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In copertina: L'apparato per le registrazioni ultrasoniche, che include il microfono Ultramic 250 e il computer portatile Asus Netbook.

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GIUSEPPE LEONARDI (*) & MARIO SPEZZAMONTE

A CHEMIST AND GEOLOGIST IN THE 1830s: DEMETRIO Z. LEONARDI FROM ROVERETO AND FIEMME VALLEY (TN, ITALY)

Abstract - Giuseppe Leonardi & Mario Spezzamonte - A Chemist and Geologist in the 1830s: Demetrio Z. Leonardi from Rovereto and Fiemme Valley (TN, Italy).

Demetrio Leonardi (1796-1881), born in Rovereto (TN) is presented herein, in the context of the history of the geology of the Dolomites. Pharmacist and chemist, he distinguished himself for the analyses of mineral waters and of the associated rocks of Trentino, publishing them in various monographs. His activity in the area of geology of the Dolomite region, with its famous Triassic eruptive center, is mainly described here. The contact between the monzonitic magma and the dolomitic limestone produced here evident contact metamorphism. This upset the theories about the primeval "granite", located as the base of all the rocks, as was believed at the time. Leonardi was the first to analyze and publish the saccharoidal marble of this contact band, the predazzite. He became the guide of numerous geologists and mineralogists from all over Europe who rushed to examine the phenomenon. Demetrio Leonardi also worked on a process of photographic reproduction, and fixing of images.

Key words: Demetrio Leonardi - Triassic eruptive center of Predazzo - Predazzite - Mineral water of Trentino.

Riassunto - Giuseppe Leonardi & Mario Spezzamonte. - Un chimico e geologo negli anni '30 del XIX secolo: Demetrio Z. Leonardi di Rovereto e Val di Fiemme (TN, Italia).

Si presenta, nell'ambito della storia della geologia delle Dolomiti, Demetrio Leonardi (1796-1881), nato a Rovereto (TN) e vissuto prevalentemente in Val di Fiemme (TN). Farmacista e chimico, si distinse per le analisi di acque minerali del Trentino e delle rocce associate, pubblicate in varie monografie. Si descrive la sua attività nell'area della geologia delle Dolomiti, particolarmente della conca di Predazzo (TN), con il suo famoso centro eruttivo triassico. Il contatto tra il magma monzonitico e i calcari dolomitici produsse qui evidente metamorfismo di contatto. Ciò venne a sconvolgere le teorie sul

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"granito" primigenio, situato alla base di tutte le rocce, come si credeva allora. Il Leonardi fu il primo ad analizzare e pubblicare il marmo saccaroide della salbanda di contatto, la predazzite. Divenne guida di numerosi geologi e mineralogisti di tutta Europa che accorrevano a esaminare il fenomeno. Demetrio Leonardi lavorò anche a un processo di riproduzione fotografica e di fissaggio delle immagini.

Parole chiave: Demetrio Leonardi - Centro eruttivo triassico di Predazzo - Predazzite - Acque minerali trentine.

"Pluto and not Neptune had done it with his own hands"

Jules Verne, *L'Île mysterieuse*, 1875

1. Introduction

The first decades of the 19th century saw a great debate in the world of geology, then still a child, on the relationship between magmatic rocks and sedimentary rocks. It was then believed that all the "granites", that is, all the magmatic rocks, were anyway and in any case at the base of the stratigraphic columns all over the world; and that only later, above them, sedimentary rocks had settled. The "granite" was the basis and foundation of all the mountains. The ancient geologists then spoke of the "protogynous granite", or of primitive rock, a concept opposed by Marzari-Pencati (1820, 1821; also see Breislack, 1821) and, for example, by Emilio Cornalia, who masterfully opposed, in a single line, this theory and the nectunist one (1848, p. 13).

There was also a fierce debate between geologists called "nectunists" and those called "plutonists". The former argued that the origin of the earth's crust and the formation of rocks originated mainly from water (of which Neptune, the god of the sea, was in some way the patron). The latter, on the other hand, argued that at the origin of everything was the intrusion of igneous rocks, hence the name (which depended on that of Pluto, the god of the depths of the earth).

The geological world of the time was therefore bewildered when the geologist Giuseppe Marzari-Pencati (1779-1836) from Vicenza made an important discovery during his 1818-19 expeditions to Predazzo, in Fiemme Valley, in the Western Dolomites. The "granite" – actually monzonite – overlapped the limestones, and subjected them to the contact metamorphism. This happened in Canzocoli locality. This famous site is located on the steep slopes of the of Mount Forcella (as von Richtofen (1860) already called it, with the form "Sforzella"), nowadays called on the topographic maps rather Mt. Pelenzana and/or Dos Capel), a secondary peak of the Dolomites Group of Mt. Cornon, located west of the village of Predazzo. The full name of the site is, or at least was, "Canzocoli delle Coste", according to Demetrio Leonardi (1831c). The discovery by Marzari-Pencati and its interpretation of the

Fig. 1 - Portrait of Demetrio Leonardi, about 40 years old (Photo by Serena Nalesso Leonardi, Courtesy of Giovanni Leonardi).

observed facts (Marzari-Pencati, 1820, 1821) created doubts and hostility by various geologists and naturalists; and especially by the "neptunists". Many, especially the "plutonists", from various countries, felt intrigued and faced the journey to visit the location of the contact in person. Generally, visiting the Canzocoli site, they were convinced of the correctness of the interpretation of the geologist of Vicenza (cf. Leonardi P., 1967, 1968).

