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PLETHORA OF PLANTS – COLLECTIONS OF THE BOTANICAL GARDEN, FACULTY OF SCIENCE, UNIVERSITY OF ZAGREB (7): HISTORICAL OVERVIEW OF FERN (MONILOPHYTA; POLYPODIOPSIDA; POLYPODIOPHYTA) COLLECTIONS

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This sequel provides a historical overview of collections of ferns (Monilophyta; Polypodiopsida or Polypodiophyta) grown in the Zagreb Faculty of Science Botanical Garden between 1895 and 2021. Although opinions on the systematics, classification, nomenclature and taxonomy of "true" ferns still diverge greatly, Equisetaceae and Psilotaceae are commonly included. At least 376 taxa of native and cultivated ferns from 29 families have been grown in the Botanical Garden during the last 126 years. Unfortunately, the complete COVID-19-lockdown, devastating earthquakes and weather extremes of 2020, extending to 2021, diminished our collections. Today we are growing 86 taxa within 20 families of ferns and their closest relatives.

Key words: Zagreb Botanical Garden, Faculty of Science, historic plant collections, ferns, horsetails, psilotum

Kovačić, S.: ***Obilje bilja*** **– zbirke Botaničkoga vrta Prirodoslovno-matematičkog fakulteta Sveučilišta u Zagrebu (7): Povijesni pregled zbirki papratnjača (Monilophyta; Polypodiopsida; Polypodiophyta). Nat. Croat., Vol. 31, No. 1, 133-206, 2022, Zagreb.**

U ovom nastavku serije o zbirkama Botaničkog vrta PMF-a u Zagrebu donosim povijesni prikaz zbirki papratnjača (Monilophyta; Polypodiopsida ili Polypodiophyta) uzgajanih u Vrtu između 1895. i 2021. godine. Iako se stajališta stručnjaka o sistematici, klasifikaciji, nomenklaturi i taksonomiji papratnjača i danas uvelike razlikuju, u ovu su skupinu biljaka već uobičajeno uvrštene i preslice te psiloti. Rezultati pokazuju da je tijekom 126 godina u Botaničkom vrtu uzgajano najmanje 376 divljih i uzgojnih svojta paprati iz 29 porodica. Nažalost, prekid redovitog rada („COVID-19-lockdown"), snažni potresi te vremenski ekstremi koji su pogodili Zagreb 2020., nastavljajući se u 2021., imali su za posljedicu i osiromašenje naših zbirki. Danas uzgajamo 86 svojti iz 20 porodica papratnjača.

Ključne riječi: Botanički vrt PMF-a u Zagrebu, povijesne zbirke biljaka, papratnjače, paprati, preslice, psiloti

FOREWORD

In 2015 we launched the "Plethora of Plants" -series for *Natura Croatica* museum journal, studying the trends in various increased or declining Botanical Garden plant collections over the years. After my first thorough inventory of the temperate glasshouse plants ('Aroideae') in 2015, attempts were made to improve the glasshouse col-

lections on the basis of these surveys, which deduced the plant-lists as initially established, and identified the plant taxa that should be added to our recent collections, thus "filling the gaps" in the inventories of families and/or genera. Statutorily protected as a monument of nature and culture of the Republic of Croatia, and the City of Zagreb, our Botanical Garden is dedicated to the preservation of the national botanical history. It is thus important to try to replace the "missing parts of the puzzles" from our collections, bringing them closer to the original framework, as depicted in the earliest reviews (Ettinger, 1892; Heinz, 1895-96).

INTRODUCTION

The comprehensive investigation of the plant collections in the Botanical Garden of the Faculty of Science, University of Zagreb (below: "Botanical Garden" or "the Garden") is continuing with inventories of indigenous, wild and cultivated ferns (Monilophyta; Polypodiopsida – Polypodiophyta), following the general principles established in the first part of this series (Kovačić, 2015).

Ferns (Monilophyta; Pteridophyta – Polypodiopsida/Pteridopsida)

The classification of ferns *sensu lato* is considered very difficult, as briefly elaborated in Kovačić (2015), just before the much-anticipated report of *The Pteridophyte Phylogeny Group* (PPG-1) was published in 2016. Alas, instead of bringing much needed consensus and order to the older group of "Filices", the solutions proposed by PPG-1 provoked more disputes and (dare we say) new confusion to the World of Ferns.

In Kovačić (2015) I was dealing with combined historical data on our temperate glasshouse collections, ferns included (according to the to then-valid plant-bases *The Plant List*, TROPICOS and IPNI), which I will not repeat here. But, it should be admitted, I was truly astonished with the assortment of (not only) ferns in our original collections: according to Heinz (1895-96; pg. 14-15), "many species" from 21 fern genera and 6 families (in my estimation, at least 35 taxa) of that time grew in our small Exhibition Glasshouse back then, while in 2015 we had 25 taxa from 7 families (data in Kovačić, 2015). Investigation of our old paper-card database, established around 1952, revealed that after the Second World War (WWII) we had a total of 13 glasshouse fern families, 26 genera and 53 species archived (Tab. 4 in Kovačić, 2015), out of which 7 fern families and 10 genera were not present in 2015. However, these numbers are highly dependent on the nomenclatural authority used, which was for ferns always questionable. From 2015 until 2021 our glasshouse fern collection increased significantly, though the nomenclature problems remained: consulting more than a single botanical authority brings linear growth to the nomenclatural nightmare among ferns. Virtually, there are not two databases capable of treating even our small fern collection in the same way: some species have more than 50 synonyms through several families, resulting in immense confusion.

As Professor Peter F. Stevens reminds us in the *Angiosperm Phylogeny Website* (APweb), terms such as *higher* and *lower* plants, or *primitive* and *advanced* characters, are outdated. Nowadays, when talking about individual characters, terms such as *plesiomorphic* vs. *apomorphic*, or *derived*, are more suitable. All "land plants" (Embryopsida) belong to a clade embedded in a predominantly aquatic, paraphyletic group of the "green algae": together, they construct the "green plants" (Viridiplantae) of our planet, in the broadest sense. No scientific consensus on the relationships among all aspects

of plant life on Earth has been achieved. Accordingly, the relationships between the "true" and "weird" ferns (actually, sophistically elaborated evolutional lineages, such as *Lycopodium*, *Selaginella*, *Psilotum* or *Equisetum*) are still being much disputed. For example, though morphologically astonishingly similar, whisk ferns (*Psilotum* spp.) really are *not* descendants from the Palaeozoic Rhyniophytes – moreover, they are entirely unrelated, and not nearly as old as previously thought. Whisk ferns are truly ferns, as already accepted in the time of our Garden collections establishment.

Ferns in the Garden collections of the late 19th century

Though never citing the authority according to which he planned the layout of our Garden, it is obvious that in imagining, planning, drawing, constructing and planting the Royal Botanical Garden in Zagreb (as it was originally christened at its foundation, during the Habsburg Monarchy), Professor Heinz (1861–1919), aided by his *Chefgärtner* Vitěslav Durchánek (1857–1924), followed Engler's System. That, one of the prime Darwinian phylogenetic systems of plant taxonomy based on evolutionary trends, was developed by the famous German botanist, *Der Altmeister* Heinrich Gustav Adolf Engler (1844–1930), Heinz's contemporary. Engler's comprehensive system of Plant Life classification with Orders and Families was commonly accepted, and it is still appreciated today. Widely called *Syllabus der Pflanzenfamilien* (or *Syllabus of Plant Names*; Engler, 1892), it was the first "post-Darwinian", at the time modern and complete, revision of plant families to generic level in a single short publication. It was followed by the monumental work *Die natürlichen Pflanzenfamilien* (*The natural plant families*; Engler & Prantl, 1887–), gradually published during the years and containing much more detail.

Though Heinz never mentioned Engler in his Guide, he states, as it goes without saying (a fine German word is *selbstverständlich*): "*Today we divide the Plants on Earth into four large natural divisions, namely:* 1. Myxothallophyta, 2. Euthalophyta, 3. Embryophyta zoidiogama, 4. Embryophyta siphonogama." (Heinz, 1895-96, pg. 13). As those terms are today abandoned, a short explanation might be in order: *Myxothallophyta* (or Mycetozoa) was a polyphyletic grouping of so called "slime moulds", evolution lineages of organisms that are, actually, unrelated, and today included mostly in the Phylum Amoebozoa of the Eucaryotes. *Euthalophyta* (Thallophyta or Thallobionta) included fungi, lichens and algae, and – according to various views – even bryophytes, bacteria and slime moulds. Thallophyta with "hidden" reproductive system was, together with ferns, incorporated into the "Cryptogamae", as opposed to "Phanerogamae" – plants with "visible" reproductive system. Also, "Thallophyta", with their "undifferentiated (thalloid) bodies", were opposed to "Cormophyta" – plants with roots and stems. *Embryophyta zoidiogama* was Engler's grouping (division) of mosses (with hornworts and liverworts) and ferns (with equisetums and lycophytes). *Embryophyta siphonogama* (or Phanerogamae) consisted of gymnosperms (conifers, cycads, Ginkgo, and gnetophytes) and angiosperms (all other "flowering plants"). This is the Engler's, Darwinian system, in its core (Buggs, 2021).

