

BOTANICAL HISTORY

Imperato, Cirillo, and a series of unfortunate events: a novel approach to assess the unknown provenance of historical herbarium specimens

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During a survey of the historical collections stored at the Herbarium of the Facoltà di Agraria, Università di Napoli (PORUN), we found 170 specimens of unknown provenance mixed within the surviving Domenico Cirillo’s herbarium (18th century). These 170 specimens were strikingly different from the rest and had never been studied previously. From an initial close examination, we suggested that they may date back to the 16th to 17th century, and likely have been part of Ferrante Imperato’s historical herbarium. To test our initial hypothesis, we employed an empirical approach to assess the age and provenance of these specimens. First of all, we assembled the available literature regarding the history of Italian botanical collections and collectors from the 16th to the 18th century in the political context of those years. We integrated our historical reconstruction with results obtained by radiocarbon analyses of the specimens and mounting paper, and watermark and paleographic analyses. Our combined results are consistent with the hypothesis that these unknown specimens may have been part of an 80 volumes herbarium that belonged to Ferrante Imperato, one of the earliest natural historians of our times. Our integrated methodology is novel in the field of historical specimen research and was critical in generating our final conclusions.

KEYWORDS: Domenico Cirillo, Ferrante Imperato, historical herbaria, paleography, radiocarbon analyses, watermark

INTRODUCTION

The Renaissance was a culture movement that stimulated the intellectual energy that profoundly affected the progress and development in the arts and sciences from the 14th throughout the 17th century (Perry & al., 2002). During that period, also characterized by the beginning of the scientific revolution (Debus, 1978), many natural history museums were founded in Europe based on personal collections, such as the *Museum Wormianum* by the Danish naturalist Olaus Worms (Schepelern, 1990) and the museum of Pisa, where Andrea Cesalpino (1519–1603) taught and was Director of the Pisan Botanic Garden (Giglioli, 1903), one of the oldest in the world (Garbari & al., 1991).

Ferrante Imperato (1525–1621) was an herbalist from Naples (Italy) who dedicated much of his time and personal assets to collect and study the “natural things” (Stendardo, 2001). The details of Imperato’s life are obscure and controversial (Imperato, no date; Placcio, 1674; Donzelli, 1737; Minieri Riccio, 1863; Faraglia, 1885; Villari, 1976). He assembled a vast collection of objects, including herbarium specimens, shells, minerals, marbles, gems, birds, sea animals, and fossils, forming one of Europe’s first natural history museums (Fig. 1)

(Hooper-Greenhill, 1992). The richness of his collections is well documented (Colonna, 1592, 1616; Capaccio, 1634; Bartholinus, 1663), along with details of his personal herbarium (Imperato, 1628; Mattioli, 1712; Cirillo, 1787–90, 1788, 1792; Martuscelli, 1814; Onorati, 1822; Pirota & Chiovenda, 1900), but we do not know much about his botanical garden.

The role of Imperato within the Italian scientific community was critical, as he fostered the historical turn from the Middle Ages to the renaissance empirical approach (Stendardo, 2001). His personal museum was renowned among European scientists and his fame became the cause of professional jealousy among many of his Italian contemporaries (Placcio, 1674; Stendardo, 1991). Imperato’s herbarium included 80 volumes and was perhaps the most important component of his museum (Giglioli, 1901, 1903; Balsamo, 1913; Neviani, 1936), probably representing the largest herbarium of the 16th century. The fate of these volumes is unclear, however. Naples was devastated by the plague of 1656, an event that profoundly changed the city (Cipolla, 1981). Part of Imperato’s museum was dispersed at this time (Giglioli, 1903), although other sources reveal that after Imperato’s death his son Francesco and later his nephew Aniello carried on Ferrante’s work and

fostered the growth of the collections until their own death (Stendardo, 2001). Their heirs, not understanding the scientific and historical value of their material, dismantled the museum (Celano, 1856–1860; Neviani, 1936; Stendardo, 2001). From that time onwards the fate of the collections of Ferrante Imperato is unknown, until the 18th century when nine surviving herbarium volumes were acquired by Nicola Cirillo (1671–1734), a physician and botanist who was a Fellow of the Royal Society of London (Giglioli, 1903) and the uncle of Domenico Cirillo (Cesati, 1879; Pasquale, 1894; Balsamo, 1913; Neviani, 1936).