It was in this climate and in these places that the great-great-grandfather of the first author, Demetrio Leonardi, chemist and pharmacist, gained growing interest in mineralogy, petrography and geology, in Predazzo and Cavalese. Demetrio Zenobio Leonardi (Fig. 1) was born in Rovereto (Trento) on 19 February 1796 ([1]). He was the son of Rosa Iovazzi, from Rovereto (TN), and of Giuseppe Leonardi, from Riva del Garda (TN), who moved to Rovereto, where he practiced as a pharmacist and chemist, holding his own pharmacy in the historic center of the town. The pharmacy was most likely located in the square now called Cesare Battisti, then "Piazza delle Oche", in an ancient building with a concave facade, where today there is a haberdashery and manufacturing shop, according to the family oral tradition.

Demetrio's family was originally from Ledro, in western Trentino (Giudicarie). As for him, he spent his youth in the city of Rovereto from where he went to Padua. At that ancient university he obtained his doctorate in chemistry and pharmacy. In this city he remained for some time after his studies as an assistant of the illustrious (but not very up to date) chemist prof. Girolamo Melandri Contessi, a specialist in mineral waters and thermality. At the death of his professor, he was invited by several professors to compete for the chair remained free (Anonimous, 1881), but Demetrio preferred to return to Rovereto, where he practiced for a short time the profession of pharmacist acquiring the esteem and sympathy of the citizenship. The return to the native city probably depended on the fact that, having died prematurely both parents and been orphaned, he found himself very soon to be "the head of eight brothers and sisters" (Leonardi D., 1831c).

During his residence in Rovereto, Demetrio Leonardi had close relations with the illustrious philosopher Fr. Antonio Rosmini-Serbati (1797-1855) from Rovereto, his contemporary, friend from childhood, cousin (Pusineri, 1928, p. 28), and of which he was co-disciple during his university studies in Padua. A series of published letters ([Pagani, G.B.], 1st vol., pp. 59, 119, 121, 130 etc.) documents an affectionate friendship between them. Demetrio Leonardi in Rovereto married the noblewoman Antonia De Alessandrini of Trento, with whom he had three children: Francesco, Giuseppe and Giulio. His first wife died on 27 July 1827.

2. Demetrio pharmacist and chemist

Demetrio Leonardi possessed considerable knowledge and experience in pharmacopoeia and produced himself manually medicines to treat the disorders described by

([1]) The majority of the personal data and many other data on Demetrio Leonardi come from a typewritten book, rather for family use, produced by the geologist Piero Leonardi (1908-1998), great-grandson of Demetrio and father of the 1st author: Leonardi P., La Famiglia Leonardi, Venezia, *pro manuscripto*, 1995, 157 p.

the clients on a case-by-case basis, medicinal products which are the result of his personal experience of the curative effects of substances which he has himself tested. We must remember his studies on alkaloids of cinchona and absinthe of which he had succeeded in obtaining extracts of undoubted therapeutic efficacy that were adopted by many hospitals in Trentino. Two reports from Dr Giuseppe Lupis (1827, 1828), head of the hospital of Trento, testifies, for example, the effectiveness of his bitter extract of absinthe. The same pharmaceutical product and others are recommended in letters of the same doctor Lupis, preserved in the Leonardi family archive.

Fig. 2 - Demetrio, already quite old, shows his General thermometric Nonius, he created to facilitate the chemical analysis of liquids.

It appears from a document of the Civic Magistrate of Rovereto that in 1822 Demetrio Leonardi was counted among the chiefs of the quarters of his city. Another document shows that his experience and capacity as a chemical analyst had been used and valued by the judicial authority. In the Rovereto phase as a young adult, Demetrio Leonardi dedicated his activity to pharmacy, but also to research in the field of physics and chemistry: he also invented new apparatus for chemical and physical analysis he devoted himself to (Fig. 2).

In the session of 3 May 1827 of the Accademia Roveretana degli Agiati (which at that time was called "Imperial and Royal" (I.R.; K.K. in German), due to the Austrian domination), of which he was a member since at last 1825, he presented his "General thermometric nonius" (Fig. 2) , he created to facilitate the chemical analysis of liquids, That instrument could be applied to any thermometer and made it possible to measure tenths of a degree thus obtaining a more precise and detailed analysis (Leonardi D., 1827).

On 14 August 1830 Demetrio sold the pharmacy of Rovereto to his brother Giuseppe Leonardi and passed in Fiemme Valley (Province of Trento; then Southern

Fig. 3 - The center of Cavalese, between Scopoli square and Fratelli Bronzetti street, in front of the building formerly seat of the town hall, on the right. On the left, one sees the pharmacy of Demetrio Leonardi, photographed on the door of his exercise. The photo was taken after 1854 and before 1873. It was courtesy of G. De Gregory to Pietro Leonardi before 1995.

Tyrol), first to Cavalese (1830-33), then to Predazzo (1833-1854) where – on his request to the Imperial Royal Judicial District – a new pharmacy was established in March 1833. On 16 August 1830 in the Church of Cavalese he married, secondly, Rosa Demattio, daughter of Giuseppe. He had nine more children: Rosa, Quintilio, Giuseppina, Teresa, Luigi, Carlo, Pietro, Luigia and Tito. From 1854, Demetrio was again and definitively in Cavalese continuing to practice his own pharmaceutical profession with the purchase of the local pharmacy from Zenone Zen, October 19, 1857 (Fig. 3).

There was no pharmacy in the whole Valley of Fassa, located upstream of the Valley of Fiemme, along the same stream Avisio, a few tens of kilometers away. For the Fassa valley dwellers who did not have their own vehicles it was difficult to reach the pharmacy in Cavalese or in Predazzo with the rare means of public transport of

those times. Demetrio Leonardi asked the competent authorities to open one, but he was only allowed to keep a medicine cabinet in Vigo di Fassa, in the middle of the valley.

