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Francesco Luzzini:

On Context

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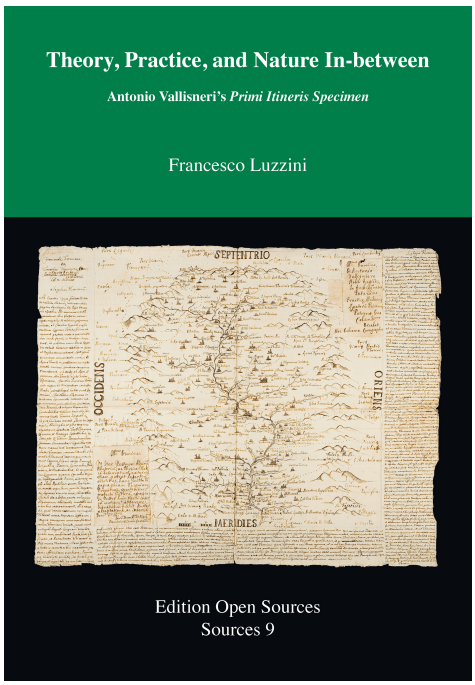

In: Francesco Luzzini: *Theory, Practice, and Nature In-between : Antonio Vallisneri's Primi Itineris Specimen*
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Chapter 1
On Context

The desk has always been
the ruin of philosophy.[1]

1.1 On Chance and Necessity, and How They Met

I have always marveled at how contingency affects human affairs. Such a consideration, of course, is especially valid when referring to battles, conquests, discoveries, inventions, explorations, and other impressive events. Yet, I dare to hold it as universally true: for a simple life, too, can provide anecdotes on the vagaries of chance.

As regards my humble self, I shall support this opinion by describing what happened one morning in September, 2009, while I was leafing through a bulk of dusty papers at the State Archive in the Italian city of Reggio Emilia. I had finished my Ph.D. a few months earlier, and had just entered that critical time in a scholar's life when a doctoral dissertation is supposed to evolve into a book and a student is expected to become a grown-up, autonomous researcher. In order to achieve these ambitious and not so obvious goals, I needed to delve even further into the topics I had been studying for about four years: the Earth sciences in early modern Europe and the work performed in this field by the Italian physician and natural philosopher Antonio Vallisneri (1661–1730).

I had been repeatedly warned by my mentor, Dario Generali, that this task would require *a lot* of research and the reading of *many, many* texts. Undoubtedly, my subject guaranteed a steady and menacing supply of both these resources. My apprentice years at the Edizione Nazionale delle Opere di Antonio Vallisneri ("National Edition of Antonio Vallisneri's Works") had made me aware of the breadth of this author's research interests and the astounding number of his published and manuscript writings. With two books explicitly devoted to hydrogeological and paleontological issues, dozens of articles and contributions which cover almost every field of the Earth sciences, and with a European-wide correspondence of more than 12,000 letters (which involved scholars like Johann Jakob Scheuchzer, Frederick Ruysch, Louis Bourguet, Luigi Ferdinando Marsili, Martin Lister, Thomas Dereham, Hans Sloane, and many others), Vallisneri was a perfect case study for significant interdisciplinary research. I was excited and motivated: I had an opportunity to shed new light on the scientific, philosophical, religious, and social issues that engaged the European intellectual community between the late seventeenth and early eighteenth centuries.

Still, despite this wealth of information and inspiring premises available to me then I missed something too important to overlook, for it lay at the root of Vallisneri's work in the Earth sciences: field research.

[1] "La ruina della filosofia è sempre stata il tavolino." Antonio Vallisneri to Gaston Giuseppe Giorgi, October 9, 1724 (Vallisneri 2005, 1091).

When he published the *Lezione Accademica intorno all'Origine delle Fontane* ("Academic Lecture on the Origin of Springs")[2] in 1715, the *philosophical* debate on the hydrologic cycle was at its peak. Indeed, Vallisneri's treatise matched the ideals promoted by the Republic of Letters, which upheld scientific progress as a a virtuous effort both collective and cumulative. By supporting the exclusively meteoric origin of fresh water with strong empirical evidence, he confirmed measurements and observations made previously by engineers, scholars, artisans, and experts all over Europe, and dealt a lethal blow to the competing (and still far from unpopular) theories of a compound origin—for example, those which supposed the existence of hidden channels connecting the oceans to the earth and the partial or exclusive distillation and/or filtration of sea water through rock layers.

The *Lezione Accademica* relied on a mass of data that the author had started collecting in the field since his early years as a general practitioner in the Duchy of Modena and Reggio. Even after he was appointed Professor of Medicine at the University of Padua, where his leisure time became an increasingly precious resource, he did not give up his "genial studies" (as he called them). Rather, he began devoting a significant part of his summer vacations in Scandiano, in the current Province of Reggio Emilia, to the exploration of nearby hills and their many natural features. Such was his delight in these activities, that soon his typically brief excursions could not satisfy his omnivorous curiosity. And so, in the summer heat of 1704, he bravely resolved to travel—with a "daring soul" and "trembling foot"—across the "silent horrors" of the northern Apennines: down the hills south of Reggio Emilia to northern Tuscany and the western edge of his native land, the Province of Garfagnana (Figure 1.1).

Once back in Padua, Vallisneri started writing a Latin report of his adventure. By January of the next year, he finished his *Primi Itineris per Montes Specimen Physico-Medicum* ("Physico-Medical Example of a First Journey through the Mountains").[3] He was so enthusiastic about his work that he sent a copy of it to the Royal Society of London, hoping eagerly for its publication in the "Philosophical Transactions." But this did not happen, and the manuscript disappeared from sight. Two decades passed before two summaries of the original version, called *Estratti* ("Extracts"), appeared in Italian in the "Supplementi al Giornale de' Letterati d'Italia."[4]

Thus, the *Estratti* seemed to be the most complete surviving records of Vallisneri's journey. Even in this condensed form, however, their contents were enough to tickle my imagination. From a preliminary study, I realized that the reports embraced far more than the (however crucial) debate on the origin of fresh water. I drafted a list of all the subjects I could identify; the result was amazingly eclectic, even for an eighteenth-century scholar. The *Estratti* encompassed the whole range of natural sciences, including topics such as mineralogy, stratigraphy, petrography, paleontology, geomorphology, hydrogeology, geography, mining technology, meteorology, chemistry, medicine, botany, and biology. Not to mention those humanistic forays which were a typical feature in texts written by early modern savants, and which embraced history, philosophy, literature, religion, archaeology, and even anthropology and folklore. Considering the mass of information contained in these two summaries, it was no surprise that the original text had been deemed by its author as being worthy of international prestige. Finding the original document would allow

[2] Vallisneri 1715.
[3] Vallisneri 1705, State Archive of Reggio Emilia, Archivio Vallisneri, 10, mazzo IV.
[4] Vallisneri 1722b; 1726.

Figure 1.1: Northern Italy, the Duchy of Modena and Reggio and Vallisneri's journey. Original map: *L'Italie: publiée sous les auspices de Monseigneur le Duc d'Orleans*, 1743 (Courtesy of the Norman B. Leventhal Map Center at the Boston Public Library, Boston (MA), USA).

me to recreate Vallisneri's itinerary with an accuracy unequaled, I hoped, in the history of early modern naturalistic explorations.

However, there was much more to research. Vallisneri was the dominant Italian figure of his time in the field of medical and natural sciences, and as such the centre of a European-wide epistolary network. Given his role in his contemporary Republic of Letters, a study of his manuscript would also add to our understanding of Italian experimentalism: how it impacted early modern natural philosophy, how it was transmitted across national and confessional boundaries, and how it had its roots in a Galilean school which branched out and expanded its influence on different disciplines.

How bright and inspiring my dreams of glory were; unfortunately, they did not take into account a prosaic fact: the manuscript was nowhere to be found. Supposedly, the official copy of the document was still held at the Archives of the Royal Society of London, though there was no trace of it in the collections database. In theory, an expensive excursion to London would have allowed me to gather more information. I felt that maybe, with (more than) a bit of luck, I would be able to find that precious manuscript.

Alas, since I lacked a regularly paid academic position I definitely could not afford to let words such as "expensive" and "travel" enter into my vocabulary. As for the National Edition, receiving a sponsorship from this institution was out of the question. Just a few weeks before, Italy's Ministry of Culture had informed us that, given the dire impact of the 2008 financial crisis on the Italian economy, our annual budget would suffer ("to our utmost regret," they said) a draconian reduction which would last "indefinitely." As we would learn in the following years, the boundary between the terms "indefinitely" and "forever" is not sharply delineated.

But there was another option—the draft copy. What if this earlier version of the *Primi Itineris Specimen* had survived? If so, this document was probably lurking somewhere in

the State Archive of Reggio Emilia, where the vast and still largely unexplored bulk of the author's unpublished writings—the Archivio Vallisneri or "Vallisneri Archive"—was held. In a kind and extreme act of optimism, Generali resolved to use the remaining public funds from the previous year for the scanning of a few carefully selected papers. So, we traveled at our own expense from Milan to Reggio Emilia: once there, we spent three days cataloging and describing the entire Vallisneri Archive, searching for all the useful material we could detect and acquire.

Of the archive's twelve parts, the tenth one—entitled *Scritti, minute e appunti scientifici e letterari d'Antonio Vallisneri sr.* ("Writings, drafts, and scientific and literary notes by Antonio Vallisneri, Sr.")—seemed the most promising. This section, in turn, was made up of four huge *mazzi* ("bundles"). It was in the fourth *mazzo* that, after having scrutinized a large pile of manuscript lesson plans with such charming titles as *Praelectiones de Urinis* ("Lectures on Urine") and *De Adiposis Ductibus* ("On Adipose Ducts"), I came across the stained brownish cover of a thin cardboard folder. This had a concise yet thorough title on it:

Iter Montanum ("Mountain Journey")

I turned the page, and my premonition proved to be true: there it was, in my hands, the original draft of the *Primi Itineris Specimen.*

In leafing exultantly through those ferociously reworked pages—replete with canceled text, slips of paper pasted here and there, confused corrections, and anxious margin notes—I realized that an exhaustive study of this document would take much more time than I had imagined. But fate seemed to have granted me a sort of compensation, or rather encouragement, for the challenging task I now foresaw. I found lying at the bottom of the stack of papers that made up the manuscript two perfectly preserved and neatly folded hand–drawn maps of the Tuscan region of Garfagnana, the place where Vallisneri's journey came to an end. Furthermore, an autographed note on the first document allowed me to identify its maker as Domenico Cecchi (1678–1745), a locally renowned cartographer from the town of Castiglione.

Undoubtedly, this finding was beyond my best expectations. Yet, such a wealth of sources had the paradoxical effect of making me feel overwhelmed by the mass of new data. This strange and unsettling feeling grew stronger a few weeks later when I obtained the digital scans of the *Primi Itineris Specimen* and started comparing its content with that from the *Estratti.* Though there was an almost perfect match between the itinerary described in the manuscript and the one in the published summaries, a number of features in the former document differed, qualitatively rather than quantitatively, from those found in the *Estratti.*

Language, of course, was the first and most important difference. In the early XVIII century, as earlier, Latin was the inevitable choice for those scholars who wished to make their research known throughout Europe. Yet this very desire, in turn, implied for Vallisneri the ambition of engaging an audience whose familiarity with Italian science—that is, with the Italian tradition of that peculiar form of inquiry which was commonly referred to as "natural philosophy," and which in Italy had been greatly influenced by Galileo's legacy—was not apparent. Hence the careful attention he paid to the description of the methods and practices of his field research, and also his strenuous upholding of this this still debated and largely neglected way to knowledge. In fact, just like his teacher Marcello Malpighi (1628–1694) and Francesco Redi (1626–1697) had extended the influence of Galilean experimentalism from physics to medicine and biology, so Vallisneri applied the experimental method to the Earth sciences by envisioning mountains, seas, rivers,

plains, caverns, and springs as giant laboratories where (more or less) controlled tests and observations could be performed.[5] From this point of view, his report was not just a philosophical enterprise but also a project which possessed an implicitly promotional and self-promotional purpose. By addressing the oldest and foremost scientific society in Europe, he aimed to establish himself as the leading Italian voice in the choir of the Republic of Letters and, therefore, as an acknowledged benchmark figure within this context.

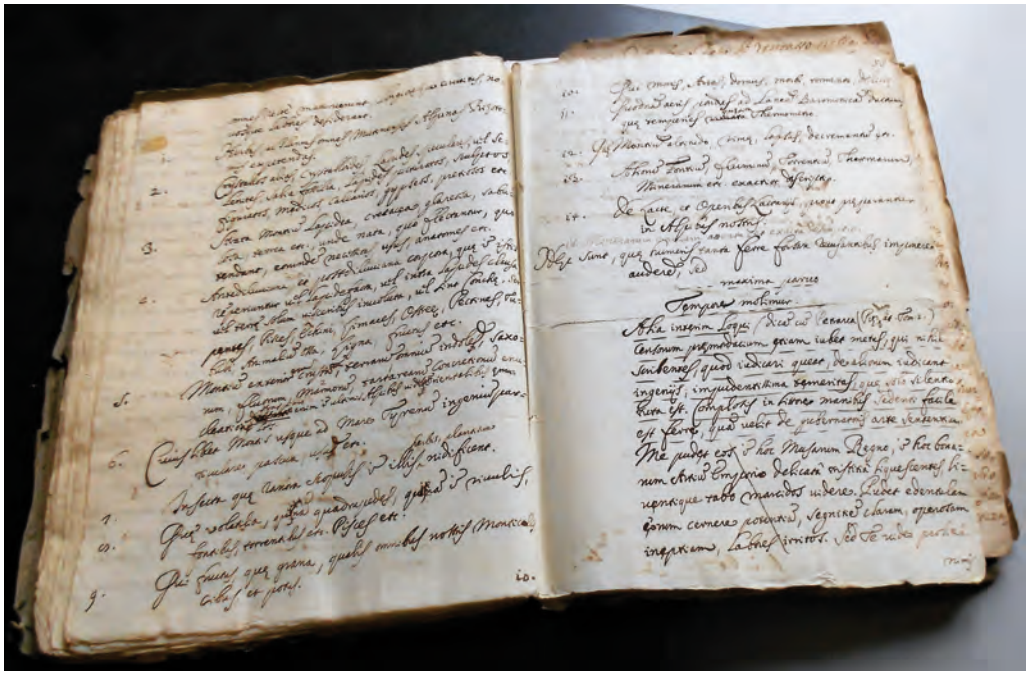

Figure 1.2: "I turned the page, and my premonition proved to be true: there it was, in my hands, the original draft of the *Primi Itineris Specimen*."

Eventually, I managed to work my way through the mountain of information provided by the *Primi Itineris Specimen* and succeeded in recreating Vallisneri's itinerary almost in its entirety. By the summer of 2010, I was even able to replicate in person his journey and many of the observations and explorations he reported in his manuscript. And, like Vallisneri, I was so proud of my work that I wanted to share it with that Republic of Letters of which I desired to become a part. In the following years, this experience became a central feature of several of my papers[6] and my first book,[7] and proved to be a decisive factor for my examination of Vallisneri's contribution to the development of the Earth sciences. In fact, as the manuscript clearly shows, field data and theories constantly interacted in his thought, and to a much greater extent than was the case for many of his Italian and European contemporaries. His was a virtuous synergy, one which led to an uncommon and not obvious understanding of a number of scientific, philosophical, medical, social, and religious issues: the genesis of springs and mountains, the organic origin of fossils, diluvialism, the discovery of deep-time in relation to geochronology, the constant search for new therapeutics (and the critical evaluation of traditional ones), the perception of man's place

[5] On this topic, see Monti 2011. See also Generali 2007a.

