



Article

Roman Marble Collections in the Earth Sciences Museum of the University of Bari (Italy): A Valuable Heritage to Support Provenance Studies

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Abstract: The Earth Sciences Museum of the University of Bari (Italy) boasts the presence of a precious and complete nineteenth-century collection of white marbles and colored stones used by the Romans to embellish their buildings and, afterward, reuse in new buildings and artworks for their high symbolic and aesthetic value. This collection, arranged by Francesco and Filippo Belli, consists of 577 samples and a printed inventory and other documents, which allowed to reconstruct the history of the collection. Another collection of 29 marble samples was donated to the museum in 2010 by the Armenise family. Both collections represent a very useful reference tool in provenance studies for marble pieces at the archaeological and artistic sites and for samples of other collections. The systematic organization of these collections and their sharing among scholars, especially through the web network, is clearly essential. The work presented here focuses on the most recent discoveries about Belli's collection, on the results of the identification of Armenise's marbles and stones, and above all, on the actions undertaken in recent years in order to valorize this museum's heritage. Specifically, both collections were reorganized following novel insights about lithotypes and the provenance of each sample, a detailed database including data on each sample was created, and a website reporting information and images of the two collections was built in order to guarantee the correct dissemination of data.

Keywords: Roman marbles; provenance; website; database; collection; catalog; Belli's collection



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1. Introduction

The presented paper concerns two marble collections preserved and exhibited in the Earth Sciences Museum of the University of Bari Aldo Moro (Figure 1). The first is a very rich collection originally composed of 600 tiles, assembled by the lawyer Francesco Belli and his son Filippo; the second is an unpublished smaller collection of 29 tiles recently donated to the Earth Sciences Museum by the Armenise family (Figure 2).

The main purpose of this paper is to present to the academic world two collections that are a valuable heritage itself and can be a useful comparison resource to support provenance studies of marbles and stones from other collections and those found in archaeological and historical-artistic sites. Certainly, the provenance identification of ancient marbles and stones represents a field of research that has received widespread acclaim over the last few decades by international scholars and researchers in order to reconstruct the sociocultural and economic relationships of the Roman provinces and main European medieval cities. The identification of marble provenance constitutes a powerful tool to advance knowledge

about archaeological and artistic sites since it provides original dating information [1]. Although for white and black marble, macroscopic identification is too unclear, and further invasive investigation such as isotopic analysis and archaeometric characterization (i.e., Refs. [2–20]) is mandatory, the recognition of colored stones and their original quarries are nowadays entrusted to specialists, who, thanks to expert and trained eyes, are able to observe distinctive features supported by reference collection catalogs [21].



Figure 1. An overview (a) and detail (b) of Belli's collection of marbles and decorative stones exhibited in the Earth Science Museum of the University of Bari Aldo Moro. For each exhibited tiles, a label reporting number and name of sample was displayed.



Figure 2. Armenise’s collection of marbles and decorative stones exhibited in the Earth Science Museum of the University of Bari Aldo Moro.

Both with the purpose of organizing all data about the collections and creating a comparing source, a complete digital database, including high-resolution photographs and data about the name, provenance, use, purpose, and description of each sample, was created and here described. Even if the catalog written by the collector, Belli, seems to be complete and accurate, some identifications of lithotypes and provenance were confused or wrong and were the reason why a new deep study was carried out in order to correct some data and, above all, to assemble the available results obtained in the last years. On the other hand, the work aimed to identify, for comparison, the lithology and provenance of Armenise’s samples.

It is necessary to premise that in artistic and archaeological fields, the term “marble”, which in the earth sciences refers to a metamorphosed carbonate, is instead used for all stones with a pleasant appearance, performant strength, and perfect workability. Moreover, nowadays, commercially, marble is a material that can be cut, carved, and polished. These peculiarities, in addition to its durability, make marble one of the most intensely quarried, worked, and used natural material over the centuries.

Although these were heavily extracted and used starting from the Neolithic period, the first exploitation of marble and colored stone quarries was by the Romans, who considered marbles all decorative stones that, when cut, would take a good polish [22]. Already in the Republican Age (sixth–first centuries BC), white marbles were carved from quarries in Greece and imported to Rome, almost exclusively for private and rich clients, initially only for sarcophagi and sculptures, and later, in the architectural field and in the decoration of domus. At the beginning of the Imperial Age (first century BC), thanks also to new and continuous Roman conquests in Europe and in the Mediterranean basin, a lively interest in precious and exotic marbles and stones coming from Spain, Gaul, Asia Minor, Greece, Egypt, Numidia, and Mauritania developed. All the quarries of the empire (almost all currently exhausted and the object of dialogue about their requalification and valorization [23,24]) were intensely exploited and administered by specific officials of the emperor, and the quarried materials were moved by sea, through *naves lapidariae*, and brought to the *statio marmorum* of Ostia (Roma). Very noteworthy are the recent articles of Al-Bashaireh [25] outlining the history of the exploitation and use of the most important ancient white marble sources located around the Mediterranean Sea till the Byzantine period.

Starting from the fifth century, at the end of the Western Roman Empire and concurrently with the strong Europe Christianization, *spolia* and remains of ruins of destroyed or abandoned Imperial buildings were reused for practical and economic reasons, but also, above all, for their ideological and symbolic connotation referring to power and prestige [26].

In the following centuries, white marbles and colored stones were protagonists of new artistic interest, especially in *cosmatesque* style floors (12th and 13th centuries) [27,28] and in Baroque (15th–17th centuries) artifacts [29] and polychrome altars [30–32]. Particularly in Rome, between the 18th and 19th centuries, interest in white marbles and colored stones encouraged the creation of a dense network of seekers, antiquarians, and dealers of Roman marbles and stones found during the first excavations of those centuries, which were collected, studied, and cataloged, generally by scientific criteria [33]. The most important collections of ancient marbles and colored stones are preserved in the European Science and Natural History Museums, almost all equipped with catalogs, such as those created by Corsi (Oxford University Museum of Natural History) [34], Grassi (Museo Nazionale Romano, Rome) [35] Tommaso Belli (University of Rome Sapienza) [36], Francesco Belli and Karolyi (lost) [37], Pescetto and De Santis (ISPRA, Rome) [38], Podesti (University of Rome Sapienza) [39], Pantaleone (Natural History Museum of London), Karrer (Naturhistorisches Museum, Vienna) and those exhibited in the Antikenmuseum in Berlin [40].