3. Demetrio naturalist

In the Fiemme valley, Demetrio devoted himself more to naturalistic studies to which he felt very inclined. In particular, he mainly devoted himself to mineralogy, petrography and geology, finding himself in an environment so interesting from the geological point of view as that of Predazzo and then of Cavalese, at the center of a stimulating international debate.

He also took care of the botanical sciences to which he had taken love in the alpine excursions made with his former professor and friend Tomaso Antonio Catullo, a good botanist and a pioneer of the Venetian geology and particularly of its stratigraphy ([2]). Demetrio Leonardi in fact left us the detailed lists of the plants present in the flora of the sites around the springs he analysed and in the immediate vicinity of the thermal baths (Leonardi D., 1825, 1835, 1838). The floras were linked to the particular qualities of the various minerals and thermal waters. He became also interested in and wrote of taxidermy and agronomy.

With the collaboration of some teachers his friends, he had set up in Cavalese a small private and informal school of sciences for the benefit of young people who had not followed regular studies higher than primary, but they were eager to have some important knowledge in various cultural fields.

4. Demetrio and geology

"What are you doing among the tertiary granites of the Canzoccoli?", Prof. Catullo wrote to him on August 21, 1833. As we can see from the fragment of Catullo's letter, we will recall that one of the fields in which Demetrio obtained the worthiest results is that of mineralogy, of petrology and of geology. He was certainly influenced by the natural environment that he practiced especially during the period he spent in Predazzo. Unfortunately, not much remains in his writings of what he had to

([2]) Tomaso Antonio Catullo (Belluno, 1782 - Padua, 1869), naturalist, geologist and zoologist, studied medicine, mathematics and chemistry at the University of Padua. Although he did not graduate, after being for years professor of science in a high school in Belluno, his native city, he obtained the chair of Natural History at the University of Padua, for merits as a researcher. He became its Rector in the academic year 1843-1844. He was a member of the most important medical and scientific academies of the time. He produced over one hundred scientific publications in the areas of geology, paleontology and zoology. His most important merit, probably, was that of being a pioneer of geology and particularly of the Venetian stratigraphy.

Fig. 4 - On the Lagorai range, "between two mountains, not far from each other formed of red porphyric-quartzitic rock" (in reality, of riolithic or riodacitic ignimbrite), in the valley of Cavelonte, in the municipality of Panchià (TN), one can see the ruins of the building (built in 1850) of Cavelonte's spa. Its ferruginous or vitriolic waters, discovered in 1754, were appreciated for their disinfectant and anti-inflammatory action, trophic on the mucous membranes; stimulating on the epithelial cells, muscle-relaxing, stabilizing mood tone. They were analyzed by D. Leonardi in 1831.

conclude in the latter field. However, there is no shortage in his publications on mineral waters of the nature of the rocks in the areas surrounding the springs he examined. The analysis of the water composition of the different sources analyzed is in fact always treated in close connection with the rocks of the mountains from which they arise.

For example, in his booklet on the spring of Cavelonte (Leonardi D., 1832; Fig. 4), he recognizes that this is situated "Between two mountains, not far from each other formed of red porphyric-quartzitic rock", and does not content himself with studying and analysing water. It carefully examines and analyses also the rock, in which the "*stol*" had been anciently excavated. *Stol* (plur. "*stoi*" or "*stoli*") is the ancient name of a mining tunnel in Fiammazzo dialect; the name comes from the German Stollen, i.e. tunnel). This tunnel of Cavelonte had to be rather wide, and it was called also cavern (*Antro* in Italian).

About the source of Carano (Leonardi D., 1835, 1885) he says that "the base of the mountain is a red porphyry to which the hill of alabaster gypsum is superim-

posed, equal to that of Castello) that was already analysed by me and I made known in 1831. To the side of the source you find sandstone, and stratified pale ash grey carbonate limestone".

Even more explicit this is in the study published by him (1876), already elderly, on the source of Carano. He there says that "the base of the mountain on which the water is located (as it happens in the whole Fiemme Valley) is the red quarzitic porphyry. Here, as in other locations, more or less far in the valley itself, it is overlapped by the chalk, alabaster or calcium sulphate, the last rock that covers the porphyry. And if you look higher from the spring you see the sandstone, lime and marl stratified". In these last two texts there is a clear reference to the Val Gardena Sandstone, the Calcari a Bellerophon with its white and pink gypsum and the Werfen Formation (Fig. 5).

Three publications of Demetrio on the rocks of Trentino are however more specifically petrographic and geological: that one on the Upper Permian gypsum of Carano (uppermost Lopingian; said by him alabaster; Leonardi D., 1831a, c); the other on mesotypes, i.e. on rocks of medium dark color found in the district of Pais near Tierno, at the foot of Mt. Baldo (1831c); and on the microcrystalline saccharoidal limestone of Predazzo, later called predazzite (1831b, c).

But it is clear that he was mainly concerned with the problem of the origin of the microcrystalline saccharoidal marble of Canzocoli (Fig. 6), near Predazzo, which occurs, with less purity, also in other localities of the valleys of Fiemme and Fassa. Even then, some geologists rightly believed that this marble was due to contact with the so-called "Tertiary granite", while others did not allow this. There has been much discussion about the age of the intrusive rocks classified as "granitic" at the time to which we refer, those whose contact is precisely due to the metamorphism of the "predazzite" of the Canzocoli. At the time of Demetrio, however, the magmatic phenomena that gave rise to these rocks would be connected with the alpine orogeny, and therefore precisely of "Tertiary" age.