The second subdivision of Engler's *Embryophyta zoidiogama* is the point where Heinz starts his systematic description of the Garden collections: supraorder Pteridophyta, with three orders – *Filicales, Equisetales* and *Lycopodiales*. The Order of Ferns (*Filicales*) of the time comprehends two Suborders: "true ferns" (*Filices*) and "water ferns" (*Hydropterides*). From the first Suborder, various families were cultivated in the Garden.

Besides some 20-odd fern taxa (some only depicted with "sp.") connected to the glasshouse cultivation from the Polypodiaceae family (published in Kovačić, 2015), Heinz (1895-96) enumerates "many species" of *Aspidium* (val. *Tectaria* Cav.; but also of Croatian flora, under other genera), *Asplenium* (incl. then separated *Scolopendrium*, of which Heinz writes himself in 1892), *Athyrium, Ceterach, Blechnum, Polypodium, Pteris* "and others", living outdoors ("beside the grotto"; Photo-tab. 1), without a single species named. However, as we still today grow some "common" Croatian taxa at the same place (though the "grotto" was removed between 1963 and 1965, when the rocks and boulders were used for constructing the Sub-Mediterranean Rockery), it could be assumed that those were similar. Table 1 (in on-line version of this text) is amended with Heinz's data for the ferns living outdoors in 1895, which were not published in Kovačić (2015).

Photo-tab. 1: Fragments of the Garden times long gone: a) The Grotto with indigenous ferns and horsetails, around 1895; b) Gentleman observing young giant redwood (*Sequoiadendron giganteum*) with some ferns beneath, before WWI; c) Warm glasshouse with Platycerium and other tropical ferns, after WWI; d) Indigenous ferns in the Karstic rockery, after WWII; e) Botanical Garden ferns among other indigenous plants presented at Zagreb *International Garden and Flower Exhibition* (today *FloraArt*), 1969.

Ferns in the Garden collections between 1900 and 1950

During the thorough digitalization of the Botanical Garden historic archives, financed by the Croatian Ministry of Culture in 2020, we recovered several forgotten notebooks, sketchbooks and lists from the early 20th century (Photo-tab. 2), with collection registries of the time – among them, also some inventories of ferns. These hand-written lists, filled with antiquated synonymy, are invaluable documentation of our history, partially filling the 50-year gap of our plant inventories between 1897 and 1952 (explained in Kovačić, 2015). Some of the registries name certain ferns for the first time in our Garden collections, and I have added them to this survey (Tab. 1). We also recovered some lists of fern spores: 60 species ordered from unidentified sources in 1925/26, and 22 ordered in 1948 via *Indici Semini* of Delft, Prague, Oslo, Dijon, etc. Ferns from these lists were not incorporated in Table 1, as we do not know their fate. There are also several lists, mostly undated, ordering plant-labels for the collections, naming some ferns among other things.

Photo-tab. 2: a) **Plant inventories written in the early 20th century**, listing taxa after taxa once existing in our collections. Many such notebooks are lost, while some of the retrieved carry only a part of the families with taxa inventoried in some year, and are marked as "No. 2" or "B" – indicating that once there were (at least) "1" and "A". b) Fern registry, around 1900. cd) Perennials registry from 1904 with the list of ferns. e) Registry of glasshouses from 191? (year illegible). f) List of 60 fern species spores "… *received in 1925, to be sown in January of 1926*", without their further fate known. g) List of warm glasshouse ferns from 1932. h) List of plant-labels for the glasshouse ferns, early 1930-ies.

As nothing of our ferns was officially peer-reviewed and published during the first half of the 20th century, and all data on our collections remained in – today seriously damaged – hand-written inventories, we do not know more about the listed plants: whether they were purchased, received as gifts, grown vegetatively, or from spores; their origin or their age. Also, complex classification of ferns was unknown to our old records: in the hand-written inventories from the first half of 20th century, sometimes very difficult to decipher due to the ornate handwriting and yellowing pages, all ferns were listed among "Filices" (without families), and later under "Polypodiaceae", until the new paper-card database was established in the early 1950-ies. It is also challenging to follow the nomenclature of the time. For the inventories written before WWI it is sometimes very difficult to found a valid name, while the author of taxon is missing. Cultons could sometimes be found in old (predominantly German) horticultural books and magazines, some today available on-line (for example, *Species Filicum* by Hooker, 1785-1865; *Lexikon der Gärtnerei* by Dietrich, 1837; *Ferns and fern culture* by Birkenhead, 1892). We do not know practically anything of the literature used by our predecessors, who might have had their private books they took with them when they retired: after WWII very little was left. We can also presume that they used the "bare" plant-names as they found them in the *Indici Semini* of the time, as synonymy in the remaining hand-written inventories is vast.

Ferns in the first Garden paper-card database (ca 1952 to 2000)

The list of the temperate greenhouse species (incl. ferns) published in Kovačić, 2015 (Tab. 2, p. S8) based on our old paper-card database (Fig. 6ab, pg. 376) was found to be incomplete, not just because of the aforementioned hand-written registries found meanwhile. As mentioned before, all paper-cards were in 2020 subjected to thorough digitalization, which is explained in Budisavljević & Kovačić (2020). This work revealed many "hidden" entries (Photo-tab. 3). Besides amending the previously published data on glasshouse ferns (Kovačić, 2015) with data of the outdoor ferns, in Table 1 I also added those "hidden" names from the reused paper-cards, whenever it was possible to reconstruct the original, erased name. However, we can be certain that many such reused cards were thrown away during the course of time; some we were unable to reconstruct, and some almost certainly went under the radar, so this historic review again could not be seen as complete.

Undoubtedly, the launch of the typed paper-card database initiated by Dr Ungar in the early 1950-ies was a significant practical improvement in comparison to the alphabetized hand-written inventories irregularly conducted before. However, during the decades, this database became drawn in rejected, unused and reused cards, many discarded as duplicates – overwhelmed with synonymy, many species inventoried separately under several synonyms, enhancing the confusion. When I became employed in the Garden (September 1st, 2000), this old database was already divided in to the "active" and "passive" parts (explained in Kovačić, 2015), which – I am sorry to say – I helped, during the years, to entangle even more. In 2002 our students benevolently started to digitalize the paper-cards into the *Flora Croatica Database* (some, some not), which led to new database separations and divisions, worsening the confusion furthermore. Completing the thorough digitalization process in 2021 to produce a brand new Online-Garden Database of his own invention, my colleague Alan Budis-

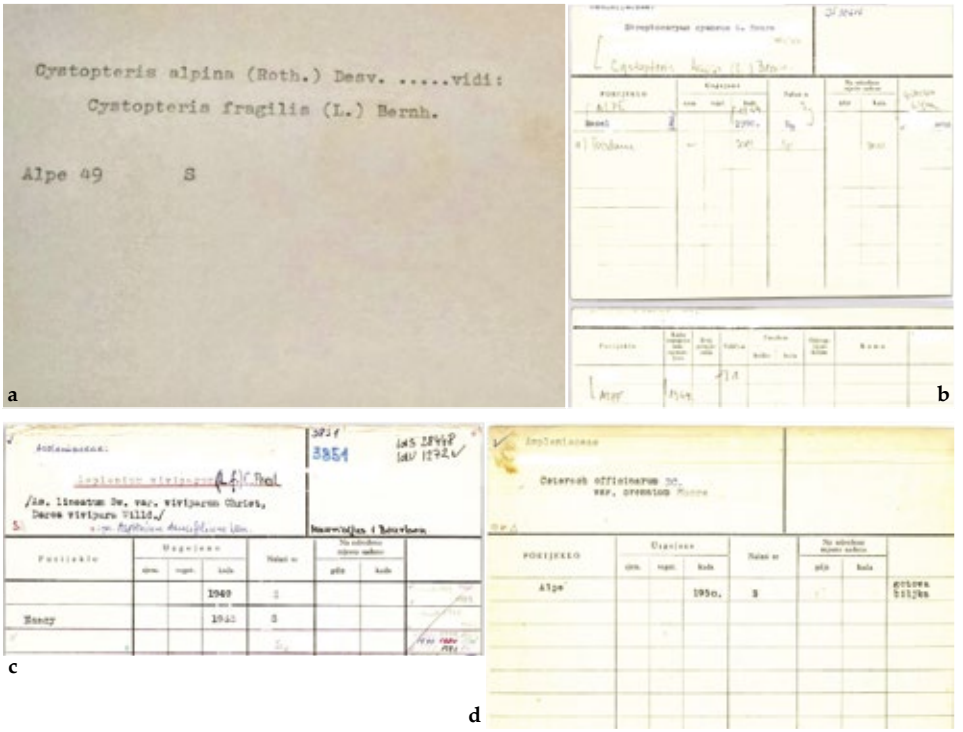

Photo-tab. 3. Oldest fern names in the paper-card database: ab) *Cystopteris fragilis* ("Alps, 1949") redetermination-card was found before the original data-card, overwritten under one of the reconstructed entries, making this name the oldest recorded fern found in our paper-card database; c) *Asplenium viviparum* (1949) and d) *Asplenium ceterach* (orig. *Ceterach officinarum* var. *crenatum*; 1950) follow.

avljević called the whole inventory system "The Quicksand Effect" (see Budisavljević & Kovačić, 2020).

