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REVIEW

Pinaceae in the Herbarium of the Institute of Botany at the Jagiellonian University, Kraków, Poland (KRA)

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Abstract

The Herbarium of the Jagiellonian University in Kraków, Poland (KRA) has extensive collections. The Pinaceae family in KRA embraces 1,057 herbarium sheets and contains representatives of eight out of 11 genera usually distinguished in the family. The collection of the family in KRA contains ca. 54–61% of the 220–250 species occurring in the world. The most numerous species (116 sheets) is *Pinus sylvestris*. There is one isoneotypus of *Larix decidua* Mill var. *carpatica* Domin (KRA 224704) and one syntypus of *Tsuga caroliniana* Engelm. (KRA 224989) in the collection. There are 706 sheets from Europe, 504 of them come from areas covered by the contemporary borders of Poland, 206 from North America, 98 from Asia, two from Africa, and one from Australia. The herbal material of the family deposited in KRA was collected in the past 200 years. The oldest specimen was collected in 1821. There are 65 sheets which date from the nineteenth century, 56 from the years 1900 to 1918, 173 from 1919 to 1939, 532 from 1944 to 2000, and 139 sheets from the twenty-first century. The most interesting collections include: the exsiccata from the nineteenth century, sheets from China (1925–1926), sheets collected by various Russian expeditions to Siberia, the collection of Professors Jan Kornaś and Anna Medwecka-Kornaś from North America, and collections documenting the scientific activity of the "Kraków geobotanical school" in the twentieth century.

Keywords

collections of dried plants; history; pine family; history of botany

Introduction

Herbaria have long histories and, being collections of dried plants with information attached to labels, they are interesting objects of research for plant systematicians, phytogeographers, and historians of botany. Not only entire herbaria, but also individual collections and even taxonomic units included in a herbarium, are the subject of research in Poland (e.g., [1–7]) and in the world (e.g., [8]). Herbarium specimens are also an important source of DNA for plant research (e.g., [9]). Herbarium labels, as well as the plant material, contain a lot of valuable information that can be analyzed for many years after collecting a specimen. Based on this information, one can comprise biographies of botanists (e.g., [10]), or analyze contacts between botanists (e.g., [11,12]).

The Herbarium of the Institute of Botany at the Jagiellonian University (KRA), founded in 1780, has the longest history among Polish university herbaria, dating back to the second half of the eighteenth century. It also holds extensive collections [13–15]. In 2016–2017, an inventory of herbarium materials belonging to the Pinaceae family located in KRA was made. During the inventory, the quantity and quality of the deposited plant material was recorded, and photos of interesting specimens, labels, and entire sheets were taken. Information from labels served to create a database. The purpose of this study is to present the Pinaceae collections in KRA.

General characteristics

The inventory showed that there are 1,057 sheets with specimens belonging to Pinaceae in KRA; they are included in 32 fascicles. Almost all specimens (995) are determined to species. A slightly lower number of specimens contains information such as locality (95%), collection date (90%), or the name of the collector (89%). Half of the labels feature information about the habitat (51%), and even fewer about the height above sea level of the locality (16%). Some labels (ca. 4%) do not provide any information except for species name and possibly the name of the collector. Almost half of the sheets (615) also contain envelopes with loose plant material.

Taxonomic characteristics

During the inventory, it was found that almost all of the herbarium material (99%) was determined to species. Only nine sheets contained specimens determined to genus (six genera), and only six were undetermined. The previous determination of specimens was not verified. Nevertheless, all species names appearing on labels were checked in the Internet database The Plant List [16]. On this basis, it can be concluded that Pinaceae in KRA embrace ca. 123 species (Tab. S1). This number may of course change in the future, after verifying the determination of the entire herbarium material. Pinaceae collections in KRA contain, depending on the adopted taxonomic approach, from 54% to 62% of all the 220–250 species distinguished within this family worldwide. In the KRA collection, there are representatives of eight out of the 11 genera usually distinguished (e.g., [17]): *Abies*, *Cedrus*, *Larix*, *Picea*, *Pinus*, *Pseudolarix*, *Pseudotsuga*, and *Tsuga*.

The largest number of herbal sheets, amounting to 116, contain specimens of *Pinus sylvestris*, while 107 contain specimens of *Larix decidua*. Much fewer, only 71, contain specimens of *Abies alba*, while 64 contain specimens of *Picea abies*, and 61 of *Pinus mugo*. The remaining species embrace from 1 to 33 sheets (average for the whole family is 7.8 sheets per species, median is 3).

From a taxonomic point of view, nomenclatural types have the highest value among herbarium collections. The types constitute the rank of a given collection, with the following two types in this set:

- Sheet KRA 224704 contains an isoneotypus of *Larix decidua* Mill. var. *carpatica* Domin indicated on August 23–28, 2011 by Larisa Orlova (from the Komarov Institute of Botany of the Russian Academy of Sciences in St. Petersburg). The plant material on the sheet was originally determined as *Larix carpatica*. It was collected on September 7, 1931 in the High Tatras (the Carpathians Mts). The sheet was part of "Flora Čechoslovenica exsiccata".
- Sheet KRA 224989 contains a syntypus of *Tsuga caroliniana* Engelm., an Appalachian endemic species, indicated on August 24, 2011 also by L. Orlova. The specimen was collected in 1881 on the Pinnacle Mountain (North Carolina, USA), i.e., the locus classicus of this taxon [18].

Geographical characteristics and the origin of specimens

Species of the Pinaceae family occur mainly in cold and temperate regions of the Northern Hemisphere.

