

Brehe's Herbarium: Botanical Knowledge and Plague Therapy in the Late Sixteenth Century

JARMILA SKRUŽNÁ^{*,1,6,7} , LUCIE STRNADOVÁ^{1,8} , ADÉLA POKORNÁ^{1,2,4} ,
SYLVA DOBALOVÁ^{1,3} , JAN KAHUDA^{1,5} , AND JIŘÍ HADINEC^{1,4}

¹ National Museum of Agriculture, Kostelní 1300/44, 170 00 Prague 7, Czech Republic

² Institute of Archaeology of the Czech Academy of Sciences, Letenská 4, 118 01 Prague 1, Czech Republic

³ Czech Academy of Sciences, Institute of Art History, Husova 4, 110 00 Prague 1, Czech Republic

⁴ Department of Botany, Faculty of Science, Charles University, Benátská 2, 128 00 Prague 2, Czech Republic

⁵ National Archives, Archivní 2257/4, 149 00 Prague 4 – Chodovec, Czech Republic

⁶ Faculty of Science, University of South Bohemia in České Budějovice, Branišovská 1760, 370 05 České Budějovice, Czech Republic

⁷ Prague Botanical Garden, Trojská 800/196, 170 00 Prague 7, Czech Republic

⁸ Department of Philosophy and History of Science, Faculty of Science, Charles University, Viničná 7, 128 00 Prague 2, Czech Republic

*Corresponding author; e-mail: jarmila.skruzna@botanicka.cz

Abstract: This study examines the herbarium manuscript of Johann Brehe of Überlingen (1595), preserved at the Museum of the Broumov Region (Broumov, Czech Republic). The herbarium contains 358 dried plant specimens accompanied by watercolor illustrations and extensive German textual annotations. In this respect, the manuscript is exceptional, as few other sixteenth-century herbaria include texts beyond the plant names, and only a small number of them have been studied in a comparable depth. We analyze the textual component to identify Brehe's sources and situate the herbarium within the broader cultural and medical context of the Lake Constance (Bodensee) region, a center of pharmacy, monastic medicine, and care of the sick. Comparative analysis demonstrates that Brehe drew primarily on Adam Lonitzer's *Kreuterbuch* (1582), adapting it for the needs of his barber-surgeon practice. We further examine the texts associated with 38 plant species recommended for plague treatment. The study highlights the dynamic relationship between botanical knowledge and medicine in the late sixteenth century, offering insights into European ethnobotany and the transmission of medicinal knowledge across textual, material, and social contexts. The manuscript also demonstrates how plant preservation was integrated into medical practice outside the university milieu and embedded in late sixteenth-century book culture.

Keywords: Historical ethnobotany, Book herbarium, Medicinal plants, Plague, Johann Brehe, Adam Lonitzer

Introduction

Received: 3 December 2025; accepted: 7 April 2026; published online _____

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s12231-026-09678-0>.

The oldest book-herbarium currently preserved in the Czech Republic is kept in the Museum of the Broumov Region, located in the Baroque complex of the Benedictine Abbey of St. Wenceslas in Broumov. According to the title page, the herbarium

was compiled in 1595 by Johannes Brehe (fl. from 1589, d. 1613), a barber from Überlingen, a town on the shores of Lake Constance (Bodensee) in Baden-Württemberg, southwestern Germany. The manuscript contains 358 dried plant specimens, each accompanied by a contemporary Latin and German name; most folios bear handwritten German texts, and in some cases watercolor illustrations (Maiwald 1937; Novák et al. 2025; Skružná et al. 2022, 2024). The entire volume is written in a single consistent hand. Its technical execution is precise. Plant specimens were mounted using isinglass, a substance made from fish swim bladders. The book was prepared in advance for gluing dried plants, as evidenced by its special binding, which allowed the spine to compensate for the increased bulk of inserted plant material. A full leather binding with wooden boards and metal fittings would have been costly, suggesting the commissioner's considerable financial standing. X-ray fluorescence analysis identified a conventional range of pigments, including malachite, cinnabar, smalt, and brown earth. The gold elements of the text and images are executed in shell gold. The handmade paper bears a watermark depicting a glove with a double cuff surmounted by a flower of six or seven petals (Brehe 1595:21,23; Slovák 2025). A watermark depicting a seven-petaled flower is also recorded for two additional documents originating from Überlingen and dated to 1592 and 1599 (Piccard-Online n.d., ref. nos. DE4215-PO-156010 and DE8085-PO-156009). The herbarium has recently undergone restoration and digitization.

The preservation of plants in herbaria emerged in the sixteenth century, driven by the enthusiasm of Renaissance naturalists and coinciding with the rise of natural history as a distinct discipline. Its aim was to review ancient writings, compare classical names with living plants, and collect, identify, preserve, and catalog the natural world (Cooper 2007; Ogilvie 2006). Herbaria became an important tool in this endeavor. The earliest such collections are known from the Italian universities of Pisa and Bologna (Baldini et al. 2022; Buldrini et al. 2026; Cristofolini 2024) and later from Padua (Cappelletti and Savoia 2011) and served as research and educational tools for scholars and students. Moreover, they came to serve various functions during the sixteenth century, including as prestigious gifts dedicated to patrons, as exemplified by the Italian *En Tibi* herbarium, now kept in Leiden

(Stefanaki et al. 2018, 2019). They might also include exotic species from distant regions, as in the case of the German naturalist Leonhart Rauwolf, whose herbarium documented flora of the Near and Middle East (Ghorbani et al. 2018; Walter et al. 2022). They were also explicitly connected with medicine, as some were produced directly by physicians or apothecaries, as exemplified by the oldest known dried plant collection from the Low Countries, compiled by the apothecary Petrus Cadé (Christenhusz 2004). The creation of herbaria can also be considered a lucrative activity, as exemplified by the herbaria produced by the German author Hieronymus Harder and his family (Dobras 2013). Besides, many of these functions overlapped.

Renaissance herbaria typically contained mounted, pressed, and dried plants accompanied by their pre-Linnaean Latin and sometimes vernacular names. A conspectus of historic herbaria (Thijsse 2023) shows that extended texts beyond plant names were rare. For example, the herbarium of 1545–1554, preserved in the Royal Library at San Lorenzo de El Escorial, Spain, includes medical texts only in connection with 45 specimens out of 1000 (Aedo and Velayos 2024; Andretta and Pardo-Tomás 2020; Carrión 2019). Likewise, one volume of Leonhart Rauwolf's herbarium (compiled 1560–1577) contains information on the local uses of various Near and Middle Eastern plants (Ghorbani et al. 2018; Walter et al. 2022). The German physician Caspar Ratzenberger also added Latin notes to some plants in his herbarium from 1598, mostly taxonomic and morphological remarks (Schaffrath 2012; Zahn 1902). Shorter comments from a botanical perspective also appeared in the herbaria of Hieronymus Harder, but only sporadically. Compared to the abovementioned contemporary works, Brehe's herbarium is exceptional for its time due to the scope of the accompanying texts (Skružná et al. 2022). It represents a rare manuscript combining the new technique of preserving plants with classical medical texts. The present study analyzes the textual content of Brehe's herbarium, which has not previously been examined in detail.