[6] Luzzini 2010; 2011a; 2014a; 2015b. On Vallisneri's journey (and, more generally, for a study of the birth and development of the practice of geological travels in Italy), see also Vaccari 2005; 2007; 2008; 2011.

[7] Luzzini 2013a.

in nature, and the tormented—though fertile and, undoubtedly, charming—relationship between science and religion.

Of course, Vallisneri's effort to provide his observations and explorations with a well-defined methodology was not exempt from ambiguities. I would have been surprised had the contrary been true. This was a trait typical of an epoch when technicians, practitioners and scholars were still far from defining common and univocal procedures and terminologies. Nor did this fact dissuade me from thinking that the *Primi Itineris Specimen* had the potential to offer a most precious insight into the requirements, criteria, and purposes to which field research should conform according to a natural philosopher of the early eighteenth century. As such, this document deserved to become the *main* subject of a study that would enhance the historical value of its content in all its richness and complexity, and would aim to break new ground in our understanding of knowledge, theories, and field research in the early modern period. In a word, it deserved a critical edition—and, as usual, I needed to find the financial support and academic stability necessary to produce one.

When, in late November of 2014, I received the news that my application for an Edition Open Sources Post-doctoral Fellowship had been successful, I realized that fate had granted me an opportunity to finish what I had started years ago. Once more, chance and necessity met at the right time in my academic life.

Let us now focus on the historical, cultural, and intellectual context from which the *Primi Itineris Specimen* took shape and developed.

1.2 Theory, Practice, and Nature In-between

The second half of the XVII century was not a peaceful time for the University of Bologna. In those years, the Palace of the Archiginnasio—with its courtyard, arcades, solemn halls, and beautiful anatomical theater—became the silent witness to a fierce battle which often overflowed the limits of the (however brutal) academic debate. Ink almost turned into blood, for much was at stake: intellectual hegemony over the most advanced medical center of its time in Italy, and one of the most advanced in Europe.

With good reason, this struggle could be considered a result of the immense impact exerted by Galilean experimentalism on medicine and natural philosophy. This new method of studying nature had aroused both strong opposition and enthusiastic support, and two radically different epistemological traditions had emerged and were now confronting each other. On one side stood empirical medicine, whose leading exponents were the Galenic physicians Giovanni Girolamo Sbaraglia (1641–1710) and Paolo Mini (1642–1693); on the other side was Marcello Malpighi, a renowned paladin of the rationalist school who had merged the experimental method with the theoretical frameworks of Baconian philosophy and Cartesian mechanism and corpuscularism, and who had upheld microscopic observation as a crucial practice for the advancement of anatomical studies.

It would be misleading (and way too simplistic) to dismiss Mini, Sbaraglia, and their followers as reactionary defenders of a backward and ineffective medicine which would soon be cast into oblivion by the relentless development of the new science. A number of studies have outlined how, in the last decades of the XVII century, the debate was far from being resolved in favor of the experimentalist side.[8] In fact, the constant and undeniable progress of anatomical knowledge had not yet had a proven positive effect on people's

[8] On this topic, see Cavazza 1990, 185–201; 1997; Crignon, Zelle, and Allocca 2014; French 2003, 215–221; Generali 2007a, 30–47.

health, and too many diseases and accidents still entailed much misery (if not a death sentence). Thus, the fierce opposition from the advocates of empiricism, and the persistence of traditional pharmacopoeias and therapeutics that were based essentially on empirical and statistical criteria, appeared reasonable to contemporaries. Significantly, these empiricist methods were still widely used by even those progressive physicians who rejected the theoretical principles of Hippocratism and Galenism; Malpighi was no exception.[9]

When young Antonio Vallisneri enrolled at the University of Bologna in 1682, the strife between the empirical and experimental factions was at its peak. Being a proud follower of Malpighi, he took the side of his mentor without hesitation: still, this stand did not imply for him an uncritical rejection of empirical medicine, which he carefully (and secretly) learned in Sbaraglia's classes.[10] This cross-pollination of experimental rationalism (itself the result of an original synthesis of Galilean and Baconian motifs) with traditional empiricism proved to be extremely fruitful for Vallisneri's research, which soon branched out from medicine to encompass a wide range of disciplines within natural philosophy. In the specific case of the Earth sciences, this approach led to his extreme dedication to field research, a steady interest in testing the chemical and physical properties of collected specimens, and a remarkable inclination to identify the connections and interactions between natural phenomena (with, moreover, special attention paid to the agreement between data and theoretical interpretation).

Important examples of this research method can be found in Vallisneri's early scientific notes. These date back to the last decade of the XVII century when, having become a doctor in 1687, he returned to the Duchy of Modena and Reggio and started serving as a general practitioner. Throughout this period, he made profitable use of his leisure time by performing a wide array of observations and experiments and by methodically writing them down in seven notebooks, now partially published by the National Edition of Vallisneri's Works as *Quaderni di osservazioni* ("Observation Notebooks").[11] His earliest geological report is a concise note dated February 24, 1694, concerning a "dreadful earthquake" that occurred in Mantua and Luzzara and which was felt "all over Europe" ("Some towers fell, along with almost all of the chimneys and many houses").[12] Another note from the same year—dated November 12—focused on the gypsum layers of Mount Gesso, a hill located in the gypsum-sulphur formation of the northern Apennines (and now part of Albinea, in the Province of Reggio Emilia). A new sulphur vein had been discovered, and the "Most Serene Prince" Luigi d'Este *Juniore* (1648–1698), Governor of Reggio and Marquess of Scandiano, had ordered the appointment of a "certain Mr. Raggi from Romagna" in order to find the vein and start digging to mine it.[13]

[9] Cavazza 1997, 140–141; Generali 2007a, 36.

[10] Generali 2007a, 36–40; Luzzini 2011b, 334–335; 2013a, 69–70.

[11] Vallisneri 1694, Biblioteca Estense di Modena, Raccolta Campori, 701–707, γ. D. 6,36–42. The first two volumes are now published in 2004; 2007.

[12] Vallisneri 2004, 37. This event may have been an aftershock of the distant and far worse earthquake of Val di Noto, which struck the eastern part of Sicily on January 11, 1693, and caused about 60,000 fatalities. The seismic sequence lasted two years, with a great number of aftershocks (almost 15,000), which occurred even in northern Italy. On the chance that Vallisneri made a mistake in noting down the year, or used the universal calendar "ab incarnatione Domini" (according to which the year started on March 25), I confirmed that in fact the event occurred a year later, on February 24, 1695. In this case, it could be identified as the earthquake of Santa Costanza, which had its epicenter in Treviso and spread all over northern Italy. This second hypothesis is confirmed by historical records, whereas—with respect to the Po Plain—there is no evidence of the earthquake reported by Vallisneri in 1694. See http://emidius.mi.ingv.it/CPTI15-DBMI15/index_en.htm; http://storing.ingv.it/cfti4med/.

[13] Vallisneri 2004, 35.

Vallisneri was particularly attracted by the peculiar lithology and geomorphology of Mount Gesso. He had been wandering in that area since May 1694, making observations and collecting specimens. He had also visited a "dark and cold place" where animals refused to drink the "clear and fresh water" from a nearby spring. That fact aroused his curiosity: he decided to taste the water, and found it extremely bitter. This was a result, he supposed, of the passage of water through the gypseous rocks which, "being bitter, give it their taste […and] their particles."[14]

Nearly seven months later, in December, he entered a cavern in the area surrounding the ancient Castle of Borzano.[15] There he observed "water coming down from above" and then "falling through large gypsum rocks, in one of which the remnants of an ancient, carved staircase" could still be seen. There was also the remains of an "old, blackened oven," on the basis of which he argued that this place "was once inhabited."[16]

It was indeed, but not in the way he thought. As the Catholic priest Antonio Ruffini (and the Abbot Gaetano Chierici (1819–1886), who later stole the discovery from him) found out in 1871, the cavern was a sepulchral site from the Eneolithic period (or Chalcolithic, 3300–2200 BC) and the "oven" was, in fact, an altar used for the ritual burning of human bodies.[17] Vallisneri, however, was more interested in natural history than in archaeology. What caught his attention, above all, was the mysterious path of the water in the cavern. It fell from above, and then disappeared down into the ground: a feature typical of karst environments, and one which—he remarked—"very well" supported the observations reported by Bernardino Ramazzini (1633–1714) in his "learned book" *De fontium Mutinensium admiranda scaturigine* ("Of the Wonderful Origin of the Springs of Modena").[18]

According to the *Quaderni*, 1694 was a very fruitful year for Vallisneri. In May, he studied one of the most peculiar and intriguing geological phenomena in the northern Apennines, the so-called *salse*. Since the late middle ages, and probably even earlier, these muddy mixtures of water, salt, clay, carbon dioxide and hydrocarbons (mainly methane and oil), which now still leak out from the ground in some areas between Reggio Emilia and Modena, became a matter of endless speculation for physicians and natural philosophers. Vallisneri, who was no exception, repeatedly explored the little mud volcanoes and the seemingly lunar landscape formed by their bubbling emissions. He focused in particular on the large *salsa* in Querciola (a few kilometers south of Reggio Emilia), where he collected many samples of the cold, oily mud that poured from the craters (Figure 1.3). Nor did he hesitate to test the therapeutic potential of this substance on a number of his patients, who obviously had been selected from the poorest—and, therefore, the least powerful and least vengeful—ranks of society. Actually, the mud proved to be "very effective to desiccate tumors, mainly those on the legs."[19]

This interdisciplinary foray into medicine was not an exclusive feature of Vallisneri's research. In a time when the borders between different disciplines were still easily and enthusiastically crossed, it was not uncommon for a physician to broaden his interests beyond the conventional (though flexible) limits of his professional competence and du-

[14] Vallisneri 2004, 42.

[15] A medieval castle, now in ruins, located close to Mount Gesso. Its original walls date back to the VIII century, at the end of the Lombard (or Longobard) dominion in Italy. See http://www.castellodiborzano.it/.

[16] Vallisneri 2004, 34–35.

[17] The cavern is now known as Tana della Mussina. On the identification of this place with the one described by Vallisneri, see Luzzini 2011b, 338–340; 2013a, 72–74.

[18] Vallisneri 2004, 34–35. Here, Vallisneri refers to Ramazzini 1691, 9–29.

[19] Vallisneri 2004, 40–41. On this topic, see Luzzini 2011b, 341–343; 2013a, 74–77; 2014a, 211; 2014b; http://www.comune.viano.re.it.

Figure 1.3: The *salsa* in Querciola (Viano, Reggio Emilia). Photo by Stefano Meloni.

ties.[20] It is undeniable, however, that Vallisneri seemed to have been more inclined than others of his contemporaries to identify the links between medicine and the many fields of natural philosophy and to strengthen and make profitable their use. A clear expression of this approach is to be found, for example, in the role he played in the re-edition of *De Thermis* ("On Thermal Baths"),[21] a sixteenth-century treatise written by the Roman doctor and philosopher Andrea Bacci (1524–1600), who examined and discussed the therapeutic effects of thermal waters. In an appendix to this book, Vallisneri included a study entitled significantly *De nova Methodo Thermarum explorandarum* ("On a New Method of exploring Thermal Springs"),[22] where he supplemented Bacci's text by reporting many of the field observations he had made since his early years of practice. Not surprisingly, a great many of these descriptions came from the Quaderni, where his effort to deepen his comprehension of the interactions between medicine and natural philosophy was constant and ubiquitous.

Not even methodology was exempt from this interdisciplinary approach. In fact, the key to understanding his role in the development of the Earth sciences lies in this crucial part of Vallisneri's work, and to such an extent that it may be worthwhile to devote a few more words to it.

As Malpighi, Redi, and other scholars and physicians had experienced in the previous decades, the passage from physics to medicine and biology did not occur without hurdles and criticisms for the Galilean experimental tradition. Vallisneri, who acquired this legacy,

[20] For some comprehensive studies on the relationship between medieval and early modern medicine and the Earth sciences, see Duffin, Moody, and Gardner-Thorpe 2013. See also Duffin 2005; Duffin and Pymm 2015a; 2015b.
[21] Bacci 1571.
[22] Vallisneri 1711.

tried to extend the use of the experimental method to cover an even more heterogeneous (and trickier) field of study, venturing forth into the vast and largely unexplored ocean of natural sciences. The challenge of this transition did not lie just in the different nature of the subject matter: it was also a question of its size. In fact, no matter how complex a human or an animal body could be, it was still possible to examine it in laboratories, in anatomical theaters, and in other environments where a series of controlled tests could be performed. Such a procedure was unthinkable, however, in the case of rivers, lakes, caverns, mountains, and other geological phenomena; especially when they were considered in their entirety and with all their mutual interactions. Accordingly, since nature could not enter laboratories, these had to be brought to (and into) nature.

This inverted approach implied an inverted perspective, one where the inquiring savant was forced to deal with an interpretive strain that greatly increased the tension between theory and practice. As a consequence of this struggle, the very notion of "experimentalism" needed to be reconsidered and reshaped, and its meaning stretched to the point that it could encompass activities—like the observation of geological phenomena or the exploration of caverns and mountains—which were more properly described as sensorial experiences than as contrived tests. Thus, in Vallisneri's investigations a vital role was played by empiricism, interdisciplinarity, and field research, and in their intersection he used and retained knowledge, practices, and most of the terminology from a number of technical and practical activities such as mining technology, chemistry, metallurgy, engineering, hydraulics, and even pottery and farming.[23]

Although the synthesis of experimental and empirical models often led to ambiguous and hybrid procedures, it also proved to be extremely efficient in addressing the great variety of natural phenomena. As such, it became the cornerstone of Vallisneri's research in the Earth sciences; even in those cases where geological samples could actually be brought into a laboratory and, therefore, the 'normality' of experimental inquiry could be preserved. This flexibility shines through in another long note from the *Quaderni.* Dated December 1694, it relates the analysis of a certain kind of "fossil coal" (probably a sort of lignite or low-carbon coal) found by the author in the Tresinaro River, close to Scandiano:

> Unlike unpetrified coal, [a piece of] petrified [coal] sinks immediately [in water] if deprived of those stone fragments which can be [usually] seen. Having ground a mixture of coal and stone chips into an extremely fine powder, and having poured spirit of vitriol[24] on it, it boiled vigorously, bubbling and swelling. It didn't boil with spirit of sal ammoniac.[25] It burns very quickly, produces a lot of smoke, and emits a foul smell. It can be presumed that the coal is from a pine wood that was not well consumed, or from another [kind of] wood.
>
> A piece of coal with stone streaks inside it was XII and XIIII grains[26] in weight. Once burnt, it became XXXX grains.
>
> [Likewise], a [piece of] pure coal with no streaks, which was 31 [grains in weight], became XXI grains.

[23] On this topic, see Generali 2007a, 221–223; Luzzini 2011a; 2011b; 2013a, 69–137; 2015b, 172–173, 181–184. For an in-depth discussion of laboratory experimentation and instrument-aided observation as applied to geology (especially with respect to the late XVIII and early XIX centuries), see Newcomb 2009.
[24] Sulphuric acid (H_2SO_4).
[25] Ammonium chloride (NH_4Cl).
[26] Grain (unit of mass).

Test what remains of the normal coal.