In the described collection, 707 sheets were from Europe, of which 503 came from areas covered by the contemporary borders of Poland, and 204 from other European countries (Tab. 1).

Most of the sheets from Poland come from its southern part, mainly the Tatra, Beskidy, and Bieszczady mountains, as well as the Kraków-Częstochowa Upland, the Włoszczowska Basin, and Opoczyńskie Hills. These specimens were collected, for the most part, by naturalists affiliated with the Jagiellonian University: employees of the Institute of Botany, assistants of the Department of Botany, or PhD students.

Tab. 1 Numbers of sheets collected from European countries (other than Poland).

Country	Number of sheets
Albania	9
Austria	8
Belarus	1
Bosnia and Herzegovina	1
Bulgaria	12
Croatia	10
Czech Republic	2
Finland	1
France	12
Germany	6
Great Britain	26
Greece	6
Italy	15
Moldova	1
Montenegro	3
North Macedonia	3
Norway	5
Romania	19
Russia (the European part)	3
Slovakia	9
Slovenia	1
Spain	1
Sweden	10
Switzerland	3
Ukraine	37
Together	204

A large group consists of sheets received from other institutions or from people outside the Jagiellonian University (often the collections contain non-native species): the Arboretum in Kórnik provided 34 sheets (mainly exotic species grown in the Arboretum); Andrzej Sendek (1933–1994), Polish botanist and professor at the Academy of Physical Education in Katowice, Poland [19][1], provided 19 sheets (Polish and foreign species); the Herbarium of Primary Forest Research Laboratory of the Department of Forest Ecology at the Research Institute of Forestry provided 15 sheets (Polish and foreign species); the Herbarium of the Pharmaceutical Faculty at the Silesian Medical Academy in Katowice provided 12 sheets (mainly Polish). Sheets from areas of present-day Ukraine were collected by Polish botanists as part of their works funded by the Physiographical Commission of the Academy of Sciences and Letters (from 1919, the Polish Academy of Sciences and Letters). A considerable number of sheets from the United Kingdom result from the fact that Stanisław Batko (1904–1975), Polish botanist and mycologist, collected samples of many exotic species at Kew Gardens in Great Britain after World War II, and then sent them to KRA [20]. More sheets also come from states whose territories embrace the Carpathians, and from the Balkan states. This was a result of the geobotanical research interests of scientists associated with the Jagiellonian University.

There are 205 sheets from North America, 46 of them were collected in Canada in 1932 (purchased in 1934 [14]), 1959, and 1975–2010. The vast majority of them contain native species. There are only six sheets from Mexico. The largest number of North American specimens come from the USA – as many as 151 (Tab. 2). They were obtained as exsiccatae from many state universities and comprise part of the American collection of the professors Jan Kornaś (1923–1994) and Anna Medwecka-Kornaś, of the Jagiellonian University.

There are 98 sheets which come from Asia: 49 from the Asian part of Russia, 30 from China, two from Indonesia, nine from Japan, one each from Kazakhstan, Kyrgyzstan, and South Korea, and five from Taiwan. Sheets from the Asian part of Russia were collected mainly in the Altai, Buryatia, the Caucasus, Irkutsk Oblast, Kamchatka Peninsula, Tyumen Region, Yakutia, and Zabaykalsky Krai in the years 1879–1968. Among the Chinese sheets, 26 were collected in the years 1925–1926 in Northwest China (Gansu Province) and northeast Tibet (purchased in the 1930s [14]). The remaining four Chinese sheets are from 1951, 2004, and 2005, mainly from Hunan Province, as a result of an exchange with the Institute of Botany of the Chinese Academy of Sciences. Specimens from Taiwan come from an herbarium exchange conducted from 1987 to 1997. Sheets from Japan were collected in 1933–2005, which are exsiccatae issued by the universities in Kyoto and Tokyo.

Two specimens come from Africa. Both were collected by Adam Starzeński, a Polish naturalist, in Kenya. *Pinus insignis* (KRA 27775) was collected in 1943 on Kapsiliat in Kenya, and *Pinus patula* (KRA 27586) in 1951 at Kilimanjaro in Tanzania. Both species are not native to those areas, originating from North America.

Only one sheet comes from Australia, the alepian pine (*Pinus halepensis* KRA 346705). It was collected in 1934 on Rottnest Island, where this species is naturalized. The specimen is a doublet from the Herbarium of the University of Minnesota, USA.

[1] Sources of biographical data of collectors – see Tab. S2.

Tab. 2 Numbers of sheets collected in North America.

Country and state	Number of sheets
Canada	46
Alberta	14
British Columbia	9
Manitoba	2
Ontario	2
Quebec	16
Saskatchewan	3
Mexico	6
Unites States of America	151
Alaska	15*
Arizona	4
California	28
Colorado	16
Delaware	1
Florida	2
Idaho	19
Illinois	1
Maine	2
Mississippi	1
Missouri	4
Montana	4
Nevada	3
New Hampshire	3
New Jersey	3
New York	3
North Carolina	26
Oregon	2
South Carolina	1
South Dakota	1
Tennessee	4
Washington	8
(America borealis)	2

* Almost all of which were collected on Kosciuszko Island.

Historical characteristics

The herbal material of the Pinaceae in KRA was collected during the last 200 years by at least 284 collectors (listed in Tab. S2). However, dates of collecting do not fall evenly throughout this period. The oldest sheets come from the first half of the nineteenth century, but most Pinaceae come from the second half of the twentieth century, when the so-called "Kraków geobotanical school" was conducting its full scientific activity [21] (Fig. 1). Information on the most interesting specimens from an historical point of view is given below.