Even today, the district of Predazzo and its surroundings are a set of the worthiest of mention – even in the world – from a geological and mineralogical point of view due to the presence of the very complicated Mesozoic - no Tertiary - eruptive center. With its exceptionally rich sample of rocks and minerals, and with problems of great importance.

At the time of Demetrio, the area of Predazzo was very fashionable for the important discoveries of Marzari-Pencati, which had caused a huge stir in the scientific circles. Even the most illustrious geologists of Europe rushed to study the phenomenon, then for many incredible, of the "Granite topping Secondary (=Mesozoic) sediments" in the famous locality of Canzocoli.

Being a rare member of the intelligentsia of that village, Demetrio had therefore the possibility to approach many illustrious scientists of the time, between which the Italians Emilio Cornalia and Torquato Taramelli; the Austrian Johann Au-

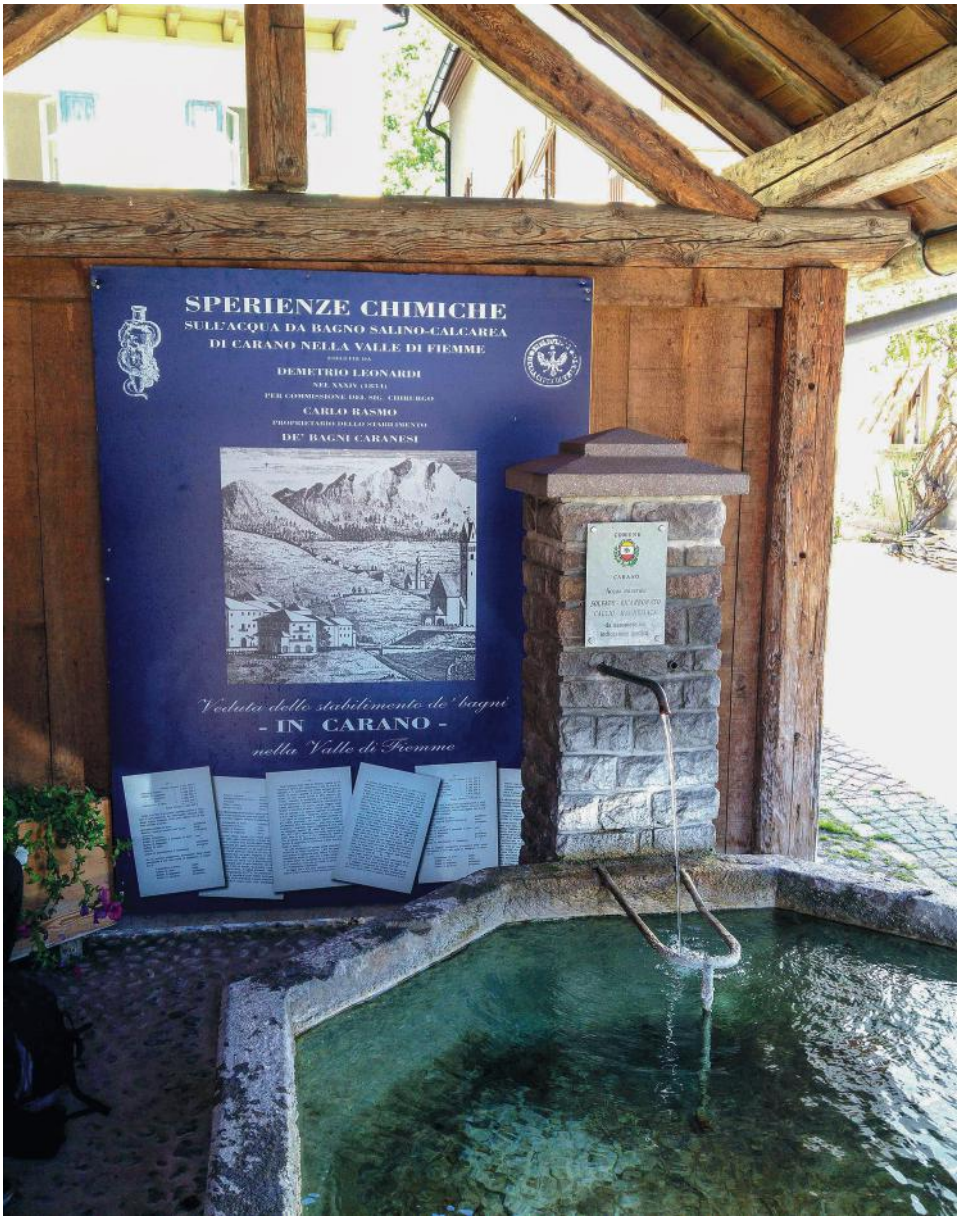

Fig. 5 - A fountain in Tomasi street in Carano (TN), from which springs the thermal water coming from the Ceva spring, in Osta valley, in the area "alle Paole". In the time of Demetrio Leonardi, in a spa building, many people, including Austrian nobles, reached Carano to drink or immerse themselves in that saline-calcareous water, suitable to heal rheumatic and dermatological diseases. Note the efflorescence of salts encrusting on the edges of the fountain. A didactic panel recalls the analyses carried out by Demetrio Leonardi in 1834.

Fig. 6 - The site Canzocoli, nearby Predazzo, on the eastern side of Mt. Forcella, in the group of Mount Cornon. One notes in the fir wood the main outcrop of white saccharoid marble, corresponding to the phenomenon of metamorphism of contact between monzonitic magma and the Anisico-Ladinian dolomitic limestones. There is also a "stol" i.e. a small ancient mining tunnel.

gust G.E. Mojsisovic; the German Alexander von Humboldt, Ferdinand von Richthofen, Julius Romberg, Cornelio August Doelter, August von Klipstein, Bernhard von Cotta; the Scotsman Roderick Impey Murchison; the French Elie de Beaumont, Marcel-Alexandre Bertrand, Joseph Fournet and others (Fig. 7). Demetrio was perhaps visited by Alexander Petzholdt, who speaks of him several times in his publications, although he does not mention him in the references of his publication (Petzholdt, 1843).