Domenico Cirillo (1739–1799) was one of the most important Italian botanists of the 18th century. He assembled a vast collection of herbarium specimens thanks to his personal collecting efforts and material exchanged with many other famous European botanists. He inherited and preserved the nine surviving volumes of Imperato's collection as his most precious treasure (Giglioli, 1903).

During most of the 18th century, Italy was dominated by foreign monarchies, although in 1735 the Kingdom of

the Two Sicilies, which included Naples, became an independent monarchy (Woolf, 1979). Later, the influence of the French Revolution caused a period of political turmoil during which several Italian Republics were proclaimed (Woolf, 1979). Domenico Cirillo became actively involved in the political life of the short-lived Neapolitan Republic. In 1799 his liberal political ideologies clashed with the then restored monarchy, he was arrested and executed in the same year (Cuoco, 1951; Croce, 1953). His house was sacked by the royalist mobs and many of his scientific papers were destroyed or dispersed (De Renzi, 1849; Carusi, 1861; Cesati, 1879; Giglioli, 1903), including the nine volumes of Imperato's herbarium (Giglioli, 1903).

Imperato's only spoils left today are some letters stored in various European libraries (Neviani, 1936; Stendardo, 2001) and a single, surviving volume of herbarium specimens that fortunately came into the hands of Camillo Minieri Riccio, a local historian. It was eventually sold to the National Library of Naples where it is stored today (Minieri Riccio, 1844, 1863; Giglioli, 1903; Neviani,



Fig. 1. Museum of Ferrante Imperato from Dell'Historia Naturale (Imperato, 1599).

1936). The surviving volume comprises 536 pages and includes 442 specimens (Minieri Riccio, 1868–1869; Ciarallo, 1986). Assuming that all 80 volumes included a similar number of samples, Imperato's Herbarium may have contained over 35,000 specimens. In comparison, the herbarium of Cesalpino, assembled by 1563, contained only 768 specimens, that of Jean Girault (1588) only 313 specimens, and that of Caspar Bauhin (1560–1624) was ca. 4,000 specimens, half of which survive at the University of Basel. Many other herbaria assembled in that period (e.g., Dalechamp, Falconer, Ferro, Fontanon) did not survive and their past existence is documented only in the literature (Mattirolo, 1897).

At the International Botanical Congress of Genoa in 1892, Orazio Comes, Director of the Herbarium of the Istituto Botanico della Regia Scuola Superiore di Agricoltura di Portici (now PORUN), reported that several specimens in the herbarium of Vincenzo and Francesco Briganti (1766–1836 and 1802–1865 respectively), came from Cirillo's herbarium (Comes, 1892). Much later, the surviving Cirillo specimens were formally assessed and quantified (Mezzetti Bambacioni, 1959). Thanks to efforts towards collection evaluation, restoration, and digitization of historical material stored at PORUN (De Natale, 2007), more specimens belonging to Cirillo were recently detected in the personal herbarium of Vincenzo Petagna, acquired by the University at the beginning of the 20th century (Motti, 2003).

Vincenzo Petagna (1730–1810) was another Italian botanist and contemporary to Domenico Cirillo. The Cirillo specimens found among his collections are not in good condition as they lack original labels, although they have "Herbarium D. Cyrilli" printed on every sheet and the careful annotations of Orazio Comes. Among these specimens, we found a few that are strikingly different for being tightly glued on paper made of a mixture of hemp and flax, and having much larger dimensions and a calligraphy that is reminiscent of 17th century printed characters. Given the evident differences among these specimens, we suggested that these unusual collections might have been part of Imperato's herbarium. The historical reconstruction of this material is hampered by the lack of documentation and literature. Therefore, we employed an empirical approach that could serve as a model for the evaluation of historical specimens when provenance is unknown.

MATERIALS AND METHODS

Archival and herbarium survey. — We consulted several Italian libraries and historical archives in search of information regarding the herbaria of Imperato and Cirillo. We were particularly interested in data concerning

size, content, history, and current location of these collections. In addition, we compared herbarium material stored at the National Library of Naples with the specimens we found at PORUN. We focused particularly on the type of paper used, specimen layout, and mounting techniques. However, we were not allowed to carry out any type of analyses on the material stored at the National Library, including watermark identification.