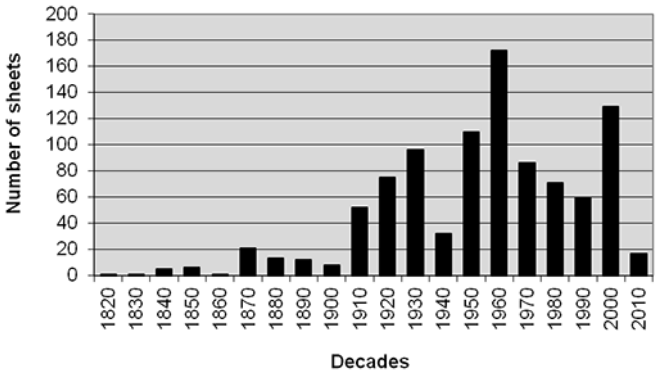
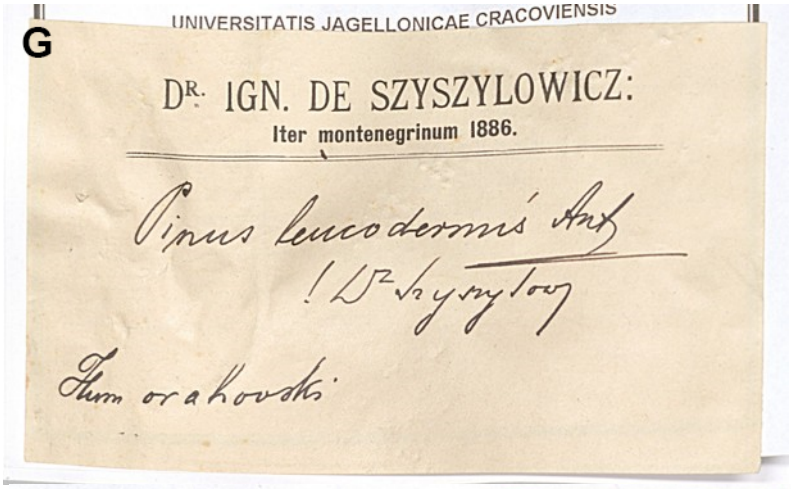


Fig. 1 Number of Pinaceae family sheets collected in individual decades (1821–2010).

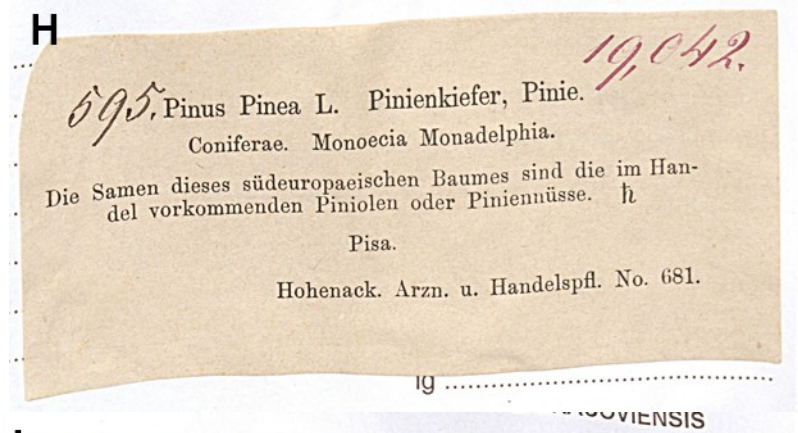
There are several sheets from the first half of the nineteenth century. The oldest specimen (*Pinus pinaster* KRA 224553) was collected, as its handwritten label informs (Fig. 2A), in 1821 in Fréjus, a city in southern France, by Jacques Étienne Gay (1786–1864), a Swiss-French botanist, civil servant, collector, and taxonomist. There is no information about how long the specimen has been in KRA. The next two specimens, from a chronological point of view, were part of a collection purchased for KRA in 1851–1852 in Germany [13]. The collection was prepared by Unio Itineraria, a nineteenth-century German joint stock company [22]. A specimen of *Pinus halepensis* KRA 224546 was gathered in St. Pietro (Sardinia, Italy) in 1827 by Franz August Müller (1798–1871), pharmacist, plant collector, and cryptogam researcher. A specimen of *Pinus pinaster* KRA 224552 was collected in November 1830 near Bayonne (a town in the Western Pyrenees in France) by Philip Anton Christoph Endress (1806–1831), a German pharmacist and plant collector from Strasburg, during his second (out of three) journey to the Pyrenees. Both specimens have original printed labels (Fig. 2B,C). *Pinus teocote* KRA 224781 (collected in Chinautla, State of Puebla, Mexico) was part of the exsiccatae "Plantae mexicanae" (Fig. 2D), prepared in Mexico from 1841 to 1843 by the Danish plant collector Frederik Michael Liebmann (1813–1856) and distributed by the botanical museum in Copenhagen from 1845. *Pinus leiophylla* KRA 224549 was part of the exsiccatae "Plante centroamericanae" prepared in 1845–1848 by the Danish biologist Anders Sandøe Ørsted (1816–1872), and also distributed by the botanical museum in Copenhagen. Both specimens mentioned above were probably purchased for KRA in 1851–1852 [13]. The next two sheets (*Pinus sylvestris* KRA 224788 and *Pinus sylvestris rubra* KRA 224787) originate in 1843, probably from the Nikitsky Botanical Garden near Yalta in the Crimea (Russia), in existence since 1812. There is no information about how long the specimens have been in KRA.


