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Herbaria of the Prussian physician Boretius (1694-1738) in the Herbarium WA

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Abstract. Pre-Linnaean herbaria have a growing value for botanists and historians of science. A unique example is a four volume herbarium from the early 18th century preserved in the archives of the Herbarium of the Faculty of Biology, University of Warsaw. They consist of one, originally five volume set. We proved that the plants had been gathered by the famous naturalist Georg Andreas Helwing (1666-1748), and his son-in-law, Matthias Ernst Boretius (1694-1738), and they annotated and classified the exhibits. Boretius was born in Prussia, in Lec (now: Giżycko). He acquired his academic training in Königsberg and Leiden, and deepened it by scientific travels. He was the first in Masuria to promote vaccination against smallpox. Earning the reputation of a distinguished scholar, he was appointed Royal Physician and Crown Councilor of the Prussian court. He died in 1738 at the age of just 44, leaving the herbarium vivum – a magnificent remnant of his times. There are over 900 cards with glued specimen, signed in three languages: Latin, German and Polish. It includes vascular plants, liverworts, true mosses, clubmosses, algae and macrofungi. Boretius implemented the system made known by the French botanist Joseph Pitton de Tournefort (1656-1708). His system divided the plant world into 22 classes, based on flower morphology but also retaining the traditional split into trees, shrubs and forbs. The choice of this arrangement by Boretius was an innovation; the earlier plant collections of his tutor Helwing lacked any attempt to classify plant species.

Key words: botanic history, herbaria viva, Boretius, Helwing, Tournefort, Prussia

1. Introduction

The oldest herbaria containing real, dried plants, the so-called "herbaria viva", date from the mid-16th century. Their preparation was possible due to the spread of paper production in Europe, because paper was the best material for drying plant specimens (Arber 1938; Mumford 1966). In the eighteenth century, botany got out of the "pharmacies" (closed gardens of medicinal and dying herbs; after Bernal 1957) and became a true "queen of sciences", a standard for other sciences, e.g.: chemistry and state matter as a subsidiary discipline for the medicine and agriculture, and also one of beloved amusements of the noble and patrician estate (Bernal 1957; Brock 1999). The manifestation of this bloom of botany was the establishment of new botanical gardens, the improvement and increase in the number of herbaria viva and, ultimately, the Linnaean revolution in the taxonomy.

2. Author and his work

An example of such a herbarium vivum is a four book set written at the beginning of the 18th century, safeguarded in the cimelia collections of the Herbarium of the Faculty of Biology of the University of Warsaw. The work, originally, consisted of five volumes, but Volume 3 was lost. The books are 34 cm × 20 cm. They are bound in sheepskin parchment and their title pages are written in calligraphy (Fig. 1). The four preserved volumes comprise 942 cards with glued plants, sometimes with several dried specimens on the same side. Plants are stuck to the surface of cards. Their names are written in three languages: Latin, German and Polish and, occasionally, in contemporary Masurian (the local dialect of Masurian Poles). At the end of the fifth volume, the author provided readers with an elaborate, three language species index (Latin, German, and Polish) with a total of 75 pages.

Fig. 1. Title page of the first volume of the Boretius' herbarium vivum stored in the Herbarium WA