Once thrown into water, [some] red-hot, burning pieces of the above said petrified coal floated for a while and then sank to the bottom. The same happened with the normal coal, which also sank. Other pieces remained afloat (just like the normal coal does) after they had cooled down. The smell of petrified coal is different from that of naval pitch: the latter being more pleasant, and almost aromatic, while the former is very annoying and offensive. When burning, naval pitch is somehow similar to the above mentioned coal, though its flame is whitish (and, as I said, its smoke is not disgusting). Moreover, as they say, [pitch] slowly melts when burning, whereas [petrified] coal and normal coal do not. Normal coal, which is called "strong," does not produce a flame; only tiny sparks spray from it, and it turns to ash little by little. [Similarly, when using] the burning glass, our [petrified] coal does not produce flame, while it emits very small sprays of sparks; [moreover], the spot where the rays strike becomes hollow and turns to ash. Having been placed on burning coals, and having used the bellows on them, our [petrified] coal started smoking a lot before burning with a dirty, smoky flame. Once burnt, it produces stains (like normal coal does), whereas it did not before. When immersed in water, the normal coal hardens even more and doesn't stain that much. Try with cloudy and saltpetre water.[27]

When normal coal gets burned, and once the fire goes out, it becomes ash even in the inside, whereas our [petrified] coal does not: this [becomes ash] only on the surface, while the inner part remains unchanged. Also, both of them are equally light [in weight]. Etc.

Cook the above said coals in water, and also see if something floats to the top.

The finely ground coal sinks once it is soaked with liquid. Fabricius, Book 2 *De halitu, Physica,* tract. VI, pag. 264.[28]

[27] Water with potassium nitrate (KNO_3).

[28] Vallisneri 2004, 52–53: "Il carbone impietrito solo senza que' ramenti di pietra, che si vedono, subito va al fondo a diferenza del non impietrito. Gettato spirito di vetriolo sopra il carbone rimescolato con pietra e macinato impalpabile, bollì molto, e sollevossi in bolle. Non bollì collo spirito di sal armoniaco. Abbrugia benissimo, fuma molto, e mena un odore fetido. Può sospettarsi, che sia carbone di pino non ben padito, o di altro legno.

Un pezzo di carbone colle strisce di sasso inframezzo, che pesava XII, e gr. XIIII, abbrugiato restò gr. XXXX.

Carbone schietto senza strisce, che era 31, restò gr. XXI.

Provare, che cosa resta il carbone ordinario.

Gettati in aqua pezzetti del carbone sudetto impietrito rosseggianti di foco, ed accesi stettero alquanto a galla, poi piomborono al fondo. Il simile fece il carbone commune, e andò anch'egli al fondo. Lasciati raffreddare altri pezzetti stettero sempre a galla, come fa il carbone ordinario. L'odore del carbone impietrito è diferente da quello della pece navale, essendo quello della pece più grato, e quasi confortativo, e l'altro noiosissimo, ed offensivo. La pece navale nell'accendersi ha qualche simiglianza col carbone sudetto, ma la fiamma è più bianchiccia, ed il suo fumo non è fetente, come ho detto. V'è anche dicono, che nell'abbruggiarsi appoco appoco si liquefà, ma il carbone nulla, come pure il carbone ordinario. Il carbone ordinario detto forte non leva fiamma, ma solo da lui si spiccano minutissime faville, e a mano a mano s'incenerisce. Collo specchio ustorio il nostro carbone non leva fiamma, ma getta gentilissimi sprizzi di faville, e resta affossato il loco, ove ferirono i raggi, e diviso in cenere. Posto il carbon nostro sopra carboni accesi stuccicati dal soffietto incominciò fortemente a fumicare, poi ad ardere a fiamma torbida, ed affumata. Abbrugiato una volta tinge poi, come fa il carbone ordinario, dove prima non tingeva. I carboni ordinari gettati in acqua via più se indurano, e non tingono così bene. Provare in acqua torbida, e nitrata.

Il carbone ordinario, quando novamente si roventa, nell'estinguersi s'incenerisce sino nel centro, ma il

An expanded and improved version of this emblematic report was published six years later in the journal *La Galleria di Minerva*.[29] This piece, too, was a perfect example of methodological eclecticism. Vallisneri started by addressing the therapeutic properties of the mysterious "erba fumana" (*Fumana procumbens,* Family Cistaceae), a dwarf shrub native to rocky and sandy soils in central and southern Europe. After focusing his attention on Montegibbio, a low hill in the northern Appennines where this weed was supposed to be particularly abundant, he hinted at a certain "bituminous earth, mixed with a lapidescent juice" which (he supposed) had been somehow "baked in the warm bowels of the mountains" and transformed into "a sort of petrified coal."[30] This last substance was, in turn, constantly eroded by water and carried downstream by rivers and creeks—for example the Tresinaro, where the author had found the specimens which he had described in 1694.

As in the *Quaderni,* a main feature of this report was the attention devoted to both *primary* and *secondary* qualities. Vallisneri did not just consider the size, weight, and shape of the coal. He also reflected on such sensorial attributes as color, smell, and even the different kinds of smoke produced when burning the samples. In doing so, he marked a sharp methodological break from his teacher Malpighi who distrusted the use of subjective qualities in the study of natural phenomena.[31] Also, we can recognize here a clear imprint of the empirical principles advocated by Sbaraglia, who in turn—and not by chance—had been greatly influenced by the severe yet constructive criticism of experimental rationalism found in the writings of Thomas Sydenahm (1624–1689) and John Locke (1632–1704).[32]

Yet, unlike Sbaraglia, Vallisneri was an earnest and passionate supporter of his mentor Malpighi and of the experimental school. His assimilation and adoption of empiricism was not just the result of Sbaraglia's influence but also—and to a greater extent—of the decisive impact of Bacon's "practical philosophy" on the scientific and academic community in Bologna, the city where he studied medicine.[33] In any case, empiricism did not prevent Vallisneri from grounding his research in the solid theoretical framework and established practices of the Galilean tradition. Not surprisingly then, in his analysis of the "petrified coals" we can find an explicit reference to the use of an instrument that Sbaraglia would have considered the very emblem of the useless and idle technologies of the *moderns:*

> In observing it with the microscope, he didn't see the same wealth of pores that the Most Inquisitive Hooke had observed in common coal; the number of which is so great, and prodigious, 'that in a line of them, 1/18 part of an inch long, he found by numbering them no less than 150. Thus, he concluded that in a piece of coal an inch in diameter there must be no less than five million, seven hundred twenty-four thousand [pores].' Rather, he could only observe

carbone nostro non s'incenerisce, se non alquanto nella superficie, e internamente resta carbone. L'uno, e l'altro poi è simile, cioè leggiero. Etc.

Cuocere in acqua i sudetti carboni, e veder pure, se in cima nuota qualche cosa.

Il carbone ben trito, ed inzuppato d'umore va al fondo. Fabricius, lib. 2 *De halitu, Physica,* tract. VI, pag. 264."

The book mentioned at the end of the quote is Fabri 1670, tractatus VI, Book II, prop. IV, "Ex terra pura nullus halitus educi potest."

[29] Vallisneri 1700.

[30] Vallisneri 1700, 106. See also Luzzini 2013a, 77–81.

[31] On Malpighi, see Adelmann 1966; Bresadola 2011.

[32] See Generali 2007a, 37–39.

[33] Generali 2007a, 24, 31–42, 49–50, 141, 215–216, 329. See also Cavazza 1979; 1990; Giglioni 2011.

> that it was covered with many roughnesses, and in some parts was sprinkled with tiny stone particles.[34]

Most likely, Vallisneri could not see the "pores" mentioned by Robert Hooke (1635–1703) because he could not rely on a microscope powerful enough to magnify them or because he did not possess one as powerful as the one invented and used by the English polymath. The non-standardization of microscope parts, both optical and mechanical, was in fact a major issue in scientific debates throughout the early modern period. This problem challenged the technical and interpretive skills of many important savants, and forced a number of them to adopt an extremely cautious approach to the use of this device, often deemed to be a deceptive instrument.[35]

In 1700, Vallisneri's life and career underwent a radical change. The "Most Serene" Republic of Venice—as he noted exultantly in his diary—had lifted him "from the mud" and placed him "in a majestic theater" by appointing him Professor of Practical Medicine at the University of Padua.[36] This new role gave him the chance to step onto the glorious stage of the European Republic of Letters. It marked the beginning of a period of feverish activity when he began and cultivated the international connections and relationships which eventually enabled him to contribute to many scientific and philosophical debates. Nor did he waste time in pursuing this goal: just one year after beginning his professorship he was maintaining a steady correspondence with one of the greatest naturalists of the early XVIII century, the Swiss physician Johann Jakob Scheuchzer (1672–1733).

This collaboration involved much more than a mere exchange of ideas. It generated an unceasing stream of scientific news, books, documents, and specimens (mostly rocks, minerals, and fossils) to and from the Alps which greatly enriched both Vallisneri's and Scheuchzer's natural collections and libraries. Many letters from Vallisneri contained meticulous lists of the objects he was sending to his Swiss friend, along with equally detailed lists of his desiderata and exhaustive reports of his frequent *philosophical* wanderings in the territory of the Venetian Republic (where he now lived). Not surprisingly, in the years which followed much of these writings' content became the subject of published works. This was the case with his account of his visit to the thermal springs in the Euganean Hills, a low, volcanic range located a few kilometers southwest of Padua where Vallisneri, accompanied by his friends the "Most Illustrious and Most Virtuous" Sirs Apostolo Zeno (1668–1750) and Bernardo Trevisan (1652–1720), performed some of the most interesting and peculiar experiments of his career.[37]

His report of this experience, published in 1706 in the journal *La Galleria di Minerva*,[38] could be described as the epitome of Vallisneri's creative synthesis of experimental and empirical methods. As he himself acknowledged, he was not the first author to write

[34]Vallisneri 1700, 107: "Guardato col microscopio non vide quella quantità di pori, che osservò nell'ordinario carbone il curiosissimo Hook, il numero de' quali è sì grande, e prodigioso, 'que dans un rang long de la 18 partie d'un poulce en a contè jusq'a 150. D'où il conclud que dans un charbon d'un poulce de diametre il n'y on doit pas avoir moins de cinque millions sept cent vingt quatre mille' […]. L'osservò solo pieno di molte scabrezze, e seminato in alcuni luoghi di micolini di pietra." Vallisneri could not read English. In fact, the quoted passage from Robert Hooke's *Micrographia* (Hooke 1665) is from a review published in the *Journal des Sçavans*, 1666, XLII, pp. 491–501 (501).

[35]On the role played by the use of the microscope in Vallisneri's research, see Generali 2007a, 271–307; 2007b; Luzzini 2007.

[36]Vallisneri n.d.(a), State Archive of Reggio Emilia, Archivio Vallisneri, Busta 27, n. 1. On this topic, see Generali 2007a, 93.

[37]On this topic—and, more broadly, on Vallisneri's correspondence with Scheuchzer—see Luzzini 2013a, 81–90, 118, 165–170, 175, 179–180, 193, 208.

[38]Vallisneri 1706.

about these thermal waters. Not a few "ancient and modern poets, historians, physicians, and philosophers," including renowned ones such as Andrea Bacci (in his *De Thermis*), Gabriele Falloppio (1523–1562)[39] and Giovanni Graziani (1675–1744)[40] had already discussed the miraculous properties of the Euganean springs. Still, he commented caustically, in reading their works he realized "how little we get to the marrow of matters […] when we depart from experiments."[41] But, as Vallisneri asserted with proud, "philosophical candor," this was not the case with him.

Before starting his research, Vallisneri kept some thermometers in cold water in order to "reduce them to the same degree." He then placed a thermometer in each spring, carefully dipping them where "the water bubbled and boiled most." The "Spring of Abano" (arguably a spring in Abano Terme, which today is still the most renowned spa town in the Euganean Hills) proved to be the warmest. But, since it was a rather windy day, he suspected this factor could have altered the temperature of the air and, therefore, his measurements. Accordingly, he resorted to an expedient which, though "coarse and plebeian," was equally ingenious and efficient. He broke a fresh egg in each spring and checked from time to time how long they took to cook. And, once more, the spring of Abano stood out from the others ("no sooner said than done, the egg white coagulated completely in one minute and the yolk in four minutes").[42]

For now, he was satisfied with this "rough judgment," not having "more suitable devices" on hand. Then, in an attempt to determine the harmful effects of boiling water on living organisms, he threw a number of animals ("fishes, frogs, salamanders, lizards, snakes," and even "birds and dogs") into the hottest springs, measuring the length of their agony with detached and philosophical dispassion.[43] He went on to describe the therapeutic use of those "spirituous waters," mocking the "excessive scruples" of many doctors and the "pompous preparations" they made

> […] in prescribing them to wealthy patients; whereas he saw all those poor, deformed cripples drinking the water and using baths and springs alike, without any medical advice, and receiving much more benefit than those who were so majestically assisted by physicians, who tormented and exhausted them with so many drugs and syrups.[44]

And finally, at the very end of the report, Vallisneri ventured onto an extremely thorny and speculative ground, one where medicine and natural philosophy touched the dangerous borders of religion: he discussed the miraculous healing virtues of the most famous thermal spring in the Euganean Hills, the Fonte della Vergine di Monteortone ("Spring of the Holy Virgin of Monteortone").

As a matter of fact, religion had been bound to the Euganean Hills since before the Roman conquest. The Italic tribe of the Adriatic Veneti had been the first to use these thermal springs, ascribing their beneficial properties to a supernatural cause. Not by chance, the name "Abano" is a variation of the ancient Italic deity Aponus, who was later identified with the Greek and Roman god Apollo—and, as such, was regarded as the supreme

[39] Falloppio 1564.
[40] Graziani 1701.
[41] Vallisneri 1706, 114.
[42] Vallisneri 1706, 110.
[43] Vallisneri 1706, 111.
[44] Vallisneri 1706, 113: "Osserva pure gli scrupoli grandi, e le pompose preparazioni, che fanno fare i medici a' pazienti ricchi prima di prenderle, mentre egli vedeva que' poveri storpi, e mal fatti prendere sì l'acqua come usare i bagni, e fonti senza alcun medico aiuto, e ricavarne più beneficio di quegli, ch'erano assistiti

dispenser of health. Hence the name "Fonte d'Abano," which descends from the Latin "Fons Aponi."[45]

Christianity followed. New legends, suited to the new religion, replaced the old ones. In 1428, in the midst of an epidemic plague, the soldier Pietro Falco stopped at the foot of the Hill of Monteortone and implored God to be relieved from his suffering. All of a sudden, the Virgin Mary appeared and invited him to bathe in a nearby spring, which he promptly did. He was immediately healed, and the news of the miracle spread across the region: soon enough, the Spring of the Holy Virgin became a destination of pilgrimage for thousands of sick and disabled people. By the end of the XV century, a sanctuary (Santuario della Madonna della Salute, "Shrine of the Madonna of Health") was built on the site.[46]

The miracle of Monteortone had been recognized by the Catholic Church, and Vallisneri carefully refrained from mentioning it (let alone discussing it). However, nothing had been said about the *miraculous origin* of the spring and its lukewarm and beneficial water. This—he remarked—was but a fable invented by the custodian of that place, regrettably backed by "many long-bearded and not short-gowned men."[47] Actually, these peculiar virtues were "adventitious" (that is to say, infused into the water from the outside) and not "natural" (innate to it and, therefore, caused by a particular act of God).[48] For

> […] the almighty arm of God did not contribute, except in general terms. It is more glorious for Him to do so many and such [great] things, working in such a rare and admirable manner, that they seem like miracles to our too short and hazy sight. Contrary to what common people think, God does not so easily resort to His omnipotence every day, and even for the smallest trifles. He arranged this great machine with such order that it runs without showing unusual eccentricities, producing marvelous, yet not always miraculous, effects.[49]

The Cartesian influence is evident here. Understanding nature as a great and flawless mechanism where divine intervention was limited to a single act of creation at the beginning of time allowed Vallisneri to keep a safe and wise distance between dogmatic faith and natural philosophy while still conforming to religious orthodoxy (or, in any case, without incurring an excessive risk of censorship). In fact, he considered the very idea of miracles to be useless, unnecessary, and even dangerous for religion. God's omnipotence was to be recognized and admired in the regular, serene, immutable harmony of natural laws: a conclusion which not everyone could achieve, of course. This substantial yet not uncritical adherence to Cartesian principles was a distinctive trait of Vallisneri's early years of activity. Even in the decades which followed, after he was crucially influenced by the philosophies of Nicolas Malebranche (1638–1715)[50] and Gottfried Wilhelm Leibniz

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con tanta maestà da' medici, e logorati, e macerati da tante medicine, e sciloppi."