Ferns in the Garden collections of the modern days

Until the early 21st century, almost all classifications were heavily based on plant morphology; as such, they differ from classifications based on molecular results. Furthermore, the use of morphology in combination with molecular data affects the relationships detected – in other words, one should use one (morphology) *or* another (molecular), not combining both (Stevens, 2021). The "clash" between *the traditionalists* (morphologists) and *the modernists* (molecular analysts) is inevitable.

As we, the *botanic garden lot*, are working among living plants in our collections on a daily basis, while the laboratory-based *molecular lot* often has very little contact with the "real plants out there", the criticism of the "molecular results" from "our side" is often pointed in that way. Having been a member of the "garden lot" for almost 25 years now, I personally think that the latest results of this extensive and immensely thorough research must be acknowledged, though, the LIVING PLANT can never be less important than a RESULT of a method (even a molecular method). The amount of

scientific results published daily on any subject today is gigantic, and so would be the literature citations on this matter, and on ferns in any sense, exceeding the length and purpose of this text. To "bridge" this problem, I decided to refer here to the *Angiosperm Phylogeny Website* (APweb), hosted by the Missouri Botanical Garden (USA) and maintained by Professor Peter F. Stevens, where an incredible amount of literature is ready to found. The APweb is dedicated to research on (first of all, angiosperm) plant phylogeny and taxonomy, where all the latest references are regularly updated and presented in a way that could be understandable not only by the professional botanists. Professor Stevens edits the ferns in APweb according to the results of *The Pteridophyte Phylogeny Group* (PPG-1, 2016), with regular modifications to incorporate new results and different views. Besides, in my opinion, his humorous and relaxed approach to the perplexing nomenclatural entanglements, which will never be completely solved, no matter what we do, is quite infectious (these days, in a good way). Clarifying that, it is needless to say that the recent classifications are much *more* elaborate and much *less* straight-forward than Engler's, in Heinz's times.

The modern clade of ferns and their relatives – **[monilophytes + lignophytes]** – stemming out of molecular investigations is sometimes called the **Euphyllophyta**; those plants share a morphologically common leaf pattern, called megaphylle or **euphylle**, which varies considerably. Phylogenetically, ferns and their relatives – the monilophytes and lignophytes – are both well supported clades. According to the latest comparative data (details in APweb, 2021), the monilophytes (ferns) derived from the lignophytes (extinct progymnosperms and all extant woody plants, which gave rise to the seed plants of today) between 482 and 385 million years ago. Until today, ferns and gymnosperms divided greatly, having very little in common (e.g., cyanogenic glucosides, unlike any other plants out of their lineages).

Needless to say, this modern **Clade of Ferns – Monilophyta** – is *not* universally accepted. It carries many former names (some *pro parte*), out of which APweb (2021) gives full synonymy only to the **Class Polypodiopsida** Cronquist, Takht. & W.Zimm. Acc. to the recent views, monilophytes include 47 families and a large group (clade) of eupolypods I and eupolypods II, which includes most ferns. Members of this clade changed their affiliations to one family or another more frequently than any other – a fact that botanical garden employees, kept busy changing plant name-plates for visitors, know all too well (Photo-tab. 4).

Morphologically (but very much supported molecularly), up to 98% of all living ferns are **leptosporangiate**: their sporangia arise from a single epidermal cell. The remaining 2% of species are distributed in no fewer than three further 'major groups' of ferns: the **eusporangiate** or marattioid ferns (Marattiidae, Marattiaceae) with sporangia rising from a group of cells, the **horsetails** (Equisetiidae, Equisetaceae), and the **whisk ferns** (Psilotaceae and Ophioglossaceae).

Within the leptosporangiates, well over 70% of ferns are so called **eupolypods** (an older term would be **Order Polypodiales** Link; as in very broadly defined family Polypodiaceae of the Christenhusz & Chase (2014) classification). It is interesting to emphasize that about one third of the eupolypods are epiphytes, ca 10% of all vascular epiphytes. Though people commonly connect ferns with shady and moist habitats, globally, desiccation tolerance is quite common in both epiphytic and terrestrial fern sporophytes: their peltate scales may play a central role in the uptake of water – rather as in Bromeliaceae. It is also found that 38-43% of all ferns, especially members of the

[Marattiidae + Polypodiidae] clade, accumulate aluminium, and in a far higher percentage than any seed plants. Ferns also commonly have phytoecdysones, chemicals they synthesize for defence again insects, also successfully shielding them against many other herbivores.

Ferns are noted for their high incidence of polyploidy, involved in almost 31% of all speciation events. Although polyploidy is common, the amount of DNA per chromosome tends to be conserved, unlike in angiosperms. Particularly large genomes occur in Psilotales and some Ophioglossales, but in a few polypods.

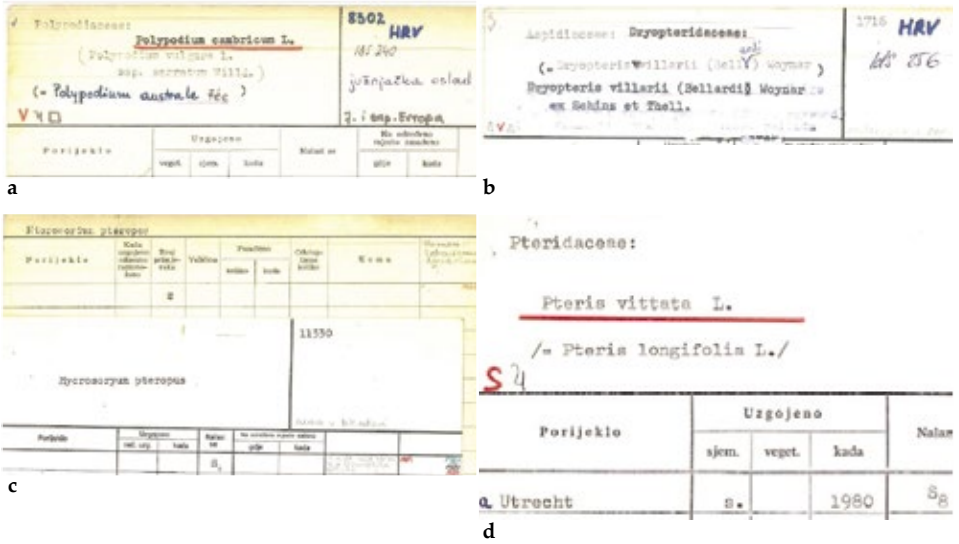

Photo-tab. 4. Complex fern nomenclature and affiliations to families are seen in our Garden paper-card database: some taxa, even Croatian native, changed names and families several times: a) Three name changes of *Polypodium cambricum*. b) Four times re-written species and three times family of *Dryopteris villarii*. Some names are unknown, left without a family: c) "Mycrosoryum pteropus" / "Microsorum pteropos". d) Many cards carry two valid names as synonyms: f.e. *Pteris vittata* = *P. longifolia*.

Review of the recent phylogenetic affiliations of ferns, with remarks on the representatives in our Garden collections

The first phylogeny-based reclassification of ferns was proposed by Smith *et al.* (2006, 2008), which has by now grown in detail (and changed) immensely. It is worth mentioning that among the "ultra-modern" molecular fern phylogenetic classifications there are different views (e.g., Christenhusz & Chase, 2014), as well as elaborated disputes (Christenhusz & Chase, 2018; Schuettpelz *et al.*, 2018) among specialists, which Stevens (APweb, 2021) calls "splitting vs lumping". Though we, the *botanic garden lot*, possibly prefer the morphological over the molecular "way" in the systematization of plants (especially when it leads to frequent changes of *names*!), we are still obliged to follow the recent literature and trends in research, to find a "least painful" mid-way in bringing the topic closer to the widest audiences, while promoting and popularizing botany. In an attempt to bring the "classic and modern" together, I should try to follow Heinz's lead from our first Garden Guide (descriptions of ferns in our

Garden collections, written in 1885-96) modified according to the latest views and discoveries. In Table 1 I compared the recent views and affiliations on ferns comparing three large plant-bases: APweb (2021, following PPG-1, 2016), the *World Flora Online* (WFO; follow-up of *The Plant List*), and *Plants of the World Online* (PoWO), maintained in the Kew Botanic Garden. For Croatian native species, I consulted *Flora Croatica Database* (FCD), to which our national legislation is connected.

Photo-tab. 5. True relatives: a) Adder's-tongue fern (*Ophioglossum vulgatum*), b) young whisk fern (*Psilotum nudum*), c) great horsetail (*Equisetum telmateia*) and d) ladder brake (*Pteris vittata*) in our Garden collections.

"Weird ferns"

From the beginnings of "modern" plant classification, *Psilotum* and *Equisetum* had been thought to represent lineages independent of each other, and unrelated to ferns. *Psilotum* and its relatives are considered to be the most primitive living vascular plants (APweb, 2021, with extensive literature). That is not the case, in spite of their "weird" morphology (Photo-tab. 5).

EQUISETOPSIDA – EQUISETIDAE Warm.

EQUISETALES DC. ex Bercht. & J. Presl. – Equisetaceae Rich. ex DC.

As the circumscription of the fern clade has only recently become clear (though disputed), there is still no consensus on the position of *Equisetum*. There are three (molecular phylogenetic) hypotheses on the position of *Equisetum* among ferns, and many details on their relationships are still waiting for explanations (APweb, 2021 with extensive literature within). Most supported seem to be the view treating the genus (family and order) as sister to all other ferns (monilophytes), though there is also much support for the theory suggesting the [Psilotales + Equisetales] clade.