A
B
920.
Pinus Halepensis Ait.
In collinis aridis insulae St. Pietro Mayo.
U. I. Müller.
4598.
C
922.
Pinus maritima. Lam.
Circa Bayonnam. Pyr. occid.
Unio itiner. Endress.
Nov. 1830.
4600.
D
E museo botanico Hauniensi.
Plantae mexicanae Liebmann.
1841—43.
determ:
E
8,195.
Pinus Mughus. Scopol.
F

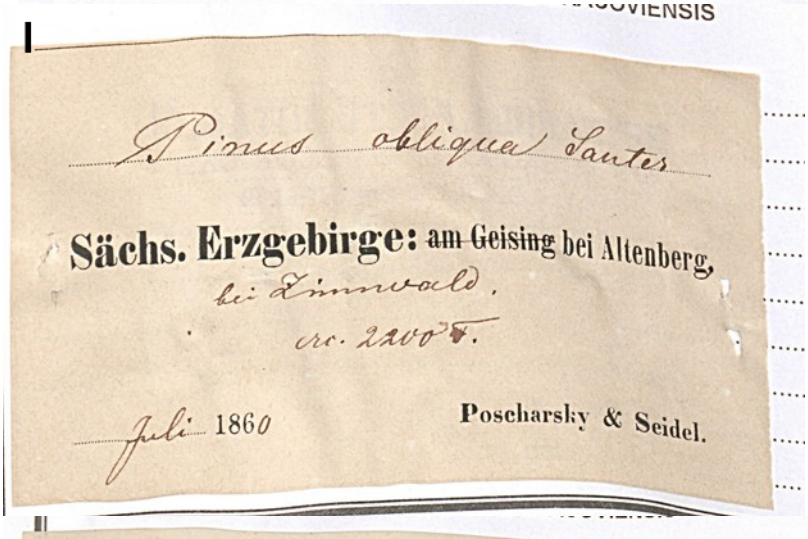
G


UNIVERSITATIS JAGELLONICAE CRACOVIENSIS
DR. IGN. DE SZYSZYLOWICZ:
Iter montenegrinum 1886.
Pinus leucodermis Ant.
! Dr Szyszylowicz
Thm. orakovski

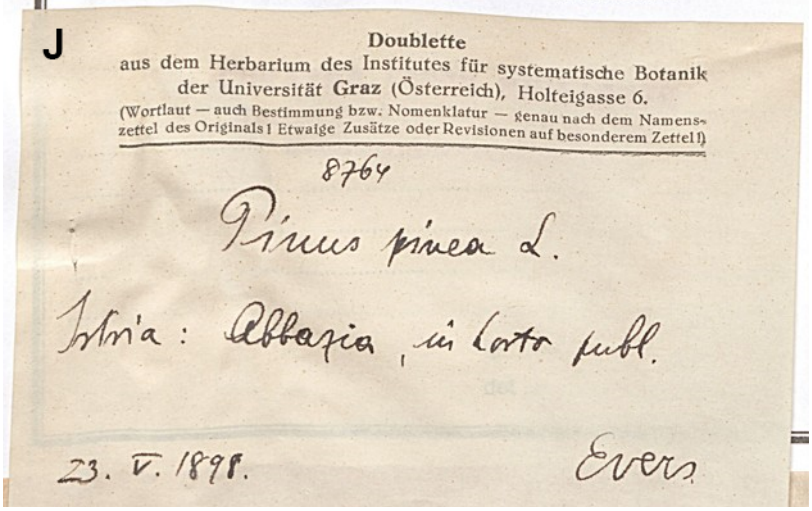
H

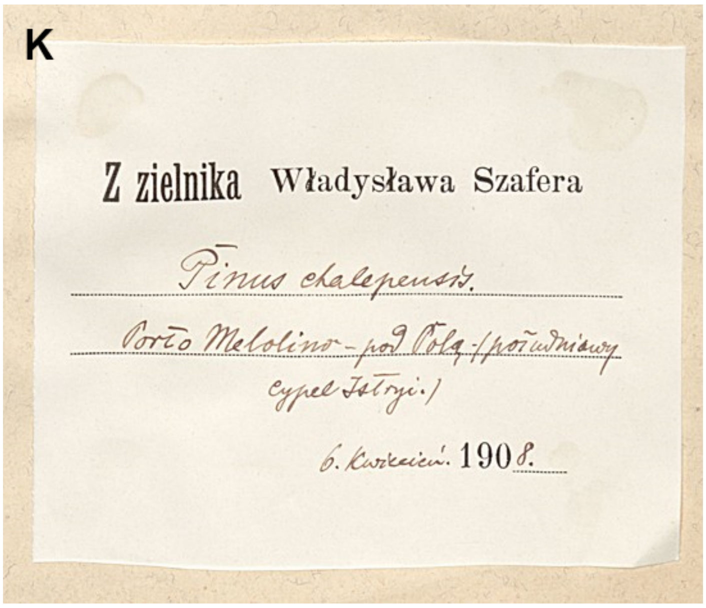

19,042.
695. Pinus Pinea L. Pinienkiefer, Pinie.
Coniferae. Monoecia Monadelphia.
Die Samen dieses südeuropaeischen Baumes sind die im Handel vorkommenden Piniolen oder Piniennüsse. ħ
Pisa.
Hohenack. Arzn. u. Handelspfl. No. 681.