[45] On this topic, see Lazzaro 1981; Luzzini 2016a.

[46] See http://www.abanoterme.net/abano-citta.html; http://www.monteortone.it/3sto/app.htm.

[47] Vallisneri 1706, 114.

[48] Vallisneri 1706, 112.

[49] Vallisneri 1706, 112: "[…] risponde con candor filosofico, essere tutti naturali effetti, né concorrervi, se non in generale l'onnipotente braccio d'Iddio. Paregli più gloria di questo l'avere fatte cose tali, e tante, che operano in tal rara ammirabile forma, che paiono alla nostra vista troppo corta, e caliginosa, miracoli. Non essere così facile, come crede il semplice volgo, che Iddio metta mano alla sua onnipotenza ogni giorno, anche per leggerissime coserelle. Avere disposta con ordine tale questa gran macchina, che senza far apparire stravaganze nuove, gira, e produce gli effetti con maraviglia, non sempre con miracolo."

[50] Malebranche 1674.

(1646–1716),[51] a strong dislike for the concept of miracles—understood as a suspension of the otherwise immutable natural order—remained a steady feature in all of his mature works. Clear examples of this approach are found in the already mentioned *Lezione Accademica* and the *De' Corpi Marini, che su' Monti si trovano* ("Of Marine Bodies found on the Mountains"), a treatise where the author disproved conventional diluvialism and the biblical notion of a miraculous, universal Deluge, suggesting instead (though remaining within the narrow rhetorical borders of a careful self-censorship) that mountains and fossils were the results of multiple localized flood/emersion sequences.[52]

Like fossils, rocks, and minerals, treatises and journals on many different *philosophical* issues were frequently exchanged between Vallisneri and Scheuchzer. By the first months of 1704, according to the titles mentioned in their correspondence, the discussion had focused on one topic in particular: the study of springs and rivers. In a letter dated March 22 of that year,[53] Vallisneri informed his Swiss friend of the price of three books specifically devoted to this subject. The first one, *Della misura dell'acque correnti* ("On the Measurement of Running Waters"), by the Benedictine monk and Galilean disciple Benedetto Castelli (1578–1643), was a seminal work in the application of the experimental method to the study of streams.[54] The others, entitled *Della natura de' fiumi* ("On the Nature of Rivers") and *Aquarum fluentium mensura* ("Measurement of the Motion of Waters"), were both written by the physician, chemist and mathematician Domenico Guglielmini (1655–1710), whose studies on fluid dynamics played a key role in the development of hydrology and hydrogeology.[55]

Such a specific interest was not accidental. By the spring of 1704, Vallisneri was already devoting much of his field research to the study of a puzzling and elusive subject whose comprehension was a major challenge for natural philosophers from the sixteenth century to the first decades of the eighteenth: the origin of springs and fresh water. Nor was it by chance that in 1705 he added another crucial name to his list of correspondents: Count Luigi Ferdinando Marsili (1658–1730), former general of the Holy Roman Empire, naturalist, Fellow of the Royal Society, and founder and supporter of the Accademia delle Scienze dell'Istituto di Bologna ("Academy of Sciences of the Institute of Bologna").[56]

Various studies have highlighted the role played by Marsili in the development of the Earth sciences: his interests and contributions covered a wide range of topics such as geography, mineralogy, stratigraphy, petrography, mining technology, hydrography, and many others.[57] This eclectic knowledge was in large part a result of the nobleman's troubled military career spent at the service of Emperor Leopold I of Habsburg (1640–1705). From 1682 to the end of the century, Marsili was stationed in the Kingdom of Hungary where he oversaw the mapping of the entire Habsburg-Ottoman border. He also had access to several mines in the Danubian provinces of Hungary, Transylvania and Slovakia between 1693 and 1694, where he acquired knowledge first-hand of the mineralogical and lithological structure of that region while simultaneously assembling one of the largest

[51] Leibniz 1693; 1710. Although Vallisneri and Leibniz never corresponded directly, they came into contact thanks to Louis Bourguet (1678–1742), who was a common friend of the two. On this topic, see Dal Prete 2015, 65; Generali 1987.

[52] Vallisneri 1721. On this topic, see Luzzini 2009b; 2013a.

[53] Vallisneri 1991, 264–266. See also the letters dated February 6 and 23 (Vallisneri 1991, 259–264).

[54] Castelli 1628.

[55] Guglielmini 1690; 1697. For a detailed study of Castelli's and Guglielmini's works, see Maffioli 1994, 29–272; 2010, 151–319.

[56] On this topic, see Cavazza 1990; De Zan 1990; Sarti 2003; http://www.accademiascienzebologna.it/en/academy-of-sciences-of-bologna-institute.

[57] See Generali 2007a, 351–360; Luzzini 2013a, 88–90; Sarti 2003; Stoye 1994; Vaccari 2003; 2008; 2010.

natural history collections of his time. The huge mass of geographical, geological, hydrological and anthropological data gathered during his experiences would be published decades later in a monumental treatise in six volumes, the *Danubius Pannonico-Mysicus* ("Pannonian and Moesian Danube").[58]

Marsili's military career came to an abrupt end in 1703. Curiously enough, this happened while he was deployed to the opposite end of the Empire. Having been appointed second in command at Breisach, an Imperial outpost on the Rhine River, he and his superior Giovanni Filippo d'Arco (1652–1704) surrendered the fortress to French troops after a siege of just 13 days. As a consequence of this premature capitulation, d'Arco was charged with high treason and sentenced to death; as for Marsili, he was stripped of his rank and honors and discharged from the army.

Deeply upset by the incident, he retired to Switzerland. There he began a fruitful friendship and collaboration with Scheuchzer and Scheuchzer's brother, Johann (1684–1738), who became his assistant and helped him in his study of the lithology of the Alpine mountains.[59] Later on, he moved to southern France where he focused his attention on the hydrography of the Mediterranean Sea and on the structure of sea floors.[60] During his travels, Marsili of course collected countless fossil, mineral, and rock samples and thus further enriched his vast museum of *natural curiosities* that he eventually donated to the Institute of Sciences in Bologna.

Vallisneri considered Marsili an absolute authority on natural philosophy. He also admired his natural history collection, which he explicitly used as a model for his own museum.[61] His fervent admiration for the nobleman's "uncommon knowledge" was remarked on in a letter which he wrote to him on January 10, 1705, with the clear intention of establishing—just like he had done with Scheuchzer—a profitable exchange of books and specimens. But there was something else in the message—a very specific and peculiar request:

> […] I have turned my mind to the study of the mineral kingdom; and, to this purpose, in the past summer I wandered through a great part of our mountains up to the farthest Panie, those facing the sea. Now, I know that when it comes to this [subject], no one can give me more enlightenment than Your Most Illustrious Lordship […]; for you had all the opportunities to satisfy your worthy hunger for reliable information in the wealthiest mines of Hungary. […] Thus, for now I beg you to let me know if you have observed any perennial waters or springs in all those mines, and if you believe all springs to come from rainwater, or snow, or partly from these and partly from the sea. Nor do I require Your Lordship to prove what you write: just say 'yes' or 'no,' which shall be enough for me to support a great argument [of mine].[62]

[58] Marsili 1726.

[59] Marsili n.d., Biblioteca Universitaria di Bologna, Fondo Marsili, codice 1044, ms. 90, cartella C, c. 41v.

[60] Marsili 1711; 1725.

[61] See Generali 2007a, 351–360; Luzzini 2013a, 89–90, 161–162; Vaccari 2008.

[62] Letter to Luigi Ferdinando Marsili, January 10, 1705 (Vallisneri 1991, 282): "[…] ho rivoltato il mio animo allo studio del regno minerale, e per tal fine l'estate scorsa ho vagato gran parte delle nostr'Alpi, sino all'ultime Panie vicine al mare. Ora, in questo io so che non v'è alcuno che possa darmi lumi maggiori di V.S. Ill.ma, […] avendo ella avuta tutta la commodità di saziare la sua degna fame di sicure notizie nelle miniere ricchissime dell'Ungheria. […] La supplico dunque per ora a favorirmi di due notizie, se in tutte le miniere ha osservata acqua perenne, o fonti, la seconda, se crede che tutti i fonti vengano dall'acque piovane, o nevi, o parte da queste, parte dal mare. Né pretendo già che V.S. Ill.ma mi provi quanto scrive, ma solo brevemente dica, o il sì o il no, che a me basterà per un grande argomento."

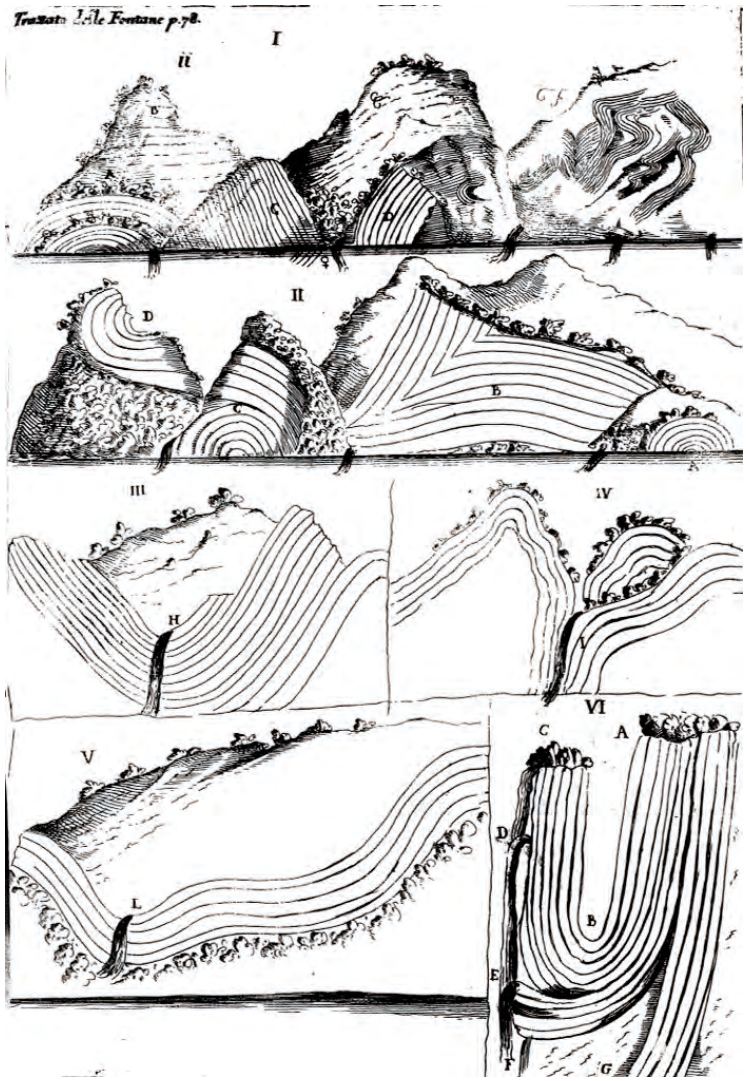

Figure 1.4: An engraving from the *Lezione Accademica intorno all'Origine delle Fontane* (1715).

The "great argument" was a new theoretical system on the exclusive meteoric origin of springs, which Vallisneri would completely explain (and support with plenty of field data) in 1715 in the *Lezione Accademica intorno all'Origine delle Fontane* (Figure 1.4). This was no small matter: with this work, he stepped into the middle of a heated debate which had been challenging the Republic of Letters (and countless other scholars and technicians all over Europe) for centuries.[63]

This interest was not just philosophical. Water management was, as it is now, a crucial topic for communities and governments. Droughts and floods often meant the difference between wealth and misery, civic stability and insurrection, abundance and famine, health and disease and, therefore, the difference between life and death (with all their related social, economic and political consequences). It is no wonder that such a vital resource became a subject of investigation and controversy evinced by a great number of texts of different kinds and lengths. These text were, in turn, produced by authors with different cultural, social, philosophical, religious and scientific values and backgrounds which—far from being mutually exclusive—often coexisted and interacted, leading to a heterogeneous mixture of theories, methods, and practices of inquiry. Already in the six-

[63] On this topic, see Luzzini 2015b; 2013a, 97–98, 109–111, 116–131, 141–153; 2014a, 208, 213.

teenth century, for example, the opinions advanced by many authors to explain the origin of fresh water relied on field research. And in fact, field research often persuaded them that water from precipitation was *not* enough to replenish springs and rivers. Hence, the idea originated that hidden channels existed which connected the oceans to the earth, and that sea water was drawn up the mountains by subterranean heat and lost its salt either by filtration through rocks or by condensation of vapor in the bowels of the mountains. This was the so-called theory of alembics, which would find its greatest champion in Descartes (1596–1650).[64]

Part of this knowledge came from the medieval elaborations of both Aristotelian and Platonic thought, which in the Renaissance interacted with different esoteric traditions. These theoretical models recognized in water and in the (supposed) subterranean passages a macroscopic analogy between them and human blood and blood vessels. Subterranean heat and other geological and atmospheric phenomena, therefore, were understood as macroscopic counterparts of metabolic processes. The evocative power of these notions spread across cultural, religious, and chronological boundaries, pervading to varying degrees the research of authors such as Georgius Agricola (1494–1555), Girolamo Cardano (1501–1576), Robert Fludd (1574–1637), Pierre-Jean Fabre (1588–1658), and Jan Baptist Van Helmont (1579–1644); of Lutheran scholars like Johann Johachim Becher (1635–1682) and Johannes Herbinius (1632–1676); and even of important Jesuits such as Mario Bettini (1584–1657), Gaspar Schott (1608–1666), and Athanasius Kircher (1602–1680).[65] It is worth noting, however, that not a few of them thought rain, snow, and glaciers to be at least *essential* causes of the origin of springs, if not the main or only ones. On the other hand, it was not uncommon that renowned and proud experimentalists—such as Edmond Halley (1656–1742), Robert Plot (1640–1696), Jacques Rohault (1618–1672), Bernardino Ramazzini, Domenico Guglielmini, and many others—partially supported the theories of alembics or of the filtration of sea water through rock strata: for, according to their measurements and observations, meteoric water alone could not completely refill the fresh water supplies.[66]

Nor was there a lack of those who maintained a strict adherence to the theory of the meteoric origin without any concession to alembics or rock filters. Already in 1580, the French potter and hydraulics expert Bernard Palissy (1510–1589) in his *Discours admirables de la nature des eaux et fontaines* ("Admirable Discourses on the Nature of Waters and Fountains") used the words of his assertive character—Practique—to reject any argument that sea water could rise up the mountains and be desalinated by passage through rock and clay strata.[67] In the second half of the XVII century, Pierre Perrault and Robert Hooke provided interpretations which, though widely differing, agreed in refuting the Cartesian concept of subterranean heat as a means to explain the rise of water.[68] In 1686, the French physicist and priest Edme Mariotte (1620–1684), a member of the Académie Royale des Sciences, published his *Traité du mouvement des eaux et des autres corps fluides* ("Treatise on the Movement of Water and Other Fluids") where he supported without hesitation (and with plenty of measurements on the flow rate of the Seine River) the mete-

[64] Descartes 1644.

