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Report on the results of my visit to Leiden University Library special collections

The purpose of my visit to Leiden University Library was to explore the life and botanical activity of Leonhard Rauwolf (1535–1596) in his early years in Southern France and Northern Italy in order to elucidate the historical context in which Rauwolf compiled the first three volumes of his herbarium. The Rauwolf herbarium, comprising 4 book volumes in total, is part of the Leiden Library Special Collections and since 2013 it is on (semi-)permanent loan at Naturalis Biodiversity Center (volumes 2 and 3) and the Boerhaave museum (volume 1).

Leonhard Rauwolf was a 16th-century German doctor, botanist and explorer, who studied medicine and botany in Montpelier, France, under the teachings of the renowned doctor and botanist Guillaume Rondelet (1507–1566). Rauwolf became famous as the first post-Medieval European to travel to the Levant and Mesopotamia in search for new medicinal plants. This hazardous journey, which resulted to the compilation of the fourth volume of his herbarium (Ghorbani et al., 2018), is documented in detail in Rauwolf's personal travel account (Rauwolf, 1738). The botanical content of this volume, c. 190 plants, has been recently studied and results were published by Ghorbani et al. (2018).

My research regards the period 1560–1563, i.e. the student years of Rauwolf, during which he collected about 690 plants in Southern France and Northern Italy, which are included in first three volumes of his herbarium. I focus on documenting the botanical content of the three volumes and exploring the historical context in which this herbarium was made. Currently I am preparing an inventory of the three books, including a plant species list, documentation of watermarks, transcription of handwritten texts and identification of the botanists whose handwritings are present in this collection. For these I collaborate with Prof. Tinde van Andel, holder of the Clusius chair of History of botany and gardens in Leiden University, Dr. Henk Porck, retired paper curator of the Dutch National Library and Dr. Tilmann Walter, specialist historian on Rauwolf.

During my visit at Leiden University I tried to find all relevant literature sources about Rauwolf and botanists that he was associated during the period 1560–1563. With these sources I am compiling a timeline about Rauwolf and the botanists of his social and professional network of that time. A draft of this timeline is shown in Appendix I.

Considering Dannenfeldt (1968) and Herde and Walter (2010) who suggested that the best source for the travels of Rauwolf in France and Italy is Rauwolf's herbarium itself, a large part of my work at the Leiden Library focused on reading and transcribing all handwritten texts present in the three book volumes, and trying to distinguish different handwriting styles in order to identify the person(s) to which the handwritings belong. I found that there are at least four different handwritings in the three book volumes, one of which I matched to the handwriting of Rauwolf in his autograph letter to Clusius dated 6 September 1584, held in the Leiden Special Collections. A second handwriting of very small letters has been noticed also by other authors who attributed it to either Carolus Clusius (Legré, 1900) or Leonhart Fuchs (Ganzinger, 1963), the handwriting of both of which is characterized by small-sized letters. I compared this handwriting with handwriting samples of Clusius in his correspondence held in the Leiden Special Collections and two autograph letters of Fuchs to Joachim Camerarius available in Stübler (1928; letter dated 27 May 1543) and the Trew Collection (letter dated 24 Nov. 1565). After having looked carefully all text in the three books, I concluded that it is Fuchs who has annotated the

Rauwolf herbarium. I could not trace the handwriting of Clusius in any of the three books. Interestingly, I discovered that a third handwriting, not belonging to Rauwolf, is the dominant handwriting in volumes 1 and 2 (but absent in volume 3). A fourth handwriting appears nine times in total in all three volumes. I have compared these two handwritings with autograph letters of Johann Bauhin (seven letters to Joachim Camerarius, dated from 1578 to 1598, available at the Trew Collection), and Conrad Gesner (letter dated 15 January 1561 to Hieronymus Frobenius and letter dated 9 October 1562 to Georg Cassander, Leiden Special Collections). I selected these two botanists because of their association to Rauwolf during the years 1560-1563. In specific, Bauhin accompanied Rauwolf in his botanical expeditions in Southern France (Longeon, 1976), and Rauwolf together with Bauhin visited Gesner on the way back from Italy to Switzerland and Germany (Dannenfeldt, 1968) (see also timeline in Appendix I). Preliminary results indicate that the most frequent handwriting in volumes 1 and 2 actually belongs to Johann Bauhin. This is an interesting new finding about the relationship of the two botanists, that shows a strong influence of Bauhin in the making of the Rauwolf herbarium. The handwriting of Gesner could not be traced in any of the three volumes. Examples of the different handwritings in the Rauwolf herbarium are shown in Fig. 1.