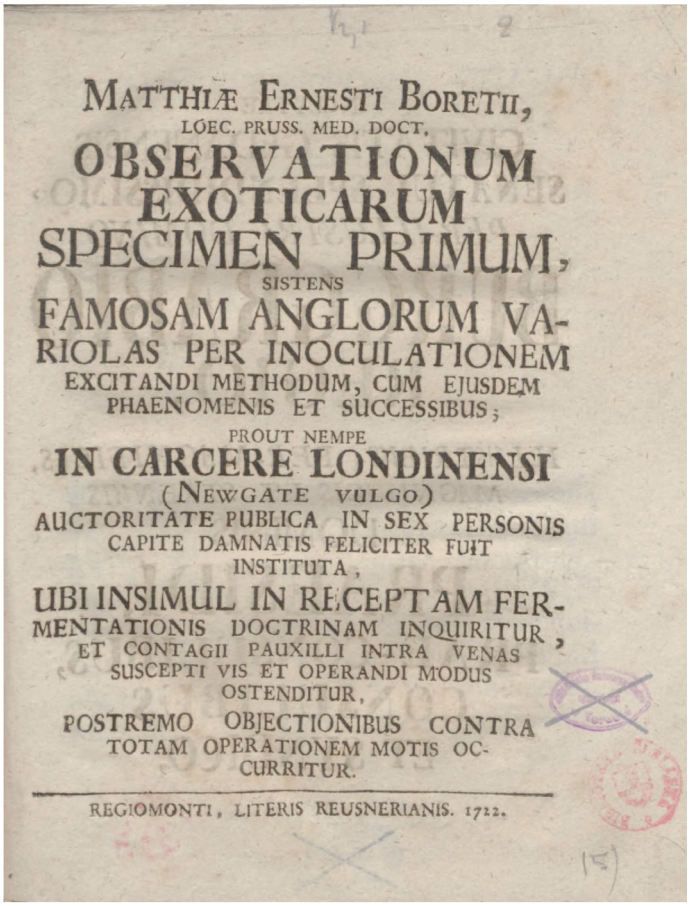


Fig. 2. Title page of the treatise on the experimental use of the smallpox vaccine, dating back to 1722

The history of this herbarium vivum is poorly researched and requires further, detailed, archival studies. The books bear stamps of the City Library in Königsberg (present day: Kaliningrad). There, they remained at least until 1940 (Flis 1956) and, most probably, until the end of the war in 1945. Until recently, it has not been possible to determine precisely when and under what war or post-war circumstances they came to the Herbarium of the University of Warsaw. Traces of high temperature show that they were probably saved from bombardment fire. The authorship of the herbaria viva was not established, because names of botanists working on this masterpiece were missing. However, as a result of F. Neuffer's and K. Spalik's archival and library research, it was proved that the above-mentioned herbaria corresponded to a five-volume set mentioned in the former library catalog of Königsberg as "Matth. Ern. Boretii Herbarium vivum, plantarum et florum in Porussia nascentium methodo Tournefortiana, in classes divisum; adscriptis nominibus Plantarum Latinis, Germanicis, Polonicis, cum Indice. Vol. V" (Spalik 2014; from Bernoulli 1779). This record proves that the author was Matthias Ernst Boretius (1694-1738), son-in-law of the famous naturalist and Lutheran reverend Georg Andreas Helwing (1666-1748), from Angerburg (now: Węgorzewo).

Boretius was born in 1694 in the Duchy of Prussia, in Lec (now: Giżycko) in a pastor's family. At the age of 14, he entered the Albertina (University in Königsberg) to study Lutheran theology. He witnessed the Black Death epidemic, which almost completely decimated the population of his town. Also the father of the Masurian scholar fell the victim to the plague. Perhaps this experience inspired young Boretius to choose medicine and education as his career. He continued his medical studies at the University of Leiden widely regarded as the best university of early Enlightenment era (Rostworowski 2000), where in 1720, he received a PhD in medicine and philosophy for a dissertation concerning the healing properties of the hawkweeds "Dissertatio inauguralis botanico-medica De hieraciis Prussicis [...]". It was written under the supervision of the world-famous polymath Herman Boerhaave (1668-1738).

In 1721, Boretius travelled to England. There he witnessed Europe's first experimental anti-smallpox

vaccination, performed on prisoners condemned to death. Later on, he described the vaccination procedure in detail (Fig. 2), refuting the idea that in vaccinating doctors, they violate the Commandments of God and human laws (Boretius 1722). This was from a dozen or so of the most frequently cited of Boretius' work. At the age of 28, Boretius returned to Königsberg, where he was soon appointed an Albertina professor. He gained fame as a magnificent botanist and doctor. He was the first to promote vaccination against smallpox in the Kingdom of Prussia. He received numerous titles, including Court Doctor and Crown Counselor at the court of "king-sergeant" Frederick Wilhelm I. He died in 1738 at the age of only 44 (http://users.manchester.edu/FacStaff/SSNaragon/Kant/bio/ bioKon.htm, Flis 1956).