Any analysis of Brehe's herbarium must start from the fact that healing and medical practice were deeply rooted in Überlingen. His herbarium should be read as the product of developments unfolding over centuries rather than as an isolated individual endeavor. On the opposite

shore of Lake Constance stood two Benedictine monasteries, Reichenau and St. Gallen, both renowned for their medicinal gardens and expertise in healing and the preparation of herbal remedies (Burrige 2024). These centers produced some of the earliest European writings on gardens: the *Liber de cultura horticorum* by the abbot of Reichenau, Walahfrid Strabo (Strabo 1966), and the Plan of St. Gall ca. 825 an idealized drawing of a Benedictine monastery (Cantale et al. 2016), both from the ninth century. Knowledge circulated between towns, monasteries, and emerging universities, and medical practice gradually shifted from monastic contexts to university-educated physicians or was placed in the hands of specialized guilds.

In the sixteenth century, Überlingen was an important Catholic town, serving as a commercial center and a port. The pharmacies founded at the end of the fifteenth century and during the sixteenth century in this and various other towns around Lake Constance are among the oldest in Germany (Munck 1951). The region also occupied a leading position in the regulation of the apothecary system, the separation of the professions between physicians and apothecaries, the apothecaries' oath, and apothecary regulations (Munck 1951:23). Überlingen at that time was not a large town, it had around 3000 inhabitants. Around the turn of the sixteenth century, it nevertheless had two hospitals, one designated for plague patients and a leprosarium. In addition, in 1553 and 1555, archival sources mention other facilities for smallpox patients (Kinzelbach 2023; Munck 1951:32–33).

Johann Brehe came from a prominent burgher family in Überlingen. He began his career as a barber. The occupation of barber or “Balbier,” as Brehe styled himself in the preface to his herbarium, was closely related to that of a surgeon; for a long time, both belonged to the same guild, and the boundaries between them were fluid (Kinzelbach 2023; Kinzelbach and Wieser 2023). Barbering, however, meant a permanent trade, an official position that was inherited and ensured a regular income, whereas surgical interventions were typically occasional. During epidemics, prohibitions and regulations concerning the practice of medicine, otherwise carefully monitored and regulated by the town council, were pragmatically relaxed (Munck 1951:34). In Überlingen,

the mayor and town council promoted not only university-trained physicians, but also a range of healers characteristic of premodern medical care (Häberlein 2010); Kinzelbach 2023:25).

Brehe became the son-in-law of Hieronymus Harder of Ulm (1523–1607), a schoolmaster and amateur naturalist who personally compiled at least twelve book herbaria, the earliest of which dates to 1562 (for a complete list, see Dobras 2013). Brehe married Harder's eldest daughter Margarita in Ulm in 1589 (Schwimmer 1941:25). It is likely that Harder respected his son-in-law, as he dedicated his personal handbook herbarium, compiled before 1594, to him (Zimmermann 1940:8). Brehe was previously known only from a mention in a herbarium produced in 1594 by another citizen of Überlingen, the apothecary Johann Jakob Han (Han 1594), acknowledging Harder's influence and suggesting that he learned the technique from Brehe (Dobras 1969, 2013:142; Zimmermann 1940). In 1610, fifteen years after the compilation of his herbarium, Brehe was officially appointed a city barber–surgeon involved in the care of plague sufferers (Kinzelbach 2023:257). Likewise, Brehe's son, of the same name, served as a city surgeon, as documented by the handwritten note behind the dedication of the abovementioned Harder's handbook (Dobras 1969; Harder 1594). The herbarium then passed to Brehe's grandson, again of the same name, whose graduation as a physician in Padua in 1639 marked a significant rise in the family's professional status (Knod 1901). It was only in this third generation that medical education in the family reached the level of a university degree. Brehe's herbarium thus sheds light on the practical routines of non-university medical care as implemented by a hands-on practitioner.

We pursue four main objectives. First, we analyze the textual component of the herbarium to identify Brehe's sources and assess the originality of his entries. Second, we discuss the author's possible motivations for compiling the herbarium. Third, we compare Brehe's notes on the medicinal use of plants against plague with those found in his sources. Finally, focusing on these plants, we analyze the herbarium's preserved specimens in relation to current plant nomenclature and their native or introduced status.

Methods

The principal source of information for this study was the transcription and translation of the herbarium's texts, i.e., the plant names and all accompanying notes on the individual folios (sheets). The main basis for transcription was a photographic record of the herbarium, taken during an initial inspection in 2018 at the Museum of the Broumov Region (camera: Canon PowerShot G7X Mark II; resolution 4864 × 3648). The aim was to minimise further handling of the volume. Additional detailed photographs were taken where necessary. Where legibility was poor, especially in passages written in red ink, or in segments faded by moisture or stained, the texts were photographed (iPhone 15, 48 MP) under UV-A light and digitally enhanced for contrast. The texts were transcribed and the passages written in regional German were rendered into a preliminary Czech translation.

In analyzing Brehe's texts, we compared selected passages with contemporary printed herbals (Arber 1912; Nissen 1951–1966) that would likely have been accessible to Brehe: Leonhart Fuchs's herbal (Fuchs 1543), Hieronymus Bock's herbal (Bock 1551), Tabernaemontanus' herbal (Tabernaemontanus 1588, 1591), and Adam Lonitzer's herbal (Lonitzer 1582). Digital copies from the Bavarian State Library and the Regensburg State Library were consulted. In the digital herbals, we identified the relevant plant chapters by the German name given in Brehe's herbarium and then compared the medical texts written by Brehe with the herbal entries. If a plant could not be found under its German name, we searched for it under its pre-Linnaean Latin name. We also compared Brehe's texts with Harder's manuscript herbarium (1576–1594), now held at the Bavarian State Library. Among the surviving Harder herbaria, this one contains the largest number of notes, and it is also available online via the Library's digital collections.

Afterwards, we selected a thematically limited group of plants associated with plague treatment as a case study, since the disease is clearly identifiable in the manuscript and, at the same time, had a significant impact on the life of its compiler. Within Brehe's herbarium, we identified occurrences of the term "Bestilenz" (plague) through a systematic search of the transcribed

text and verified each occurrence against the manuscript. For each taxon (or group of taxa), we examined the accompanying text, extracting the following information (if present): the plant's nature according to contemporary Galenic classification (Nutton 1993); other diseases mentioned; the plant part employed medicinally; the method and season of the plant's collection, preparation of the remedy, combinations with other substances, mode of application, and dosage.

To supplement our understanding of the context and Brehe's motivation and to refine our interpretation of the botanical and textual data, we also examined additional materials: reports on the conservation process of Brehe's herbarium (Slovik 2025), of Han's herbarium (Dürr 2003), and of two Harder herbaria (Rauch-Ernst 2005; unpublished restoration report, Städtisches Museum Überlingen). We also consulted additional local publications during our field research in the Lake Constance region in 2024 and personally examined Han's herbarium (Städtisches Museum Überlingen) and three Harder herbaria (Städtisches Museum Überlingen; Ehemals Reichsstädtische Bibliothek und Bibliotheksmuseum Lindau; Stadtarchiv Ulm).