Radiocarbon analyses. — The radiocarbon method is based on the rate of decay of ^{14}C to infer the age of organic material (Libby & al., 1949; Taylor, 1997). Our samples were analyzed using ^{14}C Accelerated Mass Spectrometry (AMS) method. This is the most widely used ^{14}C dating method because it counts all ^{14}C isotopes rather than just the decaying atoms, and therefore is more accurate and requires smaller amounts of material (Litherland, 1980; Herbert Budzikiewicz, 2006).

We selected a specimen of *Larix decidua* Miller (IF 136, Fig. 2) that was already partially detached from the herbarium sheet, and where the removal of fragments



Fig. 2. Specimen of *Larix decidua* hypothetically belonging to the collection of Ferrante Imperato. a, paper fragment removed for radiocarbon analysis. The label (bottom right) and the taxon name scribbled on the sheet were added later by Orazio Comes (PORUN).

would not have significantly compromised its overall appearance and value. We collected 17 mg of needle and bark's fragments, and 12 mg of mounting paper. As a control, we collected the same amount of material and paper from a specimen of *Valeriana locusta* L. (PV 65) from the Herbarium of Vincenzo Petagna that dated 1784. Sample preparation and AMS analyses were performed at the CIRCE Laboratory in Caserta, Italy (Terrasi & al., 2007) and consisted of several stages:

All contaminants were carefully removed by using an electronic microscope and tweezers. The organic carbon fraction was isolated from the herbarium sample by the use of an acid-alkali-acid procedure (Mook & Streurman, 1983). An alpha cellulose extraction procedure was used to isolate the organic carbon fraction from the paper sample (Green, 1963). Combustion and graphitization procedures were employed to obtain 0.7 mg of material required for the AMS (Passariello & al., 2007). Results were calibrated using Calib v4.4 software (Stuiver & al., 1998).

Watermark identification. — The watermark of our paper samples from PORUN is very distinct by having three crescent moons (Fig. 3). We compared our sample using several atlases that discussed pre-18th century European, Italian, and local (Amalfi area) watermark producers (Barone, 1889; Briquet, 1923; Ataide E. Melo, 1926; Churchill, 1935; Mošin & Traljić, 1957; Imperato, 1984). In addition, we consulted the watermark archive of the Institute of Book Pathology in Rome (Istituto di Patologia del Libro).

Paleogeographical analyses. — We compared the hand-writing samples on specimens from the Herbarium Porticense with a copy of a letter written by Ferrante Imperato that was obtained from the University of Bologna.

RESULTS

Herbarium and archival analyses. — The total number of specimens we found at PORUN and that we think may belong to Ferrante Imperato is 170. This is a

modest number compared to the 442 specimens stored at the National Library of Naples. These newly found specimens were mixed among the Cirillo's specimens stored at PORUN, and are characterized by having the mounting paper made of a mixture of hemp and flax and measuring approximately 22–22.5 × 33–33.5 cm. These herbarium sheets have been clearly cut by hand and therefore, do not have the exact same size. On these sheets, plant specimens are entirely glued on the mounting paper, and often it is obvious that they had been removed and re-mounted from another sheet where they were arranged together with other specimens. We compared these collections with the ones stored at the National Library whose measurements are approximately 20 × 30 cm, with uneven sheets clearly cut by hand. We concluded that these specimens were very similar, and completely glued and arranged on the sheets using the same mounting techniques, although in the Library's specimens each sheet has a pre-Linnaean name, whether in the PORUN material only an index number was found written on each specimen (Fig. 2). In contrast, Cirillo's specimens are mounted on a completely different paper type and size, and are not entirely glued on the herbarium sheets, rather secured with glued paper strips (Fig. 4).

Radiocarbon analyses. — Radiocarbon dating analyses showed some conflicting results. The presumed Imperato collection (IF 136) dated back to the 17th century for both the plant specimen and the mounting paper. However, the Petagna's specimen (PV 65) used as control dated back to the 14th century for the plant specimen and 18th century for the mounting paper.