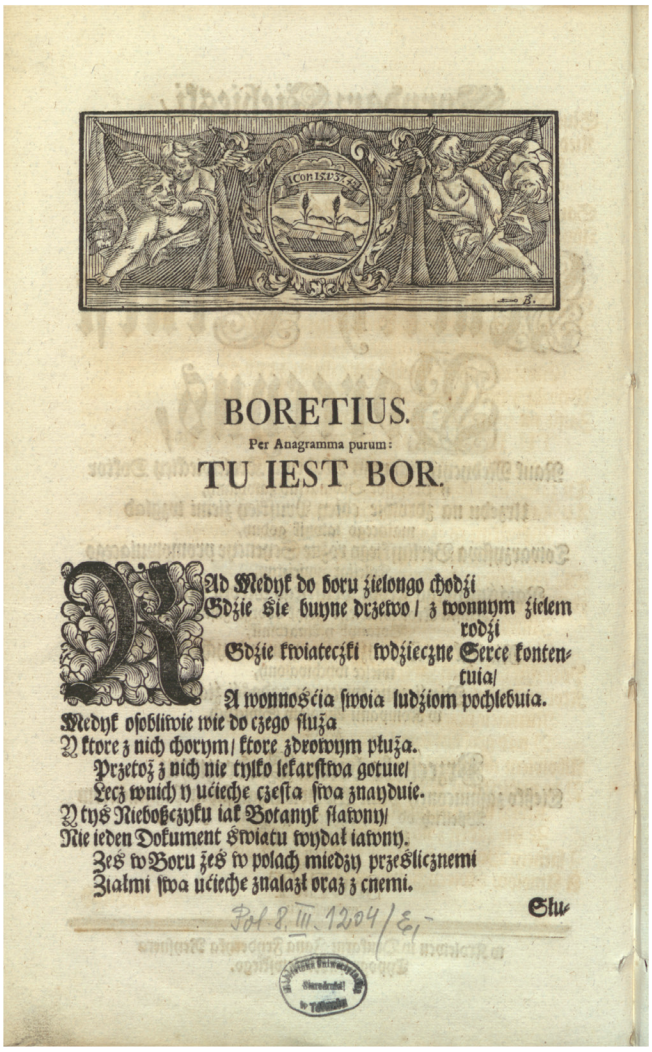
3. Dispute about the herbarium' authorship

A special part of Boretius' legacy are his herbaria viva – a remarkable testimony to the contemporary flora of Prussia. Although Spalik (2014) points out that, according to Pisanski (1886), those herbaria were actually prepared by Helwing, with Boretius only writing the plant names, at the present time, it is difficult to determine to what extent Jerzy Krzysztof Pisanski (1725-1790), Helwing's grandson, who – at the time – was studying under the supervision of his grandfather, could have, reliably, assessed the true contribution of both naturalists. At the time of Boretius' death, Pisanski was only 13 years old. He, most likely, did not participate in his uncle's and grandfather's disputes concerning species classification that took place several years earlier. Even if Pisanski observed Helwing working on the aforementioned five-volume masterpiece, it is possible that some (if not most) of the dried specimens were actually provided by Boretius. The posthumous panegyric printed in his honor (Fig. 3) is a testimony that he was not just a cabinet scientist working behind a desk (Flis 1964). Rather, he willingly took students out to natural locations of plants in local wilderness areas, so that they would acquire "the knowledge of all the forbs". The correspondence of Boretius with Gdańsk naturalist Johann Philip Breyne (1680-1764), proves the great practical knowledge of medicinal and systematic botany that had been acquired by Boretius during his Leiden medical studies. While in the Netherlands, he sent dried specimens of plants, viable seeds, and healthy seedlings of exotic species, carefully conserved so that they could survive a long stagecoach trip to a friend in the Royal Prussia at the Polish-Lithuanian Commonwealth (Pękacka-Falkowska 2012).

Boretius possessed both the knowledge and manual skills necessary to create the masterpiece preserved in the Herbarium Universitatis Varsoviensis. Even if the Angeburger reverend had been involved in the creation of the book, the scientific order and arrangement of dried specimens was surely proposed by Boretius. This is an innovative approach in comparison with earlier herbaria created by Helwing, preserved in the National Library in Warsaw (Helwing 1695-1705), because in Helwing's work the specimen are arranged in accordance with the subjective morphological similarity, for example *Drosera* and *Hottonia* are glued next to each other (Fig. 4). Boretius wrote his masterpiece "living herbarium" thirty years later, and had new tools and a new scientific approach, taught in Leiden and other leading botanical centers.

4. The idea behind the herbarium arrangement

In the 17th century, several plant classification systems existed. The Doctrine of Signatures, assuming that plant morphology indicated their therapeutic application, was


BORETIUS.
Per Anagramma purum:
TU IEST BOR.