These scientists were often addressed to him as a deep connoisseur of the phenomena in question, he received them in his pharmacy and accompanied them to the field in the mountains. Demetrio himself (1857; Leonardi P., 1949) personally recalls the visits of Alexander von HUMBOLDT, Jean Baptiste Élie de Beaumont, Marcel-Alexandre Bertrand, Joseph Fournet, Herschel (probably John F.W. Herschel).

He accompanied these geologists and other naturalists to the location discovered by Marzari-Pencati to touch the contact "*sahlband*", to examine the metamorphosed

Fig. 7 - Some of the European geologists who rushed to Predazzo in the first half of the 19th century to visit the Canzocoli and see for themselves the monzonits covering the Mesozoic dolomitic limestones and metamorphosing them by contact. Clockwise, from top left: Torquato TARAMELLI, August von KLIPSTEIN, Alexander von HUMBOLDT, Giuseppe MARZARI-PENCATI, Julius ROMBERG, Waldemar Christofer BRØGGER, Cornelio August DOELTER, Ferdinand von RICHTHOFEN, Johann August G.E. MOJSISOVICS. C. The panel, now in the Geological Museum of the Dolomites of Predazzo, comes from the hotel La Nave d'Oro. This picture was courtesy of Mario Bragagna to Pietro Leonardi before 1995.

stone, the dolomitic limestones "cooked" by magma, become a microcrystalline saccharoidal marble. He also led them to visit the other mountains of the surroundings, especially the Mt. Mulat, the Mt. Viezzena and the Mt. Malgola, which he knew perfectly, being inspector of mines and quarries of the valley. (Leonardi, P. 1949). These meetings with Italian and foreign specialists stimulated him.

There is some documentary evidence of this, in the famous guest book of the Nave d'Oro (=Golden Ship) Hotel, at that time the only real hotel in Predazzo. The visiting scientists stayed there, wrote comments, sketched out geological landscapes, sometimes remembered the accompanist, the kind pharmacist of Predazzo. There is also references to Dr Demetrio Leonardi. The original book had been lost, but today it is preserved and can be examined in the Geological Museum of the Dolomites in Predazzo (Fig. 8).

There remains significant evidence of these visits of geologists, mineralogists and naturalists, much appreciated by our Demetrio, even in correspondence with some of the most famous scholars of that time. These documents are represented