[65] Agricola (Bauer) 1546; Becher 1669, 51–80; Bettini 1642, 24–25; Cardano 1550, 10–11; 1557, 33–44; Fabre 1639, 1–15; Fludd 1617, 199–200; Herbinius 1678, 69, 73–74; Kircher 1664, 226–233; G. Schott 1663, 131–354; Van Helmont 1682, 646–648.

[66] Halley 1687; 1691; Guglielmini 1697, 41; Plot 1685; 1686, 51–52, 74–75, 88; Ramazzini 1691, 29–39, 53–64; Rohault 1671, 249–252.

[67] Palissy 1580.

[68] Hooke 1678; Perrault 1674.

oric origin of fresh water.[69] Later on, in 1689 the Danish physician Caspar Bartholin (the Younger, 1655–1738) published a treatise whose title was more eloquent than any further description: *De fontium fluviorumque origine ex pluviis dissertatio physica* ("Physical Dissertation on the Origin of Springs and Rivers from Rains"). As expected, Bartholin refuted both rock filtration and distillation as natural means of producing fresh water. And like Mariotte (and, a few years later, Vallisneri), he pointed out that no springs existed on the very top of mountains. This phenomenon was simply impossible, as it would have "contradicted the very laws of hydrostatics and equilibrium" and therefore would have been "against nature itself."[70]

Such was the situation when Vallisneri entered the debate. A busy and lively debate indeed, where theory and practice, tradition and innovation, field research and speculation intermingled to form a turbulent stream of knowledge whose components—like creeks merging into a single, mighty river—would eventually contribute to the comprehension of the hydrologic cycle. However, this goal was still far from being achieved at the turn of the eighteenth century. Even though Vallisneri was convinced that his theory on the meteoric origin of springs had the potential to triumph over rival systems, he was concerned that it would conflict with the interpretations advanced by other prominent natural philosophers—especially the ones he admired most—on account of their first-hand experience of nature. Hence his urgency to know Marsili's opinion, which would have been an eminent support for his "great argument."

Actually, and contrary to what Vallisneri had hoped for, Marsili was more inclined to uphold the thesis of a compound origin for fresh water.[71] Moreover, this was also the opinion of other illustrious scholars from Italy such as Ramazzini and Guglielmini (who referred to the system of "the most ingenious Descartes" as "perhaps the most probable, and the closest to the truth").[72] However, despite the importance and influence of these judgments, none of them discouraged Vallisneri from presenting his theories to the distinguished audience of the Republic of Letters. His intellectual ambition was as great as his passion for natural philosophy; nor was the origin of springs the only issue he meant to discuss, given the countless number of natural phenomena that he had been studying over the years. From the gypsum outcrops and the sulphur mines of Mount Gesso to the mysterious *salse* of Querciola, and from the iron mines in Garfagnana to the badlands south of Scandiano; from the "petrified coal" found in the Tresinaro River to the dark, chilly caverns in Borzano and Fornovolasco, and from the discovery and therapeutic testing of new substances to the field observation of mountains and rock layers: these and other "genial studies," performed over two decades of frantic activity, had given him an unmatched knowledge of the Earth and of many different geological contexts.

From his early experiences as a general practitioner to his more recent wanderings in the northern Apennines, Vallisneri had dissected and studied the "great body"[73] of nature with tireless zeal. Now, in 1705, he felt ready to enter the international stage by thrusting himself into the forefront of the European scientific community.

He knocked at the door of the Royal Society of London, bringing with him a rich gift of new data, theories, and practices. This came in the form of an elegant and baroquely written Latin manuscript: the *Primi Itineris Specimen.*

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[69] Mariotte 1686.
[70] Bartholin 1689, 34.
[71] Marsili 1725, 13, 32–34; 1930, 57. On this topic, see the note from Dario Generali in Vallisneri 1991, 282–284; Luzzini 2013a, 98, 109, 114.
[72] Guglielmini 1697, 41.
[73] Vallisneri 1715, 29; 1721, 60.

1.3 A Physico-medical Journey

Vallisneri wrote the following to a friend of his, the physician Flaminio Corghi (16?–17?), in a letter dated June 1705:

> My alpine journey will probably come out this year and—for my part—I consider it most interesting, given the the new medical and physical things which I have observed in those mountains. It will be [written] in Plinian Latin, and first will be submitted to the eyes of the [reviewer], and then it will be published. In light of the furious work I have done, you will see that my Latin style has changed completely.[74]

In early February of the same year, the author had sent the official copy of his *Primi Itineris Specimen* to Sir Hans Sloane (1660–1753), secretary of the Royal Society and, since 1695, editor of the "Philosophical Transactions." Vallisneri had been a fellow of that glorious institution since 1703, though he had never had the opportunity to take part in any of the debates which were held in its journal.[75] But by now, matters seemed to have changed. He was impatiently waiting for a message which, finally, would confirm that his work was to be hosted in the pages of the scientific periodical *par excellence.*

As we know, events went differently and the manuscript was never published. The reasons behind this missed chance are shrouded in speculation, though both the considerable length of the text and the fact that it was written in Latin—by the early XVIII century, the Royal Society tended to favor the publication of English-language papers—are the most plausible culprits. With regard to this issue, Vallisneri's correspondence offers interesting, but not conclusive, clues. As he wrote to Sloane in a letter dated March 9, 1710, his works were for the most part "written in the Italian language."[76] Arguably, the English scholar had asked him for a shorter Latin version of the manuscript, which he could—or would—not provide. Also, the possibility that Vallisneri's strong and proud advocacy of the use of the Italian language by all Italian scholars (even when addressing the international company of the Republic of Letters) played an important role in his hesitation to comply with Sloane's request cannot be excluded.[77] In any case, what we know for sure is that the "furious work" mentioned in the letter to Corghi was not hyperbole. The frantically and ferociously (re)written papers of the draft copy are eloquent testimonies to an ornate and seamless stylistic effort, one which presumably lent a gracious charm to the—now lost—official version. Nor was *form* the only aspect of the manuscript which had been carefully crafted; for its content, too, was the result of a shrewd selection.

As the author's early notebooks (the *Quaderni*) attest, a significant number of the many explorations, observations, and experiments reported in the *Primi Itineris Specimen* had been performed well before the summer journey of 1704. This was the case, for example, with the bituminous *salse* in Regnano and with the gypsum layers and the sulphur mines of Mount Gesso, which had already been studied in 1694.

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[74] Letter to Flaminio Corghi, June 24, 1705 (Vallisneri 1991, 322): "Uscirà forse quest'anno il mio viaggio alpino, che per me stimo curiosissimo, per le cose mediche e fisiche osservate di nuovo in quelle Alpi. Sarà in latino pliniano, e passerà prima sotto gli occhi del Davino, e poi uscirà. Vedrete mutata affatto la mia maniera latina, per lo studio rabbioso che vi ho fatto."

[75] See Generali 2007a, 123, 195–196, 347–350.

[76] Letter to Hans Sloane, March 9, 1710 (Vallisneri 1991, 503).

[77] This ideal was publicly promoted and upheld in Vallisneri 1722a. The same work is now published in Vallisneri 2013. On this topic, see Generali 1985; 2006; 2007a, 384–386; 2011b; Luzzini 2013a, 217–226; Rappaport 1991; 1997, 218–219.

From this point of view, and especially with respect to the first part of the journey, Vallisneri's manuscript could be described more as an anthological collection of field experiences (enriched with a profusion of philosophical, historical, literary, archaeological, ethnographic, and theological notes and considerations, not to mention a good number of folkloristic stories and anecdotes) than the faithful report of a temporally circumscribed journey. But this does not imply, of course, that any of the descriptions in the text was invented. As I personally verified, all were the result of actual experiences and—as such—deserved to belong in the report, although more from a logical than a chronological point of view.[78] Also, the information contained in the draft copy was so detailed that I was able to successfully use it to replicate Vallisneri's entire itinerary (and his most remarkable explorations) through a series of excursions and journeys which I carried out from 2006 to 2010.[79]

Vallisneri's path stretched from north-northeast to south-southwest for a total distance of about 130 kilometers (Figure 1.5). From Scandiano, just south of the city of Reggio Emilia, he reached the Alp of Saint Peregrine, one of the highest peaks in the northern Apennines. From here, the author crossed the homonymous pass—which now links the Province of Modena with the Province of Lucca—and descended to the historical region of Garfagnana. He then followed the course of the Serchio River southward, from Castelnuovo to Gallicano. Once there, he headed west and climbed the valley of the Petrosciana Torrent (also known as Turrite di Gallicano, a tributary of the Serchio) before finally reaching the western end of Garfagnana in the Apuan Alps. In this area, he visited the iron mines of Fornovolasco and the renowned cavern known as Tana che urla ("Screaming Cave"), where he collected crucial data to support his theory on the meteoric origin of springs.

It was in the nearby sulphur mines of Mount Gesso, however, that Vallisneri started his account, resuming and extending his report of 1694 with new observations and data. And, not surprisingly, even then he found a wealth of *philosophical* subjects to feed his curiosity. In this "foul-smelling" cave, fruitful enough "to supply all the nearby and remote cities,"[80] he observed many different kinds of sulphur and other sorts of minerals and rocks and carefully noted the peculiar terms used by local miners (*canopi*) to describe them. Thus, a *cretone* was a "subcinereous, somewhat hard, scaly and bright clay or marl"; when sulphur was "fixed in very hard, tartareous stones" it was called *caninum* ("because, as they say, they have to work like dogs to dig it"); the "bright, colorful, [and] transparent" variety of sulphur was known as *vivum,* or "virgin"; and at the bottom of the mine there was a "tree-like piece" of sulphur, called *filone,* from which "a number of branch-like shapes spread everywhere," like "sparsely attached fruits."[81] Nor did he omit to discuss the therapeutic properties and uses of that place; for it was an established fact that the sulphur miners from Scandiano constantly lived lives that were "healthy, to the no small relief of the working people."[82] Besides—he proudly noted—he had been the

[78]This kind of narrative structure (a composite of accounts of distinct journeys stitched together as a fictitiously unified itinerary) was widely and commonly used among naturalists at least up until the end of the XVIII century, a notable and later case being the itineraries described by Horace Benedict de Saussure (1740–1799) in his *Voyages dans les Alpes* (Saussure (de) 1796). I am grateful to Ken Taylor for this important clarification.

[79]Luzzini 2008; 2010; 2011a; 2011b; 2011c; 2013a, 90–143; 2014a; http://www.vallisneri.it/osservazioni_geologiche.shtml.

[80]Vallisneri 1705, 3. Here and below, I refer to the page numbering of the transcribed and translated manuscript as it is provided in this critical edition.

[81]Vallisneri 1705, 4–IX.r.

[82]Vallisneri 1705, IX.r.

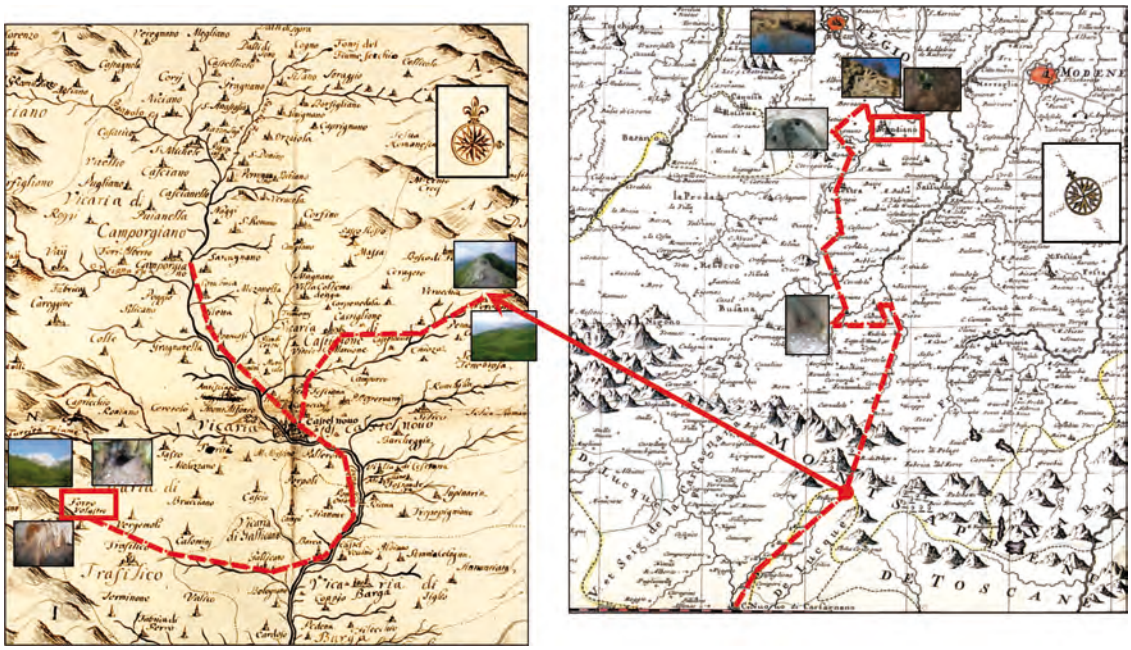

Figure 1.5: A detailed view of Vallisneri's journey: from Scandiano (top right) to Fornovolasco (far left). The red arrow connects the same point (i.e. the Alp of Saint Peregrine) on the two maps.

first to discover its "ubiquitous benefits" for the body, having sent "those afflicted with the filthiest French scabies into that sulphurous laboratory, as if it were a panacea";[83] and even "asthmatics and consumptives [were] certainly and unequivocally healed" once they inhaled the "balsamic and cleansing vapors" released from the burning sulphur.[84]

Having made a list of the many samples which he had taken from the mine (and which he had shared with the "Museum of the Most Illustrious […] Count Luigi Ferdinando Marsili"),[85] Vallisneri went on to describe the southeast slope of Mount Gesso; he found it to be sprinkled with pyrites and marls. He then followed a small creek downstream and reached the Rio Riazzone, a tributary of the Tresinaro River, whose banks held "countless treasures from the sea": tusk shells ("antales"), tube worms, pectens, oysters, gastropods ("buccinula" and "turbines"), shark teeth (or "glossopetrae," which some wrongly claimed to be "arrows" or "petrified tongues of snakes"),[86] and many, many more. Other fossils could be found on the western flank of the mountain, along with marcasites, marls, and flints. And, of course, gypsum rocks and selenite crystals of all sorts, and of various shapes and colors—a "beautiful specular stone" known as *scaiola;* another one called "lapis arabicus," very "similar to ivory"; "trapezoidal" and "specular" ones; other "chalky, caementarius, siliceous, sandy, tuffaceous" and "marble-like" specimens; and even one "with waves" that was "decorated with gold and many other colors"[87]—could be found everywhere in the area surrounding that hill.

[83] Vallisneri 1705, 5.
[84] Vallisneri 1705, XII.v.
[85] Vallisneri 1705, 7.
[86] Vallisneri 1705, 10.
[87] Vallisneri 1705, 12.

Figure 1.6: Gypsum outcrop, Mount Gesso (Albinea, Reggio Emilia). Photo by Stefano Meloni.