Ad Medyk do boru zielonego chodźi
Gdzie sie buyne drzewo / z twonnym zielem rodźi
Gdzie kwiateczki tudziecznе Serce kontentuia/
A wonnoścta swoia ludźiom pochlebuia.
Medyk osobliwie wie do czego służa
Ktore z nich chorym / ktore zdrowym pluża.
Przetoż z nich nie tylko lekarstwa gotuie/
Lecz wnich y ucieche czesta swa znayduie.
Tys Nieboszczyku iak Botanyk sławny/
Nie ieden Dokument swiatu wydał iawny.
Zes w Boru żes w polach miedzy prześlicznemi
Ziałmi swa ucieche znalazł oraz z cnemi.

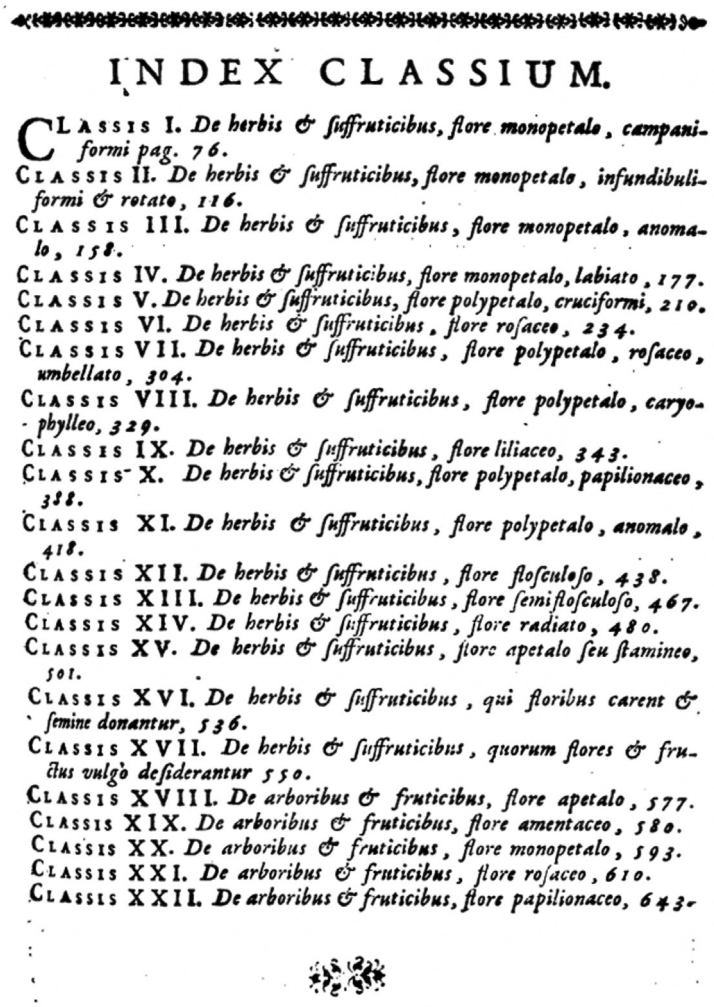
Stu

Fig. 3. An original homage to Boretius – as a teacher, physician and naturalist, written by one of his students

slowly withdrawn (Bennett 2007). It was explicitly rejected by the English naturalist John Ray (1627-1705), who classified plants according to similarities and differences in their morphology (Ray 1682). Unfortunately, Ray's system was very complicated. Although it was a big step towards modern taxonomy, it did not gain popularity. In 1694, when Boretius' family celebrated his birth, the French botanist Joseph Pitton de Tournefort (1656-1708) proposed a system that was commonly used for the next half century. It was an artificial system based on arbitrarily selected, but easy to notice plant features. Boretius decided to arrange the specimens in the herbarium on the basis of Tournefort's classification (Fig. 5). It ignored the previously introduced division of the plant world into cryptogams and phanerogams as well as the division into monocotyledonous and dicotyledonous plants. The reason for that was that Tournefourt believed that the Creator equipped people with simpler methods of recognizing the true nature of the species so they could see the rationality of the created order (Bowler 2007). The presented system divided the plant world, including algae, fungi and lichens, into 22 classes (Tournefort 1694).