There is a long fossil trail of *Equisetum*-like plants ("equisetophytes") from the Upper Devonian onwards, while "true" *Equisetum* is known from the Triassic. Fascinatingly little change has been undergone by the horsetails in their basic morphology over a very long course of time, visible even in our little fossil collection (Photo-tab. 6 in Suppl.); *Equisetum* is considered to be one of the most successful genera of extant vascular plants of all times. Most of the apomorphies of the genus are to be seen in the context of variation in the taxa of extinct equisetaceous Calamitaceae, rather than other extant ferns. The clade containing *Equisetum* (some suggest the existence of a [Equisetidae + Ophio-

glossidae] clade) has probably been separated from the other monilophytes since the Permian, ca 250+ million years ago. However, the modern species of *Equisetum* seem to have separated as late as the Caenozoic, before ca 65 million years. The single extant family has a single extant genus (Christenhusz *et al.*, 2019).

Among the many traits unique to horsetails, or connecting them with other ferns, are: having both erect and creeping stems without secondary thickening; non-mycorrhizal roots; accumulation of SiO_2; leaves not photosynthetic, whorled and small, simple and 1-veined; spores with circular aperture; n = 108. It is interesting to emphasize that the leaves of *Equisetum* – so different from a fern's 'fronds' – may be secondarily simple. Early members of this clade had secondary thickening, while their spores were very different from those of today (3-ridged in *Calamites*, unridged in *Equisetum*). Aided by their elaters, spores of *Equisetum* can "jump" up to 1 cm in the air as they dry, or "walk" by short random movements along the ground.

It is worth mentioning here that the stomata of a few monilophytes, including *Equisetum* (and perhaps also *Psilotum*), do not respond to red light; they are likely to be immobile (permanently closed), especially when older, because of the rigid radiating rib-like silica thickenings of the subsidiary cells. In total absence of silicic acid, stomata can develop normally, as well as the whole plant.

In their distribution, horsetails are nearly cosmopolitan: there are 18 species in total, out of which we in Croatia have 9 (FCD, 2021).

Heinz (1895-96) described "several species of *Equisetum* growing by the grotto" in the Garden, without further details (Tab. 1). Older inventories rarely mention this genus. The first entry in our recent database is from 1961, of a freshwater *E. fluviatile* L. (already noted in the inventory of 1958), which since then has vigorously filled one of the ponds of our systematic field (Photo-tab. 7 in Suppl.). *Equisetum arvense* L, common throughout the temperate Northern Hemisphere, was never inventoried, as it grows wild along the Garden's disturbed places. Recently, we are trying to keep it in our *fernarium* collection, primarily for educational purposes. Surprisingly, even *E. telmateia* Ehrh. does not live long with us in recent decades, since the summers become hotter and dryer. Short-lived in our *fernarium* were *E. sylvaticum* L. and *E. hyemale* L. (vulnerable (VU) and strictly protected in Croatia), which are occasionally brought from wild localities. According to Dr. Regula (pers. comm.), other native horsetails were also brought from field research occasionally and placed in the cold greenhouse, but they never survived a single year. In order to show more horsetails to our visitors, we recently purchased *E. giganteum* 'El Tabacal': it proved to be vigorous, growing happily with the rest of the ferns in our *fernarium*, though it should be monitored and kept from spreading too much.

Horsetails tend to grow in ecologically rather stressful habitats. They have so-called convective ventilation from the stems into the rhizomes, allowing the "equisetaceous" plants to penetrate deeply into the anoxic substrates, commonly favoured by this group. However, species like *E. hyemale* lack that interconnected air space and have no convective ventilation, yet still can grow in anoxic, partly submerged conditions.

PSILOTALES & OPHIOGLOSSALES (in different versions)

The close affiliation of these plants with ferns, today commonly accepted, was indeed surprising, though some older authors had earlier compared *Psilotum* with some extinct and extant ferns (comprehensive literature in APweb, 2021).

The clade consisting of [*Psilotum* + *Ophioglossum*] is perhaps sister to all other ferns. Ophioglossidae could also be comprehended as an equivalent to the class Psilotopsida, or one of the four subclasses of Polypodiopsida (ferns), containing the orders Psilotales and Ophioglossales. This relationship was only confirmed by molecular phylogenetic studies (APweb, 2021), and it is morphologically highly disputed. Like *Equisetum*, both *Psilotum* and *Ophioglossum* have erect and creeping stems, but their gametophytes are subterranean, axial and non-photosynthetic (mycorrhizal). Both have large genomes which are similar in terms of apomorphies to those of seed plants, and share mycorrhizal associations with the fungi of glomalean *Glomus* group A. The age of this clade (if such exists, as APweb (2021) puts it) is estimated to be ca 275 million years.

PSILOTALES Prantl – Psilotaceae J.W.Griff. & Henfr.

If taken as such, this Order contains a single family: Psilotaceae, with two genera. These are epiphytes without true roots; leaves are small and simple (laterally flattened in *Tmesipteris* and highly reduced in *Psilotum*); spores are kidney-shaped and monolete. The "whisk ferns" are of pantropical distribution; their age is estimated at between 80 and 72 million years (APweb, 2021, literature within).

The genus *Tmesipteris* is notoriously difficult in cultivation with very specific requirements, and we never had it growing in our Garden. Its 15-odd species (depending on the authority) are delicate, low-height epiphytes growing on the trunks of tree-ferns (*Dicksonia*, *Cibotium*) and occasionally on shady, moist rock-faces. The most recognizable species, *Tmesipteris obliqua* Chinnock, is famous for its genome gigantism (Hidalgo *et al*., 2017): the largest known of all ferns.

The genus *Psilotum*, which contains two species, has also never been inventoried in our collections since Heinz's times (1895-96): there is just a single note of spores received in 1925 (Tab. 1). Preparing the exhibition on the evolution of plants in 2018 (Kovačić, 2018) in our Garden pavilion, we constructed a "Devonian Diorama" (Photo-tab. 8 in Suppl.) along with Carboniferous and Cretaceous, designed in accordance to the data and drawings of the famous Lower Devonian Rhynie Chert in Scotland. As our gardeners were making some simple *Rhynia*-models for this Diorama, we came to the conclusion that the psilotums would be ideal to show to our visitors (mostly children) some similar extant plants, not related to the extinct Devonian rhynias (Psilophytales). Through the *European Botanic Garden Consortium* (EBGC) network we asked for help, which came immediately from our neighbours, the Budapest Botanical Garden of the Eötvös Loránd University **(**ELTE). Our colleagues sent us several young *Psilotum nudiflorum* (L.) P. Beauv. plants, which we incorporated into our exhibition, and afterwards into our glasshouse collection.

OPHIOGLOSSALES Link – Ophioglossaceae Martinov

This order and family of the peculiar-looking "moonworts" consists of 4-10 genera and 55-125 species (depending on the authority), while their classification is still on-going (APweb, 2021). Most of these species have fleshy roots and a single, simple leaf blade with netted venation; spores are short-lived. They are nearly worldwide in their distribution, with age estimated at between 256 and 162 million years (APweb, 2021; literature within).

The eponymous genus *Ophioglossum* holds at least two records in the plant kingdom: for the world's smallest land fern (*O. malviae* Patel & Reddy: ca 1 cm) and the largest

known number of chromosomes (*O. reticulatum* L.: n = 720). Years could pass before the plant sends a leaf above ground, with (or without) a spore stalk. The non-photosynthetic gametophyte meanwhile lives underground, sustained by peculiar soil fungi, not known from any other plants.

In the Croatian flora we have two genera of this family, living shortly growing in the Garden (perhaps not, but when the plants withdraw underground it is quite difficult to maintain the "empty pot" (which our gardeners soon forget), so they were regularly "presumed dead"). *Ophioglossum* is represented by three species, out of which *O. lusitanicum* L. is critically endangered (CR) and strictly protected (FCD, 2021). Most common of three Croatian species in this genus, *Ophioglossum vulgatum* L. (Photo-tab. 5 in Suppl.) is sporadically brought to the Garden from the field, where it can be found in its "regular places" – as is *Botrychium lunaria* (L.) Sw. The genus *Botrychium* is presented in our flora with two species, out of which *B. matricariifolium* (Döll) A. Braun ex W.D.J. Koch is critically endangered (CR) and strictly protected (FCD, 2021). The leaves of *Botrychium* can take up to five years to develop, perhaps a record for land plants (APweb, 2021).

"True" ferns

The position of the first "true" ferns, **Marattiidae/Marattiales**, is still disputed. Some molecular phylogeny research suggests that the [Marattiales + Psilotales] clade could be sister to all leptosporangiate ferns. However, the [Marattiidae + Polypodiidae] clade is more widely accepted. Ferns of this group share compound leaves (fronds) with scales; the gametophyte is green (photosynthetic) and above-ground; plants very often accumulate aluminium. Various authors have suggested ages of this clade between 337 and 329 million years (APweb, 2021 and literature within).

MARATTIIDAE Klinge – MARATTIALES Link – Marattiaceae Kaulf.