Watermark identification. — The comparison with the available material on published watermark led us to conclude that the mounting paper was produced by paper factories in Amalfi (near Naples, Campania) between 1576 and 1616, in the special occasion of the visit to Amalfi from the Archbishop Giulio Rossini (Gargano, 2006). Our results were evaluated by Dr. Giovanni Gargano, an expert on watermarks, especially from the Amalfi area.

Fig. 3. Watermark on the herbarium sheets hypothetically belonging to the collection of Ferrante Imperato.



Paleographical analyses. — The herbarium material hypothetically belonging to Imperato have only index numbers written above the actual plant specimen. The paleographical analyses revealed that these numbers do not correspond to the typical characters that can be identified with 17th century writing. Therefore, these index numbers may have been added at a much later time.

DISCUSSION

Among Cirillo's collection stored at PORUN, we found several herbarium sheets of unknown provenance. We attempted to assess the origin of that material by using

a novel approach that included careful examination of the type of mounting paper, mounting technique, watermark, specimen layout, paleographic and radiocarbon analyses. In combination with the available historical elements, we suggest that these newly discovered specimens may have been part of the 80 herbarium volumes of Ferrante Imperato (17th century).

The sheets are distinct for not having any writing, apart from consecutive numbers on each specimen that clearly refer to an index. Unfortunately, this index could not be located. The specimens are tightly glued to the paper and the sheet right margins are very uniform suggesting that they were cut for binding. Indeed, when arranging the specimens according to their progressive numbers,