In most cases, we identified the plant taxa of Brehe's herbarium on the basis of digital photographs. Where necessary, additional details were obtained using a Leica S6D stereomicroscope with accessories and a Canon 600D DSLR, as well as an Apexel 24× macro lens for a mobile phone. Some specimens were examined in situ to verify color or the indumentum of the leaves and calyx, not visible in the photographs. Based on current distribution ranges of the taxa, we estimated whether the taxa were native to the Lake Constance region or whether they were cultivated or imported. Our identifications were based on standard floristic and taxonomic literature (Aeschimann et al. 2004; Dörfler and Roselt 1988; Kaplan et al. 2019; Müller et al. 2021). References to folios are given with r (recto) and v (verso).

Results

In his herbarium, Brehe addresses the treatment of various diseases: from ulcers, wounds, poisonings, and sleep disorders, through

diseases of individual organs or systems, children's diseases, and gynecological complaints, to toothache, earache, and, for example, fevers or chills. In addition, the author mentions, on three folios, cultivation of certain plants just for pleasure (01r, 21v_a, 34v_a). Also, culinary use is recorded on eleven folios (25v, 36r_c, 37v, 53r, 58v, 59r, 62v, 63r, 68v, 85r, 89r). Besides, the herbarium includes uses of plants in veterinary practice (on ten folios: 15r, 35r, 38v, 42r, 53r, 66r, 76v, 83r, 85v, 92r). Of the 358 plant specimens in the herbarium, medicinal uses are specified for all but 27 specimens (7.5%). On fourteen folios, the author states that the relevant plants are not used in medicine. The predominance of references to external applications, documented for 156 plants on 102 pages, corresponds to treatments of wounds, stings, and plague buboes, traditionally associated with barber-surgical practice. In several cases, Brehe also specifies the preparation of ointments, poultices, plasters, and baths.

From the entire corpus of recorded diseases, we selected, for a deeper analysis, texts referring to the treatment of plague. The term "Bestilenz"

was identified on 23 pages out of the 190 text-bearing pages (Fig. 1). Transcriptions and translations of the relevant plague-related passages are presented in the Electronic Supplementary Material (ESM) 1, using the original plant names as recorded in the herbarium; current taxonomic identifications are given in ESM 2. In total, 38 plants are associated with plague treatment.

For these entries, we then looked for more general trends, such as the basis on which Brehe grouped the plants. In the group of gentians (4r, 4v, and 5r), four plants of similar morphology are mounted across three consecutive pages, although they do not necessarily have the same medical properties. The caption states: "There are four kinds listed above, but not all are used in medicine. The first is the best and is widely employed in medicine; the two in the middle may be used medicinally. If others are not available, they may substitute for one another." According to current taxonomy, they correspond to species of three genera: *Gentiana lutea* L., *Gentiana pneumonanthe* L., *Gentianopsis ciliata* (L.) Ma, and *Gentianella* cf. *aspera* Hegetschw.



Fig. 1. Detail of the text on 72r in Brehe's herbarium, showing the term 'Bestilenz' (plague), highlighted with a red circle. The text is written in German Neo-Gothic cursive with occasional ornamental embellishment

A frequent arrangement places two plants side by side which, according to the text, have the same effect but not entirely similar morphology. These pairs are either treated as congeneric in contemporary terms (12r and 54r) or labeled as male and female forms of one species (15v, 25r, and 39r), although current taxonomy distinguishes them as separate taxa. For example, on folio 25r there are three plants, all designated ‘Anagallis’, distinguished primarily by flower color: *Anagallis foemina* Mill./*Anagallis coerulea* Schreb. (‘das Weible’) with blue flowers; *Lysimachia nemorum* L. (‘das Edel’) with yellow flowers; and *Anagallis arvensis* L. (‘das Mendle’) with red flowers. The caption partly addresses them collectively but also attributes specific effects according to flower color, for example associating red blossoms with promoting blood circulation. In some cases, plants were associated with each other based on a very specific characteristic, for example, a resemblance to a snake. On folio 33v, two morphologically dissimilar and taxonomically unrelated plants are mounted: *Polygonum bistorta* L. and *Ophioglossum vulgatum* L. Both share their vernacular name the word ‘Nater’ (adder, viper), and the page is supplemented with an image of two green snakes, one crawling and the other coiled. The herbarium also contains one case of a botanical chimera. In the specimen labeled “Beifolium/Zway Blat,” the inflorescence is *Orthilia secunda* (L.) House, whereas the leaves belong to *Listera ovata* (L.) R. Br. These taxa belong to different families, Ericaceae and Orchidaceae, respectively. It remains unclear whether this combination originated with the compiler or resulted from a later conservation intervention.

The example of “Marvbivm” (folio 96r) shows that Brehe also considered the ecological demands of plants. There are three plants on folio 96r, but the caption comments on four. Although they are all labeled “Marvbivm/Andorn,” they belong to different genera within the Lamiaceae family. The “noble” one (‘der Edel’) is cf. *Stachys germanica* L.; the “white” one (‘der Weiss’) is *Marrubium vulgare* L.; and the “black” one (‘der Schwartz’) is *Ballota nigra* L. The caption on this page also mentions a fourth, designated the “water” one (‘der Wasser’), namely, *Lycopus europaeus* L., which is placed elsewhere in the herbarium (70r). After mentioning that the “Edel Andorn” is considered

the best one against cough, there is text that refers to all four plants on folio 96r. By contrast, in the note referring to “Marvbivm Aquaticum/Wasser Andorn” (*L. europaeus*) on the folio 70r, it is stated that the white Marvbivm is the best one, but it is apparently assumed that if the best plant is missing, then the others may serve as its substitutes. *Lycopus europaeus* is separated from the other members of the same group and placed among aquatic plants. This shows that Brehe preferred to arrange the plants according to habitat rather than morphology or medicinal effect. Nevertheless, the aquatic “Marvbivm” is considered an effective plant for the treatment of plague.

Brehe usually specifies the plant part used medicinally, such as the root (05r, 15r, 33v, 39r, 48v, 56r, and 101r) or the leaves (52v and 96r). The recipes list additional ingredients (most often wine, but also chicory water, vinegar, etc.) and describe methods of preparation (powder, distilled/“burnt” water, and boiling/decoction). He also employs volumetric (for example, hand-ful and spoonful) and weight measures, including uncia (“Lot”) and drachma (“Kvintel”), the latter traditionally defined by the weight of a single white peppercorn. Internal administration is more common, but external application also occurs, for example, through the application of leaves (52v). The most common effects mentioned include profuse sweating immediately after administration of the remedy (15v, 25r, 33v, and 54r).

Several species of *Gentiana* Tourn. ex L./*Gentianella* Moench (04r-05r) are listed among the most effective plants against plague and are even cited as being used as ingredients of theriac. Two additional plants are prescribed in combination with theriac (33v and 86v) (Fig. 2). In one case, repeated administration is recommended (75v). An antiplague effect is often mentioned together with an antipoison effect. Additional actions attributed to plague plants include benefits against jaundice, abdominal pain, wounds, and nosebleeds, among other ailments. In some cases, the text merely states that a plant is good against plague or drives the plague away (12r, 24v, 38v, and 72r). An interesting case is *Petasites* cf. *albus* (L.) Gaertn., “Bestilencz Wurtz” (98r) (Fig. 3). Here, the disease name appears directly in the plant’s vernacular name (“plague root”), yet the accompanying note does not

Fig. 2. On 86v, two plants are shown. The text is structured in two columns, each dedicated to a single plant species. Only the plant on the right, a fragment of sorrel (*Rumex cf. acetosa*), belongs among the plants recommended against plague



explicitly refer to plague therapy but instead notes an antidotal effect and application to festering wounds.