Eusporangiate Marattiaceae are considered to be one of the most "primitive" living families of ferns, diverging from other ferns very early in their evolutionary history and quite different from other ferns common in temperate parts of the world. Ferns of this lineage are richly represented in the Permo-Carboniferous fossil records, about 300 million years ago (Photo-tab. 9 in Suppl.). At least five marattiaceous clades lived from side to side of Pangaea before its splitting (APweb, 2021).

Today, the Order consists of just one family with 6 genera and 110 species of pantropical distribution, the estimated age of which is between 236 and 201 million years. Many have massive, fleshy rootstocks and largest known fronds of any (except tree) ferns: up to 9 meters long in *Angiopteris javanica* C.Presl.

Heinz (1895-96) states "Angiopteris longifolia" (val. *A. evecta* (G. Forst.) Hoffm.) to have been living in the glasshouse of the time, but there is no trace of this family's representatives afterwards. In 1925, the spores of several species from *Angiopteris* and *Marattia* (incl. *Eupodium* and *Ptisana*) were inventoried as having arrived, but nothing further. In 2016, we tried to grow *A. evecta* from spores, with poor success.

POLYPODIIDAE Cronquist, Takht. & Zimmer.

The largest clade of extant ferns on Earth, the leptosporangiate Polypodiidae have very strong support and share many common characteristics (APweb, 2021). The polypodiidian gametophyte is cordate and above-ground, with more or less exposed an-

theridia. Blue light stomatal opening response is absent in this group, unlike in all previously described lineages. Sporangia bear 64-800 spores. Tolerance of extreme desiccation is sometimes facultative and scattered through this clade, which occurs in gametophytes, too. The estimated age of Polypodiidae varies from 350 to 170 million of years, according to different reconstructions.

OSMUNDALES Link – Osmundaceae Martinov

This lineage seems to have special position within the leptosporangiate ferns, as their sporangia bear some eusporangiate features, and are strongly supported as being sisters to the rest. A large portion of Osmundales became extinct at the end of the Permian, especially of genera that lived in various damp habitats. For such a small group, there is an extensive literature depicting complex classification relations of extant and extinct osmundaceous taxa (APweb, 2021 and literature within).

Today, there is a single extant family with 1(-6?) genera and 18 species of nearly cosmopolitan distribution. Some of the mutual features are accumulation of SiO_2, green spores and n = 22. The age of this fairly isolated clade is estimated to between 265 and 200 million years, but it has also been suggested that the *Osmunda* clade in particular originated as early as the Carboniferous (ca 323 to 305 million of years). The extinct osmundaceous taxa are particularly interesting, while their fossils have been extremely well preserved: for example, the fossil from Sweden, dated to ca 180 million of years, has anatomy that remarkably resembles living *Osmunda* ("*Claytosmunda*") *claytoniana* L.

A critically endangered (CR) and strictly protected member of the Croatian flora (FCD, 2021), *Osmunda regalis* L. is the largest and most impressive European fern, a deciduous species bearing separate dimorphic (fertile and sterile) fronds. Results of fossil examination show that neither ploidization events nor notable amounts of gene loss have occurred in the genome of the "royal fern" since the Early Jurassic, ca 180 million years ago – which is astonishing to our Garden visitors of all ages, observing the living plants in the Garden since Heinz's times (1895-96). The oldest living in our collections today was brought in 1962 from the Borlin locality near Karlovac, where it vanished since then, due to the unwise habitat changes. Later samples were brought from the Croatian Banovina region, always as living plants (Photo-tab. 10 in Suppl.). Of the mature plant we brought in 2016, I took some spores in 2017 and grew several "babies" in our laboratory, which we planted in the spring of 2021 around their "mother". Heinz (1895-96) also cites "*Todea* sp." of this family, as living in the greenhouse. The later, hand-written inventories named several representatives (incl. *O. gracilis* = val. *O. spectabilis* Willd. and *O. cinnamomea* = val. *Osmundastrum cinnamomeum* (L.) C.Presl), living in the Garden of the time, as seen in Table 1. The list of spores received in 1925 depicts three more: *Osmunda barbara* Moore (? Thunb.; val. *Todea barbara* (L.) T.Moore) and *O. claytoniana* L., which was noted as "possible", so I presume that it sprouted, but the further inventories are lost.

The polypoid clade consisting of [Hymenophyllales, Gleicheniales [Schizaeales [Salviniales [Cyatheales + Polypodiales]]]], is estimated to be between 286 and 273 million years old. The most important trait separating these ferns from the eusporangiate Marattiales (and "transitional" Osmundales) is that their stems have a single apical cell: they are true leptosporangiate ferns.

HYMENOPHYLLALES A.B. Frank - Hymenophyllaceae Martinov

This group of leptosporangiate ferns holds just one family, with 2(-34!) genera and ca 435 species, which are most often epiphytes without mycorrhizal fungi, and filamentous or ribbon-like gametophyte. The age of this group is broadly estimated at between 243 and 176 million years. Hymenophyllaceae are not exclusively tropical plants, but are very vulnerable to desiccation which limits the range of habitats in which they can survive. Often called the "filmy ferns", they are restricted to humid or constantly sprayed places (for instance, under waterfalls or by springs).

Traditionally, two genera of this family were recognized, as in Heinz (1895-96): (1) the mostly terrestrial *Trichomanes* s.l. (now a central genus of the clade Trichomanoideae) with tubular involucres, and (2) the epiphytic *Hymenophyllum* (a single genus of the clade Hymenophylloideae) with bivalved involucres. Heinz (1895-96) cites representatives of both genera as „growing in the greenhouses" of the time: "Trichomanes radicans" (val. *T. speciosum* Willd.) and *Hymenophyllum tunbrigense* (L.) Sm. The latter is of worldwide but discontinuous distribution, in accordance with its special living requirements. It was recognised above Rijeka (the Rječina) for Croatia by Schlosser & Vukotinović (1869), but nobody since them has seen it at the alleged locality. Decades later, it was found again (Hirc, 1903) in Samoborsko gorje, today a Nature Park. In spite of several "sightings" during the 20th century, Trinajstić (1994) claimed that after the 1930s nobody actually had a proof of finding this elusive fern in Croatia.

In our paper-card database there is no trace of this family members being grown in the Garden. I must admit that it is a mystery to me where and how the "filmy ferns" were kept in our Garden in the late 19th century, as we do not have the means to maintain them today, nor have they ever appeared in any of the Garden inventories after Heinz's in 1895.

SCHIZAEALES Schimper

Members of this order share dimorphic (fertile and sterile) fronds. There is a lack of well-defined sori: schizeaceous sporangia have a horizontal annulus encircling the top of the sporangium. The age of this group is estimated to between 218 and 184 million years; it includes 3 morphologically well-distinguished (though disputed) families, with 4 genera and up to ca 200 species. According to the older views, the order consisted of just a single family, the eponymous Schizeaceae s.l.

Ca 100 species of the monotypic **Anemiaceae** Link family are widespread, typically terrestrial or epipetric ferns. In his times, Professor Heinz (1895-96) tagged "Aneimia Phyllitidis" (val. *Anemia phyllitidis* (L.) Sw.) as living in the greenhouse, present also in later inventories (Tab. 1). The monotypic family of climbing ferns, **Lygodiaceae** C.Presl, is distributed along tropical and warm temperate regions. The rachis of each frond is long and flexible, with indeterminate growth, forming climbing or trailing vines. The family has only one genus, *Lygodium*, with ca 20 species, not mentioned by Heinz (1895-96). In the hand-written registries *L. japonicum* (Thunb.) Sw. was inventoried several times (Tab. 1), as well as sprouting among spores received in 1925. Recent specimens, grown in the Garden laboratory, are living in our tropical Victoria glasshouse (Photo-tab. 11 in Suppl.). We have never had representatives of the pantropical-temperate family Schizaeaceae Kaulf. in the recent sense (two genera) in our collections.

SALVINIALES Link

This Order encompasses aquatic and semiaquatic ferns without mycorrhizal fungi. They have dimorphic (fertile and sterile) fronds and sporocarps; the plants are heterosporous; sporangia lack annulus and contain a single megaspore per megasporangium. The age of the order is estimated to be between 186 and 153 million years, including 2 families (Photo-tab. 11 in Suppl.) with 5 genera and 80-odd species.

Mostly tropical to warm temperate, **Salviniaceae** Martinov is a family of free-floating ferns, carrying sessile, 2-ranked, simple fronds with distinctive stomata. It holds two genera, both of which we have representatives in our collections, always inventoried among "water plants", never among ferns. The native Croatian species, *Salvinia natans* (L.) All., has lived in our outdoor and indoor basins since Heinz's (1895-96) time, being required for teaching water repellence of fronds to our students. Though in Croatia not endangered in the wild (even a serious nuisance in fishponds and fish farming basins), *S. natans* is nevertheless statutorily strictly protected, due to the EU-legislation (Bern Convention). During the years, we also had several exotic representatives of the genus *Salvinia* (Tab. 1), which are challenging to keep separated outdoors, due to the transfers between the basins. The American genus *Azolla* ("sp.") was also known to Heinz (1895-96): we always keep *A. filiculoides* Lam. in our collection. All *Azolla* species have obligate association with *Nostoc azollae* cyanobacteria, important nitrogen fixers (APweb, 2021). A second family, **Marsileaceae** Mirb., includes three tropical-temperate genera of (semi)water ferns. Fronds are simple, linear or divided to 2/4 leaflets, characterized by bean-shaped sporocarps and heterosporangiate sori; long and slender rhizomes creep along or beneath the ground. Out of the three genera, we have two in the Croatian flora. The critically endangered (CR) and strictly protected *Pilularia minuta* Durieu was never inventoried in our Garden database, as it never lived long (Dr. Regula, pers. comm.). Endangered (EN) *Marsilea quadrifolia* L. inhabits our outdoor basins since the time of Heinz, who also mentioned some unnamed "other species". We also grew several "water clovers" in our more recent collections (Tab. 1), but *M. quadrifolia* is the most stable; one of 20-odd strictly protected "Natura 2000"-Croatian plant species the conservation of which is important for the EU. We acquired the monotypic *Regnellidium diphyllum* Lindm., representative of the third Marsileaceae-genus, for the first time in 2021 from Bonn Botanical Garden (Germany).