2. Marble Collections of the Earth Sciences Museum

Francesco Belli's collection, preserved and exhibited in the Earth Sciences Museum of the University of Bari, was studied for the first time about ten years ago thanks to a valorization project designed by the SIMA, *Sistema Museale di Ateneo*—University Museum organization (at that time CISMUS, *Centro Interdipartimentale di Servizi per la Museologia Scientifica*—Interdepartmental Center of Services for Scientific Museology), an institution that includes all the Bari University museums, and funded by the *Banco di Napoli* Foundation. In that circumstance, the importance and potential value of the collection were further highlighted thanks to its variability, the number of samples, the presence of three kinds of labels, and an accurate catalog in which the provenance and rarity of each marble were reported [41]. Belli's collection was organized in Rome by lower Francesco Belli in 1850 and, afterward, by his son Filippo, who arranged the rich collection of marbles and stones and wrote a detailed catalog (Figure 3). The collection and its catalog were improved by Filippo Belli, who completed the document with his notes and probably replaced some labels. The collection was purchased by the University of Bari in 1957 by the Roman antiquarian Tito Calvesi [42]. Nevertheless, news of the acquisition of the collection by the university did not spread at least until 1992, when Paola Bozzini [43] affirmed that the only collection created by Francesco Belli, which remained unsold and inherited by his son Filippo, had a very high value but that it was lost.

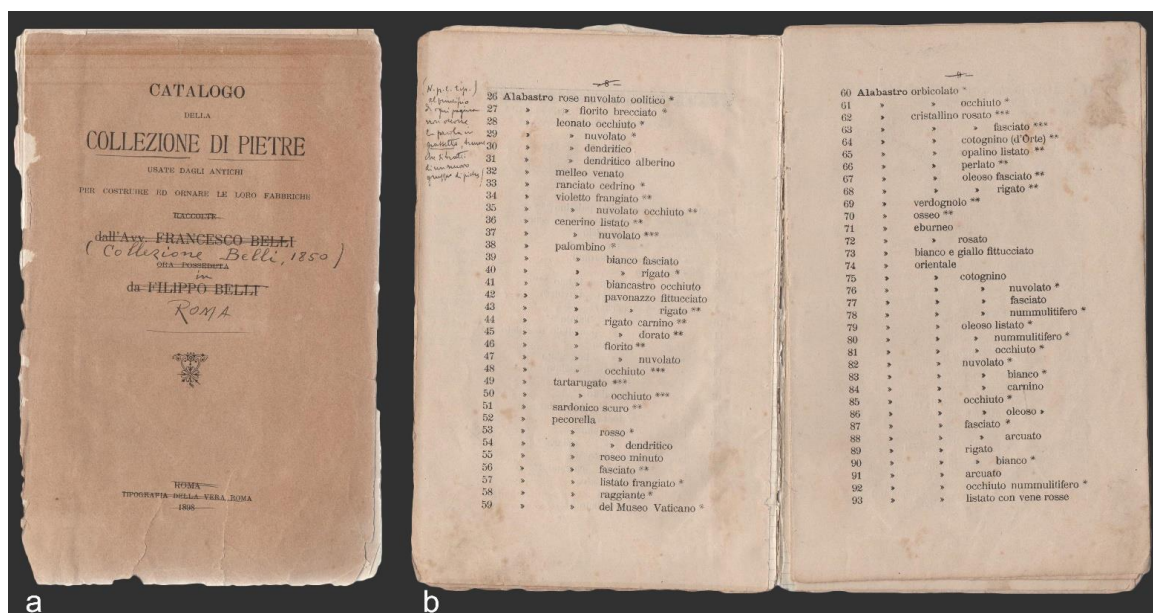


Figure 3. The first page (a) and a page of the Belli catalog (b).

Today, the collection consists of 577 rectangular tiles (size of $12 \times 7 \times 2.5$ cm) polished on five sides; on the back, each sample has a label indicating the number and the name of the marble, in accordance with Belli's geolithological and mineralogical knowledge and the available information of his contemporaries. However, the scientific organization of samples and the correct attribution of name and provenance are very impressive and denote the remarkable expertise of the collection's creator. The cultural value of this collection is due to the lithological variability, the large number of samples, the presence of rarer varieties (i.e., the breccia frutticolosa) and representative holotypes, the sample size, and the very detailed catalog. The database and websites, created thanks to the most recent research and valorization projects, further enhance the collection. Moreover, in the last years, Belli's collection has been considered a reference source for the identification of stones and marbles in the valuable mosaics of St. Nicholas's Basilica of Bari [44] and in the altar intarsia in the Apulian churches [45]. In Figure 4, the rarer and most precious materials of the collection are reported.