Based on a focused analysis of selected plague-related texts, we found that Brehe primarily derived his texts from Adam Lonitzer's herbal, even though Lonitzer's name was never explicitly cited. All plants that Brehe mentions as anti-plague treatments are also associated with plague remedies by Lonitzer. In most cases, the texts of both authors agree verbatim. Minor differences occur rarely, mainly in connection with word order, transcription, or synonym usage, for example, in the interchange of "Kopf" and "Haupt," both meaning "head." In order to locate all plague-related passages in Lonitzer,

we conducted a reverse comparison, using the herbal's index. Through this cross-check, we found that Lonitzer listed only a few additional anti-plague plants that Brehe did not include in his herbarium, for example, fig, walnut, and hemp. Among the plants found in both authors, there is only one case where Lonitzer recommends a plant against plague, but Brehe does not record the same effect: *Arum maculatum* L. (Brehe 1595:5v; Lonitzer 1582:231v).

Since the space available in Brehe's manuscript was limited compared to printed herbals, it is not surprising that he is more concise and restricts himself to a narrower selection of information from his source. In several cases, Lonitzer gives additional antiplague recipes

Fig. 3. Coltsfoot (*Tussilago farfara* L.) in the Brehe herbarium (52v). The left leaf is mounted with the abaxial surface exposed, highlighting the tomentose underside and demonstrating the compiler's attention to morphological detail



associated with a given plant that Brehe does not include. This is especially conspicuous for two taxa: *Cnicus benedictus* L. (50v) and *Angelica officinalis* (75v). The greater part of Brehe's note under *Cnicus benedictus* corresponds to Lonitzer's text, except for Brehe's closing remark: "It is used for many things, as is generally known." By contrast, Lonitzer discusses plague in considerably greater detail (Lonitzer 1582:100v), noting, for example, that the crushed herb should be applied to plague buboes. He further recommends mixing the powder with vinegar and flour to prepare a sticking plaster for application to the buboes. Moreover, all documented anti-plague species were associated with numerous complaints by Lonitzer, typically with 10–15 ailments, up to 35 (Lonitzer 1582:173r). From these, Brehe typically chose only three, at most six. This is likely

constrained by the limited space allotted to the manuscript text, yet the pattern of selection is revealing. The most frequently selected indications are poisoning (eight cases) and wounds or the staunching of bleeding (five cases), followed by dog bites, jaundice, and dropsy (two cases each). Other uses drawn by Brehe from Lonitzer include abdominal pain, headache, chest pain, nosebleed, toothache, kidney stones, "worms in the belly" ('Wurm im Bauch'), and "women's time" ('Frauenzeit').

We also compared several entries unrelated to the plague in order to better understand Brehe's approach to his source and to the construction of the text, particularly those entries containing personal and place names. Where other authorities are cited in Brehe herbarium, the wording is always reproduced verbatim from Lonitzer; these authorities include Pliny and Dioscorides

(13v) as well as Matthias Lobel (78v). By contrast, the information about the persons or places from which Brehe obtained the plant specimens constitutes his original contribution (87r and 79r). At several points, Brehe even added new plants (25v, 32r, and 67v) that he could not equate with any item in Lonitzer's book. For these newly added plants, Brehe usually did not mention any medicinal uses.

Not only did Brehe draw texts from Lonitzer's printed herbal, but within the plague-related subset of entries he also adopted Lonitzer's visual motifs. For example, drawings of a cat (Fig. 4), a weasel, and snakes, associated with *Valeriana* L. (54r), *Ruta* L. (72r), and *Bistorta* (L.) Scop./*Ophioglossum* L. (33v), respectively, correspond to animal figures found in Lonitzer's work. Brehe's rendering of the weasel with *Ruta* likewise follows the printed model, though with minor variations (Fig. 5). Whereas in Lonitzer's book these animal figures occur in separate sections and are not integrated into the botanical woodcuts of the respective plant entries, in Brehe's manuscript herbarium, the same motifs are visually associated with the mounted plant specimens on the same folios. In each case, the animal corresponds either to the plant's vernacular name, ecological context, or attributed properties.

Discussion

Two herbaria were completed in Überlingen at roughly the same time, Brehe's and that of Johann Jakob Han. Hieronymus Harder also finished in Ulm some of his herbaria in that period. All these herbaria display, in terms of their dried specimens, a number of shared features, suggesting that the two Überlingen authors, in particular, were in mutual communication (Skružná et al. 2022). Both buildings, the Han pharmacy and the hospital where Brehe worked, are still standing in close proximity on the same street. Surprisingly, it was the barber Brehe, rather than the apothecary Han, who systematically supplements each plant entry with medical information, pointing to his therapeutic focus as well as to the permeability of disciplinary boundaries in Überlingen.

While certain of Harder's herbaria also contain texts, these are far less extensive and differ

from those of Brehe. The largest number of texts is found in Harder's herbarium preserved in Munich, Germany (Dobras 2013; Harder 1576–1594). Although Harder also occasionally provided some medical information, the primary motive for his interest in plants does not appear to have been their medical uses. For example, in his description of the pasqueflower (3r), Harder writes: "I have never used this herb and flower other than gathering it for my pleasure and later inserting it into my herbaria" (Harder 1576–1594; Schinnerl 1912). For many records, Harder also noted places and times of their findings, which points to his interest in the distribution of plants and their phenology. Hieronymus Harder had a more botanical and, as a teacher at the Latin school, likely also pedagogical motivation than Brehe, as indicated in the preface to his Vatican herbarium (Harder 1574; Skružná et al. 2022). Harder also envisaged his herbaria as field aids for plant identification (Dreher 1986).

The production of herbaria within the Harder family circle was probably an important source of income: the books were produced for patrons and also served as gifts. Brehe compiled his herbarium with the support of the Habsburg court in Meersburg (Skružná et al. 2022). We also considered the possibility that Brehe's herbarium functioned as a vehicle of self-presentation intended to advance his position within existing professional and social hierarchies. Brehe strives to make his herbarium look learned, visually akin to professional prints. The title page corresponds to this ambition, though compared, for example, with the herbarium of Han, it remains somewhat amateurish. Han's book shows greater practical familiarity with books: the decorative initial K is carefully traced from printed herbals, and the color scheme of the page, unlike Brehe's title page, follows a clear internal logic (Fig. 6). In the plant entries, Brehe employs rubrication: passages written in black ink are interspersed with red letters or words. This tradition goes back to the Middle Ages, when red or blue script aided navigation in texts that did not yet use headings, paragraphs, or punctuation (Brown 1994). In many places, the use of rubrication is purely decorative.