Fig. 1. Examples of handwriting from the three first volumes of the Rauwolf herbarium.

Future steps and research outputs

The results I have obtained during my visit at Leiden University, along with those of my on-going research at Naturalis Biodiversity Center concerning the identification of the plant species included in the Rauwolf herbarium, will be further processed and are planned to be published in three articles. One article will include the botanical inventory of the Rauwolf herbarium, intended to be submitted to *Taxon*. A second article, to be prepared in collaboration with Dr. Walter and Dr. Porck, will deal with

non-botanical aspects of the Rauwolf herbarium, namely the transcription of handwritten texts, a discussion on the botanists who annotated the herbarium and observations on the paper quality, binding and watermarks. This article is planned to be submitted to a historical journal, e.g. *History of Science*. A third article, to be prepared in collaboration with Dr. Walter, will deal with Early Modern botanizing and social botanical networks in Southern France and Northern Italy in the mid-16th century.

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Appendix I. Timeline Leonhard Rauwolf and associated botanists

1535	Leonhard Rauwolf is born in Augsburg (Dannenfeldt, 1968)
	Leonhart Fuchs (1501-1566) starts teaching in Tübingen. He stays there until his death (Stübler, 1928)
1540	Conrad Gesner studies medicine in Montpellier. He learns zoology from Guillaume Rondelet, and makes frequent trips to nearby Mediterranean coast where he collects specimens of plants, fishes and seashells. After only a few months in Montpellier he returns to Basel where he finishes his medical studies (Wellisch, 1984).
1541?	Gesner becomes a lecturer at Carolinum in Zürich (Wellisch, 1984).
1542	Fuchs publishes his <i>De historia stirpium comentarii insignes</i> etc with 344 chapters and 551 illustrations (Stübler, 1928).
1544-45	According to Lewis (2007), this academic year is the first evidence that Rondelet starts lecturing on Dioscorides in Montpellier (but Lewis mentions it can also be earlier. So possibly also in 1540 when Gesner was there?). Rondelet is a well-known enthusiast for the improvement of pharmacy based on the study of living plants in their natural habitat (Lewis, 2007).
1548-9	Rondelet lives in Rome and visits Padua, Bologna, Ferrara and Pisa. In these places he establishes acquaintance with the leading local botanists, spends time in botanical gardens and probably learns from Luca Ghini the technique of making a herbarium or <i>hortus siccus</i> (Lewis, 2007).
1549-50	Clusius studies law at Wittenberg (Dannenfeldt, 1958)
1551 – 1554	Clusius matriculates in 1551 in Montpellier and is taught Dioscorides by Rondelet (Lewis, 2007). Clusius is offered accommodation in the house of Rondelet and serves as Latin secretary of Rondelet for the latter's <i>Historia piscium</i> (Lewis, 2007; Hunger, 1927; Legré, 1901). He frequently goes botanizing around Montpellier (Lewis, 2007; Legré, 1901). He does so either alone, with few friends or in expeditions organized by the university, in which groups of students are led by bachelors and doctors of the faculty, with spades and knapsacks and notebooks, and possibly also with dogeared portable copies of botanical texts to find and identify plants named by Dioscorides and collect specimens. Most of the plant collecting was done quite near the town, in the nearby fields or in the Bois de Grammont, or up on the aromatic south-facing slopes of the garrigues or down on the flat and waterlogged land near the salt-water lagoons between Montpellier and the sea, or out on the sand-spits of Maguelone. Clusius recorded the exact locations and more than two dozens of these plants were given named locations near Montpellier. Plainly these expeditions were undertaken not only to instruct medical students in the plant materials used by apothecaries but also to locate, identify, name and describe the different plants. Clusius collects plants also in Cevennes and organizes with friends an ambitious expedition into Provence, proceeding via Nîmes to Arles and thence via Salons and the plain of Crau to Marseille (Lewis, 2007).
1552 – 1557	Felix Platter studies in Montpellier with Guillaume Rondelet (Dannenfeldt, 1968)
1554	Rauwolf matriculates at the University of Tübingen (Ganzinger, 1963)