But "let us climb higher,"[88] as the author said. The journey continued along the Tresinaro River, where Vallisneri headed south and passed through the first slopes of the Emilan Apennines. There, five miles from Scandiano, he witnessed the barren landscape of the badlands (not improperly called Inferno by the inhabitants) where the "grim sight" of the eroded clay soil was enhanced by the "rude variety" of its colors "wrapping and adorning all the slopes with black, reddish, ferruginous, sallow, [and] white [hues]."[89] And—as if to reinforce the gloominess of this picture—on the other side of the river stood the mysterious *salse,* with their rumbling and their bubbling, smoking craters. What is horrible to common people, however, can be a "not unsightly source of pleasure for the eyes of philosophers": and Vallisneri, being devoted equally to natural philosophy and medicine, paid attention both to the oddities of these little volcanoes ("you could have […] called it a small Etna, if it is allowed to compare small things with great. For this, too, […] rumbles, strikes, and threatens destruction")[90] and to the medical properties of the mud leaking and spewing out of them, whose virtues he had been testing for years. Their waters, for example, were "a remedy for many diseases proceeding from viscous humours, especially from the cold ones"; and their "salty clay" dispelled "old tumors, […] scabies, […] and stagnant fluid, and was even "beneficial for nerves" ("when they are contracted by a too crude lymph") and for "edematous legs," especially when "unresponsive to other treatments."[91]

The day after, Vallisneri headed further south and reached Mount Valestra, which has a homonymous village lying at its feet. The mountain was "almost entirely made of

[88] Vallisneri 1705, 13.
[89] Vallisneri 1705, 13–14.
[90] Vallisneri 1705, 15.
[91] Vallisneri 1705, 15.

Figure 1.7: "The inhabitants […] call it *salsa,* from the salty mud which that pot, perpetual and incombustible by nature (so to speak), cooks and spits out." Photo by Stefano Meloni.

stone, with nearly perpendicular strata": not by chance, he noticed it was "dry, and devoid of springs."[92] But now the time had come to "disregard for a while the weight of physical studies, softening the severity of nature with an amusing break"—these words mark the first important foray into folklore that can be found in the *Primi Itineris Specimen.* This "not unfunny anecdote" concerned the local inhabitants who—like many others before and after them—firmly believed that a hidden treasure lurked in the bowels of the mountain.[93] According to these "rural minstrels," a long time ago a farmer was guided there by two strangers on black horses: once past invisible doors and a "soot-blackened gallery," they entered a "rough-vaulted, large room" full of "idols of pagan gods shining with gold and jewels, […] glass and marble urns with burnt human bones inside, […] vials and small caskets filled with various fluids and mysterious powders," and—last but not least—"coins, golden jewels, and a wealth of precious stones" in countless other chests.[94] The strangers generously invited the farmer to take as much gold as he wanted, which he promptly did. But, as often happens in folk tales, greed is the ruin of the poor. The farmer secretly "planned to return the following night with a cart, and to plunder that wealth of the underworld"; thus, "in the great silence of the night" he came back and sought the keys for the invisible doors, which the strangers had abandoned in a bush nearby.[95] And "scarcely had he thought that they were in his hand, when he grabbed a nest of twisting and fiercely hissing vipers."[96] Curiously, Vallisneri remarks that the descendants of that

[92] Vallisneri 1705, 16.
[93] Vallisneri 1705, 16.
[94] Vallisneri 1705, 16–17.
[95] Vallisneri 1705, 17–18.
[96] Vallisneri 1705, 18.

farmer still lived nearby and were among the wealthiest inhabitants of Valestra. And, since fortune had "smiled on their enterprise," their wealth—in accordance with a widespread and enduring belief among rural cultures all around the world[97]—was attributed to "the necromancy of some strangers."[98]

Other important details in the story make it interesting from an anthropological and ethnographic point of view. For example, it may be (though this is just a hypothetical conjecture, of course) that the caverns and the urns with "human bones inside" mentioned in the story were mythicized versions of vague memories of real but ancient events, places and/or objects, which—in turn—were connected to the area's sepulchral practices during the Eneolithic period.[99] However, this story was nothing more than a "pretty fable" to Vallisneri, who was more interested in natural than in human treasures.[100] Thus, he quickly mocked the mountaineers for their credulity and irredeemable greed ("many […] mutter, swearing that they will find it"), and abruptly returned to the noble ground of philosophy ("let's not wander from the subject, and let us return to the road from our digression").[101]

On the following day, the author proceeded southward to the town of Toano before arriving at the ancient baths of Quara, which were located on the western side of the Dolo Creek. These mineral springs, whose fame dated back to the Roman times and, up until the XV century, were widely and successfully used, now lay abandoned and in ruins, "barely known to the inhabitants themselves."[102] This was a real pity, as those waters—endowed with a "truly pleasant saltiness," a "very bright color," and the "smell of volatile sulphur (which someone erroneously associated with camphor)"—had effectively treated a wide array of ailments such as "weak stomach, shortness of breath, flatulence, hypochondria, painful colics, sterility (when caused by a too viscous lymph)," and even "dizziness, the pain proceeding from slow, especially polypous blood, glutinous phlegm," and many others.[103] Alas, none of these medicinal virtues were valued by modern doctors: consequently these ancient springs, once renowned all over Europe, were now full of stones, mud, and sand, the water being drunk "only by cattle, sheep, and goats."[104]

Still absorbed in these sad thoughts, Vallisneri crossed the Dolo Creek and headed east. He visited the ancient Romanesque church in the village of Rubbiano (now part of the municipality of Montefiorino), where he met a family of surgeons whose members were known for healing viper bites ("they carefully suck the inflicted venom as the Psylli […] used to do, and wash the fatal wounds with their own saliva").[105] They all had a snake-like mark on their shoulders; and, especially in springtime (when the sign had "a brighter color"), it portrayed "the rough image of a nest of vipers."[106] The author tried in vain to ascertain "with curious eyes" whether or not the mark was artificial.[107] He then resumed his journey, and, still going east, he soon came in sight of the springs of Vitriola, which were "provided by nature with gratuitous coloring properties."[108] These waters

[97] For some interesting considerations on this subject, see Hiebert 2008, 123–137.
[98] Vallisneri 1705, 18.
[99] These practices often involved the ritual burning of human remains, as attested by the discoveries in the Tana della Mussina (see note 17).
[100] Vallisneri 1705, 16.
[101] Vallisneri 1705, 16–18.
[102] Vallisneri 1705, 18.
[103] Vallisneri 1705, 19.
[104] Vallisneri 1705, 20.
[105] Vallisneri 1705, 20.
[106] Vallisneri 1705, 21.
[107] Vallisneri 1705, 21.
[108] Vallisneri 1705, 21.

Figure 1.8: Dolo Creek, the natural boundary between the Provinces of Reggio Emilia (on the west) and Modena (on the eastern side).

were clear and tasteless, and yet they colored the surrounding soil and aquatic weeds with a "yellowish, ferruginous dye" that was used by the people of the countryside to "blacken linen clothes and wool" (but not without "some previous preparation," whose (rather) complex procedures were meticulously described in the pages which followed).[109]

Being in Vitriola, he was now between the mountain ridge of Montefiorino (on the west) and, on the east, the Dragone Creek, so-called because of its "serpentine course" and the different colors of the stones "arranged like a mosaic in its gravelly bed" which resembled "the speckled back of a dragon."[110] Not a mile from there, "on the top of a dreadful cliff," lay the ancient citadel of Medola: formerly a powerful and impregnable stronghold, but now in ruins.[111] Where he stood he could see mountains on both sides; their slopes were "barren, made of sharp stones, and parched by mineral exhalations."[112] Vallisneri found "many silvery and bronze-colored pyrites, and many stones sprinkled with a green color"; countless rocks "filled the ground everywhere with tartar and small spherical pebbles." He could see the entrance to a mine which "stood open under a steep rock," a place where "some believed that a gold or silver vein could be exploited" (although he found it to contain only "rough, unprofitable copper").[113] At that time, just like today, hydrogeological events were particularly frequent in this area of the northern Apennines. The

[109] Vallisneri 1705, 21–XIII.r.
[110] Vallisneri 1705, 22.
[111] Vallisneri 1705, 23.
[112] Vallisneri 1705, 23.
[113] Vallisneri 1705, 23.

"unsteady foundations of the Earth" were so "weakened and eroded by the waters and by the melting snows" which sank "through cracks in the rock layers" that they were "loosened by the enormous pressure upon them," and signs of recent and old landslides could be seen everywhere, especially—he noticed with interest—where springs gushed out from the rocks.[114]

His path lay to the southwest. Finally, after "arduous efforts and a rough journey," the Alp of Saint Peregrine—the highest point in the northern Apennines, overlooking the homonymous Pass and the village of San Pellegrino in Alpe—came into sight (Figure 1.9).[115] Once the author reached this privileged viewpoint, a wealth of information was revealed to his eyes. Although it was the "scorching month of August," "cruel winter [still] raged" there "with snow and cold."[116] It was then that he "reconsidered the origin of springs and rivers from a higher [perspective]," and his mind "ventured to seek more in depth" by following the "immense mass of water that was absorbed by underground streams through the darkness of [those] paths"; thus, he realized that the different "nature and disposition" of rock layers was the key to understanding *where* and *how* springs emerged.[117] For example, the perennial springs flowed more copiously in the Apuan Alps (a mountain range of the Apennines at the western end of Garfagnana), where the strata were horizontal for the most part and "almost entirely made of hard rock": consequently, the "melted snows and the flowing waters" could "barely stay in their innards," wept "from small cracks," and formed "perpetual and inexhaustible springs" owing to the "dense structure and to the position of strata and mines."[118] The situation was quite different in the Alp of Saint Peregrine, where the "abundant earth, the bibulous sand, and the looser structure" absorbed the falling and flowing water and carried it "down to the deepest roots" of the mountains, thus forming "an invisible river" (hence the "dreadful slidings of the mountains themselves" and the "collapses proceeding from their flanks").[119]

The stage was now set for theoretical interpretation. For his considerations on *where* and *how,* in turn, were empirical premises to a following crucial step: *why.* It is in this part of the *Primi Itineris Specimen* that field research and natural philosophy come together in their most elegant, refined and ambitious form. In the next few lines, Vallisneri discloses and explains the core of his theory on the hydrologic cycle:

> From whence the mind is inclined to guess, why the waters hide themselves here and appear there; why the perennial springs are uncommon here and the course of rivers is more infrequent, while the both of them flow more abundantly in that [other place]. For this, I thought, is the only circulation of waters (in the bosom of these lands of ours, at least): from the sky to the earth, from the earth to the sea: and, in turn, from the sea to the sky, from the sky to the earth. That is to say, the cavernous mountains and the thirsty land absorb the waters pouring from the sky; [and these waters], flowing for the most part, and absorbed along the way, sink back to the sea through obscure paths. From there, they rise back to the clouds, which make them thin; and

[114] Vallisneri 1705, 23.
[115] Vallisneri 1705, 24.
[116] Vallisneri 1705, 24.
[117] Vallisneri 1705, 24–26.
[118] Vallisneri 1705, 25.
[119] Vallisneri 1705, 26.

from the clouds they descend once more, in a perpetual circulation of the liquid element, whose operation never fails.[120]

Figure 1.9: "After arduous efforts and a rough journey, we finally climbed to the highest point of the Apennine Mountains—which the Ancients called Letum, and some now call Alp of Saint Peregrine."

Descartes' theory of alembics, which suited "the Italian tastes" so much, was not appealing to Vallisneri.[121] In fact, these supposed alembics derived "the rise [of water] from the sea, rather than from transitory rains and melted snows"; but this system of filtration and distillation was both "doubtful and deceptive" according to experiments and observations performed by him and other members of the Republic of Letters.[122] Indeed, sea water could not lose its salt "by percolating through any sand or marble, nor through any vase […] tempered with the fire of a furnace" ("either the bond between the salt and the water particles is so strong that they can be separated only by gentle evaporation, or both

[120] Vallisneri 1705, 26: "Ex quibus coniicere gestit animus, cur hic abscondantur aquae, ibi exantlentur, cur hic rari appareant fontes aeterni, fluminumque rarior cursus, ibi utrumque luculentius effluat. Haec enim, me cogitante, fere sola in hoc saltem nostro terrarum gremio aquarum est circulatio. E caelo in terram, e terra ad mare: rursusque e mari ad caelum, a caelo in terram. E caelo scilicet fluentes aquas cavernosi montes, terraeque bibulae absorbent, fluxae ut plurimum, per obvias absorptae, per obscuras vias in mare devolvuntur. Ex hoc, et ab illis attenuatae rursus in nubes ascendunt, ex nubibus denuo descendunt, perpetua fluxilis elementi, incrementisque nunquam fallentibus, circulatione."

[121] Vallisneri 1705, 26.

[122] Vallisneri 1705, 27–28.

the shape and the mass are such that the draining pores would absorb the salts along with the water").[123]

As the author tactfully remarked, by questioning "such great [issues]" he did not expect "to insult the value and the authority of great men": for he meant "not to dispute, but to strengthen."[124] However, these and many other considerations had persuaded him of the value of refuting rock filtration and distillation, and he joined those who had already tried to provide an exclusively meteoric explanation for the water cycle and the origin of springs (for example, the already mentioned Mariotte, Hooke, Palissy, and Bartholin). He was even "pondering other things" which—he promised—would be revealed in the future.[125] However, now the time had come to "keep the promise" and finish the journey by making sure that the readers could "see, once again, everything" that had been witnessed by him with his "curious eyes."[126] Thus, after a description of the many "crystals and crystal-like" minerals that could be found in these mountains (all of them proving the existence of a "geometric design in nature, and of a somewhat indistinct vegetative power" caused "by an exhalation from the ground"),[127] the "highest summit of the Apennines" was passed.[128] Thereafter, brooks and torrents followed "an opposite course, as if the empire of the waters was divided," descending to the Tyrrhenian Sea. The beautiful Province of Garfagnana—with its "populous towns and villages"—appeared to the southwest.[129]

At this point in the manuscript natural philosophy merges with the "history of men," an additional stack of nine unnumbered papers (XIV.r–XXII.v) that is occupied by a long digression on history, literature, anthropology and folklore (a foray "which, although going beyond my scope, still I consider to be perhaps not useless, nor unnecessary").[130] This region was renowned for enjoying a "friendlier climate" thanks to "the high ridges of the Apennines" that warded off "the icy northern winds by receiving and breaking against them the furious rage of the air currents."[131] It was called "Garfagnana, from the Latin Caferoniana"—whose name, in turn, was borrowed from "Oppidum Caferonianum," an ancient Roman town established close to the Tyrrhenian outposts "of Lucca and of the destroyed Luna."[132] The name came from "Feronia, goddess of pastures, freedmen, fertility, and joy"; and the origin of its inhabitants was rooted in "those Etruscans, Greeks, and Romans who were dispersed and banished everywhere by fate" and by "people, who always (and still) foster cruelty."[133] This happened especially during the period of Roman rule, when countless civil conflicts scourged the late Republic in the I century BC, and many supporters of the losing factions were forced to escape from Rome. Not a few of them took shelter in these mountains: hence the many "foundations and ruins of citadels still

[123] Vallisneri 1705, 28.
[124] Vallisneri 1705, 27.
[125] Vallisneri 1705, 29.
[126] Vallisneri 1705, 29.
[127] With respect to the debated issue of mineral genesis and growth, Vallisneri's thought was not exempt from ambiguities and fluctuations. Though he supposed and—somehow—admitted the existence in minerals of such biological features as seeds (or "matrices") and nourishment, by the last decade of his life he did not seem to persist in supporting the view of a vegetative power in minerals. On this topic, see Luzzini 2011a, 109–110; 2013a, 132–137.
[128] Vallisneri 1705, 30–XIV.r.
[129] Vallisneri 1705, XIV.r.
[130] Vallisneri 1705, XVI.r.
[131] Vallisneri 1705, XIV.r.
[132] Vallisneri 1705, XVI.r.
[133] Vallisneri 1705, XVI.r.