By contrast, Brehe's handling of the specimens displays expertise, care, and dexterity. The dried, pressed plants were pasted into the herbarium over their entire surface with isinglass,



Fig. 4. (A) Cat with valerian (*Valeriana officinalis* L.) in Brehe herbarium (54r). The accompanying note reads: "They turn their faces to it (rub their faces on it)." (B) Cat traced from the printed herbarium of Adam Lonitzer. Lonitzer's depiction served as a model for Brehe's rendering on folio 54r

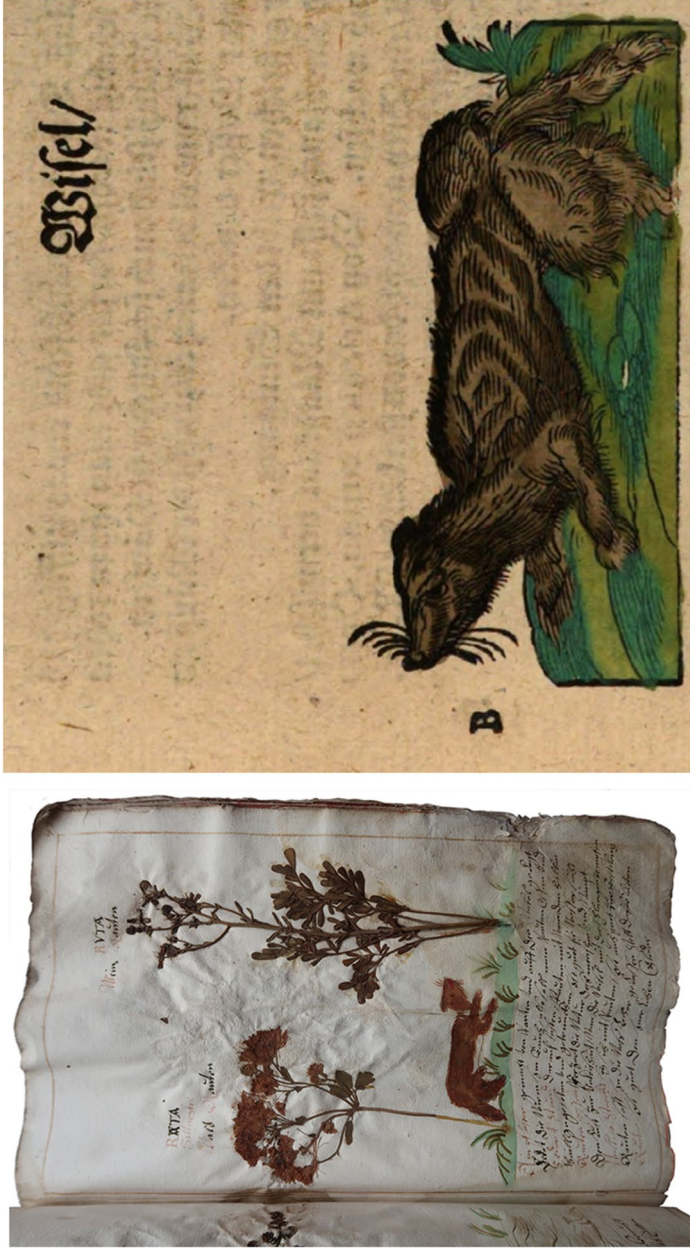


Fig. 5. (A) Rue (*Ruta graveolens* L.) with a weasel in the Brehe herbarium (72r). (B) Woodcut of a weasel in Adam Lonitzer's *Kreuterbuch* (1582). The figure corresponds to the model adopted in Brehe's manuscript (cf. 72r)



Fig. 6. Title pages of Lonitzer's, Han's, and Brehe's herbaria

and there are no swellings or glue drips around the specimens (Novák et al. 2025; Slovík 2025). Thanks to this method, the plants have survived in good condition for more than 400 years. Taken together, these factors suggest that Brehe's herbarium was simultaneously a therapeutic tool, a marker of professional identity, and a means of social positioning.

As noted above, Brehe's textual component is unique even within Harder's circle. He chose the then very popular herbal by Adam Lonitzer as his source of texts. To understand the nature of Lonitzer's work and its influence on the phrasing in Brehe's herbarium, we must look back to the first half of the sixteenth century. In 1533, the Frankfurt printer Christian Egenolff (1502–1555) produced a compilation of late fifteenth-century German medical texts and added to them a series of botanical woodcuts. These woodcuts were not original; most were taken from Otto Brunfels' herbal (Brunfels 1530). The derivative character of the texts and the plagiarized illustrations were a thorn in the side of many contemporaneous authors and publishers. Brunfels' Strasbourg publisher Johannes Schott even litigated against Egenolff in what is often considered one of the earliest copyright disputes in scientific illustration (see Kusakawa 2012). Leonhart Fuchs, in the preface to his own herbal, wrote: "Of all the herbals produced to date, none is burdened with so many foolish errors as those which the printer Egenolff brings out again and again" (see Neville 2021). This did not deter Egenolff, as the herbal continued to appear and was extremely popular in its day. The woodcuts were skilfully executed, and the book was available to readers at a relatively low price. The most famous editions became those edited by Egenolff's son-in-law, Adam Lonitzer, who later inherited the entire Frankfurt publishing house (Anderson 1977; Arber 1912). Lonitzer's herbal is thus a compilation of German medical texts from the late fifteenth century, repeatedly copied and reworked (esp. Cuba 1487, see ESM 3). First published in 1557, it appeared in numerous editions (Habermann 2001). Brehe builds on this long-standing tradition yet renders it in a wholly new form by embodying it within his herbarium of dried plants. His originality therefore lies not in the creation of new medical doctrines but in the selective adaptation and practical embedding of inherited textual knowledge within the

materially innovative medium of a *hortus siccus*. Brehe's reliance on Lonitzer does not represent a lack of originality but rather constitutes a characteristic mode of knowledge transmission in sixteenth-century medicine.

The herbarium's medical orientation is firmly linked to Brehe's occupation as a barber-surgeon. One of the fatal diseases he encountered in his practice, and ultimately succumbed to, was the plague. During Brehe's lifetime, Überlingen experienced repeated plague outbreaks (1574–1635) (Eitel 1973; Munck 1951). Archival sources indicate that Brehe died of the plague in 1613 after extensive service to the community (Munck 1951:34). At the beginning of the early modern period, plague was a highly topical concern, with far-reaching social, economic, and political consequences. The cause of plague, as defined today, is the bacterium *Yersinia pestis*. In the early modern period, the term "plague" was also applied to other rapidly spreading diseases characterized by high mortality. The cause of plague remained unclear until the early nineteenth century (Carmichael 1998). Many eminent physicians authored anti-plague tracts containing recommendations on prevention and treatment (Černý 2013, 2020; Lonitzer 1616:3r). Laypersons also engaged with antiplague measures (Dryáková 2006). Measures also included dietary recommendations, reflecting blurred boundaries between dietetic and pharmacological practices (Duranti 2024:141).

Wild or locally cultivated plants were advantageous compared to the popular remedies theriac and mithridatum, which often contained dozens of ingredients and required costly, complex production because they were more readily available and less expensive, particularly when trade in medicinal substances was disrupted by epidemics (Henderson 2019; Raj 2021). The sixteenth century also saw a rise in purely botanical interest in the local flora (cf. Cooper 2007), which intersected with, but did not replace, therapeutic concerns. Likewise, the plants recommended against plague by Brehe could be obtained locally. With the exception of theriac, the herbarium makes no reference to exotic *materia medica* or complex imported preparations. The manuscript thus brings together Brehe's personal experience of plague with his knowledge of regional flora.