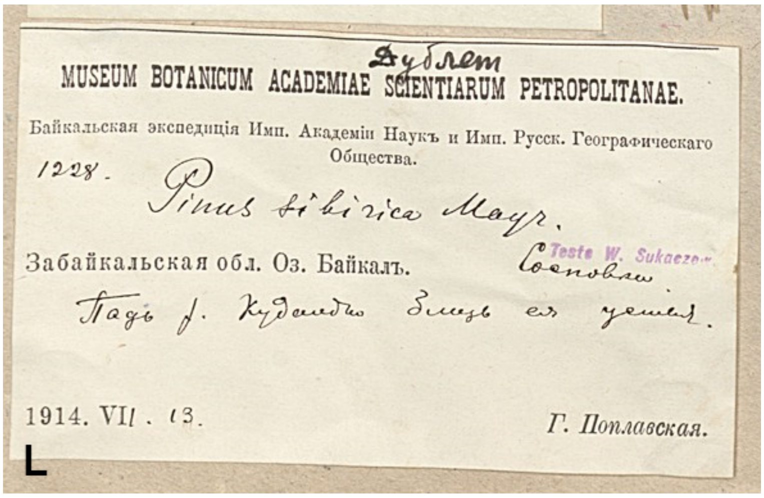
I

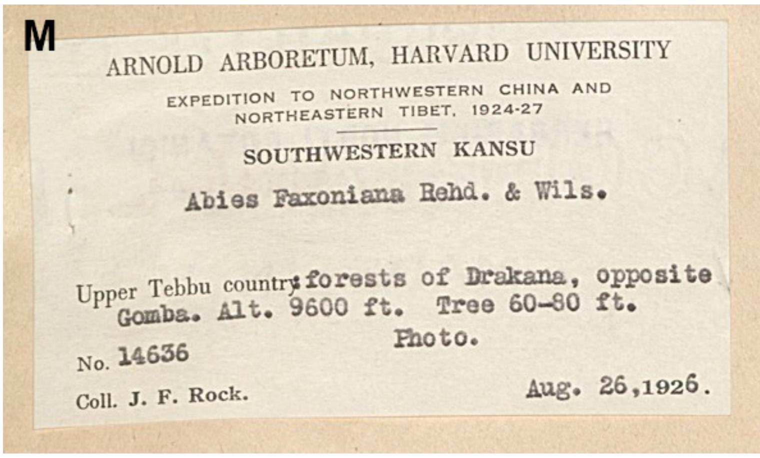

Pinus obliqua Sauter
Sächs. Erzgebirge: am Geising bei Altenberg,
bei Zinnwald.
ca. 2200'.
Juli 1860
Poscharsky & Seidel.

J


Doublette
aus dem Herbarium des Institutes für systematische Botanik der Universität Graz (Österreich), Holteigasse 6.
(Wortlaut — auch Bestimmung bzw. Nomenklatur — genau nach dem Namenszettel des Originals! Etwaige Zusätze oder Revisionen auf besonderem Zettel!)
8764
Pinus pinea L.
Istria: Abbazia, in horto publ.
23. V. 1898.
Evers


K
Z zielnika Władysława Szafera
Pinus chalepensis.
6. kwietnia 1908.


Дублет
MUSEUM BOTANICUM ACADEMIAE SCIENTIARUM PETROPOLITANAE.
Байкальская экспедиція Имп. Академіи Наукъ и Имп. Русск. Географическаго Общества.
1228.
Pinus sibirica Mayr.
Забайкальская обл. Оз. Байкалъ.
Teste W. Sukaczew
1914. VII. 13.
Г. Поплавская.
L


M
ARNOLD ARBORETUM, HARVARD UNIVERSITY
EXPEDITION TO NORTHWESTERN CHINA AND NORTHEASTERN TIBET, 1924-27
SOUTHWESTERN KANSU
Abies Faxoniana Rehd. & Wils.
Upper Tebbu country; forests of Drakana, opposite Gomba. Alt. 9600 ft. Tree 60-80 ft.
Photo.
No. 14636
Coll. J. F. Rock.
Aug. 26,1926.

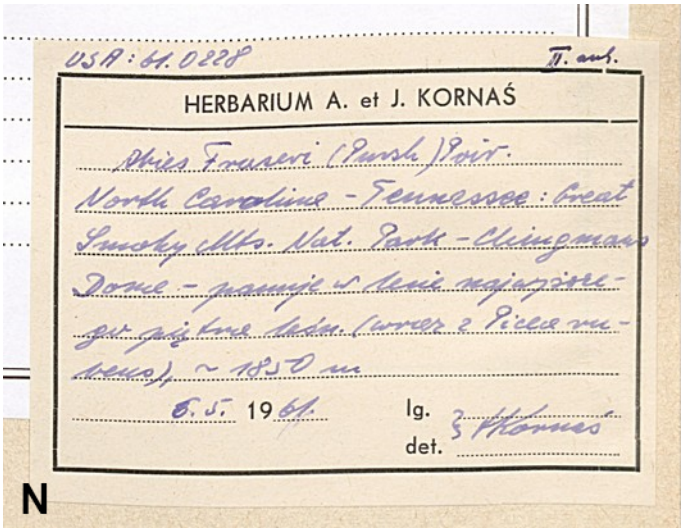


Fig. 2 Examples of labels of Pinaceae family specimens in KRA from the following collectors: (**A**) J. É. Gay, (**B**) F. A. Müller, (**C**) Ph. A. Ch. Endres[s], (**D**) F. M. Liebmann, (**E**) F. Berdau, (**F**) A. J. Śleńdziński, (**G**) I. Szyszyłowicz, (**H**) R. F. Hohenacker, (**I**) G. A. Poscharsky, (**J**) G. Evers, (**K**) W. Szafer, (**L**) G. I. Poplavskaya, (**M**) J. F. Ch. Rock, (**N**) J. Kornaś.