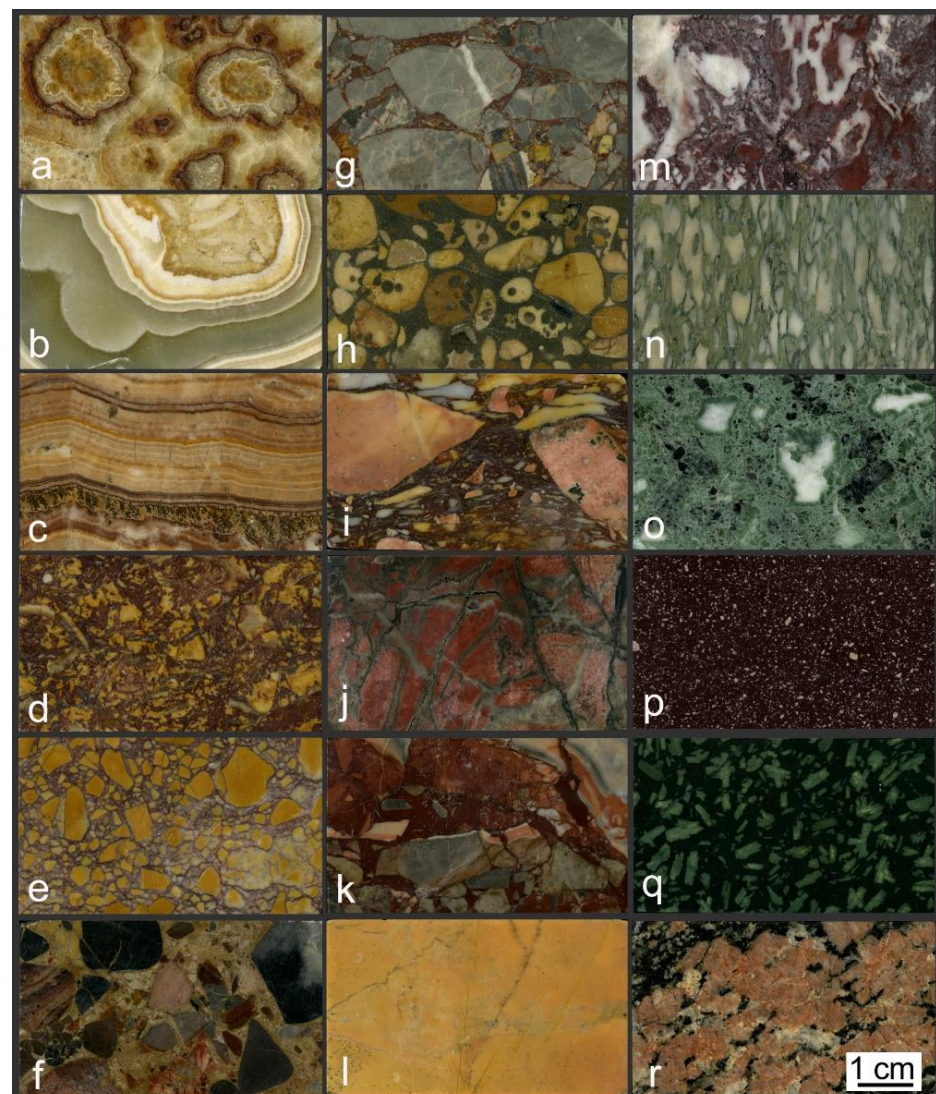


Figure 4. A composition of the rarer and most precious marbles of Belli's collection: (a) 021-Alabastro rose occhiuto (*Marmor hierapolitanum*); (b) 080-Alabastro orientale oleoso nummulitifero (Alabastro orientale, *Lapis alabastrites*); (c) 103-Alabastro fiorito frangiato (Alabastro pecorella); (d) 151-Lumachella broccatello rosso e giallo (Broccatello); (e) 190-Breccia dorata tipo (Breccia dorata); (f) 200-Breccia policroma capitolina sanguigna (Breccia policroma); (g) 209-Breccia policroma aleppina bigia cenerina

(Breccia di Aleppo); (h) 228-Breccia trapanata o frutticolosa (Breccia frutticolosa); (i) 229-Breccia Settebasi rossa (Breccia di Sciro, *Marmor Scyreticum*); (j) 312-Africano rosso (Marmo africano, *Marmor luculleum*); (k) 341-Portasanta rossa brecciata policroma dislocata (Marmo Portasanta, *Marmor Chium*); (l) 373-Giallo antico tipo (Giallo antico, *Marmor numidicum*); (m) 392-Fiore di Persico tipo o palatino (Fior di Pesco, *Marmor chalcidium*); (n) 462-Marmo Cipollino mandolato verde (Cipollino mandolato, *Marbre Campan*); (o) 512-Serpentina Verde antico tipo (Verde antico, *Marmor thessalicum*); (p) 527-Porfido rosso (Porfido rosso antico, *Lapis porphyrites*); (q) 535-Porfido Serpentino tipo; (r) 543-Granito rosso degli Obelischi (Granito rosso, *Lapis pirrhopocilos*).

Armenise's collection is a small collection of marbles and colored stones donated in 2010 by Prof. Porcelli, a relative of the Armenise family, to the Earth Sciences Museum. It consists of 29 squared tiles with dimensions of approximately 4.1 by 4.5 cm and variable thicknesses from 4 mm to 1 cm.

At the donation time, there were no documents such as a catalog or an inventory, even if the tiles show traces of original numbering written in a golden yellow color on the back. The samples are missing evidence of names and provenance or other information useful for holotype identification.

3. Documentation of Collections

The identification provided by the collector was verified by comparing them with the most recent data available in the abovementioned literature and in the other catalogs, and all mistakes were corrected.

All the images of Belli's tiles, together with the information provided in the catalog edited by Francesco and Filippo Belli, the articles already published in the literature concerning the collection [41,42,46], and the findings of the abovementioned project and unpublished results reached in recent years, were collected in a database created using Microsoft Access (365 edition). For each sample, identified with a unique number, a specific card was created. It contains, as explained in Section 4.2, a high-resolution image, the name and number shown on the tile back, the lithology recognized on the basis of comparison with other catalogs, collections, or volumes [22,38–40,47–50], the provenance, the petrographic classification and macroscopic description, and main uses.

Furthermore, for marbles and colored stones of Armenise's collection, identified by a unique number code, cards including high-resolution images, the number indicated on the back, new provenance data obtained by comparison with Belli's collection and, alternatively, with other collections and available bibliographic material, were produced.

4. Results

4.1. Arrangement of Collections

Observation of Belli's collection samples highlighted the good reliability of the collector in finding, annotating, and sharing correct information about the marble names and then provenances. As usual among nineteenth-century collectors and antiquarians, the names attributed to each tile were very imaginative and based on aesthetic as well as scientific characteristics.