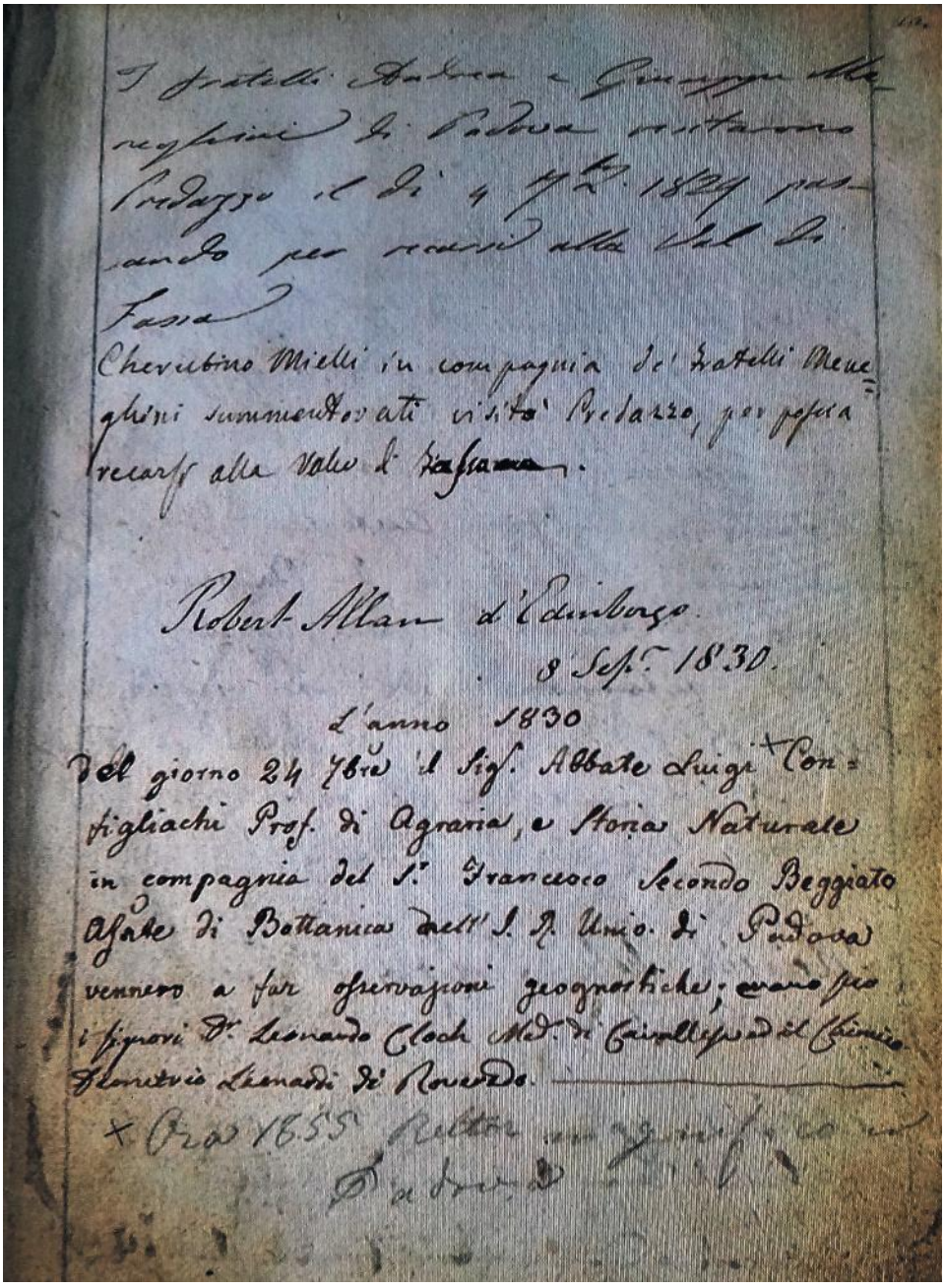

Fig. 8 - A page from the guest book of the hotel "La Nave d'Oro" in Predazzo, in which there is reference to the chemist Demetrio Leonardi from Rovereto, in the company of the future rector of the University of Padua and his assistant (1830).

in the Leonardi family archive by various letters. It seems strange, perhaps, that in the scientific publications of Demetrio's era he is rarely mentioned. For example, Petzholdt in his text (1843) speaks and rejoices that he has had at his disposal the analyses that Demetrio had made and published, but ignores him in the references. Even von Richthofen cites his analyses (1860, p. 275), but does not cite their author. Of course, D. Leonardi was not a member of an illustrious university, although he came from a very famous one, Padova; and he appeared to the eminent guests as a mere pharmacist of a village in the Alps.

On the other hand, Demetrio was not really geologist in the modern sense of the term. At that time many people carried out geological activities within a broader framework of naturalists. However, he made a considerable contribution to solving those big problems by performing concrete chemical analyses that remained famous, among which the most important is that of predazzite. We speak here of the white microcrystalline saccharoidal marble by Canzocoli (Leonardi D., 1831c), due to contact with the monzonitic intrusive masses of the eruptive center of Predazzo. In short, he became one of the deepest connoisseurs of the particular geological structure of the area, although he often modestly disputed his competence in the matter, claiming to be "One who possesses superficial and only vague theoretical cognitions" or even to be "fully unskilled in this part of Natural History" as he wrote in 1838 to a friend and in 1842 to the I. R. Civil Court of Cavalese, in letters that are kept in the Leonardi family archive.

A letter of 17th July, 1847, directed to him from Milan by Emilio Cornalia, by way of example, shows that he was not so "fully unskilled" in geology. Cornalia, "having taken the hammer" (1848, p. 1) would later become one of the major Italian geologists and mineralists. He asks Demetrio questions as to a specialist in geology. He would have used them for the publication of his 1848' monograph. He writes to him: "I would need your lordship's valuable help in some data that escaped me [...] in those days, or that I could not harvest in that short time. If you would please give me a kind answer to the following questions, I would be eternally grateful; warning you already that my motto is "*unicuique suum*", so I will never make myself beautiful of the things of others, but to all others I will leave the honour that suits them:

- Height above the sea of Predazzo, Canzocoli, Mulat and Vezzena.
- Some geological news about the porphyry columns of St. Lugano used as a wayside post on the way from Egna to Cavalese.
- Some historical information about the marble quarries of the Predazzite of Pehtzold or Predazzo marble.
- Some information about the places where the fossil combustible is found, of which you kindly gave me two specimens. [...].

I do not want to exceed, because I was already very indiscreet; however, any geological information, that you have and that you do not mind communicating me,

would procure for me an immense pleasure, and founded hope to better illustrate those beautiful and instructive valleys. [...]». This letter also is kept in the Leonardi family archive.

Demetrio Leonardi enjoyed the esteem in Predazzo and Cavalese for his deep geological and mineralogical knowledge, also by the authorities of the valley. This is demonstrated by the numerous commitments he officially had for the exploitation of rocks of very varied types that could be used both for building material, both for craftsmen and sculptors. These found very suitable for their work the "statuary" marble of Canzocoli. Demetrio was also in charge of analysing the waters of the springs, particularly those with thermal and therapeutic qualities.

Demetrio was seen by the Imperial Royal Austrian government with some suspicion from a political point of view. This happened because of his being a committed Italian patriot, impatient with the foreign yoke (Marta, 1931a, b). His son, the pharmacist, chemist, bromatologist Dr Pietro Leonardi continued on the same policy, resulting in persecution of both by the Austrian and then (1867) Austro-Hungarian government (Marta, 1931a, b).

The same government, on the other hand, estimated him from the point of view of his moral integrity and from that of his professional expertise. Some monographs of Demetrio were kept in the I.R. library of the emperor in his Hofburg (*Bibliotheca Palat. Vindobonensis*) in Vienna, as it is obtained from the examination of the stamps affixed to them, which are recognized in the current copies reproduced as e-books. So, the government assigned him the commitment and the title of "*Ispeziente*" (=inspector) for the exploration and exploitation of the mines and quarries in the area of Predazzo and surroundings", in Fiemme and in Fassa. This results from some official technical reports he presented to I. R. District Government of Cavalese about sampling tasks to understand the characteristics and geological situation of the various rock outcrops in the surroundings of Predazzo. These reports are kept, in detail, in the Leonardi family archive. They can give a concrete idea of the kind of field research and lab study that these official assignments involved. He was in practice an appointee of a kind of Geological Service *ante litteram* of the Austrian and then Austro-Hungarian Empire.

Demetrio Leonardi contributed to the study of the problems posed by the geological conformation of the Predazzo basin with various chemical and physical analyses.