The bases for the classification were flowers and their morphology, but the author still kept the traditional, reaching back to Aristotle times (Bowler 2007), division into herbs, shrubs and trees. Herbaceous plants were grouped into 16 classes defined as "herbis et suffruticibus" (annuals, biennials and "subshrubs" or perennials), while woody plants were grouped into XVII - XXII classes. Thus, for example, plants with papilionaceous flowers can be found both in class X (forbs) and class XX (trees and shrubs). In many cases, the flower structure exactly reflected the affinities of plants and grouped whole natural families in separate classes (e.g.: Lamiaceae in IV, Brassicaceae in V, Apiaceae in VII, as well as Asteraceae in XIII and XIV classes). A very diverse group was class XV ("herbaceous plants with flowers without a crown and/

Fig. 4. *Drosera* and *Hottonia* put next to each other in the Helwing's herbarium from 1695-1705 (left), and *Drosera* in the Boretius' masterpiece from the 1730s (right)



INDEX CLASSIUM.

CLASSIS I. *De herbis & ſuffruticibus, flore monopetalo, campaniformi pag. 76.*
CLASSIS II. *De herbis & ſuffruticibus, flore monopetalo, infundibuliformi & rotato, 116.*
CLASSIS III. *De herbis & ſuffruticibus, flore monopetalo, anomalo, 158.*
CLASSIS IV. *De herbis & ſuffruticibus, flore monopetalo, labiato, 177.*
CLASSIS V. *De herbis & ſuffruticibus, flore polypetalo, cruciformi, 210.*
CLASSIS VI. *De herbis & ſuffruticibus, flore roſaceo, 234.*
CLASSIS VII. *De herbis & ſuffruticibus, flore polypetalo, roſaceo, umbellato, 304.*
CLASSIS VIII. *De herbis & ſuffruticibus, flore polypetalo, caryophylleo, 329.*
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CLASSIS XXI. *De arboribus & fruticibus, flore roſaceo, 610.*
CLASSIS XXII. *De arboribus & fruticibus, flore papilionaceo, 643.*

Fig. 5. Index of classes from the Tournefort's work "Institutiones rei herbariae" (1700), written in Latin. International, Latin version was published six years after the first French edition

or with stamens") containing Equisetophyta and wind-pollinated species with strongly reduced perianths from presently recognized Amaranthaceae, Cannabaceae, Chenopodiaceae, Poaceae, Polygonaceae, Urticaceae families, as well as the *Carex* genus and other similar plants. It is worth mentioning that much later, under current classification systems, we recognize the close relationship of the Chenopodiaceae with Amaranthaceae or Urticaceae with the Cannabaceae (Szafer *et al.* 1986). Class XVI grouped the "herbaceous plants that never produce either flowers or seeds" (in the Boretius five-volume set these were ferns, liverworts and part of lichens). In class XVII, there were "plants that usually do not produce either flowers or seeds" (in Boretius' masterpiece, we can find mosses, lycopods, algae and other lichens). Apparently, for Boretius, sporophytes of bryophytes, sporophylls of clubmosses and firmosses, sori and/or air bladders of algae as well as soralia of lichens were a kind of flower or fruit of the aforementioned plant species.

5. Conclusions

The pre-Linnaean herbaria are botanical monuments of great historical value. Chiefly, they included a set of plant species with known medicinal value and acted as pharmaceutical manuals. Boretius' masterpiece is distinguished from this group by the fact that it presents the whole vascular flora of the Masuria province in a relatively complete manner. What is more, in this work, there are also cryptogams including fungi, much less frequently gathered and presented in contemporary herbaria viva (Magdefrau 2004). It is a unique source of floristic, phycologic and mycologic data for Prussia, although the exact places of specimen gathering are not stated. The nomenclature value of the herbarium is undisputed, because the names of plants contained in it, referring to specific specimens, allow their precise identification. Plant names, written in three languages, can enrich our knowledge about the history of the languages and the perception of plants by people of that era and

region (Rostafiński 1904). Detailed species analysis may also bring new data on the introduction of species into modern Poland territory, as some cultivated plants were found in Boretius' collection.

Boretius' scientific approach to botany rejected the Doctrine of Signatures, most often referring to the analogy of: form, structure, color and odor. The use of the modern Tournefort system at that time was part of wider cultural changes taking place in the science and economy of the Enlightenment epoch.

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