Even Belli's collection, although attributions to the well-known marble lithologies tend to be correct, contained about 40 samples, above all, *marmor chium*, *marmor luculleum*, and alabasters, for which no indicative names were reported. For this reason, the tiles were reorganized, maintaining the original numbering and nomenclature used by the collectors. However, they were allocated a different clustering based on a correction of the attribution in order to facilitate consultation and also for archaeologists and, therefore, also geologists and earth sciences scientists.

In view of all the corrections made, Belli's collection currently consists of 577 tiles, even if the original numbering and catalog reported that the collection was made up of 600 tiles. Therefore, 23 tiles were lost in an indefinite time between 1898, when Filippo Belli

last modified the catalog with his annotations by pen, and 1957 when the collection came to the University of Bari.

Furthermore, nine tiles considered contemporary to the creation of the collection were possibly introduced only for aesthetic and commercial purposes, even if documents did not indicate if they were added by Filippo or Francesco Belli.

In addition, although their provenance is uncertain because they lack distinctive macroscopic features, a further 89 samples complete the collection.

As reported in the plot in Figure 5, the largest group is that of breccias, followed by limestones and marbles, and alabasters. However, the other groups, although more limited in number, are also very indicative since they contain the most representative lithotypes. A summary but exhaustive report is shown in Table 1.

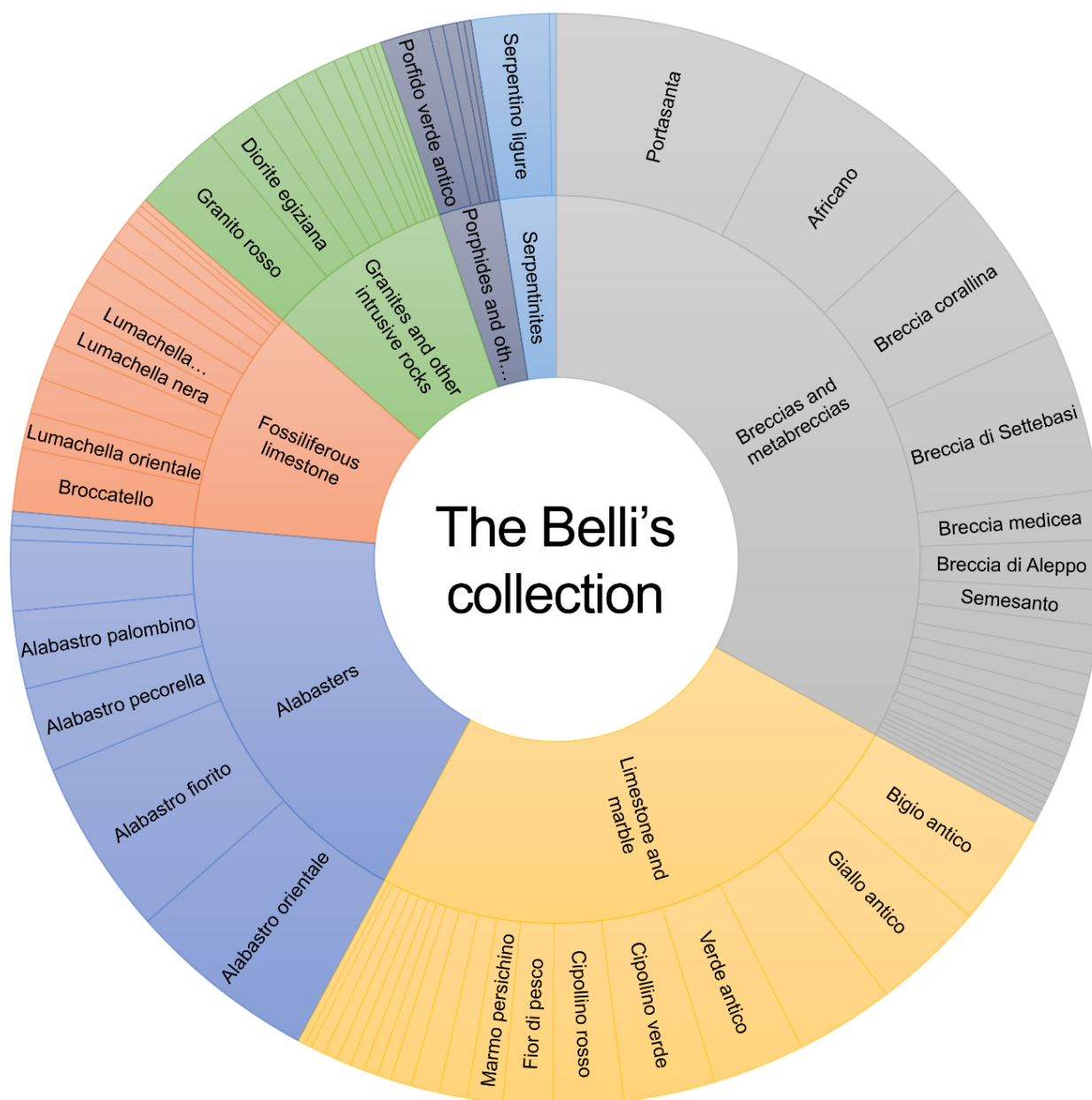


Figure 5. Pie chart showing the lithotype distribution and abundance of Belli’s collection of samples. For graphic layout reasons, the less numerically represented varieties are not indicated with the label but can be completely reported in Table 1.

Table 1. A complete and detailed overview of Belli's collection of marbles reporting all the recognized lithology, names, provenance, and number of corresponding Belli's samples: N.i., not identified.