A slightly larger number of specimens come from the second half of the nineteenth century. At that time, collections gathered by assistants of the botanical chair and Botanical Garden of the Jagiellonian University began to flow into the KRA. The earliest four specimens [*Pinus mughus* KRA 224557 (Fig. 2E) and KRA 224686, *Pinus cembra* KRA 224543 and KRA 224669], dating from 1854 to 1855, from the Tatra Mountains were donated by Feliks Berdau (1826–1895), an assistant from 1848 to 1855. In 1868, the botanist received a doctorate at the Jagiellonian University. Perhaps on this occasion he handed over part of his herbarium to KRA in the same year [13]. This second part includes *Pinus sylvestris* (KRA 224801) from Wola Justowska, then a village near Kraków.

In 1876, Władysław Kulczyński (1854–1919), then a student of the Jagiellonian University, and later zoologist-arachnologist, handed over a set of Galician herbarium consisting of 435 sheets collected in the previous year [13]. Three sheets come from this collection: two of them were collected in the Tatras (*Pinus cembra* KRA 224666 and *Pinus montana* KRA 224556), and a specimen of *Pinus sylvestris* KRA 224799 was collected in Bielany near Kraków.

Aleksander Jan Śleńdziński (1848–1881) was a botanist-florist. Already in the last year of his studies, he was an assistant at the chair of botany and in the Botanical Garden of the Jagiellonian University under Professor Ignacy Rafał Czerwiakowski (1808–1882). While still at university, he began working with the Physiographical Commission of the Academy of Sciences and Letters, which financed his floristic studies of Eastern Galicia from 1873 [23]. In KRA, there are 18 of his sheets (including one without a given locality) collected from 1872 to 1879: six from Kraków and its surroundings (*Abies excelsa* KRA 224867, *Abies pectinata* KRA 223674, *Larix decidua* KRA 224471, 224470, and 224699, *Pinus sylvestris* KRA 224798), and 12 from the Eastern Galicia (*Abies pectinata* KRA 223673, *Pinus cembra* KRA 224541, *Pinus silvestris* KRA 224794, etc.) (Fig. 2F). In 1877, he handed his herbarium consisting of about 1,000 sheets over to KRA [13]. Perhaps in later years he also made some donations or maybe after his death some of his herbaria was transferred to KRA, since among these 18 sheets one was collected in 1879, after his donation.

In 1886, Ignacy Szyszyłowicz (1857–1910), while working as an assistant-volunteer at the Imperial Nature Museum in Vienna (K. k. Naturhistorisches Hofmuseum), traveled to Montenegro and Albania. Two sheets (*Abies alba* KRA 223672 and *Pinus leucodermis* KRA 224551) collected by this naturalist in 1886 in Montenegro are preserved in KRA (Fig. 2G), but there is no information about when they were handed over to KRA.

From 1875, a sheet of *Larix decidua* KRA 224469 comes from Rakowice near Kraków (currently near the city center). Unfortunately, only the initials of the collector appear on the original label. Perhaps the specimen was collected by the then student of the Jagiellonian University and later assistant to Czerwiakowski, Józef Krupa (1850–1889), who donated his collection of west Galician plants to KRA in 1876 [13].

There are six sheets of plants from the Kamchatka Peninsula (Russia). They were collected in 1879–1882 by Benedykt Dybowski (1833–1930), a Polish zoologist and limnologist, and outstanding researcher of Lake Baikal. Later, Carl Maximovich (1827–1891), a famous Russian botanist who specialized in Asian plants, among others, determined such sheets. There is no evidence regarding their arrival to KRA. Perhaps Marian Raciborski (1863–1917) obtained them from Dybowski when he and Dybowski were working at Lwów University (as the university was known until World War II, currently Lviv University in Ukraine) at the same time, and he brought them with him when moving to the Jagiellonian University in 1912.

Beginning in 1852, the Jagiellonian University was able to allocate income from its plant sales from the University Botanical Garden to enlarge its herbarium collections. Thanks to this possibility, Czerwiakowski purchased various European exsiccatae [13]. Given below is information about the oldest and most interesting exsiccatae preserved in collections in KRA.

"Herbarium normale plantarum officinarum et mercatorium" was published in 1850–1872 by Rudolph Friedrich Hohenacker (1798–1874). He was a Swiss living in Esslingen, Germany from 1842–1858, and from 1858 in Kirchheim. Four sheets acquired in 1869 were part of these exsiccatae (*Pinus halepensis* KRA 224547, *Pinus laricio* KRA 224571, *Pinus pinea* KRA 224806, and *Pinus sylvestris* KRA 224909) (Fig. 2H) [13]. Gustav Adolf Poscharsky (1832–1915), inspector at the Royal Botanic Garden in Dresden, Saxony (now Germany), collected plants from territory of present-day Czech Republic, Germany, and Switzerland. In KRA, there is one sheet collected by this naturalist, *Pinus obliqua* KRA 224566 (Fig. 2I). C. Reuterman was a Scandinavian naturalist who gathered plants there in 1830–1894. One sheet (*Abies excelsa* KRA 224717) created by this collector is at KRA. In 1881–1913, "Flora exsiccata Austro-Hungarica" was published under the direction of Anton J. Kerner von Marilaun (1831–1898), an Austrian botanist and professor at the University of Vienna. These exsiccatae include *Pinus pallasiana* KRA 224695. Carl Oscar Schlyter (1836–1901) was, among other things, a Swedish plant collector. From his collection, two doublets of *Picea bies* (KRA 224714, KRA 224720) were obtained through the Botanical Museum in Uppsala. Georg Evers (1837–1916) collected plants throughout his whole life from places he traveled to. His herbarium of about 20,000 sheets is stored in Graz (Austria), and doublets were sent by the Herbarium of Institute of Systematic Botany at the University of Graz (Herbarium des Instituts für systematische Botanik der Universität Graz). In KRA, there are eight sheets collected by G. Evers: two from Precia d'Oro in Trento, Italy in 1893 (*Pinus lambertiana* KRA 224675 and *Pinus rigida* KRA 224804), and six from the Istria Peninsula in Abbazia (currently in Croatia) in 1898 and 1899 (*Pinus halepensis* KRA 27771 and KRA 224545, *Pinus pinaster* KRA 224678, *Pinus pinea* KRA 224900 and KRA 27583, *Pinus strobus* KRA 224782) (Fig. 2J). The collections were most probably obtained in the interwar period.