CYATHEALES A.B. Frank

Depending on the authority (literature in APweb, 2021), the order of "tree-ferns" has a single family, Cyatheaceae, with 13 genera and ca 745 species, while other views recognize 8 families (optionally, subfamilies of Cyatheaceae), which are predominantly monotypic. The age of this order is estimated at between 187 and 109 million years.

Cyatheaceae Kaulf. in the modern sense – out of which seven smaller families were extracted – is a family of pantropical ferns with large fronds. This family includes the tallest extant ferns on Earth, some growing up to 20 m high. As suggested by PPG-1 (2016), three genera with more than 600 species are *true* members of Cyatheaceae s.s.: *Cyathea*, *Alsophila* and *Sphaeropteris*, which representatives in the Garden are listed in Table 1. The newly established family **Cibotiaceae** Korall is monotypic: its 10 species are scattered through tropical Central America, Southeast Asia to Malesia and Hawaii. Several species were inventoried in the Garden before WWII (Tab. 1). Members of **Dicksoniaceae** Bower *nom.cons*. never accumulate aluminium; their long, tapering

hairs are composed of cells arranged end to end, unlike the scales characteristic for members of the Cyatheaceae s.s. family. Three genera (*Calochlaena*, *Lophosoria* and *Dicksonia*) with ca 40-50 species have recently been classified in this monophyletic family, out of which we occasionally have dicksonias (Tab. 1; Photo-tab. 12 in Suppl.). The rich fossil record originates from all continents of ex-Gondwana, while their recent distribution is much narrower: tropical America, St Helena, Malesia to the Antipodes and New Caledonia. It seems that some extant *Dicksoniaceae*-species have estimated ages older than the islands they currently inhabit, so understanding the biogeography of the family is still to be solved (APweb, 2021). We have never had representatives from the rest of the "tree-fern" families in our collections, or else they were very short-lived.

POLYPODIALES Link

According to PPG-1 (2016), but not universally accepted, this mega-order includes 25 clearly separated families, and two groups of families of which the mutual boundaries are (so far) highly disputed. Polypoid ferns comprise nearly 90 % of all extant fern species.

A number of small, often monotypic families with ambiguous positions are described (and disputed), leaving the total number of (many!) genera and species highly dependent on the authority consulted. According to APweb (2021, literature within) the morphological traits common for the members of Polypodiales are very general: they share, for example, black, wiry roots; dorsiventral rhizome; vertical annulus interrupted by stalk and stomium, and age estimated between 260 and 150 million of years. As confusing and entangled as the systematic and classification of this large fern group always was, it is clearly reflected in the chaotic paper-cards from our old Garden database: names of species and affiliations to families were sometimes several times changed, with various synonyms marked as non-valid. In Tab. 1 I have tried to affiliate our past and present ferns of this large Order to the recent nomenclature, as much as possible. WFO and PoWO disagree in affiliations of species to genera, and even families, which is truly confusing. Consequently, I have arranged the families alphabetically, according to APweb (2021), and genera according to PoWO, while WFO is soon to be reassembled (as of December, 2021). Still, it is quite confusing in relation to our own database, so I added the affiliation to family with each species, if it is different to APweb/PPG-1.

Most of the Garden fern inventories name polypoid taxa and families.

Out of the monotypic **Lonchitidaceae** Doweld family we had one species (Kovačić, 2015) out of two in total (possibly many more, according to the other sources): *Lonchitis hirsuta* L., affiliated to Pteridaceae and then to **Dennstaedtiaceae** Lotsy. The latter family is much disputed, the range of genera changing many times, hard to follow even in our humble Garden database. According to PPG-1 (2016), 10 genera with 265 species belong to Dennstaedtiaceae, out of which the most common in our collection is *Pteridium aquilinum* (L.) Kuhn. This Croatian native fern was never attributed to this family in our national Floras (or in the Garden), but first to Polypodiaceae, and then to Hypolepidaceae (FCD). To add taxa to Dennstaedtiaceae in our collection, in 2016 we grew *Hypolepis millefolium* Hook. and *Histiopteris incisa* (Thunb.) J. Sm. from spores (Photo-tab. 13 in Suppl.).

Pteridaceae E.D.M.Kirchn. is a family of worldwide distribution (according to PPG-1, 2016), which does not exist according to other authorities (for example, FCD: single

Croatian species of *Adiantum*, *A. capillus-veneris* L., is affiliated to Adiantaceae). Ferns of this clade have bilateral spores; there is no indusium; gametophyte is ribbon-like, and mycorrhizae are not present. They could be epiphytic, xeric or aquatic. Nine genera (disputably) belong here, out of which we have some growing wild in Croatia, and many in the Garden collections since its foundation (Kovačić, 2015; listed in Tab. 1) Today, 53 genera with 1210 species are included in Pteridaceae *sensu* PPG-1 (2016; via APweb, 2021), with most gathered in *Pteris* (250), *Adiantum* (225 – in FCD Adiantaceae), *Cheilanthes* (100 – in FCD Adiantaceae) and *Pellaea* (40).

Besides the taxa of this group which were published in Kovačić (2015), we grew some new plants in 2016: for example, *Llavea cordifolia* Lag., *Hemionitis palmata* L., *Cryptogramma acrostichoides* R.Br., and a rare (or rarely found) species of Croatian flora, *Anogramma leptophylla* (L.) Link (in FCD under Adiantaceae; depicted in Kovačić, 2017). Alongside the data already published for the greenhouses, Heinz (1895-96) does not list any particular species as growing in the open. In the hand-written records, many species of this family could be recognized, but never classified as such, only under other families. For example, the genus *Gymnogramma* Desv. should be a full synonym of *Hemionitis* L., but the particular species often inventoried in our olden collections, *G. aurea* (Willd.) Desv., belongs to two different genera: *Cerosora* according to PoWO, and *Pityrogramma* according to WFO (Tab. 1)! Likewise, *Pteris palmata* Willd. belongs to *Hemionitis* according to PoWO, and *Doryopteris* according to WFO. *Gymnopteris repanda* (Blume) Christ, inventoried in 1958, could be *Bolbitis repanda* (Blume) Schott of Polypodiaceae (PoWO), while WFO recognizes only *G. repandra* Christ – nevertheless, this genus, *Gymnopteris*, is a synonym of either *Leptochilus*, Polypodiaceae (PoWO) or *Hemionitis*, Pteridaceae (WFO)… etc., etc… There are many more examples of this complex systematic in the Polypodiales, all based on molecular results, not on morphology (to be clear), as seen in Table 1 (some representatives of our collection are shown in Photo-tab. 14 in Suppl.).

Where the story of the well-defined (if disputed) families of Polypodiales ends, another one starts: that of the large and unwieldy clade of **Eupolypods** [Eupolypod I + Eupolypod II] sensu PPG-1 (2016, via APweb, 2021). This heterogeneous group includes most of the extant fern taxa, scattered through many families (all heavily disputed). The "eupolypoid" fronds are to 1.5-times pinnate; spores are monolete and reniform; x = 41. The age of this group has been estimated between 116 and 105 million of years.

Eupolypod group I (**'Polypodiineae'**) is a clade (suborder) which includes 9 families: [Didymochlaenaceae [Hypodematiaceae [[Nephrolepidaceae + Lomariopsidaceae] [Dryopteridaceae [Tectariaceae [Oleandraceae [Davalliaceae + Polypodiaceae]]]]]]]. Members of this clade are quite commonly epiphytic, sharing many anatomical and morphological characteristics (such as dense rhizome scales, perhaps protecting the plants against desiccation and aiding in the absorption of water and nutrients). Many taxa of this clade changed affiliations in our Garden database during the years – as described in Kovačić (2015; pg. 369), shortly before the results of *The Pterodophyte Phylogeny Group* (PPG-1) research were published in 2016.

In the past, our Garden "eupolypods-1" were by default affiliated to **Polypodiaceae** J. Presl & C. Presl (*sensu lato* – that is, *sensu* recent "Polypodiineae"). Most of Heinz's (1895-96) outdoor ferns (Croatian native, and exotic) initially belonged here, many of them having been transferred to other families, as literature authorities changed.

Though Heinz recognized fern families of that time, eupolypoid species in our hand-written inventories were (together with all other ferns, equisetums and lycopods) for decades later inventoried under "Filices" (for convenience, I presume), which were after the WWII renamed "Polypodiaceae". In the "new" paper-card database, founded in 1952 (with some back-notes to 1948) ferns were finally placed into proper families.