Lithology	Sublithology	Other Name	Petrographic Description	Provenance	No. of Samples
Alabasters	Alabastro a tartaruga	-	Yellowish-brownish banded, compact travertine	Montauto, Tuscany, Italy	10
	Alabastro ciliegino	Violetto ciliegino	Hematite-rich banded, compact calcite travertine	Unknown quarry	2
	Alabastro fiorito	<i>Marmor Hierapolitanum</i>	Fine-grained banded, compact calcite travertine	Pamukkale (ancient Hierapolis), Turkey	25
	Alabastro ghiaccione	-	Pure compact, banded calcite travertine	Circeo Mount, Italy	2
	Alabastro orientale	Alabastro egiziano, <i>Lapis Alabastrites</i>	Coarse-grained compact, banded travertine	Nile River Valley, Egypt	27
	Alabastro palombino	Alabastro di Palombara	White-brownish banded, compact travertine	Various quarries	11
	Alabastro pecorella	-	Hematite-rich banded, compact calcite travertine	Ain Tekbalet, Algeria	12
Fossiliferous limestone	Broccatello	-	Red and yellow fossiliferous limestone	Tortosa, Spain	9
	Broccatellone	-	Carbonate breccia with pink or yellow matrix	Minor Asia	4
	Lumachella pavonazza	-	Reddish-brownish fossiliferous limestone	Austrian Alps, Austria	3
	Lumachella astracane	Astracane dorato	Yellowish-black fossiliferous limestone	Henchir el Kasbat (ancient Tuburbo Maius), Tunisia	5
	Lumachella astacane veronese	-	Limestone with abundant recrystallized fossils	Verona, Italy	1
	Lumachella di S. Vitale	Lumachella di Verona	Fossiliferous microsparitic limestone	Lessini Mounts, Italy	2
	Lumachella nera	-	Fossiliferous sparitic black limestone	Algeria; Morocco (?)	5
	Lumachella nummulitica	Lumachella rosea	White-pink fossiliferous micritic limestone	Kairouan, Tunisia	3
	Lumachella occhio di pavone	<i>Marmor Triponticum</i>	Reddish fossiliferous limestone	Izmit (ancient Nicomedia), Turkey	5
	Lumachella occhio di pernice	-	Yellowish-grayish fossiliferous limestone	Verona, Italy	5
	Lumachella orientale	Lumachella d'Egitto	White-yellowish-black fossiliferous limestone	Henchir el Kasbat (ancient Tuburbo Maius), Tunisia	5
	Lumachellone antico	-	Grayish fossiliferous limestone	Eastern Alps, Italy	1

Table 1. Cont.

Lithology	Sublithology	Other Name	Petrographic Description	Provenance	No. of Samples
Breccias and metabreccias	Pietra Bekhen	Basanite, <i>Lapis Basanites</i>	Dark-gray-greenish metagraywacke	Wadi Hammamat (ancient <i>Mons Basanites</i>), Egypt	2
	Breccia corallina	<i>Marmor Sagarium</i>	Carbonate breccia with white clasts and red matrix	Vezirhan, Turkey	24
	Breccia di Aleppo	-	Poorly sorted polymictic carbonate conglomerate	Karyes, Greece	7
	Breccia di Hereke	-	Reddish well-rounded polymictic conglomerate	Hereke, Turkey	3
	Breccia di Sparta	-	Greenish, poorly sorted breccia	Sparta, Grecia	1
	Breccia dorata	-	Yellowish carbonate breccia	Apuan Alps, Italy	4
	Breccia frutticolosa	-	Well-rounded polymictic carbonate conglomerate	Unknown quarry	1
	Breccia gialla e rossa	-	Pinkish-yellow limestone	Uadi Abu Gelbano, Egypt	2
	Breccia Godoy	-	Yellowish limestone with sparry calcite-filled fractures	Unknown quarry	1
	Breccia medicea	Breccia di Seravezza, Breccia di Stazzema	White-grayish-violet carbonate metabreccia	Lucca, Italy	7
	Breccia policroma capitolina	-	Variable-colored polymict carbonate conglomerate	Minor Asia	3
	Breccia policroma della Vittoria	-	Polymict carbonate breccia with red matrix	Kocani, Macedonia	1
	Breccia policroma lucullea	-	Variable-colored and poorly sorted polymictic metaconglomerate	Minor Asia	1
	Breccia quintilina	Breccia di Tivoli	Serpentine breccia	Apuan Alps, Italy	1
	Breccia di Settebasi	Breccia di Sciro, <i>Marmor Scyreticum</i>	Sheared polymict carbonate metabreccia	Skyros and near Islands, Greece	23
	Semesanto	Breccia di Sciro, <i>Marmor Scyreticum</i>	Sheared polymict carbonate metabreccia (minute fragment variety of Breccia di Settebasi)	Skyros and near Islands, Greece	5
	Semesantone	Breccia di Sciro, <i>Marmor Scyreticum</i>	Sheared polymict carbonate metabreccia (variety of Breccia di Settebasi)	Skyros and near Islands, Greece	2
	Breccia verde d'Egitto	<i>Lapis hecatontalithos</i>	Greenish, poorly sorted polymictic metaconglomerate	Wadi Hammamat (ancient <i>Mons Basanites</i>), Egypt	2
	Bianco e nero antico	Marmo d'Aquitania; <i>Marmor Celticum</i>	Black and white carbonate fault breccia	Aubert, Francia	3

Table 1. Cont.