Several specimens were damaged; in some cases, only fragments or imprints of the original plant material remained, preventing precise identification. A further limitation was reduced legibility of the text, resulting from damage to individual folios caused by inadequate storage conditions and from the fading of passages written in red ink. The present translation must therefore be regarded as preliminary. Nevertheless, the manuscript remains the principal source for reconstructing Brehe's intellectual profile. Historical herbals employed polynomial nomenclature, as they predate the gradual adoption of the binomial system following the publication of Linnaeus's *Species Plantarum* (1753). These works are therefore referred to as pre-Linnaean. Authors used plant names with considerable variability, and certain printed herbals functioned as de facto reference standards. It must thus be borne in mind that a plant now recognized under a single scientific name could have been designated differently by individual authors. In comparing Brehe's herbarium with printed herbals, we therefore examined contemporary plant names rather than biological taxa as currently defined. Moreover, although modern identifications of plants are available for some herbals, such as those of Hieronymus Bock (Hoppe 1969) or Pietro Andrea Mattioli (Mariotti 1997), no modern identification of the plant names in Lonitzer's herbal is available. These limitations introduce a degree of uncertainty into both taxonomic identification and textual comparison.

Conclusion

Textual analysis shows that Brehe drew extensively on Adam Lonitzer's herbal, yet worked with the material creatively: he selected passages in line with his professional experience, occasionally added his own notes, and commented on plant species not recorded by Lonitzer. We identified 38 plant species associated with plague treatment, for which Brehe recorded the plant parts, time of collection, and methods of preparation and application. The most frequent preparations were decoctions or mixtures with wine or theriac. Brehe's herbarium thus provides valuable evidence for contemporary phytotherapy.

Brehe's herbarium represents a unique conjunction of the new technique of preserving

plants with the late sixteenth-century medical practice outside the university milieu. This new technique, often associated with the emancipation of botany from medicine and with increased attention to plant morphology and diagnostic characters, is, in the case of Brehe's herbarium, once again bound to medicine, producing a work that in many respects resembles a printed Renaissance herbal. Brehe's manuscript is therefore a singular source for the transmission of medical knowledge and for material and visual culture in the history of science.

The herbarium also testifies that barbers possessed a wide-ranging knowledge and were able to combine learned literature with their own experience. The chosen approach to compiling the book points to a pragmatic adaptation of medical knowledge suitable for everyday practice. In this way, Brehe's herbarium enriches our understanding of the history of plague therapy, of the transfer of knowledge between learned and extra-university traditions, and of the social role of barbers in the Renaissance. The study also places Brehe's life and work within the broader cultural and medical context of the Lake Constance region. Local medical traditions, the presence of apothecaries and hospitals, and recurrent plague epidemics shaped his professional trajectory.

Further research will refine the botanical identification of the entire collection, drawing methodologically on similar historical herbarium studies, where the plants are identified according to current nomenclature (Buldrini 2026; Christenhusz 2004; Stefanaki et al. 2018). We also intend to examine more closely the relationship between the Habsburg court in Meersburg and its support for Brehe's compilation of the herbarium.

Acknowledgements

We are grateful to the Benedictine Archabbey of St. Adalbert and St. Margaret in Prague-Břevnov and to the Museum of the Broumov Region for making this research possible. We sincerely thank Marie-Kristin Hauke and Mareikje Mariak (Stadtarchiv Ulm), Marcus Breitwieser (Reichsstädtische Bibliothek und Bibliotheksmuseum Lindau), Peter Graubach (Städtisches Museum Überlingen), Dirk Munck (Münster-Apotheke Überlingen), and Radomír Slovík for their generous support and valuable expertise. We thank Karel Černý for consultation on the historical background of the plague. We are also grateful to Steve Ridgill for English language editing.

Author Contribution

Jarmila Skružná: Conceptualization and Design, Data Acquisition and Curation, Analysis, Writing–Original Draft, Supervision, Visualization, Project Administration, revision of the article in terms of content and form
Lucie Strnadová: Conceptualization and Design, Data Acquisition and Curation, Writing–Original Draft, Validation, Writing–Original Draft, revision of the article in terms of content and form
Adéla Pokorná: Conceptualization and Design, Data Acquisition and Curation, Writing–Review & Editing, Validation, Analysis; ESM review
Sylva Dobalová: Conceptualization and Design, Data Acquisition and Curation, Writing–Review & Editing, Validation, Analysis
Jan Kahuda: Data Acquisition and Curation, transcription and translation of German texts
Jiří Hadinec: Data Acquisition and Curation, classification of specimens according to current nomenclature.

Funding

This study is an output of the project DH-23P03OVV044, “History of the use and cultivation of medicinal plants as part of national and cultural identity”, which was supported by the Ministry of Culture of the Czech Republic within the framework of the program to support applied research in the field of national and cultural identity for 2023–2030 (“NAKI III”).

Data Availability

All data supporting the findings of this study are available within the paper and its Supplementary Information.

Declarations

Competing Interests The authors declare no competing interests.

References

- Aedo, C., and M. Velayos. 2024. Botanical catalogue of the Mendoza herbarium in the Real Biblioteca del Monasterio de San Lorenzo de El Escorial. *Anales del Jardín Botánico de Madrid* 81(2): e151. <https://doi.org/10.3989/ajbm.625>.
- Aeschimann, D., K. Lauber, D. M. Moser, and J.-P. Theurillat. 2004. *Flora alpina*. Bern: Haupt Verlag.
- Andretta, E., and J. Pardo-Tomás. 2020. Books, plants, herbaria: Diego Hurtado de Mendoza and his circle in Italy (1539–1554). *History of Science* 58: 3–27. <https://doi.org/10.1177/0073275319838891>.
- Anderson, F. J. 1977. *An illustrated history of herbals*. New York: Columbia University Press.
- Arber, A. 1912. *Herbals: their origin and evolution*. Cambridge: Cambridge University Press.
- Baldini, R. M., G. Cristofolini, and C. Aedo. 2022. The extant herbaria from the sixteenth century: a synopsis. *Webbia* 77: 23–33. <https://doi.org/10.36253/jopt-13038>.
- Bock, H. 1551. *Kreuterbuch*. Basel: Wendelin Rihel. <https://daten.digitale-sammlungen.de/~db/0009/bsb00091270/images/>. Accessed 3 Nov 2025.
- Brehe, J. 1595. *Kreüter Büoch*. Manuscript. Broumov, Czech Republic: Museum of the Broumov Region.
- Brunfels, O. 1530. *Herbarum vivae eicones*. Strassburg: Johann Schott.
- Brown, M. P. 1994. *Understanding illuminated manuscripts: A guide to technical terms*. London: The J. Paul Getty Museum in association with the British Library.
- Buldrini, F., A. Paolini, and G. Cristofolini. 2026. New light on a so far neglected heirloom of sixteenth century botany. *Rendiconti Lincei. Scienze Fisiche e Naturali*. <https://doi.org/10.1007/s12210-026-01408-x>.
- Burrige, C. 2024. Setting the scene. In: *Carolingian medical knowledge and practice, c.775–900: New approaches to recipe literature*, eds. M. Beretta, and S. Dupré, 37–64. Leiden: Brill.
- Cappelletti, E. M., and A. U. Savoia. 2011. Didactics in a botanic garden. Garden plans and botanical education in the ‘horto medicinale’ of Padua in the 16th century. In: *A Passion for plants. materia medica and botany in scientific networks from the 16th to the 18th centuries*, eds. S. Anagnostou, F. Egmond, and Ch. Friedrich, 79–92. Stuttgart: Wissenschaftliche Verlagsgesellschaft.
- Cantale, C., D. Cantone, M. Lupica Rinato, M. Nicolosi-Asmundo, D. F. Santamaria, and M. R. Stufano Melone. 2016. The ideal Benedictine monastery: From the Saint Gall map to ontologies. *Applied Ontology* 1(1): 1–5. <https://doi.org/10.3233/AO-210248>.
- Carmichael, A. G. 1998. The structure of plagues and pestilences in early modern Europe: Central Europe, 1560-1640. *Bulletin of the History of Medicine* 72(1): 110–111.