Beside the glasshouse species in our historic collections (Kovačić, 2015), Heinz (1895-96, p. 15) listed under Polypodiaceae also other native ferns, growing at the time "…around Grotto (Photo-tab. 1): *Aspidium, Asplenium, Athyrium, Ceterach, Scolopendrium, Blechnum, Polypodium, Pteris*, etc." (Tab. 1). As he rarely affiliated species of ferns to the genera, we cannot say today which were there. For example, "Aspidium filix mas" is *Dryopteris filix-mas* for sure; "Ceterach" is almost certainly *Asplenium ceterach*; while "*Scolopendrium"* refers to *Asplenium scolopendrium* of the "Phyllitis /sub/clade". Many of these ferns today do not belong to the Polypodiaceae family *sensu* PPG-1 (2016), as seen in Table 1. However, many disagree (e.g.,PoWO).

So many Polypodiaceae members in the modern sense (reduced to "only" 63 genera) suffer the enormous lists of synonyms and "accepted names" in various printed sources and online databases. The WFO accepts one, PoWO the other, while the Croatian FCD – to which national legislation is related – often gives a third synonym of the same taxon; not to mention that APweb sometimes does not agree with any. The first row of Polypodiaceae family in Table 1 already illustrates this. The "crassifolium" polypoid fern in our collection could belong to at least four genera: following Linnaeus' *Polypodium*, to *Pleopeltis* (in our Garden database), *Niphidium* (according to WFO) or *Campyloneurum* (according to PoWO). The confusion over the changing names of just two of the existing ferns in our temperate glasshouse illustrates this (Photo-tab. 15 in Suppl.). Succeeding the recent views (APweb, 2021 following PPG-1, 2016; amended with many since then published results of various fern investigations), I tried to revise some of our confusing historical nomenclature and synonymy (Tab. 1), partially published in Kovačić (2015).

Almost 90% of all Polypodiaceae are epiphytic (called the "grammitid" ferns), promoting this group as the major "hanging-on"- clade of the Monilophyta in general. Though the first epiphytic fern coming to our minds is probably the giant "stag horn" (*Platycerium* spp., indeed a member of this family), the majority are rather small, "twig" epiphytes (APweb, 2021). Also, there is apparently the secondary association with mycorrhizal ascomycetes, which has developed in the sporophytes (unlike in the epiphytic Hymenophyllaceae, which are non-mycorrhizal), and the polypoid epiphytic ferns seem to be dependent on this association. Many of them trap litter, for example *Drynaria* and *Platycerium* (examples in Photo-tab. 16 in Suppl.).

Cosmopolitan **Dryopteridaceae** Herter *nom.cons*. also are mostly epiphytic ferns, with >3.5 times pinnate fronds. They include 26 genera and ca 2,135 species (PPG-1, 2016): the largest genus is *Elaphoglossum* (620-795 species, of which we have never, since Heinz's times, had representatives), followed by (also Croatian native) *Polystichum* (500) and *Dryopteris* (400). Heinz (1895-96) had these ferns listed under the Polypodiaceae family of his time.

Glasshouse representatives – according to the systematic views before PPG-1 (2016) – were published in Kovačić (2015). Species found in our recovered hand-written plant registries, Croatian native and outdoor species, as well as newly grown and acquired taxa, are listed in Table 1. Genus *Cyrtomium* is a good example of the mixed synonymy

in this family, of which the members often changed their affiliation: in our database, at first, mostly because of the lack of literature – and then, lately, because of the plethora of sources. Three species which we grew in our collections were systematized under three different families: first as Polypodiaceae, then Aspidiaceae, and finally Dryopteridaceae. The 'Japanese holly-fern' (*Cyrtomium falcatum* (L.f.) C.Presl) is a newcomer to the Croatian flora, for the first time noted as an escapee from cultivation on the walls of the Old City in the Island of Rab (Trinajstić & Španjol, 1994), and by now scattered down the Croatian coast to the Old City walls of Dubrovnik (FCD, 2021).

Croatian common Dryopteridaceae members include *Dryopteris* with 10 species (examples in Photo-tab. 17 in Suppl.), and *Polystichum* with four species and two hybrids (Photo-tab. 18 in Suppl.), one of which is a statutorily strictly protected endemic hybrid *P.* x *illyricum* (Borbás) Hahne (Tab. 1), also popular in horticulture.

Monotypic "PPG-1-families", excluded from Polypodiaceae s.l. on the basis of a single genus (or even species), are disputed – also in our collections. For example, the pantropical *Didymochlaena truncatula* (Sw.) J.Sm. (with 20-odd synonyms) gets its own, monotypic family Didymochlaenaceae L.-B. Zhang & L. Zhang, which is not recognized by either PoWO (Polypodiaceae) or WFO (Hypodematiaceae). Professor Heinz (1895-96) mentioned "Didimochlaena" under Polypodiaceae, and afterwards *Didymochlaena sinuata* Desv. (val. *D. truncatula* (Sw.) J.Sm.) could be found just once, in the hand-written inventory of 1904 (Tab. 1). The predominantly South-East-Asian **Davalliaceae** M.R. Schomb. are also monotypic (*Davallia* with 65 species) according to PPG-1 (2016), while other views divide *Davallia* into up to seven genera, and both principles are equally disputable (Christenhusz & Chase, 2014). Representatives of this family in our glasshouses were published in Kovačić (2015): since then, we grew two new species from spores (Photo-tab. 19 in Suppl.).

PoWO places **Tectariaceae** Panigrahi to the large Polypodiaceae family. These (often climbers) are pantropical, with 7 genera out of which the largest is *Tectaria* (210 species). In addition to our old *Tectaria cicutaria* (Photo-tab. 19 in Suppl.), in 2016 we grew *T. zeylanica* (Houtt.) Sledge (syn. *Quercifilix zeylanica*) from spores, a pretty little fern suitable for terrariums.

Family **Nephrolepidaceae** Pic.Serm. contains the sub/tropical genus *Nephrolepis* with 20 or 30-odd taxa, which PoWO again attributes to Polypodiaceae. In the Garden database affiliated to Davalliaceae or Dryopteridaceae, our glasshouse 'sword ferns' were published in Kovačić (2015), while some new or previously "misplaced" plants (Photo-tab. 20 in Suppl.), are listed in Table 1. It is interesting that, among so many ferns of his time, Heinz did not mention this horticulturally famous genus as existing in our collections of 1895, which is hard to believe: there are at least a hundred different cultivars of 'Boston fern' (*N. exaltata* (L.) Schott) alone, many regularly inventoried in our later handwritten registries (though the "names" of these cultons today are mostly unknown and difficult to trace, Tab. 1).

Eupolypod II ('**Aspleniinae**') is a clade/suborder that includes 11 families: [Cystopteridaceae [[Rhachidosoraceae [Diplaziopsidaceae [Desmophlebiaceae [Hemidictyaceae + Aspleniaceae]]]] [Thelypteridaceae [Woodsiaceae [Athyriaceae [Blechnaceae + Onocleaceae]]]]]].

As the families of Eupolypod I-clade could be seen as subfamilies of the large Polypoidaceae s.l., so the families of Eupolypod II-clade could be seen as subfamilies of the widely distributed **Aspleniaceae** Newman *nom.cons.* Unlike many previous classifica-

tions (also in our Garden), this "old" family in its "new" classification (according to PPG-1, 2016) is *monotypic*: strictly speaking, it holds just the eponymous *Asplenium* (or perhaps also, the not widely recognized *Hymenasplenium* and *Hemidictyum*) – needless to say, a view which is highly disputed. This "supergenus" is indubitably paraphyletic, including more than 40 formerly described genera, with ca 700 species (APweb, 2021 and literature within). Some of the characteristics common to these (very variable) "new Aspleniums" are: fronds with decurrent margins and lateral ridges along rachis'; often epiphytic and litter trapping plants.

To add to the data published by Heinz (1895-96) and Kovačić (2015), we have grown different outdoor 'spleenworts' in the Garden for decades (Tab. 1). There are 20, often lithophytic, *Asplenium*-taxa in Croatian flora, mostly under the older synonymy according to the botanic sources used in this part of Europe (extensive literature could be found in FCD). For example, the original 'Linnean' name *A. trichomanes-ramosum* L. was at its time widely accepted, but in "everyday use" was *A. viride* Huds., today valid for both WFO and PoWO. *Asplenium ceterach* L. (PoWO, 2021; also FCD, 2021) is again a "more popular" *Ceterach officinarum* Willd. (WFO, 2021), while *A. scolopendrium* L. was always better known as *Phyllitis scolopendrium* (L.) Newman (in Heinz's times *Scolopendrium phyllitis* Roth). Statutorily strictly protected, the endemic *A. hybridum* (Milde) Bange is *nomen conservandum* of Croatian flora (FCD, 2021; also PoWO, 2021), though *Phylitopsis hybrida* (Milde) T.Reichst according to WFO (2021). In 2017, we grew some from spores (Photo-tab. 21 in Suppl.) brought by Dr Vedran Šegota from the Island of Rab. Critically endangered (CR), elusive *A. sagittatum* (DC.) Bange, which Dr Šegota also brought from the single confirmed Croatian locality in the Island of Krk, sprouted very poorly and lived just briefly.