Lithology	Sublithology	Other Name	Petrographic Description	Provenance	No. of Samples
Limestone and marble	Breccia cinerina	-	Purple and white carbonate metabreccia	Apuan Alps, Italy	2
	Portasanta	<i>Marmor Chium</i>	Limestone fault breccia with variable color, mainly with red cement	Chios Island, Greece	36
	Africano	<i>Marmor Luculleum</i>	Carbonate metabreccia with variable-colored clasts and black matrix and cement	Teos, Turkey	27
	Cipollino mandolato	<i>Marbre Campan</i>	Reddish-greenish nodular metalimestone	Campan, France	4
	Cipollino marino	-	Folded and banded marble with chlorite	Apuan Alps, Italy	2
	Cipollino rosso	Africanone, <i>Marmor Iassense</i> or <i>Carium</i>	Red marble, white curved veins, rich in hematite, chlorite, and graphite	Kiyikislacik (ancient Iasos), Turkey	10
	Cipollino verde	<i>Marmor Caristium</i>	White and green impure marble with chlorite	Karystos, Greece	13
	Cottanello antico	-	Reddish and white brecciated limestone	Italia	2
	Fior di pesco	<i>Marmor Chalcidium</i>	Pinkish red metalimestone with large white veins	Nea Psara (ancient Eretria), Greece	7
	Giallo antico	<i>Marmor Numidicum</i>	Yellow limestone with limonite and hematite	Chemtou (ancient Simitthu), Tunisia	16
	Giallo tigrato	-	Manganese-oxide-rich yellow and white limestone	Unknown quarry	1
	Greco scritto	-	White calcite marble with graphite	Ephesus, Turkey	2
	Rosso antico	<i>Marmor Taenarium</i>	Red hematitic marble with small white veins	Mani peninsula, Greece	2
	Rosso Francia	-	Red limestone with sparry calcite veins	Caunes-Minervois, France	1
	Marmo bianco (n.i.)	-	White saccharoid marble	-	2
	Marmo pavonazzetto	<i>Marmor Phrygium</i> or <i>Docimium</i> or <i>Synnadicum</i>	Brecciated white or light-yellow marble with violet veins	Isehisar (ancient Dokymeion), Turkey	14
	Verde antico	<i>Marmor Thessalicum</i>	Green ophicalcite breccia	Chasabali, Greece	13
	Marmo persichino	-	Purple fractured marble	Unknown quarry	5
	Marmo proconnesio	Marmo di Proconneso, Marmo Cipolla, <i>Marmor Proconnesium</i>	White marble with gray veins	Marmara Island, Turkey	4
	Rosso ammonitico veronese	Rosso di Verona	Red limestone with ammonite fragments	Verona, Italy	3
Bigio antico	<i>Marmor Lesbium</i>	Gray marble with white veins and fossils	Lesbos Island, Greece	16	
Pietra paesina	Pietra ruiniforme	Variable-colored micritic limestone with sparry calcite-filled fractures	Lazio and Tuscany, Italy	2	

Table 1. Cont.

Lithology	Sublithology	Other Name	Petrographic Description	Provenance	No. of Samples
Serpentinites	Serpentino ligure	-	Sheared or brecciated serpentinite	Liguria and Piemonte, Italy	11
	Verde ranocchia	-	Serpentinite	Wadi Umm Esh, Egypt	1
Granites and other intrusive rocks	Granito bianco e nero	<i>Marmor Tiberianum</i>	Quartz diorite	Uadi Barud, Egypt	4
	Granito bigio grafico	-	Medium-grained syenite	Fontaine du Gènie (ancient Tipasa), Algeria	1
	Granito a morviglione	Porfido bigio	Porphyritic dacite with zoned plagioclase	Boulouris, France	2
	Granito del foro	<i>Marmor Claudianum</i>	Metatonalite, sometimes foliated	Gebel Fatireh (ancient Mons Claudianus)	3
	Granito della colonna	-	Coarse pegmatitic diorite/gabbro	Umm Shegilat, Egypt	2
	Granito grafico	-	Granitic pegmatite with feldspar and quartz intergrowth	Siberia, Russia	1
	Granito rosso	<i>Lapis Pirrhopoecilos</i>	Medium-grained pinkish-red quartz sienite	Aswan (ancient Siene), Egypt	13
	Granito verde della sedia	<i>Lapis Ophytes</i>	Metagabbro with dark green crystals of pyroxene and white crystals of plagioclase	Uadi Semnah (ancient Mons Ophyates), Egypt	3
	Gabbro eufotide	-	Coarse-grained metagabbro	Wadi Maghrabiya, Egypt	3
	Fluorite antica	-	Pink-yellow-green fluorite	Murrha, Spain	1
Porphyries and other effusive rocks	Diorite egiziana	Granito nero	Medium-grained granodiorite	Gebel Nagug, Aswan, Egypt	7
	Porfido nero	-	Black porphyritic meta-andesite with white crystals of plagioclase	Gebel Dokhan (ancient Mons Porphyrites), Egypt	1
	Porfido rosso antico	<i>Lapis Porphyrites</i>	Red porphyritic meta-andesite with white crystals of plagioclase; piemontite in the groundmass	Gebel Dokhan (ancient Mons Porphyrites), Egypt	2
	Porfido serpentino nero	-	Black porphyritic metatrachyandesite with white crystals of plagioclase	Uadi Umm Towat, Egypt	1
	Porfido verde antico	<i>Lapis Lacedemonius, Krokeatis lithos</i>	Green porphyritic meta-andesite with white crystals of plagioclase	Laconia (ancient Krokeai), Greece	7
	Porfido verde egiziano	<i>Lapis Ieracites</i>	Porphyritic meta-andesite with white crystals of plagioclase	Gebel Dokhan (ancient Mons Porphyrites), Egypt	2
Modern stones					9
n.i. samples					89

Moreover, observation of the back of each tile revealed the presence of two polished tiles on all six sides (instead of five as in the rest of the collection) in samples 120 (*Lumachella orientale dorata*) and 459 (*Marmo cipollino policromo*) and a thinner tile to which a black plate was added on the back to uniform the dimensions to the rest of the collection in sample 124 (*Lumachella Astracane dorato Madreperlifero*). These latter variances could suggest that the three samples were not shaped specifically for Belli's collection but that they could have come from other collections of other collectors or from one of the numerous collections of Francesco Belli himself.

Furthermore, it was observed that the labels, which can be grouped into three categories (Figure 6), as already highlighted by Conte et al [41], are present only on 177 tiles, of which 108 have an a-type label, 65 have a b-type label, and only 4 have a c-type label. The remaining 400 samples show no original label.