- Carrión, M. M. 2019. Planting dwelling thinking. Natural history and philosophy in sixteenth century European dried gardens. *Género y Literatura of Portugal* 6(1): 5–19. <https://doi.org/10.2478/glp-2019-0009>.
- Christenhusz, M. 2004. The hortus siccus (1566) of Petrus Cadé: a description of the oldest known collection of dried plants made in the Low Countries. *Archives of Natural History* 31(1): 30–43. <https://doi.org/10.3366/anh.2004.31.1.30>.
- Cooper, A. 2007. Inventing the indigenous: local knowledge and natural history in early modern Europe. Cambridge: Cambridge University Press.
- Cristofolini, G. 2024. Origin and evolution of herbaria in the sixteenth century. *Rendiconti Lincei. Scienze Fisiche e Naturali* 35(1): 63–75. <https://doi.org/10.1007/s12210-024-01232-1>.
- Cuba, J. von. 1487. *Gart der Gesundheit*. Ulm: Conrad Dinckmut. <https://www.digitale-sammlungen.de/de/view/bsb00048197?page=216,217&q=Die+wurzel+wirt+genutzt±> (28 June 2025).
- Černý, K. 2013. Magical and natural amulets in early modern plague treatises. *Sudhoff's Archiv* 97(1): 81–101. <https://doi.org/10.25162/SUDHOFF-2013-0005>.
- Černý, K. 2020. *Mor 1380–1730. Epidemie v lékařských traktátech raného novověku*. Prague: Karolinum.
- Dobras, W. 1969. Jakob Han und sein Herbarium aus dem Jahre 1594. *Pharmazeutische Zeitung* 43: 1614–1617.
- Dobras, W. 2013. Hieronymus Harder und seine zwölf Herbare. Montfort. *Zeitschrift für Geschichte Vorarlbergs* 2: 121–150.
- Dörfler, H. P., and G. Roselt. 1988. *Heilpflanzen gestern und heute*. Leipzig: Urania Verlag.
- Dreher, I. 1986. *Das Herbarium des Hieronymus Harder (1574–1576). Wissenschaftshistorische Untersuchung eines frühen Herbars als Informationsquelle zur Beurteilung von Autor und Werk*. Doctoral thesis. Munich: Technische Universität München.
- Dryáková, K. 2006. *Morové epidemie a svět, který zrodily. Rigorózní práce*. Prague: Univerzita Karlova.
- Duranti, S. 2024. The language of plague treatises in early modern Italy. *Medicina nei Secoli* 36(1): 117–146.
- Dürr, H. F. 2003. *Restaurierung. Kreutterbuch*. Museum Stadt Überlingen. Unpublished conservation report.
- Egmond, F. 2022. Plants and medicine. In: *A cultural history of plants*, eds. A. Dalby, and A. Giesecke, 117–136. London: Bloomsbury Publishing.
- Eitel, P. 1973. Studien zur Geschichte der Pest im Bodenseeraum unter besonderer Berücksichtigung der Konstanzer Pestepidemie von 1611. *Hegau* 29/30: 57–89.
- Fuchs, L. 1543. *New Kreuterbuch*. Basel: Michael Isingrin. <https://www.digitale-sammlungen.de/en/details/bsb00017437>. Accessed 28 June 2025.
- Ghorbani, A., J. J. Wieringa, H. J. de Boer, H. Porck, A. Kardinaal, and T. van Aniel. 2018. Botanical and floristic composition of the historical herbarium of Leonhard Rauwolf collected in the Near East (1573–1575). *Taxon* 67(3): 565–580.
- Habermann, M. 2001. *Deutsche Fachtexte der frühen Neuzeit: naturkundlich-medizinische Wissensvermittlung im Spannungsfeld von Latein und Volkssprache*. Berlin: Walter de Gruyter.
- Häberlein, M. 2010. Botanisches Wissen, ökonomischer Nutzen und sozialer Aufstieg im 16. Jahrhundert: Der Augsburgische Arzt und Orientreisende Leonhard Rauwolf. In: *Humanismus und Renaissance in Augsburg. Kulturgeschichte einer Stadt zwischen Spätmittelalter und Dreißigjährigem Krieg*, ed. G. M. Müller, 101–116. Berlin: De Gruyter.
- Han, J. J. 1594. *Kreutterbuch*. Museum Stadt Überlingen, Inv.-Nr. 1515. Überlingen.
- Harder, H. 1574. *Herbarium vivum*. Manuscript Pal.lat.1276. https://digi.vatlib.it/view/MSS_Pal.lat.1276. Accessed 28 June 2025.
- Harder, H. 1576–1594. *Herbarium vivum*. BSB Cod.icon. 3. <https://www.digitale-sammlungen.de/en/view/bsb00011834?page=4,5>. Accessed 28 June 2025.
- Henderson, J. 2019. *Florence Under Siege: Surviving Plague in an Early Modern City*. New Haven: Yale University Press. <https://doi.org/10.2307/j.ctvk8w059.6>.