standing out on the highest summits of hills and crags," where "gold, silver, and other precious Roman coins" could be "unearthed here and there."[134]

Destiny had endowed this province with a curious ship-like form. It was bathed by many "perennial and clear torrents, rills, springs, and rivers," and abounded with "most excellent fishes," among which trout were renowned for "enriching the tables, and for delighting the palates of magnates and princes."[135] Its main stream, the Serchio River, ran into the sea about three miles from the estuary of the glorious Arno; and like its noble neighbor, it was "swollen at times, and threatening."[136] The entire land was rich in metals; nor did it lack for "wheat, wine, hemp, fruits, vegetables, and fishes." Furthermore, the land had "plenty of meat, cheese, [and] chestnuts," so that, while it was "sufficiently furnished with the former [goods]," it had "far more than enough of the latter ones."[137] As to the inhabitants, the men were "generally short and—for the most part—dark, muscular, strong, always ready to fight, easily inclined to anger, vengeful, [and] mindful of injuries."[138] Still, they were "smart, clever, friendly to strangers, lovers of hospitality, loyal to their lord, inclined to literature, naturally gifted with the most beautiful Tuscan language" and even "cheerful, lively, skilled in mechanics, and constantly engaged in commerce."[139] And though these people had suffered "under various lords" in the past ("whom it would be tedious to list individually"), they now flourished happily "under the rule of the Most Serene House of Este, all the tragedies […] having been forgotten."[140]

After these and other digressions—including a rather long list of the many names of "Roman places and mountain summits" that had been "distorted by the injury of time with popular terms"—it was now time for Vallisneri to return to the main path of natural philosophy.[141] Thus, he resumed his *physico-medical* account by describing his descent from the Alp of Saint Peregrine into Garfagnana. The first town he entered was Castiglione: its surroundings offered him "all sorts of curiosities" like "silvery pyrites from an underground copper and silver mine" and many other mineral and rock samples.[142] Not far from there, on the lower plain on the eastern side of the Serchio River, he visited the thermal springs known as Bagno della Pieve. As he remarks, among the "many healthy ones" that gushed out in that area, these alone were still used by the inhabitants, for it was not possible ("as experience" attested) to find "better remedies" in that place.[143] Their waters (which were "clear, more than lukewarm, with a somewhat salty, bitter taste and a bituminous smell") were considered a "universal remedy," their "amazing properties" having been tested "against rheumatic and arthritic pains" and "various diseases of the nerves."[144] As for their internal use, waters from these springs were believed to get rid of an incredibly broad spectrum of ailments such as "persistent or often recurrent headaches, […] epilepsy, dizziness, deafness, […] lymphatic affections, […] palpitations of the heart" (especially the "spasmodic ones"), "ulcers in the lungs," and "asthma"; also, they were comfortable to the "worn-out stomach, or to the one suffering from dyspepsia"; they removed "jaundice," […] colic pains, hysterical passions, intestinal affections," and cured even those "affected

[134] Vallisneri 1705, XVI.v.
[135] Vallisneri 1705, XVIII.r.
[136] Vallisneri 1705, XVIII.r.
[137] Vallisneri 1705, XVIII.v–XIX.r.
[138] Vallisneri 1705, XIX.r.
[139] Vallisneri 1705, XIX.r.
[140] Vallisneri 1705, XX.r–XX.v.
[141] Vallisneri 1705, XXI.r–XXII.v.
[142] Vallisneri 1705, XXII.v–31.
[143] Vallisneri 1705, 32.
[144] Vallisneri 1705, 32–33.

by edema."[145] These waters also restrained "intestinal fluxes" and took away "gallstones and sandy matter" by "flushing the urinary passages"; moreover, by "promoting menstrual discharges" and by "opening the obstructed passages" they restored fertility and alleviated the "torments of gout"; finally, they were particularly effective at removing "worms, their slimy nests, and their offspring" from the "small, hidden recesses of the intestines."[146]

The causes behind such wonderful virtues were a matter of speculation. According to the amazed Vallisneri, most of the qualities possessed by the waters were probably a consequence of the "alkaline, calcareous salt" and of the bitumen which could be commonly found in the area.[147] In fact, "long ago the inhabitants extracted an excellent kind of bitumen from the mines above"; and not by chance, other "extraordinary" thermal waters—which were famous for being "similar to milk in taste and warmth" and "useful for gently subduing the sharp muriatic salt of the bile"—had been discovered in the past on the opposite side of the same mountain, although now they had almost fallen into disuse "in their very cradle."[148]

After proceeding on his journey, Vallisneri descended to Camporgiano, the former capital of Garfagnana. There he was received by his uncles the "Most Noble Sir Carlo Davini" and the "Most Excellent Sir Giambattista Terni," and also by his "fellow citizen and relative, the Most Illustrious Sir Giulio Rossi," who was Capitano di Ragione (that is, governor and chief magistrate) of the town. Now the author and his companions could relieve themselves of the "hard discomfort of the rugged journey" and restore their "shattered energies."[149] Everyone "competed with favors": and with their offerings of "merry banquets, bottles, and celebration toasts" they urged him to "set aside the philosophical seriousness and the austerity of the wandering doctor."[150] As he recalled with delight, "at that moment the thermal springs, the mines, and the entirety of nature lay drowned in wine, and we had fun as if we had seen a totally new [amusement]."[151] But alas, soon enough he and his companions had to take their leave "of such a lovely hospitality," and so they moved on to Castelnuovo, the new capital of the entire province.[152]

He then visited the ancient—and, unfortunately, half-ruined—Torrite baths, located just one milestone west of this city. These thermal waters were replete with "salt, sulphur, volatile matter, and spirit" (as was evident from "the taste, the smell, the experiments, the properties, the touch, and the analysis"): as such, they were well suited to ward off all the "enduring and obstinate ailments" derived from the "sealed channels" of the "[human] machine, and from the occluded sieves."[153] These were all the diseases which evaded the common remedies and responded to the name of "scourge of doctors": the fearsome "affections of the kidneys, of the ureter, of the bladder, and the uterine filth."[154] Nor did they "have a sure effect only internally, but also externally": for the "sulphurous and the saline particles, agitated by the spirit and by the activity of the heat," were surely able to "eject" such afflictions as the skin diseases originating "from the dregs of the blood," the

[145] Vallisneri 1705, 33–34.
[146] Vallisneri 1705, 34.
[147] Vallisneri 1705, 34.
[148] Vallisneri 1705, 34.
[149] Vallisneri 1705, 35.
[150] Vallisneri 1705, 35.
[151] Vallisneri 1705, 35.
[152] Vallisneri 1705, 35.
[153] Vallisneri 1705, 37.
[154] Vallisneri 1705, 38.

"pustules" and "small ulcers" caused by worms, the "polypous and indolent disposition of a vapid blood," the "torpor of lymph," and any other "cause of anomaly."[155]

Figure 1.10: "[Hiking] along barely passable trails, we finally reached the extreme boundaries of the [Apuan] Alps, called Panie […]."

His path continued south, following the course of the Serchio. After arriving in Gallicano, Vallisneri headed west along a small tributary of this river (the Petrosciana Torrent) and proceeded towards the western end of Garfagnana by climbing a steep valley. Having found himself at the top, among "such precipitous rocky ridges, and […] high lands, and rough crags," he saw "strong and brawny men living long and happily" and "charming women" who, at times, surpassed "even the urban Venuses in beauty and in gentle appearance"; and yet, they drank only the "clearest water" and filled "the growling stomach with the most rustic food."[156] At this point, the account lingers for a moment on his (quite intriguing) description of some peculiar habits of that "astute" people, who managed to flourish in a land where "neither Minerva, nor Ceres, nor Bacchus" dispensed gifts.[157] Given the scarcity of wheat, they prepared starch—"for stiffening linen clothes and mantles"—from the "arum root": after removing its "external peel" and dissolving its "corrosive salts" with water, the "shining white substance" resulting from this process could not be distinguished from common starch.[158] Moreover, in "times of famine" they even used it as a "healthy food," all of its "caustic power, and the corrosive strength […] having been absorbed by the aqueous particles."[159]

[155] Vallisneri 1705, 38.
[156] Vallisneri 1705, 39–40.
[157] Vallisneri 1705, 40.
[158] Vallisneri 1705, 40.
[159] Vallisneri 1705, 40–41.

Finally, after having walked "barely passable trails," the author reached the Apuan Alps—not far from which the "raging Tyrrhenian Sea" could be seen (Figure 1.10).[160] As he commented with pleasure, "a curious seeker of nature" would have wearied "body and mind alike" among those "barren rocks" by satisfying "his passionate hunger for knowledge, while increasing the one of the body."[161] He arrived in a small (and very poor) village called Fornovolasco, home to a "hard and most warlike people."[162] This place was made up of just some huts and a few houses lying at the base of the mountains; not far from there were the famous iron and vitriol mines that had been exploited on behalf of the the Dukes of Este since the second half of the XV century. In the early XVIII century, this iron was still extracted and widely used for military purposes: in fact, many of the workers were descendants of expert miners from the Lombard city of Brescia who the Duke Ercole I (1431–1505) originally hired to find and work the first ore veins. A "non-trivial proof of this" was that many dialect terms from Brescia could still be heard, which the "unaware people" combined with the "gracefulness" of the Tuscan language.[163]

Visiting the mines of Fornovolasco was not supposed to be an easy, let alone a safe task. The village and the nearby tracks were infested with bandits and robbers; and even its inhabitants and the miners, according to many rumors, had often proven to be unsafe company to strangers. However, once more in this story chance and necessity met at the right time—and did so by way of a "certain sagacious man," a "youngster" whose "unexpected politeness"

> […] overwhelmed [our] minds and eyes with sweet delight: having entered the small inn where I was staying, he covered me with devoted and trustworthy embraces, showing clear signs of joy […]. I was amazed at such kindness in such a rude place; and when I asked where so much courtesy […] could live among crags and caves, he openly revealed that he, too, was a foreigner, and that his name was Domenico de' Corradi d'Austria […]. Since, by an unexpected gift of fate, I was not unknown to him, he invited me to share dinner with him; nor did he want me to spend the night in [that] desolate tavern, which was often unsafe for strangers. As soon as I heard [that] name (which was equally familiar to me), […] I did not refuse the loyal hospitality and the friendly services of [my] host; and, with the promise of a safe shelter, and with the most pleasant conversation, I restored my energies, drained by the difficult journey. What a perfect knowledge of the natural things in a youthful mind, indeed! What an abundance of secrets! What an incomparable erudition! For, during the sweetest rest of the night, there was no rest at all: we conversed on the admirable structure of mines, on the inaccessible origin of springs and of thermal waters, and on the great inheritance of medicines and [natural] wealth […] that the Divine Protoplastes had stored in those chasms.[164]

[160] Vallisneri 1705, 41.
[161] Vallisneri 1705, 41.
[162] Vallisneri 1705, 42.
[163] Vallisneri 1705, 42.
[164] Vallisneri 1705, 42–43: "Complevit dulce mentis, et oculorum oblectamentum inexpectata urbanitas iuvenis, qui diversoriolum, ubi morabar, ingressus, […] certa laetitiae signa prodens me fidis, sanctisque amplexibus implicuit. Obstupui facilem in aspero solo humanitatem, ubi cautes inter, atque speluncas tanta comitas […] lateret, cum mihi quaerenti, se quoque advenam, se Dominicum de Corradis Austriae […] candide aperuit. Me sibi non ignotum incogitato fortunae favore suae mensae socium, non in sylvatico diversorio quandoque exteris infido, pernoctantem velle. Ut nomen mihi pariter perspectum audivi, […] fidelia

The young man was Domenico de' Corradi d'Austria (1677–1756), chief superintendent of artillery on behalf of the Duke—and a very expert miner himself. His peerless knowledge of the Apuan Alps played a key role in the success of Vallisneri's investigations in Garfagnana, for Corradi provided him with advice, direct assistance, helpers, and equipment for his explorations. Vallisneri, on his part, was not ungrateful to his new friend: this fortunate encounter marked the beginning of a long-standing and fruitful collaboration, and in the following years Corradi's work appeared in the pages of the "Giornale de' Letterati d'Italia," where he published several brilliant works on hydraulics, gunpowder, mines and minerals.[165]

Figure 1.11: "Not far from there are the iron and vitriol mines, which we inspected, to our utmost pleasure […]."

The information collected by Vallisneri in the iron mines was crucial for the development of his new theory on the origin of springs; and even for other theories, like his controversial one on the existence of seminal and vegetative principles in minerals.[166] For, even here, he found "perpetual waters": although ("in truth") he did not understand whether they came from the center of the Earth, or from above, or both.[167] He had cer-

tecta, benignumque hospitis officium non renuens fractas senticoso vires itinere, securi tessera hospitii, et amoenissimis recreavi colloquiis. Quanta enim in iuvenili pectore rerum naturae exacta cognitio, quanta arcanorum ubertas, quam incomparabilis eruditio? Dulcissima noctis quies fere tota fuit nulla quies, admirandam minerarum fabricam, inaccessam fontium, ac thermarum originem, tam grande remediorum ac divitiarum patrimonium, quod Summus Protoplastes […] specubus in illis condiderat, fere percurrimus."

[165] Corradi d'Austria (de') 1710; 1711; 1713; 1716; 1719. On this topic, see Luzzini 2012, 51; 2013a, 101.

[166] See note 127.

[167] Vallisneri 1705, 44.

tainly seen the "vertical, or celestial ones" flowing through "large and gaping fissures from above" and through "the broken ceilings of the [rock] strata" where the "main trunk of the iron vein" flourished: from here, he argued, "the seeds of the mines" took their nourishment.[168] Thus, he wondered if mines (just like the seeds of plants) could absorb their nourishment from rain, and especially from rain "impregnated with niter, different salts, and earthly moisture" and "tempered by the sun's rays."[169] As to any nourishment coming from alleged subterranean seas, he was still doubtful. Why seek in the sea what could be recognized in the air? Why look for something that was "hidden in the innermost part of the abyss" when it was surely in the "sunny cellar" above?

> The dried and exhausted seeds could flourish again in the air, but could not do so in the sea. [For] the [sea] mixes with salts of a certain kind, and not with all [kinds of salts]; while the [air] mixes with all [salts], and not just with that certain kind.[170]

As a logical consequence of this stance, the hypothesis invoking the rise and desalination of sea water through the mountains was excluded not only from the problematic (and not empirically grounded) generation and growth of minerals, but also from the origin of springs. In fact, if the waters "bathing and nurturing the mines" were filled with "such an abundance of sea salt," why then didn't they have "the bitter, salty flavor of the sea"? Why weren't the "cubic fragments" of salt found "everywhere in the mine"?[171]

Actually, Vallisneri's question was little more than rhetorical, as the answer was already clear in his mind: it would become even more so in the following days, when his loyal Corradi assisted him in the exploration of the most intriguing and mysterious cavern in Garfagnana: the renowned Tana che urla ("Screaming Cave," Figures 1.12 and 1.13).

