the text on the whale in the cave during the 2012 NEH Summer Institute on Leonardo sparked my interest in this topic.

“marvelous thing” Leonardo chanced upon as a young man set him on one of his many paths of inquiry into nature, and perhaps contributed elements both naturalistic and mysterious to his art.

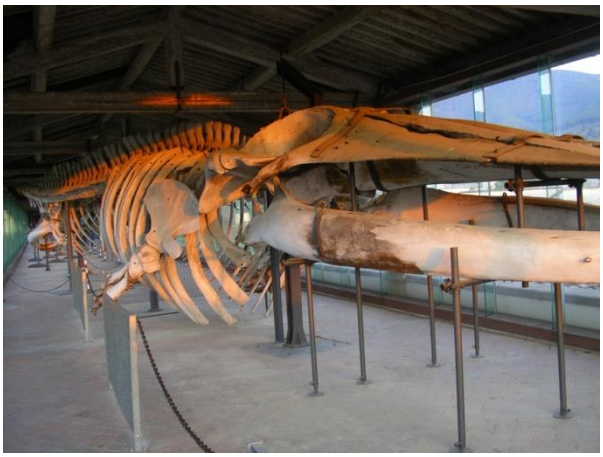

Figure 1. A whale skeleton in the Certosa di Pisa museum, Calci, Italy. Photograph by Marco Conti (www.marco83.com). Permission CC-BY-SA.

Figure 2. Whale fossil excavation in Tuscany at Orciano Pisano (see Dominici et al 2009). Photo courtesy of Stefano Dominici.