From 1900–1918, there are 56 sheets. Among them, a specimen of *Larix decidua* (KRA 224703) deserves attention. It was collected in 1902 in Niańków near Nowogródek (now Nyan'kovo near Navahrudak in Belarus) by Władysław Dybowski (1839–1910), a Polish naturalist and brother of the aforementioned Benedykt Dybowski. In 1892–1901, W. Dybowski, Antoni Rehman (1840–1917), and Eustachy Wołoszczak (1835–1918) prepared the first edition of "Flora polonica exsiccata", and the specimen was collected for the exsiccata [24].

A large group of sheets result from the activities of Marian Raciborski and his students who prepared another Polish exsiccatae, "Rośliny polskie" [Polish plants] [25]. There are three specimens collected in 1911 by Raciborski himself: *Pinus cembra* (KRA 223624) and two sheets of *Larix decidua* (KRA 224744 and 223619), both from the Pieniny Mts. Karol Huppenthal (1874–1941), a graduate of the Agricultural College at the Jagiellonian University, was an adjunct in the Botanical-Agricultural Station in Lwów and the head of the experimental station for melioration of mountain meadows at Pozyzevska Polonyna in the Charnohora Mts (Carpathians) from 1908 to 1919. At the

time, he was collecting plants for the aforementioned "Rośliny polskie". The Pinaceae collection includes three sheets of *Pinus mughus* (KRA 25623, 224554, and 224683) collected by him in 1911 at Pozyzevska Polonyna. One sheet of *Pinus mughus* (KRA 224681) was collected by H. Liber in 1911 in the Tatra Mts near Czerwone Wierchy. A year later, one sheet of *Larix polonica* (KRA 224749) was collected by Z. Kossuthówna in Ostrów in the Kielce region.

In KRA, there are also specimens collected by Polish botanists during their foreign trips before World War I. Władysław Szafer (1886–1970), later a professor of botany at the Jagiellonian University and one of the leading Polish botanists of his time, studied at the Faculty of Philosophy of the University of Vienna, under Richard Wettstein, among others. In 1908, Szafer participated in a several-week-long biological course at the sea station in Trieste, and also went on a floristic trip to nearby Dalmatia. During the trip he collected *Pinus halepensis* (KRA 224673) in Porto Medolino near Pula in the Istria Peninsula (Fig. 2K). In 1913, Józef Antoni Żmuda (1889–1916), assistant to M. Raciborski at the Botanical Garden and Botanical Institute of the Jagiellonian University, spent some time at the same sea station. In KRA, there are three sheets collected by him at that time, e.g., *Pinus halepensis* (KRA 224674), and transferred to KRA in 1914 [14]. Based on their label data, one can ascertain that they were part of a documentation of the Istrian flora.

Among the other sheets from the period, many doublets were obtained from other herbaria. Most of these (22) come from the Herbarium of the Institute of Botany, Academy of Sciences of the USSR. They were collected mainly from 1909–1914 during various Russian expeditions carried out in different areas of Siberia, e.g., *Larix sibirica* (KRA 27589) (Fig. 2L), *Larix czekanowskii* (KRA 28369), or *Picea schrenkiana* (KRA 224967). They were purchased in 1933 [14].

A total of 173 sheets were collected in the interwar period. Undoubtedly, the most interesting are specimens (26 sheets) from China. They were gathered by Joseph Francis Charles Rock (1884–1962) during an expedition organized by the Arnold Arboretum (Harvard University, USA) to Northwest China (Gansu Province) and northeast Tibet, e.g., *Abies faxoniana* (KRA 225083) (Fig. 2M). In September 1937, Stefan Jarosz (1903–1958), a Polish naturalist and ethnographer, visited Kosciuszko Island (Alaska, USA). He brought 10 sheets of Pinaceae from there, including *Abies amabilis* KRA 225081 and *Tsuga mertensiana* KRA 62959. From the interwar period, there are sheets collected by botanists associated with the Institute of Botany of the Jagiellonian University (representing the so-called "Kraków geobotanical school"): Władysław Szafer (13 sheets collected in the Swiss Alps, and in Poland in Nowa Słupia, in the Gorce Mts and Gorgany Mts); Bogumił Pawłowski (1898–1971) (12 sheets collected in the Carpathians, in France near Montarnaud, and in Romania); and Andrzej Środoń (1908–1998) (four sheets collected when he was a scholarship holder of the Polish Ministry of Religious Denominations and Public Education in the office of the State Council for Nature Conservation in Kraków and a volunteer at the Institute of Botany of the Jagiellonian University, who took part in a team study of the vegetation of the Chyvchyn Mts in the Eastern Carpathians in 1933–1936, under the leadership of B. Pawłowski).