- Gesner becomes the city physician of Zürich (Wellisch, 1984).
- 1556 Rauwolf matriculates at the University of Wittenberg (Ganzinger, 1963; Dannenfeldt, 1968). Johann Hermann, who obtained his M.D. degree in Bologna, taught botany there since 1554 (Dannenfeldt, 1968). But Dannenfeldt doesn't mention if he was still teaching by the time Rauwolf was there.
- 1559 Gesner is invited to Augsburg by Emperor Ferdinand I. This is his last journey abroad. He is offered a position as imperial court physician but rejects it due to his protestant beliefs. During his stay in Augsburg he becomes friend of the city physician Adolph Occo, with whom he later exchanged many letters and specimens of plants. In the large botanical garden of Johann Heinrich Herwart he sees new and rare plants brought from America and the Near East; among the latter tulips that were brought to Europe a few years earlier, in 1554, by de Busbecq. A few years later Gesner wrote the first scientific treatise on tulip (Wellisch, 1984).
- 1560 Rauwolf matriculates in Montpellier where he studies medicine for two years (until 1562) under Guillaume Rondelet. Evidence for studying with Rondelet is Rauwolf's later reference to him as "the very learned and famous Doctor Guillaume Rondelet, my faithful preceptor" (Dannenfeldt, 1968). Rauwolf collects plants around Montpellier and also in Savoy, Geneva, Dauphine, Lyon, Valence, Provence, Avignon, Arles, Marseilles, Crau, Languedoc, Nimes, mouth Cette, Auvergne (Frontispiece vol.1, 2). In many of these fieldtrips he is accompanied by his friend Jeremiah Martius from Augsburg who matriculated in Montpellier two years before Rauwolf (Dannenfeldt, 1968). Dannenfeldt (1968) mentions that apparently some exploring and collecting was also done with Johann Bauhin.
- Johann Bauhin (1541-1613) goes to Tübingen to study botany under Fuchs. He is Fuchs' disciple for a couple of months before becoming a disciple of Gesner in Zurich (Longeon, 1976).
- Caspar Ratzenberg, compiler of a large herbarium, matriculates in Montpellier few weeks after Rauwolf (Dannenfeldt, 1968).
- 1561 According to Longeon (1976), Johann Bauhin matriculates in Montpellier, where in the company of his friend Rauwolf he attends the classes of Rondelet and collects plants in Languedoc and Provence. Probably the catalog of Languedoc herbs from which J. Bauhin had collected the materials during his stay in Montpellier in 1561-1562 is the one that he brought as draft in Basel at the end of September 1562 ("Vale et Catalogum stirpium Monspeliensium perfice" - letter from Gesner to Bauhin of September 30, 1562 in *Epistolae*). This Catalog has never been published, but Bauhin has used it for his *Historia Universalis Plantarum* (Longeon, 1976).
- Bauhin accompanies Gesner in a botanical field trip in the Rhaetian Alps in Switzerland (Legré, 1900).
- 1562 According to Legré (1900) Bauhin takes advantage of his stay in Languedoc to collect plants in large quantities. He announces his plan to draw up a catalog of these plants. Gesner wrote to him in 1562 asking him to communicate, as soon as this catalog would be completed, of the exsiccata brought back from France: "Catalogum stirpium Monspeliensium perfice, et mitte, aut excludendum apud nos cura". In his *Historia*

universalis plantarum, Johann Bauhin alluded to the numerous visits to mount Cette, while he was botanizing in Languedoc with Rauwolf.

Rauwolf moves from Montpellier to the University of Valence, Dauphiné, where he graduates.