The most interesting is the one that led him to analyse and describe first and to publish the white saccharoidal marble present in the locality Canzocoli of Predazzo (Leonardi D., 1831b, c), with its "*stoi*" (singular: "*stol*"), i.e. with its short mining tunnels. It is the rock that a decade later Alexander Petzholdt of Leipzig called predazzite (Petzholdt, A., 1843, on pages 194-205) or rather, in German, *predazzit* (as also Cornalia observes, 1848). Demetrio personally remembers the passage of Petzholdt to Predazzo and to the Canzocoli (Leonardi D., 1857). The German geologist, in his cited work, speaks several times of Demetrio, beginning with page

194. Piero Leonardi writes about Petzholdt and this marble: "When it was discovered, at the beginning of the nineteenth century, it was first analysed by D. Leonardi and called by Petzholdt with the term "predazzite"." (Leonardi P., 1955a, b). This stone, sometimes called a mineral, is actually a rock: a contact metamorphism rock between dolostones, dolomite limestones and monzonite (Panizza, 2018); with the presence of veins of brucite, a magnesium hydroxide of the family of phyllosilicates, produced by the hydration and alteration of periclase, a magnesium oxide. Demetrio often speaks in his letters and technical reports, as well as in his main publication on the subject (Leonardi D., 1831c), of these crystalline infiltrations. These, when concentrated in small veins, damaged the quality of marble. Besides describing the predazzite, in the paper cited, Demetrio also described the surrounding rocks, and the origin of particular details of the local metamorphism (Leonardi P., 1967, vol. 1°, 16-17), as already noted by E. Cornalia (1848), referring several times to D. Leonardi and wrote it in letters to the same.

5. Demetrio and the invention of photography

Even before 1838, Demetrio Leonardi would undertake photographic experiences trying to fix on a glass plate prepared with certain chemical reagents (L. G., 1920) the image drawn by the light through a dark room. They say that in 1838 he also was able to reproduce it on paper, where a faded but well recognizable image appeared. Sometimes these experiences of his aroused superstitious distrust on the part of the simple countrymen. After long and patient work, when he judged that he had achieved his goal, he went to the civil and political head of the district to ask to begin the bureaucratic procedures to patent his invention. He went to Vienna – the capital of the Empire – where he illustrated his photographic processes and successes at a learned congress and was strongly encouraged to pursue such promising studies (Anonimous, 1881; Ferraris Di Celle G., 1965). Some people considered him as the predecessor of Joseph-Nicéphore Niépce and Louis Daguerre: "and he anticipated in some things Daguerre's experiences in the field of photography" (Österreichisches Biographisches Lexikon, 1970, vol. 5, p. 142; also see: Anonymous, 1930; G.B., 1932; Unterveger, 1939; Various authors, 1979, p. 126; Ferraris Di Celle, 1965; Tomasi, 2014). Soon after, however, he was told that Daguerre had preceded him. It was a bolt from the blue for the poor and unfortunate discoverer. He understood the uselessness of his effort, and gave a kick to the experiences and apparatuses and returned to his alembics of apothecary and of chemical analyst, the study of rocks and mineral waters and its pharmacopoeia (L. G., 1920).

Following the observations of E. Unterveger (1922, 1939, 1940a, b), one can put some order in these somewhat confused memories and familiar oral traditions. Let us admit for a moment that the local traditions and articles on this topic

are correct; and that really Demetrio devoted himself to the production of a photographic process. It was said, however, that he would obtain the photograph, and on paper, in 1838. If so, it is not correct to call him the predecessor of Louis J.M. Daguerre and Joseph Nicéphore Niépce. These inventors had in fact obtained their pre-photographic reproductions already before 1838. They had directly obtained a kind of photograph as positive, not reproducible image, on a metal support. It would be more accurate to say then that the novelty introduced by Demetrio would be to use the paper chemically treated as an image support, instead of the metal plate of Daguerre and Niépce. Demetrio would then have understood that it was necessary to fix the image on a transparent support (the glass plate, as a negative matrix) and then transfer the image on a treated-paper support and make positive copies, on paper. In this, Demetrio would have rather preceded Hyppolite Bayard and William Talbot (Unterveger, 1939, 1940a, b).

Unfortunately, as noted by E. Unterveger (1940a, b), Demetrio, disappointed, would have destroyed his notes and any apparatuses, materials, drafts, photographs produced with greater or lesser success, and collections of chemical reagents pertaining to these experiences; unfortunately, nothing has been found. So, nothing can be said about the light-sensitive substances Demetrio would have used, so it is unknown even if these were previously known or if it were the result of his personal research (Unterveger,1940a, b).

In 1854 Demetrio Leonardi moved permanently to Cavalese, and on October 19, 1857 he bought from Zenone Zen the pharmacy of Cavalese. He undertook, often of the commission of the Authorities, the chemical analyses of the springs of the Fiemme Valley around Cavalese. He analysed the springs of Cavelonte, with its vitriolic water (in Fiemme, TN; Leonardi D., 1832, 1867 and, posthumously, 1898), on behalf of the "Magnifica Comunità di Fiemme"; that of Carano (also in Fiemme valley, TN; Leonardi D., 1835 and 1885 posthumously), of Pontara (Tesero, TN; Leonardi D., 1832), of the Colombadoi valley on Mt. Cugola, in the county of Castello di Fiemme (TN); and the waters of Pozza and Soraga (in Fassa valley, TN; Leonardi D., 1869). Again, he analysed the spring waters of other areas of Trentino, such as those of Comano, in the Giudicarie (Leonardi D., 1826b), of Fondo, in the Valley of Ammone (in Val di Non; Leonardi D., 1839), of St. Colombano (in Vallarsa, district of Rovereto), of Spino (also in the district of Rovereto), of the Val Peraga and of Ciomba (district of Pergine), of Brentonico, at the foot of Mt. Baldo.