From 1944 to 2000, there are 532 sheets. Among these, specimens (132 sheets) collected from 1944 to 1977 by professors of the Institute of Botany of the Jagiellonian University and the main figures of the "Kraków geobotanical school" at that time, Jan Kornaś and Anna Medwecka-Kornaś, deserve attention. Among their collection, only a dozen or so sheets come from Poland (Kraków-Częstochowa Upland), France, Albania, and Greece. However, the majority (81 sheets) were collected in 1961 in the USA during a 6-month stay of J. Kornaś on scholarship at Duke University in Durham and Washington State University in Pullman, and 41 sheets in Canada and the USA in 1959 during a 3-month stay of A. Medwecka-Kornaś on the Rockefeller Foundation scholarship at Montreal University. Other botanists from the Institute of Botany at the Jagiellonian University gathered much less: Helena Trzcińska-Tacik provided 22 sheets between 1958–1998 (various regions of southern Poland), Krystyna Towpasz was responsible for 20 sheets between 1966–1997 (mainly the Beskid Wyspowy Range, southern Poland), while Marek Leda created 19 sheets (mainly exotic cultivated species from city parks in Poland). From the post-war period, there are also collections in KRA from botanists who did not work at the Jagiellonian University. Andrzej Sendek

was a professor at the University of Silesia. In KRA, there are 22 sheets created by this botanist from 1960 to 1993, originating mainly from various regions of southern Poland (received in 1994 [14]). From the Herbarium of the Pharmaceutical Faculty of the Silesian Medical Academy in Katowice come 37 sheets collected mainly by Krzysztof Jędrzejko (1945–2012), Henryk Klama, and Jan Żarnowiec mostly in the Kraków-Częstochowa Upland and Śląska Upland from 1983 to 1992 (received in 1993 [14]). From the Herbarium of the Primary Forest Research Laboratory of the Forest Ecology Department at the Forest Research Institute, eight sheets were obtained in 1962 from the Białowieża National Park by Aleksander Sokołowski. From the second half of the twentieth century, 75 sheets of exsiccatae were also derived, most of them (43) were distributed by various American state universities.

There are 139 sheets which come from the first decade of the twenty-first century. Most of them were collected in Poland by PhD students of the Institute of Botany at the Jagiellonian University. Given below are the most active collectors: Wacław Bartoszek – 27 sheets from 2005–2008, mainly from the Western Carpathians; Marcin Bielecki – 19 sheets from 2007–2010, mainly from the Włoszczowska Basin; Anna Trojecka-Brzezińska – 15 sheets from 2007 to 2010, mainly from the Wzgórza Opoczyńskie Hills; and Agnieszka Nobis (née Michalewska) and Marcin Nobis – 12 sheets from 2003 to 2006, mainly southeastern Poland. From the first decade of the twenty-first century, there are also 16 sheets of exsiccatae obtained through exchange, including seven from Canada, four from the USA, and three from China.

Final remarks

The collections of the Pinaceae family in KRA, their species composition, and geographical origin reflect the changing purposes that the Herbarium of the Jagiellonian University fulfilled over the past 200 years. From the time when it served mainly as a didactic aid, i.e., around the World War I, specimens originating from outside present-day Poland prevail. They were to document mainly the taxonomic diversity within Pinaceae. Sheets of the oldest exsiccatae come from that period as well. Later, the task of documenting Polish flora and research came to the forefront. These studies were conducted (and still are, as evidenced by sheets from the twenty-first century) mainly by members of the so-called "Kraków geobotanical school". Therefore, most of the sheets from this period contain specimens from Poland, and the collectors mostly work at the Institute of Botany of the Jagiellonian University. The enlargement of KRA collections with collections from outside Poland, such as China, Russia, or North America, has not been neglected either, which serve as comparative material.

The taxonomic rank of a herbarium is confirmed by the number of nomenclature types in its possession. Unfortunately, there are only two types of Pinaceae in KRA (for comparison, Kew has at least 178). This difference results from both the history of the KRA and the entire specific character of Polish science. During the period when the most active botanical exploration on Earth was conducted and huge funds were allocated to it, Poland was either not on the map or had no money for expensive research expeditions, seen in its failure in organizing an expedition to Brazil and Peru in 1928 [26].

Thanks to the historical analysis of the Pinaceae collection in KRA, it is possible to supplement unknown biographies of some botanists with details and dates. An example may be the sheets collected by Śleńdziński in Kraków and its surroundings in 1872–1875, which is proof of the previously unknown activity of this botanist in his place of residence (it is a pity that he did not publish anything about it). Raciborski's sheets testify to his research in 1911 in the Rodnei Mountains (in the Inner Eastern Carpathians, now in Romania), and in the Pieniny Mts, while the sheets of Szafer indicate that he was in Switzerland in 1923, etc.

Analysis of data obtained from the labels of the Pinaceae collection in KRA provided previously unknown knowledge about the set itself, as well as its geographical, taxonomical, and historical structure. Furthermore, it contributed to clarifying the biographies of some botanists and disclosed mutual contacts between KRA and other botanical institutions.

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Supplementary material

The following supplementary material for this article is available at http://pbsociety.org.pl/journals/index.php/asbp/rt/suppFiles/asbp.3624/0:

Tab. S1 Species list with number of sheets.

Tab. S2 List of plant collectors.

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