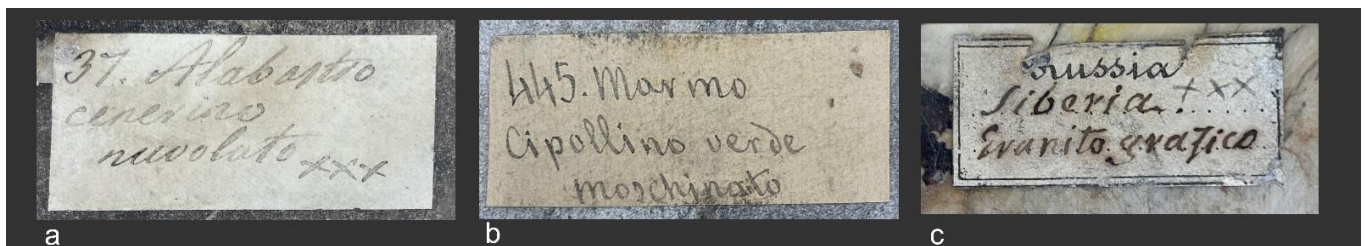


Figure 6. Three different labels (a–c) found on the back side of Belli's marbles.

Referring to Armenise's collection, despite the small size of the tiles, thanks to a comparison with the samples of other collections and, above all, with the samples of Belli's collection, it was possible to identify, with certainty, 17 samples and their provenance on the basis of their distinctive macroscopic features. For the other 12, it was not possible to attribute a known lithology due to the small size of the samples and the lack of distinctive features. A summary is reported in Table 2.

Table 2. Report of number, name, and attribution, if recognized, of lithology and provenance of marbles of Armenise's collection: n.i., not identified.

Sample	Lithology	Petrographic Description	Size (mm)
1	n.i.	–	45 × 45 × 7
2	Portasanta	Limestone fault breccia with variable color, mainly with red cement	46 × 46 × 7
3	n.i.	–	45 × 45 × 5
4	Alabastro a tartaruga	Banded, compact travertine	44 × 44 × 6
5	Portasanta	Limestone fault breccia with variable color, mainly with red cement	45 × 45 × 7
6	Verde Alpi	Green ophicalcite breccia	44 × 46 × 11
7	n.i.	–	44 × 44 × 5
8	Bigio antico	Gray marble with white veins and fossils	45 × 46 × 8
9	Rosso Francia	Red limestone with sparry calcite veins	44 × 44 × 7
10	n.i.	–	46 × 45 × 5
11	Rosso Levante	Red ophicalcite breccia	47 × 45 × 6
12	n.i.	–	45 × 44 × 9
13	Portoro	Black limestone with white and yellow (limonite) veins	45 × 45 × 7
14	n.i.	–	44 × 44 × 8
15	Breccia corallina	Carbonate breccia with white clasts and red matrix	44 × 45 × 7
16	Libeccio antico	Fossiliferous, brecciated, and very variable-colored limestone	44 × 45 × 7

Table 2. Cont.

Sample	Lithology	Petrographic Description	Size (mm)
17	Rosso Francia	Red limestone with sparry calcite veins	45 × 45 × 4
18	n.i.	–	44 × 44 × 5
19	n.i.	–	43 × 44 × 8
20	Libeccio antico	Fossiliferous, brecciated, and very variable-colored limestone	43 × 43 × 7
21	Breccia medicea	Pink, white, and black dolomitic metabreccia	45 × 42 × 4
22	n.i.	–	46 × 44 × 8
23	Alabastro pecorella	Hematite-rich banded, compact calcite travertine	44 × 44 × 5
24	Alabastro pecorella	Hematite-rich banded, compact calcite travertine	44 × 39 × 6
25	Libeccio antico	Fossiliferous, brecciated, and very variable-colored limestone	46 × 44 × 6
27	n.i.	–	46 × 45 × 9
28	Portasanta	Limestone fault breccia with variable color, mainly with red cement	45 × 45 × 7
29	n.i.	–	45 × 45 × 8
30	n.i.	–	45 × 45 × 7

The numbers reported on the backside reach 30, but the samples are 29, with no reason why a sample was lost or donated after its first classification. Furthermore, the presence of original numbering suggests the existence of an inventory or a list of samples containing their names, now lost.

4.2. The Database

The database of the marble collection was created using Microsoft Access 365 edition software. It consists of 606 records referable to 577 samples of Belli's collection and 29 to Armenise's collection. For each record, a description file (Figure 7) is available. It reports, where available, from top to bottom: (i) a high-resolution photograph of the sample; (ii) a section including the identification number in the database and the original number and name reported in the catalog; (iii) another section reporting size, petrographic classification, lithological description, lithotype attribution and then provenance, common uses and purposes, and historical information; (iv) a final box showing references.

4.3. The Website

In order to share Belli's collection and the new Armenise's collection, a dedicated website (<https://marblecollectionuniba.wordpress.com/>, accessed on 1 April 2023) was created, registering a free domain and using the WordPress platform (Figure 8).

The website is organized into five menus, as explained below. The first section collects information on the two marble and colored stone collections and about previous projects and studies about them. In the second section, which represents the heart of the site, it is possible to navigate between the samples of Belli's collections through a hierarchical structure based on antiquarian terminology and to browse among the photographs and description contents. In fact, although the complete database is not available online but is explorable after agreement, the main and most important lithotypes of the ancient marbles and colored stones are reported. The third section is a photo gallery showing some images of ancient marble objects. The fourth section contains all the articles, chapters, conference talks, and posters edited in the last two decades and documents that cite Belli's collections as references for the recognition of marbles and stones used in artistic, architectural, and archaeological finds.