Sometimes (e.g., Leonardi, D. 1832, 1867, 1898) these publications on mineral and thermal waters also contained data of mineralogical value; in the cases indicated above, on "red ferruginous ochre", that is, on hematite. Only one of his publications deals with an unusual zoological topic, namely the skin of the lizard (Leonardi D., 1826a), a research also published in the Messaggiero tirolese and in the Gazzetta d'Innsbruck.

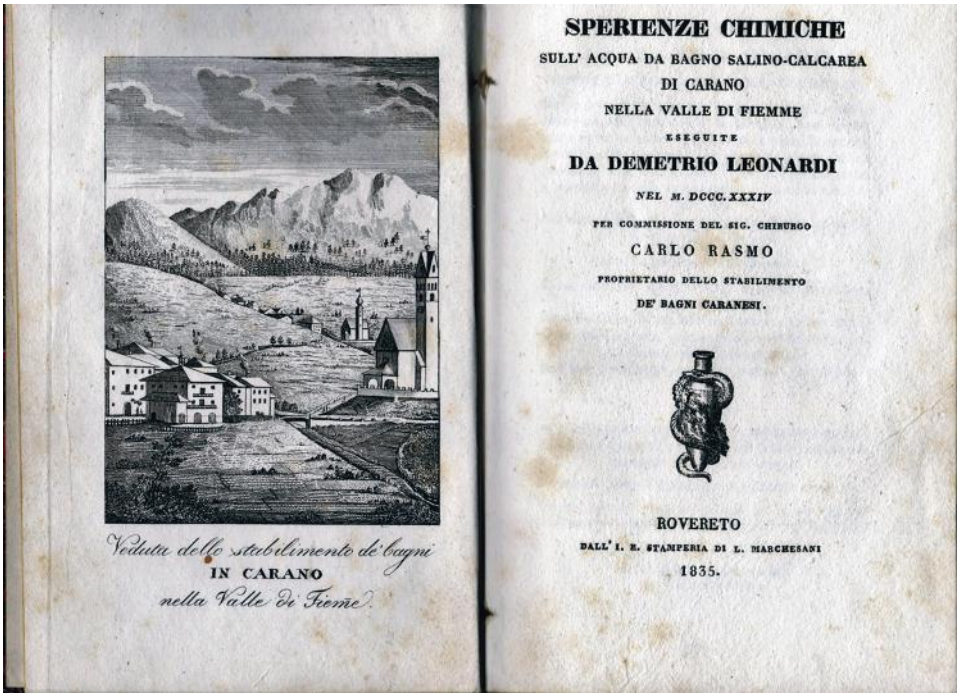

Fig. 9 - The frontispiece and the title page of Demetrio Leonardi's monograph on "Chemical Experiences on Carano's Salina-Calcarea Bathing Water in the Fiemme Valley etc.", 1835. In the engraving, naive style, you can see on the left the Spa of Carano, on the right the bell towers and churches of Carano and Daiano; in the background from left to right Mount Cugola and Mount Rocca.

In his last years Demetrio Leonardi often spent his holidays in Rovereto, where his daughters Luigia (Gigia) and Beppina habitually resided; and in Venice where his son Pietro, a pharmacist, chemist and bromatologist, had been forced to move for political reasons.

Demetrio Leonardi in the last decade of his life was affected by boring health disorders that forced him to a sedentary life. After a short illness, he died in Cavalese on 28 January 1881 at the age of eighty-five (Anonymous, 1881).

Conclusions

In a multi-faceted and slightly restless figure like that of Demetrio Leonardi, so inclined to deal with different things, and to change residence, several times, one may wonder what space has occupied geology in his life. As for the overall state of his mind, one would have thought that the happiest period for him corresponded

to what he spent in Predazzo, at least according to the documentation resulting from the correspondence and the documents kept in the Leonardi familiar archive.

Nor does it seem to surprise such a supposition if one thinks of the enormous satisfactions that his activities in his time spent in Predazzo (1833-1854) must have procured him. He liked his personal research in a field of study so outstanding as that from the eruptive center of Predazzo. And the excursions in the mountains with the hammer in hand and the backpack full of minerals and of rock samples were his true passion. The frequent and pleasant encounters with some of the greatest scholars of the time in the field of metamorphism and the revolution of the previous concepts on the origin of rocks and mountains filled him with pride. The appreciation shown by the authorities and state institutions of that time gave him satisfaction and a sense of security in civil and family life.

The second period in which he lived in Cavalese (1854-1881) was more difficult. Political problems afflicted him somewhat, especially after 1867, when his son Pietro fled into forced exile; and with the problems that followed (Leonardi P., 1930). He loved Cavalese very much, however, and various episodes told in his private papers suggest that, even so, he was a man to maintain good humor and hope. By the way, as a pharmacist, he was really helpful and affable to everyone, always.

The fellow citizens of Cavalese showed esteem and sympathy for him and his family, so much so that his grandchildren and successors were called "the *Demetri*", as the first author of this writing recalls, from his childhood. They also dedicated to him the square in which he had his house in Cavalese. This formerly was simply called "Sboz", and now it's called "Demetrio Leonardi Square".

It is interesting that Demetrio, as epigraph for his major geological publication (1831c) chose the following sentence, quoting the Italian scholar Pier Luigi Mabil (1752-1836): «A man devoted to studies, drinks from these wide and salutary medicines and feels stronger and freer and independent from external things».

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