Johann Bauhin goes to Italy to visit famous botanists: Aldrovandi in Bologna, Jacques-Antoine Cortusie and Melchior Guilandini in Padova, Francisco Calceolari in Verona... He collects plants in the Appenines with his friend Oswald Gabelhauser and returns to Zurich and then Basel (Longeon, 1976).

1563 Rauwolf goes to Italy for his *peregrination academica*. According to Legré (1900) he was there possibly together with his friend Jean Bauhin who lived in Bologna that year. Rauwolf (possibly together with Bauhin) crosses Northern Italy and Switzerland collecting plants, which are included in the third volume of his herbarium (see collection areas in Italy and Switzerland in Legré, 1900, p. 8).

According to Dannenfeldt (1968), Rauwolf went to Italy on the way back from France to Augsburg. Dannenfeldt cites Durling (1965), according to which Rauwolf inscribed his name in Gesner's *Liber amicorum* in May 1563.

However, according to Legré (1900) Rauwolf returns from France directly to Augsburg in 1562. On the way he meets Conrad Gesner (1516-1565) who was returning to Switzerland and they travel together a part of the journey. Legré writes that Gesner remembers this in his letter to the Augsburg doctor Adolphe Occon from 1565: "E Gallia redeuntibus nobis, iter mihi cum eo fecisse, sanè exciderat" (Returning from France, the way I did with him I had forgotten" (Legré, 1900, p. 7). Perhaps Legré assumed that Rauwolf returned from France to Augsburg and then went to Italy to explain the hypothetical meeting of Rauwolf and Clusius in Augsburg.

Ganzinger (1963) suggest that Rauwolf possibly visited Fuchs in Tübingen on his way back from Italy to Augsburg since Schwarzwald is mentioned in the frontispiece of the 3rd volume as one of the places that Rauwolf collected plants. According to Ganzinger, Fuchs is the one who annotated the herbarium folios; Fuchs added missing plant names, corrected some of Rauwolf's plant names and indicated to his illustrator some specimens to be drawn for his upcoming herbal with the phrase "Soll gerissen warden". Perhaps Bauhin, former student of Fuchs, was there with Rauwolf, but no evidence has been found.

According to Legré (1900, 1901), in 1563 Rauwolf meets Clusius in Augsburg, the latter being there invited by the Fugger family. Legré assumes that Rauwolf asked to meet Clusius and showed him his herbarium. Clusius annotates the herbarium contributing plant names that are in several cases less accurate than the ones of Rauwolf. Also Hunger (1927), Dannenfeldt (1968) and Ogilvie (2006) describe this meeting of Rauwolf and Clusius citing either Legre (1900) or Hunger (1927). Dannefeldt (1968) places this hypothetical meeting of Rauwolf and Clusius in 1564.

1564 Rauwolf compiles the index of the 2nd volume. No such information is mentioned for vol. 1. The information of vol. 3 is missing (piece of paper intentionally cut out)

1565 Rauwolf marries Regina Jung, daughter of an Augsburg patrician. Among the people who congratulate him is Conrad Gesner (Dannenfeldt, 1968).

In a letter of 7 Jan to Augsburg physician Adolf Occo III (1524-1606), Gesner thanked the “most learned and renowed Dr. Rauwolf” for sending him some unusual seeds and expressed the desire to enter into correspondence with the Augsburg botanist (Dannenfeldt, 1968 reference to Babinger, 1913). At the end of the same year Gesner dies of Plague.

Fuchs, one of Matthioli’s favorite targets, writes to Joachim Camerarius the elder in his letters of 10 Aug and 24/25 Nov that in the revised three-volume version of his herbal he would demonstrate Matthioli’s mendacity (Ogilvie, 2006). Perhaps it is also out of this hate against Matthioli that Fuchs (somewhat rudely) struckthrough the plant names that Rauwolf/Bauhin attributed to Matthioli in the herbarium volumes.