ID
118
ID (Belli)
123
Name ((Belli)
Lumachella orientale minuta
Petrographic classification
Fossiliferous limestone
Description
Sample shows a gray background with golden yellow shades, including white, gray and black bivalve inclusions (2-3 m)
Lithotype
Lumachella orientale (or Lumachella d'Egitto)
Provenance
Hencir el Kasbat (ancient Thuburbo Maius), Tunisia
Main uses
Tiles, Floor slabs, intarsia, rare use in sculpture
Historical information
Spread in Rome starting from the Augustan age. The varieties with yellow backgrounds were greatly desired by Roman marble workers in the 16th and 17th centuries
References
Gnoli 1988; Borghini 1992; Lazzarini 2006; Lazzarini 2012

Figure 7. Example of a database card [47–49].

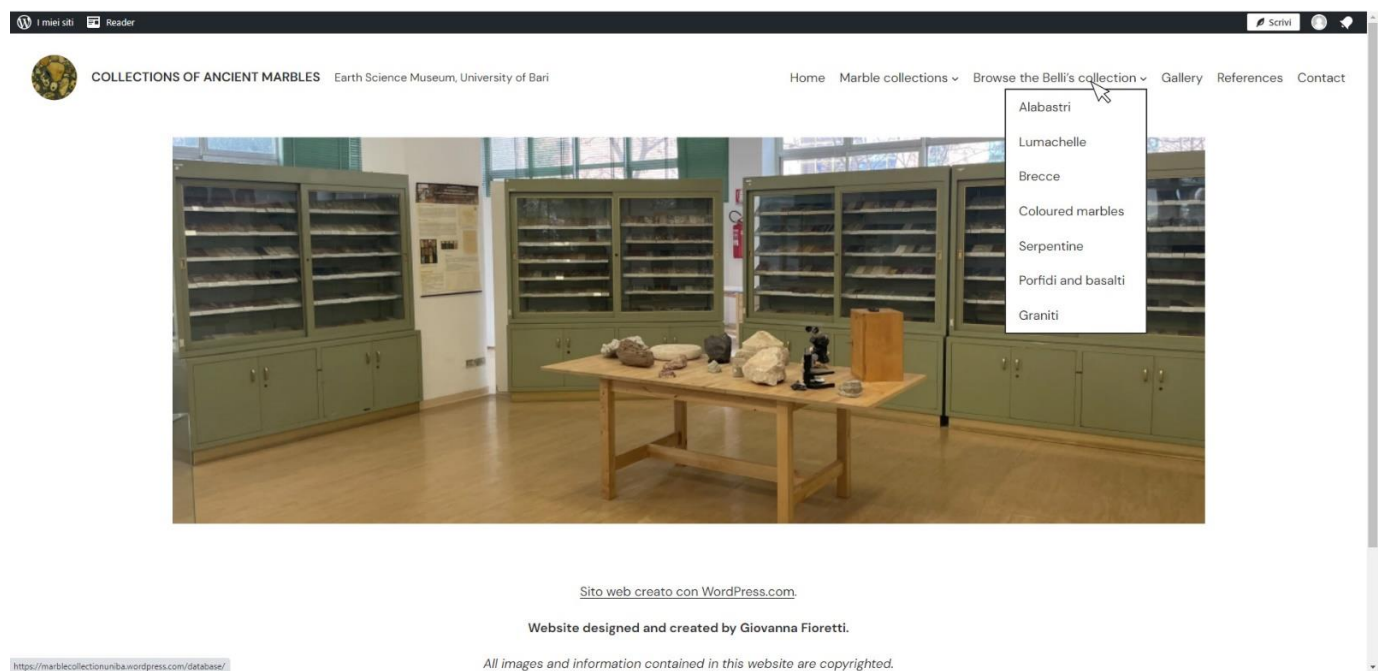


Figure 8. Home page of the website “Collection of ancient marbles—Earth Science Museum, University of Bari” (<https://marblecollectionuniba.wordpress.com/>, accessed on 1 April 2023).

The final section shows useful information for reaching the museum and contacts. Of course, all images and data are copyrighted.

In the coming months, the website will be enriched with a 3D model of the renewed exhibition area of Belli’s collection, obtained using an effective photogrammetry approach [51], which, on the one hand, produces an interactive high-resolution model and, on the other hand, can be constantly improved by linking 3D models of other areas of the museum.

5. Conclusions

Thanks to valorization projects, conference talks and posters, promotion activities, and guided tours for university students and schools, in recent years, Belli’s collection has been the focus of interest from numerous scholars and academics who have appreciated its variability and richness.

In fact, the collection boasts the presence, on the one hand, of the most important marbles and colored stones used in the Roman Age and, afterward, in the post-Roman period, and on the other hand, very rare lithotypes not always included in all nineteenth-century collections of ornamental and decorative marbles and stones. Alongside these qualities, the tile size is notable because it guarantees the identification of the peculiar features of each stone and, therefore, their effective representativeness.

For these reasons, it is evident that Belli’s collection, similar to other important collections stored and exhibited in the most famous science museum in the world, can be considered a powerful tool for identifying the lithotypes and, above all, the provenance of materials, in order to deepen the knowledge relating to the archaeological, artistic, and architectural sites in which they were used.

A correlation is also possible with tiles of other collections without a catalog or inventory. This is the case of Armenise’s collection, which was a donation to the Earth Sciences Museum from an enthusiast, which had never been studied and disclosed and which is presented for the first time in this paper.

The arrangement of images and dates produced in recent years in a dedicated database allows to quickly find information and to ensure their longstanding conservation, as well as their consultation.

Furthermore, the website represents an important tool for disseminating the collection and, above all, a source of research for the identification of ancient marbles and colored stones and their provenance.

A task for the future will be to maintain the database and website to ensure it is always up-to-date and enriched with unpublished content useful to scholars, archaeologists, scientists, and experts in the field. In addition, the new and correct rearrangement of the collection, after the new insights achieved in the most recent studies, will stimulate the creation of a new setup of the area dedicated to the collection inside the museum. Samples will be exhibited in new showcases, with labels showing the correct provenance of materials; artworks found in local archaeological and artistic contexts and made with Roman marbles and stones will be unveiled; and further and larger sites will be reconstructed and virtually reproduced by means of holographic projectors.

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