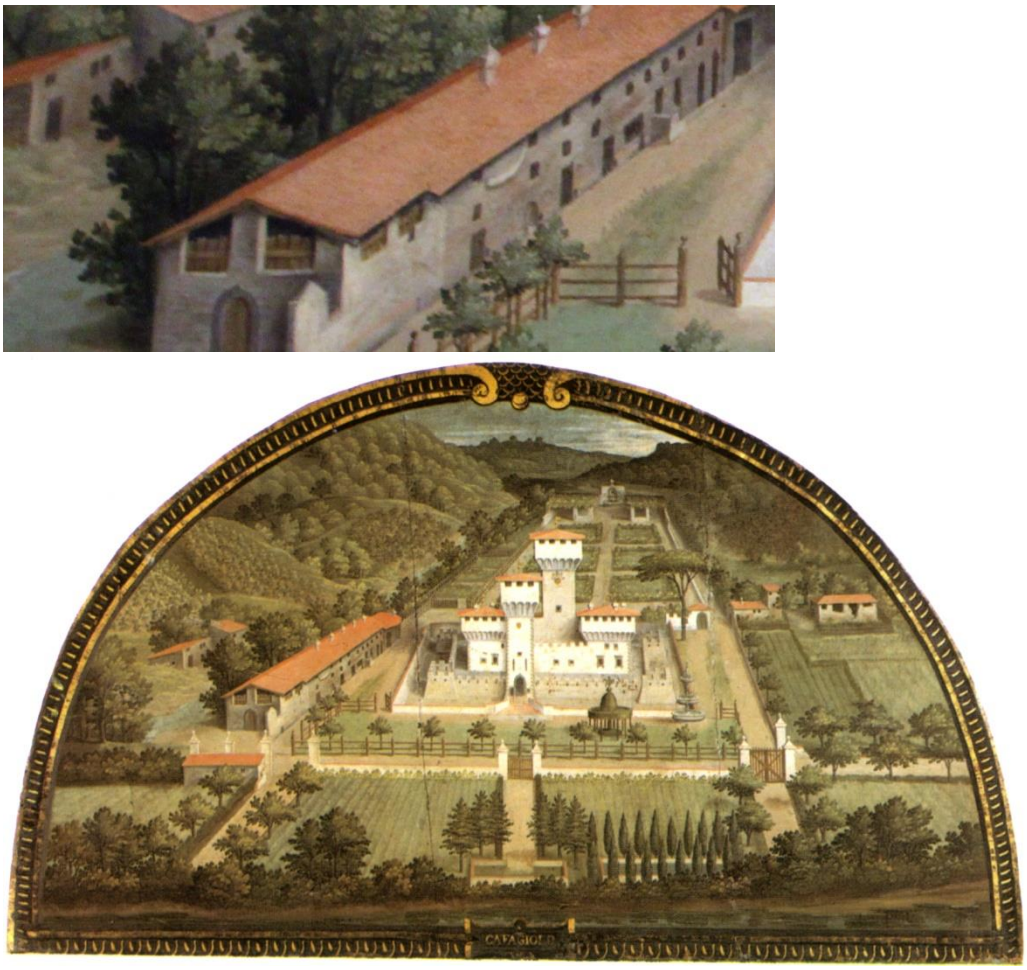

Figure 3. *Gustav Utens,* Castello Mediceo di Cafaggiolo (*1599*). The Castello was a favored residence of Lorenzo de' Medici, a patron of Leonardo. A whale jawbone is mounted on the façade of the stables (see detail). Image in the public domain.

Figure 4. Jawbone of a whale in Cafaggiolo. The 2006 photograph is courtesy of Nicholas Redman, Whalebones Worldwide.

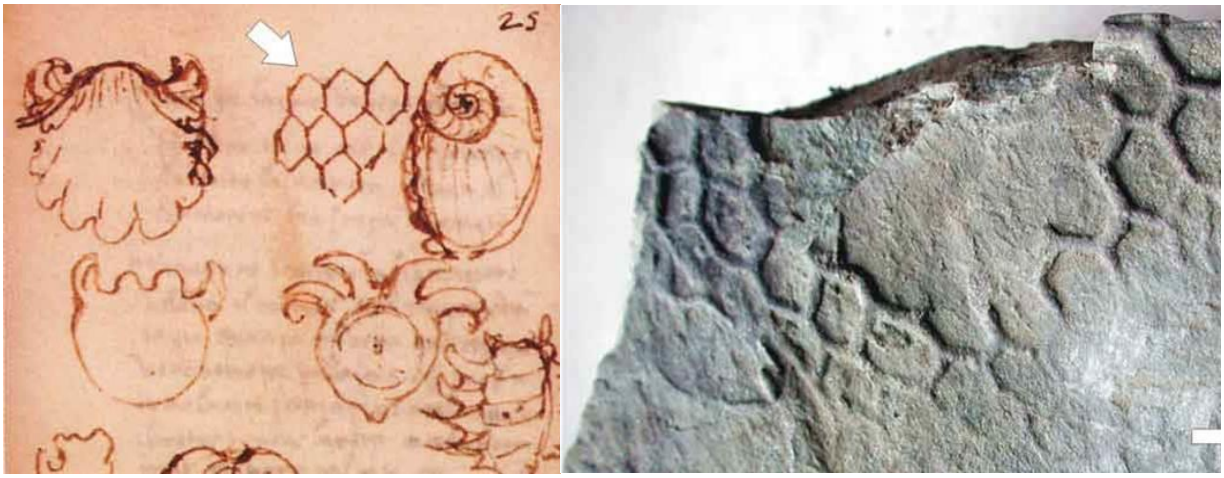


Figure 5. The drawings from Manuscript Madrid I, f. 25r depict shells and a hexagonal pattern. The latter has been identified as traces of the burrows of Paleodictyon, an ancient form of marine worm. (Baucon, 2010). Image courtesy of *Palaios* and the Society for Sedimentary Geology.

Figure 6. *Leonardo da Vinci*, A rocky ravine (*c. 1475-80*). Royal Collection Trust /© Her Majesty Queen

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Figure 7. *Leonardo da Vinci,* The Burlington House Cartoon of the Virgin and Child with St. Ann (1499-1500). National Gallery, London. Image in the public domain.

Figure 8. *Leonardo da Vinci*, Map of the Valdichiana (*c.1503-4*). Royal Collection Trust /© Her Majesty Queen Elizabeth II 2016.