- 1566 Death of Rondelet.
- 1570 Rauwolf is appointed official doctor of Augsburg. This is mentioned in the frontispieces of the three book volumes. Certainly the three books were not bound before this year (Legré, 1900, p. 11). Possibly they were not bound also before Rauwolf’s journey to the East, i.e. not before 1576, if the same calligrapher was asked in a single occasion to prepare the frontispieces of the four volumes.
- 1573 – 1576 Rauwolf travels to the Levant and Mesopotamia and collects the plants included in the fourth volume of his herbarium (Legré, 1900). In 1576 he returns to Augsburg.
- 1582 In 4 September Clusius writes to Camerarius that he has heard of Rauwolf’s name. In another letter of 10 October Clusius thanks Camerarius for sending him “his Dasylycus”, i.e. a copy of Rauwolf’s travelogue (Hunger, 1942). Hunger wonders about the fact that Clusius had only heard of Rauwolf as he still believes that Clusius and Rauwolf met in Augsburg in 1563. In a third letter of 21 November that year Clusius writes to Camerarius that he would like to see the botanical observations of Rauwolf published and encourages Camerarius to suggest this to Rauwolf (Hunger, 1942).
- Rauwolf publishes his travelogue. In the introduction he mentions about his botanizing in Languedoc, in specific in Montpellier, in the company of his friend Jeremie Martius, in the mountains and valleys, and mostly mount Cette, near Frontignan, situated in the sea front etc. (Legré, 1900). Interestingly Bauhin is not mentioned as a botanizing companion.
- 1584 Rauwolf in his letter of 6 September asks Clusius if he knows a prince that would be interested to buy the fourth volume (or all volumes?) of his herbarium (Leiden special collections; Legré, 1900)
- 1588 Rauwolf loses the position of city doctor in Augsburg due to his protestant beliefs and is appointed doctor of Linz, Austria, for eight years (Legré, 1900).
- 1596 Rauwolf joins the Austrian troops as army doctor and goes to Hungary. He dies there the same year of dysenteritis at the age of 61-66.
- 1650-1 In Bauhin’s posthumous *Historiae plantarum generalis novae et absolutae prodromus*, the famous Leonhard Rauwolf is mentioned as a faithful traveling companion, “et peregrinationum socium fidelissimum, clarissimum virum Leonhardum Rauwolff” (Legré, 1900; also Dannenfeld, 1968 referring to Legré). Regarding a specimen of *Helianthemum syriacum* name handwritten by Rauwolf “Heliophaes”, Vol. 2, folio 120,

Bauhin in his *Historia universalis plantarum* mentions that he has found this plant together with Rauwolf in Provence, “Repertus a socio fidelissimo Leonhardo Rauwolff in montibus Provinciae”. Bauhin names it “*Helianthes*” or “*Helianthemum rectum*”, but later he believes that he was mistaken and he identifies it as “*Cistus folio Lavendulae*”, the name that he has written in his work. Regarding the specimen in folio 32, Vol. 2, name handwritten by Bauhin “*Polygalum Gesneri*”, that Fuchs has stricken through and named it “*Glycyrrhiza sylvestris*”, Legré (1900) mentions that Gesner actually calls “*Polygalon*” the *Onobrychis* and that, according to the testimony of Bauhin, Rauwolf had collected this *Onobrychis* near Arles: “Diligens simplicium indagator Leonhardus Rauwolffius propé Arelatem In Provincia mense Maio collegit.” (*Hist.*, t. II, p. 335). About the specimen in folio 145, Vol. 2, name handwritten by Bauhin “*Seseli peloponesiacum*”, Bauhin writes: “Deferebatur nobis non longè ab Arelata in Provincia di Sant-Martin a Leonh. Rauwolffio” (*Hist.*, t. III, p. 186). Although *Asphodelus fistulosus* is not present in the herbarium volumes, Bauhin writes about the “*Asphodelus minor folio fistuloso*”, “Ante quadraginta annos descripsimus plantam repartam mense Maio in Provincia pers tudiorum socium Loenhard Rauwolff, Augustanum medicum, cum essemus Monspelii (*Hist.*, t. II, p. 631) (Legré, 1900). According to Legré (1900), it is only plants collected in Provence that Bauhin mention that he has collected with Rauwolf but never plants collected in Languedoc.

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