> Many [springs] emerge from the stern boundaries of these mountains […]. Among the others, the one flowing in the Screaming Cave (commonly known as Grotta che urla), and which, in turn, hides in that same place, is the most famous. This cavern opens southward, a little above Fornovolasco: it is rough and dark, with much tartar, and is terrifying because of the confused noise of the roaring waves.[172]

The entrance to the cavern was "dirty, with much yellowish earth and sand" carried and deposited by an internal brook (especially when it was "swollen and turbid").[173] In fact, as the inhabitants claimed—and as the author himself attested—this stream swelled and overflowed with water from the melting snow from the peaks above whenever the south wind blew or the air was warmer than usual. Thus, the waters broke out from the entrance and, after subsiding, they laid down "the dirt and waste from the mountain" in that very place.[174] The practical and unpleasant consequence of this fact was that Vallisneri and

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[168] Vallisneri 1705, 44.
[169] Vallisneri 1705, 44–45.
[170] Vallisneri 1705, 45: "Potuerunt exsucca, et effoeta semina reflorescere rursus in aere, non in aequore poterunt. Condit illud sui generis salia, non omnia, condit hic omnia, non sui tantum generis."
[171] Vallisneri 1705, 45.
[172] Vallisneri 1705, 46: "Plurimi e rigidis horum montium finibus emergunt […]. Inter alios celeberrimus est, qui in Antro ululante (vulgo la Grotta che urla) gemit, ibique rursus reconditur. Meridiem versus hoc antrum paulo supra Furnum Volastrum hiat, plurimo tartaro scabrum, tenebrosum, et incondito murmure strepentium undarum terrificum."
[173] Vallisneri 1705, 46.
[174] Vallisneri 1705, 46.

his companions had to bend over in order to enter—and, furthermore, they all soiled their backs because of the low ceiling.

Figure 1.12: "This cavern opens southward, a little above Fornovolasco: it is rough and dark, with much tartar, and is terrifying because of the confused noise of the roaring waves."

After about twenty feet, the narrow passage expanded into a much larger chamber where "various oddities, made of a lapidescent juice" came into sight; while admiring these products of a "playful nature," they saw a stream of water falling from a rocky wall in front of them which was being "swallowed down with spinning vortexes by a deep chasm" and "diverted through a hidden path into the nearby Petrosciana Torrent."[175] Although troublesome and unexpected, this obstacle did not mark the end of Vallisneri's journey. With steadfast resolution, and with the intention of crossing the water with no excessive damage to their noble persons (or clothes), he and Corradi promptly jumped "on the backs of porters"; and, being carried thus past "many rough, stony tracks," they arrived in a "large and vaulted room" where "countless tartareous concretions, and innumerable, hardened cements" could be seen.[176] Here they saw the origin of the subterranean brook which, by means of "lapidescent waves," partly "glued new stones to the old ones in an enduring fellowship" and partly "slid with a foaming course down through the described channel."[177]

From this final adventure in the deepest bowels of the mountains, the author took his cue to address the hydrogeological issue again by dealing a final blow to the rival theories

[175] Vallisneri 1705, 46–47.
[176] Vallisneri 1705, 47.
[177] Vallisneri 1705, 47.

of alembics and rock filters. "Whence" did the "flow of the perennial waters become now clear and calm, now dirty and swollen"? According to the inhabitants, these were "drawn out from the nearby sea" ("they rage when the south wind blows, and the sea rages; and, when it calms down, they, too, are still").[178] However, this was not Vallisneri's opinion. In fact, he had explored the summits of the mountains: he knew that the cause of this phenomenon was to be sought not in the depths below but in the clouds and snowy peaks above. It was from there that the "waters and the dissolved snows" percolated through "slightly adhering layers" and were absorbed by the "various chasms" that passed through "rocks and bibulous gravel"; and then, having moved through the furrows, they crept along this "hidden bed" to a "cavernous spring" which was thus constantly replenished.[179] For many unknown glaciers and snows lingered there "almost perpetually" and "untouched" in hidden recesses, "inaccessible to the sun's rays," and they melted not with the first heat of the season but only in late spring when the sun was "more furious."[180]

> [The snows] melt slowly and gently; and, as if filtered, descend without mud, crystalline, and for a long time. In fact, when the warm winds breathe, so [the snows], having been reduced at once to liquid, like wax in a fire, run (rather than flow) through underground waterfalls, and carry mud and sand with them. Hence, the above said fountain is now clear, and poor in water; and now muddy, and abundant. Similarly, having been collected in cisterns, and perhaps in hidden pits, they are gradually sifted through the wide pores of the earth and, after a brief delay, fall into the basin of the fountain, as if on a plate; or, if [the waters] swell enormously, they will fall into a more empty basin, having overflown the mounds.[181]

With an air of finality, Vallisneri concluded that any origin of springs other than the meteoric was not allowed in his model. He could find no means of persuading himself that the waters came from the nearby sea without resorting to evaporation as an explanation. In fact, if "veins and venules" and "channels and gutters" were so wide to "let the sand and gravel in," why didn't they also take in "salts, small shells, little fishes, and other marine trifles"?[182] And, with respect to those who believed that the "vapors" from the sea were condensed "into dewy drops" by the "coldness of the rocks" (this, he noticed, was the "general opinion among Italians"): had they ever entered the "bowels of the Earth" and proven the existence of such "immense alembics" and "perfect chemical laboratories"?[183] More probably, these condensed vapors would have run back into the sea rather than be found "flowing laterally through imaginary pipes or supposed gutters."[184]

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[178] Vallisneri 1705, 47.
[179] Vallisneri 1705, 47–48.
[180] Vallisneri 1705, 48.
[181] Vallisneri 1705, 48: "Lente, ac molliter tabescunt, velutique filtratae per longa temporis spatia descendunt illimes, atque crystallinae. Si vero calidis efflantibus ventis, sicuti cera ad luculentum ignem, ita in liquorem statim extenuatae per subterraneas catharactas ruunt potius, quam fluunt, secumque terras, arenasque transportant. Hinc praedictus fons modo limpidus, et aquarum pauper, modo lutosus, et aquarum dives. In cisternis etiam, occultisque lacunis forsan recollectae vel per laxa aggerum spiracula sensim cribrantur, velutique ad lancem, ac per iustas morulas in fontis pelvim cadunt, aut si enormiter turgeant, superatis aggeribus liberiore gurgite devolvuntur."
[182] Vallisneri 1705, 48–XXIII.r.
[183] Vallisneri 1705, XXIII.r.
[184] Vallisneri 1705, XXIII.r.

Enough with speculations, however. Antonio intended to explain his thoughts more thoroughly, of course, but not here. He would do that "elsewhere, in a particular letter."[185] As we know, his purpose was achieved successfully in 1715 with the publication of the *Lezione Accademica,* where the complex hydrogeological debate was described and discussed in full detail and on the basis of a constant and fertile interaction between field data and theories. Still, for the time being the author didn't go further and instead concluded by remarking, with his usual "philosophical candor," that his field experiences were confined to northern Italy. He was not "familiar" with the springs of such great rivers as the Danube, the Rhine, or the Rhône, nor with all the "enormous mountains" and "immense regions" in the other parts of Europe—let alone in the rest of the world.[186] Persuading the "eviscerate Earth" to disclose "what it had concealed for a long time" would take more time, more people, and more attempts: in other words, it would need the joint effort of many other members of the Republic of Letters (and "may this not be an arrogant dispute between intellectuals, nor a bitter logomachy which sets us one against the other"!).[187]

Figure 1.13: "[…] various oddities, made of a lapidescent juice, come into sight, [produced by] the playful nature: which […] equals art with its talent, and surpasses it in substance."

Yes, this quest required "longer journeys and new works," for his explorations had been geographically and chronologically limited.[188] But even so, Vallisneri did not give up his ambition of providing his field research with a well-defined and univocal methodology, one that he would follow in case of further travels in the mountains. This aspiration was described at the end of the manuscript in the form of a rather detailed list of instructions—

[185] Vallisneri 1705, 49.
[186] Vallisneri 1705, 49.
[187] Vallisneri 1705, 51.
[188] Vallisneri 1705, 52.

or "index of observations," as he would call it, in the Italian *Continuazione dell'Estratto* of 1726.[189]

According to the fifteen points of this peculiar sort of field handbook (and not surprisingly, given the eclectic content of the *Primi Itineris Specimen*), a worthy natural philosopher was expected to focus on an extremely heterogeneous range of subjects—and objects. First, he had to observe and describe all the "herbs and plants" that he could find in the mountains (1); next came the study of all the "crystals" and "crystal-like [minerals]," "specular stones," the many different "fossil salts," and the "variegated, sculpted stones" along with the "shaped, curative, chalky, gypseous, [and] precious ones" (2). These observations were to be followed by the examination of the "stony, chalky, gravelly, [and] sandy layers of the mountains," along with "those made of earth"; it was also important to ascertain "whence they originated," in which direction they stretched, and "their necessity, use, structures, etc." (3).[190] It was then time to look at the "so-called antediluvian and postdiluvian bodies" that could be found in rock layers: one must see if "mussels, snakes, fishes, sea urchins, snail shells, oysters, pectens, tube [worms], bones of animals, wood, fruits, etc." are present and then determine whether these are "petrified, or enclosed within the rocks, or barely enveloped in the bowels of the Earth" (4).[191] Also, attention should be paid to the "outer surface of the mountains," to the "quality of every soil" and to "the elucidation of every stone, streak, and concretion of tartar or marble" (5); then "the particular nature, the pastures, the use, etc., of any mountain" must be determined (6).[192] Even living animals deserved to be studied, of course: from the "rarest insects" that built their nests "among herbs and plants" in the rocks (7), to the many birds, fishes, and quadrupeds living in meadows, pastures, forests, crags, springs, and streams (8).[193] As to the countless "fruits and grains," it was important to know which ones were used "as food and drink" by mountaineers (9)—whose "customs, arts," and "buildings," in turn, had to be considered, along with their "diseases, torments, and delights" (10).[194] Points 11 and 12 deal with the measurement of sundry items: a mountain's height and its other features such as "fissures, slidings, [and] decreases"; the air's weight ("measured with a barometric device"); and "the climate" ("measured with a thermometer").[195] Point 13 recommends that the researcher provide a "more accurate description of the other springs, rivers, torrents" and "thermal waters," while point 14 focuses on "milk and dairy products" and how they are prepared in the mountains.[196] Finally, point 15 returns to the Earth sciences and prescribes the "careful and accurate description of every mine": for too many of these precious, hidden places were still unknown to natural philosophy.[197]

Such were the "things" that Antonio meant to carry on his "reluctant shoulders" if given a fortunate turn of events that would allow him to resume his wanderings in the northern Apennines.[198] But, he was well aware that performing these "genial studies" was no easy task. It would require a spectacular amount of time—much more than the busy Paduan professor could hope for considering his academic and medical obligations.

[189] Vallisneri 1726, 404–417.
[190] Vallisneri 1705, 52.
[191] Vallisneri 1705, 52.
[192] Vallisneri 1705, 52.
[193] Vallisneri 1705, 52.
[194] Vallisneri 1705, 52–53.
[195] Vallisneri 1705, 53.
[196] Vallisneri 1705, 53.
[197] Vallisneri 1705, 53.
[198] Vallisneri 1705, 53.

And yet, as we can see, he never abandoned the idea of defining unambiguously the goals and procedures of a philosophical field research. Not by chance, over the next two decades he enriched and refined his "index," which in its final version—published in 1726 in the *Continuazione dell'Estratto*—had 26 points.[199]

The "index of observations" marks the end of Vallisneri's report. However, in the same cardboard folder from the State Archive of Reggio Emilia I found other interesting documents: an additional group of eight loose papers, written by four different hands (Vallisneri, the cartographer Domenico Cecchi, and two unknown contributors), and two elegant, hand-drawn maps of Garfagnana, the first bearing an autographed dedication by Cecchi. The additional papers cover a broad range of topics that encompass history ("Reasoning about the many consular names assigned to the villages and towns of Garfagnana"; "Petition from the Community of Busana to Borso, Duke of Ferrara, for an exemption from taxes"), toponomastics ("Old and new names noted in the Province of Garfagnana"), poetry (a few quotes from Claudian and Virgil), engineering ("Proposal […] to send Master Carlo da Maleone, engineer, to the Lake of Ventasso in order to try to conduct the water of that same lake to Reggio"), and—not surprisingly—natural philosophy ("Strange fountain […] at the foot of the Panie"; "Little soil in plants"; "Salt in plants"; "Description of the Lake of Ventasso"; "Memorandum for the natural history"; etc.).[200] The notes report both experiences had by Vallisneri himself and information that he, Cecchi, and the unknown authors gathered from various sources. Most likely, these documents were material for further investigations that Vallisneri meant to, but could not, perform—and which, therefore, were not included in the main text.

The beautiful map by Domenico Cecchi is, in fact, much more than a simple map: it is framed on the left, right, and bottom sides by densely written text. According to the title, both the quoted passages ("Chronology of Garfagnana" and "Religion of Garfagnana") are from Book 2 of the *Silvae Feronianae,* a manuscript (now lost) composed by the antiquarian Timoteo Tramonti, "Chancellor of the Archive of Castiglione" (XVI–XVII century).[201] Relying on an intriguing mixture of facts and legends, these documents offer a great number of literary, religious, mythological and folkloristic anecdotes that relate the turbulent history of the province: from the foundation of the first "fortified huts" and the arrival of the Greek heroes Ogyges and Ligisto (son of the Greek demigod Phaeton) to the then recent dominion of the Princes of Este. The documents address the Etruscan kingdoms, the Celts, the Gauls, the Romans, the difficult transition from paganism to Christianity, the barbarian invasions and sackings, the fierce struggles for power between the Guelphs and the Ghibellines (who "almost destroyed each other and their belongings"), and the countless battles for independence from the Republic of Lucca.[202]

(Natural) philosophy and (natural) history; medicine and chemistry; geography and literature; anthropology, ethnography and material culture; archaeology, religion and folklore; and now, at the very end of the journey, cartography and mythology: the contents of the *Primi Itineris Specimen* match the versatile talents of its author, and his strong, colorful, and enthusiastic personality shines through every word of this amazingly deep and rich text. And, in light of all that has been said thus far, we can't help but regret the

[199] Vallisneri 1726, 404–417. On this topic, see Luzzini 2013a, 104–106; 2014a, 215–217; Vaccari 2005, 9–11; 2007, 7–8; 2008, 394–395; 2011, 104.
[200] Vallisneri 1705, XXIV.r–XXX.v.
[201] Vallisneri 1705, XXXII.r.
[202] Vallisneri 1705, XXXII.r.

unfortunate—and still unknown—circumstances which prevented this manuscript from being published and disclosed to the *literary* world. However, as already remarked, the importance of Vallisneri's report for the history of early modern science lies not just in the impressive amount of information it contains, nor in the variety of subjects it covers. Even its flaws and limits are valuable, as they are particularly revealing of the hurdles the Galilean experimental tradition had to overcome when it ventured into the mountains and turned its curious eye to the heterogeneous field of natural philosophy.

It was especially in his attempt to define a methodology of field research (an attempt equally interdisciplinary and unifying, we might say) that Vallisneri faced his greatest challenge. Unavoidably, the size and complexity of the natural phenomena he examined took a toll on the effectiveness of his efforts. But, it is not unreasonable to claim that all the difficulties he encountered do not affect the historical and scientific significance of his manuscript. For limits and failures, just like successes, are precious clues to the past: and, as such, they can teach us a lot about the events that shaped the path of human knowledge and the very idea(l)s and debates that caused these events to happen. Despite—or thanks to—all the lexical and descriptive inconsistencies, the frantically reworked pages, and the anxious margin notes, the *Primi Itineris Specimen* is a brilliant and charming proof of this fact.