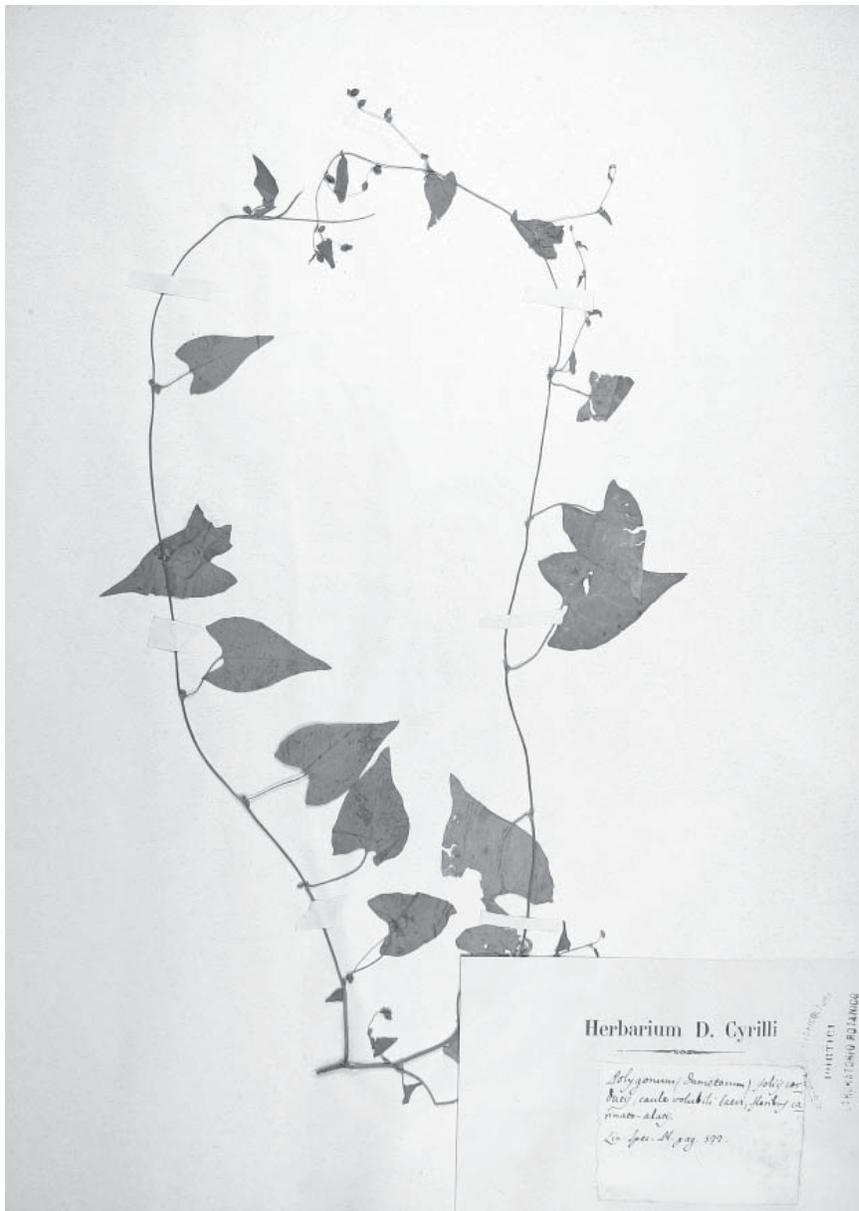


Fig. 4. Specimen of *Polygonum dumetorum* from the collection of Domenico Cirillo.

we observed that in many sheets the lower side has a perfectly matching impression of the specimen mounted on the next sheet, typical of volume bound herbarium sheets. Similarly, the specimens stored at the National Library are bound in a volume, tightly glued on the mounting paper and numbered.

The calligraphic analysis reveals that it was not Imperato who wrote on these sheets, rather someone else curated these specimens by numbering the sheets and compiling an index. Similarly, the numbers written on the specimens stored at the National Library, including the volume index, are not in Imperato's handwriting, rather were written by others, including possibly, a French botanist in view of the language of some of the annotations, e.g., "*fleur de la passion*" (Neviani, 1936; Ciarallo, 1986).

Radiocarbon methods have been applied in many disciplines but never to investigate the origin of herbarium specimens. Our analyses showed that the specimen of Vincenzo Petagna we used as a control resulted dating to the 14th century, instead of the 18th century. The error is most likely caused by the presence of old contaminants used to disinfect the herbarium material. However, the mounting paper provided more accurate results and dated back to the 18th century as expected. The difference in these results is probably due to the fact that we sampled the small fragment of paper away from the actual plant specimen, at the very edge of the sheet where probably it had not been affected by the sublimate used. On the contrary, the results we obtained with the specimen putatively belonging to Imperato showed that both paper and herbarium material date back to the 17th century.

The expensive quality of the mounting paper suggests that the collector was a wealthy person with great interest in botany. The watermark analysis revealed that the paper was produced locally in Amalfi, most likely between 1576 and 1616. That period represents a time of great productivity of Ferrante Imperato whose activities during these years are documented by his exchange of material and information with many other European scientists of his time (Imperato, 1599; Stendardo, 2001).

Currently, approximately 1,000 surviving Cirillo specimens are stored at PORUN (De Natale, 2007), in addition to Imperato's herbarium volume stored at the National Library in Naples and several manuscripts and unpublished plates. All this material, which had survived a series of unfortunate events including family dispute, plague, and civil war, was donated by Cirillo to his closest friends and collaborators before his arrest. Following the restoration of the monarchy it was very dangerous to keep objects that had belonged to revolutionaries (De Lorenzo, no date; Colletta, 1852; De Nicola, 1906; Albanese, 2004). Probably, Cirillo's material had to be well hidden among the personal collections of Briganti and Petagna and this may have been the reason for the loss of many specimen labels.

More of Cirillo's material may be found at PORUN based on the ongoing digitization efforts. Currently, his collection includes only vascular plants from Europe, with a good representation across plant diversity. Several types and potential types are present, many of which are still accepted names with the original binomen given by Cirillo, such as in *Allium neapolitanum* Cirillo, *Allium trifoliatum* Cirillo and *Lycopsis bullata* Cirillo. Others are now synonyms, e.g., *Allium ciliatum* Cirillo, *Allium speciosum* Cirillo, *Daphne australis* Cirillo, *Imperata arundinacea* Cirillo, *Ornithogalum montanum* Cirillo ex Ten. and *Scabiosa crenata* Cirillo

In some cases, reconstructing the past can be just as challenging as forecasting the future. The lack of available data and the mystery still surrounding the life and historical collections of Imperato and Cirillo, who helped to shape botanical research in Italy during their times, motivated us to explore an integrated approach that allowed to generate valuable hypotheses on concealed herbarium material of unknown provenance. Although some of our results may not seem compelling, our overall methodology allowed us to interpret our findings in a more general historical and scientific context. We hope that current digitization efforts at PORUN will bring a renewed interest in the preservation of these precious historical herbarium materials, among the oldest available in Europe.

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