- Hoppe, B. 1969. *Das Kräuterbuch des Hieronymus Bock*. Stuttgart: Hiersemann.
- Kaplan, Z., J. Danihelka, J. Chrtek Jr., J. Kirschner, K. Kubát, M. Štech, and J. Štěpánek, eds. 2019. *Klíč ke květeně České republiky*. 2nd ed. Prague: Academia.
- Kinzelbach, A. 2023. Nicht krank und hilflos. Gesundheit und Politik in der Reichsstadt Überlingen in der Vormoderne. In: *1250 Jahre Überlingen: eine Zeitreise vom Mittelalter bis zur Moderne*, ed. Stadt Überlingen, 248–262. Meßkirch: Gmeiner Verlag.
- Kinzelbach, A., and F. Wieser. 2023. A new concept of surgery in European hospitals? Records of practice in Germany, Italy, and Spain during the sixteenth and early seventeenth centuries. *NTM* 31(1): 27–49. <https://doi.org/10.1007/s00048-022-00342-1>.
- Knod, G. C. 1901. Oberrheinische Studenten im 16. und 17. Jahrhundert auf der Universität Padua. *Zeitschrift für die Geschichte des Oberrheins* 55(NF 16): 635. <https://archive.org/details/zeitschriftfrdi98unkngoog/page/n648/mode/2up>. Accessed 28 June 2025.
- Kusukawa, S. 2012. *Picturing the Book of Nature: Image, Text, and Argument in Sixteenth-Century Human Anatomy and Medical Botany*. Chicago: University of Chicago Press.
- Lonitzer, A. 1582. *Vollständiges Kräuterbuch oder Das Buch über alle drey Reiche der Natur*. Frankfurt: Egenolff. <https://www.digitale-sammlungen.de/en/view/bsb11200293?q=%28Lonitzer,+Adam%3A+Kreuterbuch%29&page=164,165>. Accessed 10 Sept 2025.
- Lonitzer, A. 1616. *Eigentlicher bericht Von Aderlassen in der zeit der Pestilentz: und von Cur der Pestilentz Drüsen, auch wie man sich in regierender Straff der Pestilentz halten soll*. Augsburg: Michelspacher. <https://diglib.hab.de/drucke/ip-45/start.htm>. Accessed 28 June 2025.
- Maiwald, V. 1937. Ein deutsches Herbar vom Jahre 1595 in Braunau. *Natur und Heimat* 8: 61–66.
- Mariotti, M. G. 1997. L'identificazione delle piante. In: *Pietro Andrea Mattioli (Siena 1501–Trento 1578). La vita, le opere, con l'identificazione delle piante*, ed. S. Ferri, 161–214. Perugia: Quattroemme.
- Munck, A. 1951. *Das Medizinalwesen der Freien Reichstadt Überlingen am Bodensee*. Eutin: Internationale Gesellschaft für Geschichte der Pharmazie.
- Müller, F., C. M. Ritz, E. Welk, and K. Wesche, eds. 2021. *Rothmaler – Exkursionsflora von Deutschland. Gefäßpflanzen: Grundband*. Berlin: Springer Spektrum.
- Neville, S. 2021. *Early Modern Herbals and the Book Trade: English Stationers and the Commodification of Botany*. Cambridge: Cambridge University Press.
- Nissen, C. 1951–1966. *Die botanische Buchillustration*. Stuttgart: Hiersemann Verlags-Gesellschaft.
- Novák, Z., J. Sobotková, J. Skružná, L. Kubásková, L. Strnadová, and R. Slovík. 2025. *Metodika péče o historické herbáře typu hortus siccus*. Prague: Národní zemědělské muzeum.
- Nutton, V. 1993. Humoralism. In: *Companion Encyclopedia of the History of Medicine*, vol. 1, eds. W. Bynum, and R. Porter, 281–291. London: Routledge.
- Ogilvie, B. W. 2006. *The science of describing: natural history in Renaissance Europe*. Chicago: University of Chicago Press.
- Piccard-Online. n.d. *Piccard Watermark Index*. <https://www.piccard-online.de>. Accessed 19 Feb 2026.
- Plan of St. Gall. ca. 825. *Stiftsbibliothek St. Gallen, Cod. Sang. 1092*. https://www.europeana.eu/en/item/9200211/en_list_one_csg_1092
- Raj, D., K. Pękacka-Falkowska, M. Włodarczyk, and J. Węglorz. 2021. The real theriac – panacea, poisonous drug or quackery? *Journal of Ethnopharmacology* 281: e114535. <https://doi.org/10.1016/j.jep.2021.114535>.
- Rauch-Ernst, C. 2005. *Restaurátorská zpráva Harderova herbáře z Ulmu*. Ulm: Unpublished restoration report. Stadtarchiv Ulm.
- Schaffrath, U. 2012. *Läuse, Muscheln und Tabak – Das Herbar Ratzenberger*. *Philippia* 15(3): 191–214.
- Schinnerl, M. 1912. Ein neues deutsches Herbarium aus dem XVI. Jahrhundert. *Berichte der Bayerischen Botanischen Gesellschaft* 13: 207–254.
- Schwimmer, J. 1941. *Hieronymus Harder – Leben und Arbeiten eines Pflanzenkundigen des 16. Jahrhunderts*. *Jahrbuch des Vorarlberger Museumsvereins* 1: 23–65.

- Skružná, J., A. Pokorná, S. Dobalová, and L. Strnadová. 2022. Hortus siccus (1595) of Johann Brehe of Überlingen from the Broumov Benedictine monastery, Czech Republic, re-discovered. *Archives of Natural History* 49(2): 319–340. <https://doi.org/10.3366/anh.2022.0794>.
- Skružná, J., A. Pokorná, S. Dobalová, and L. Strnadová. 2024. Nejstarší herbář sušených rostlin na území České republiky (1595). *Dějiny věd a techniky* 57(1–2): 70–98. <https://doi.org/10.70391/7e8.1-2.d>.
- Slovik, R. 2025. Restaurátorská dokumentace. Komplexní restaurování herbáře typu hortus siccus z roku 1595. <https://www.nzm.cz/onas/veda-a-vyzkum/vedecke-projekty-a-vyzkumne-zamery/historie-uzivani-a-pestovani-lecivych-rostlin-jako-soucast-narodni-a-kulturni-identity/broumovsky-herbar>. Accessed 28 June 2025.
- Stefanaki, A., G. Thijssse, G. A. van Uffelen, M. C. M. Eurlings, and T. van Anandel. 2018. The En Tibi herbarium, a 16th century Italian treasure. *Botanical Journal of the Linnean Society* 187: 397–427.
- Stefanaki, A., H. Porck, I. M. Grimaldi, N. Thurn, V. Pugliano, A. Kardinaal, J. Salemink, G. Thijssse, C. Chavannes-Mazel, E. Kwakkel, and T. van Anandel. 2019. Breaking the silence of the 500-year-old smiling garden of everlasting flowers: the En Tibi book herbarium. *PLoS One* 14(6):e0217779. <https://doi.org/10.1371/journal.pone.0217779>.
- Strabo, W. 1966. *Hortulus*. Translated by Raef Payne. Commentary by Wilfrid Blunt. Pittsburgh: Hunt Botanical Library.
- Tabernaemontanus, J. T. 1588. *Neuw Kreuterbuch Mit schönen, künstlichen vnd leblichen Figuren vnnnd Conterfeyten aller Gewächß [...]*, Franckfurt am Mayn: Nicolaus Basseus. <https://www.digitale-sammlungen.de/en/view/bsb11057803?page=,1>. Accessed 28 June 2025.
- Tabernaemontanus, J. T. 1591. *D. Iacobi Theodori Tabernaemontani Neuw, vnd volkommenlich Kreuterbuch*. Franckfurt am Mayn: Nicolaus Basseus. <https://www.digitale-sammlungen.de/en/view/bsb11057663?page=,1>. Accessed 28 June 2025.
- Thijssse, G. 2023. “Everlasting gardens”: Origin, spread and purpose of the first herbaria. In: *The green middle ages, the depiction and use of plants in the western world 600–1600*, eds. C. A. Chavannes-Maze, and L. Ijpeelaar, 72–108. Amsterdam: Amsterdam University Press.
- Walter, T., A. Ghorbani, and T. van Anandel. 2022. The emperor’s herbarium: The German physician Leonhard Rauwolf (1535?–96) and his botanical field studies in the Middle East. *History of Science* 60(1): 130–151. <https://doi.org/10.1177/00732753221081247>.
- Zahn, G. 1902. *Das Herbar des Dr. Caspar Ratzenberger (1598) in der Herzoglichen Bibliothek zu Gotha*. *Mitteilungen Thüringischer Botanischer Vereins* 16: 50–121.
- Zimmermann, W. 1940 *Hieronymus Harders Handherbarium Archiv der Pharmazie* 1: 7–34.

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.