Members of the "aspleniinian" family **Cystopteridaceae** Schmakov share long-creeping rhizomes; veins reach the frond margins; hood-like or unresisting indusium; n = 40. To the recent views, three genera belong here (Heinz did not list any). PoWO does not recognize this family but classifies its genera under Aspleniaceae. *Cystopteris fragilis* (L.) Bernh. and *Gymnocarpium robertianum* (Hoffm.) Newman are Croatian native, which we brought many times from the field research and planted in our rockeries with autochthonous species. Being the mountainous plants, they dislike hot and dry Zagreb summers, and withered soon. According to FCD, both genera belong to the Woodsiaceae family, as does *Athyrium* (Athyriaceae), *Matteucia* (syn. *Onoclea*; Onocleaceae) and *Woodsia* (the single Croatian representative of the genus, *W. ilvensis* (L.) R.Br., was never inventoried in our collections). The modern view of the mostly montane, northern hemisphere 'cliff-ferns', **Woodsiaceae** Herter differs from the FCD's: it (disputably) includes a single genus (*Woodsia*, with up to 50 species; APweb, 2021), and it is a sister to the rest of the 'Aspleniinae'. PoWO does not recognize this monotypic family, but includes this genus in Aspleniaceae. We grew three *Woodsia*-species in 2016 (Tab. 1), out of which *Woodsia plummerae* Lemmon is the hardiest. Several examples of Cystopteridaceae and Woodsiaceae can be seen in Photo-tab. 22 in Suppl.

The mostly terrestrial, understory **Athyriaceae** Alston encompasses 2(3-7) genera with a few constant features by which they can be identified as members of this (disputed) family (for instance, sporangia have stalks two or three cells wide in the middle, brown monolete spores). We are growing three *Athyrium*-taxa in our *fernarium*, out of which the cosmopolite *A. filix-femina* (L.) Roth is a Croatian native (Tab. 1; Photo-tab. 23 in Suppl.). It is, traditionally, grown side-by-side with *Dryopteris filix-mas* (L.) Schott,

as the "pair" is in Latin, and many other languages, called the 'lady fern' (Croat. "ženska paprat"; Lat. *filix-femina*) and the 'male fern' (Croat. "muška paprat"; Lat. *filix-mas*). This evokes the "Shakespearian" and much older times, when the world of ferns was poorly understood (*"We have the receipt of fern-seed, we walk invisible."* – "Henry IV, Part 1", Act 2, Scene 1). Mature fronds of Athyriaceae are often abundant in anthocyanins (APweb, 2021), a feature happily used in horticulture.

The "Aspleniinian" clade of [Blechnaceae + Onocleaceae]] is morphologically characterized by dimorphic (fertile and sterile) fronds, for which they are also popular in horticulture. Northern-hemisphere **Onocleaceae** Pic.Serm. have four genera with five species in total. Croatian native is *Matteucia* (*Onoclea*) *struthiopteris* (L.) Tod., grown in our older collections, and flourishing in our *fernarium* for years (Photo-tab. 24 in Suppl.). *Onoclea struthiopteris* was noted in the Registry of Spores Received in 1925, separately from *Matteucia struthiopteris* Tod. and *Struthiopteris germanica* Willd., showing that the synonymy was already complex to navigate. *Onoclea sensibilis* L. was inventoried in 1904 and again in 1963 (Tab. 1); we acquired some young plants in 2021. Fossils of this species are known from Palaeocene North America (62-58 million of years ago), being remarkably similar to the extant individuals.

Cosmopolitan **Blechnaceae** Newman have reddish young fronds (Photo-tab. 25 in Suppl.) with linear sori. The family includes 24 genera (with many synonyms), out of which we have (or had) in the Garden representatives of *Blechnum, Doodia* and *Stenochlaena* (Kovačić, 2015; Tab. 1). There is a significant discrepancy in affiliation species and genera, according to PoWO and WFO. For example, our old *S. tenuifolia* (Desv.) Moore (val. *Lomariopsis tenuifolia* (Desv.) Christ) according to PoWO) belongs to the Polypodiaceae – not even Aspleniaceae – family. The acidophilic *Blechnum spicant* (L.) Roth is the only member of this family in Croatian flora, grown on-and-off (with poor success) for years. In 2016 we grew 3 subspecies' of *Blechnum penna-marina* (Poir.) Kuhn, *Woodwardia orientalis* Sw. and, after a long while, *Blechnum brasiliense* Desv. again, which we had in our older collections (Tab. 1).

The terrestric **Thelypteridaceae** Pic.Serm. have an especially problematic range of 8 to 30 genera, with more than 1000 species (APweb, 2021). 'Thelypteroid' ferns were often included in *Dryopteris*, and when you grow them side by side, you can see why: morphologically, they could be very similar. However, there are many differences between the two groups (as *Dryopteris* belong to "polypodiinean" and *Thelypteris* to "aspleniinean" ferns), supported by genetic evidence, which shows that Thelypteridaceae are clearly monophyletic. However, the division of taxa into genera has been described as "highly controversial and fluctuating" (Hassler & Schmitt, 2021); PoWO does not recognize this family, and even places some genera into Polypodaceae. Consequently, it is really hard for me to say, at this moment, whether Heinz (1895-96) had some representatives of 'thelypterioids' in the Garden collections, as the synonymy is overwhelming. For example: we have had the Croatian native *Thelypteris palustris* Schott (orig. *Nephrodium thelypteris* (L.) Strempel, Dryopteridaceae) in the Garden since 1962 (Photo-tab. 26 in Suppl.); the synonymy of this plant is utterly confusing (Tab. 1). WFO does not recognize synonymy of the classic South-European taxa, proposed by the first explorers of this part of Europe, whose works are fundamental to our local and regional Floras (e.g.., Hayek, Visiani, Javorka, etc.). In 2016 we tried to grow several representatives of *Thelypteridaceae* for our *fernarium* (Tab. 1), with moderate success.

CONCLUSIONS

According to the new and some old (recovered) sources, I have amended the historical data of the ferns growing in Botanical Garden since 1895 until the end of 2021 (Tab. 1). Though the synonymy of taxa is immense, and many of the old entries were registered without the authors of plant names, my educated guess at this point is that we had in our Garden collections around 376 species of ferns, including, presumably, Heinz's ca 35 in 1895, from 29 families. At this moment (December, 2021) we grow 86 taxa from 20 fern families, including Equisetaceae and Psilotaceae.

Annus Horribilis of 2020, which brought not only COVID-19 pandemic with lockdowns at planetary level, but also severe earthquakes and floods to Zagreb in particular, directly and indirectly diminished our collections. Consequently, among other things, we lost a lot of ferns grown from spores and kept in our warm greenhouses, due to the weather extremes and loss of heating while temperatures dropped below 0° C. The year 2021 was not much better.

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ZAKLJUČCI

Prema novim i nekim starim (naknadno pronađenim) izvorima, dopunjeni su povijesni podaci o papratnjačama u zbirkama Botaničkog vrta između 1895. i kraja 2021. (Tablica 1 u Dodatcima). Kako je sinonimika paprati nepregledna, a mnogi stari unosi zabilježeni bez autora vrste, pretpostavljam da je kroz naše zbirke dosada prošlo oko 376 vrsta papratnjača, uključujući 35 Heinzovih iz 1895., iz oko 29 porodica. U ovom trenutku (prosinac 2021.) uzgajamo 86 svojti iz 20 porodica, uključujući Equisetaceae i Psilotaceae.

Annus Horribilis 2020. – koja nije donijela samo pandemiju bolesti COVID-19 s prestankom rada na planetarnoj razini, nego i razorne potrese i velike poplave posebno Zagrebu – izravno i neizravno utjecala je i na naše zbirke. Posljedično, između ostalih vrsta, izgubili smo više svojta paprati uzgojenih iz spora i držanih u našim toplim staklenicima, zbog vremenskih ekstrema i obustave grijanja u duljem razdoblju kad su vanjske temperature pale ispod 0° C.

Godina 2021. nije bila puno bolja.

Primljeno 10. siječnja 2022

REFERENCES

Angiosperm Phylogeny Website (APweb; 2001 onwards). Version 14, July 2017 [and more or less continuously updated since]. http://www.mobot.org/MOBOT/research/APweb/

Birkenhead, J., 1892: Ferns and Fern Culture: Their Native Habitats, Organisation, Habits of Growth, Compost for Different Genera; Cultivation in Pots (…) Available at: https://books.google.hr/books/about/Ferns_and_Fern_Culture.html?id=j53uxwEACAAJ&redir_esc=y

Buggs, R.J.A., 2021: The origin of Darwin's "abominable mystery". American Journal of Botany **108**(1), 22-36. doi:10.1002/ajb2.1592

Christenhusz, M.J.M. & Chase, M. W., 2014: Trends and concepts in fern classification. Annals of Botany **113**(9), 571–594. doi:10.1093/aob/mct299

Christenhusz, M.J.M. & Chase, M. W., 2018: PPG recognises too many fern genera. Taxon **67**(3), 481–487. doi:10.12705/673.2

Christenhusz, M.J.M., Bangiolo, L., Chase, M.W., Fay, M.F., Husby, C.E., Witkus & M., Viruel, J. 2019: Phylogenetics, classification and typification of extant horsetails (*Equisetum*, Equisetaceae). Botanical Journal of the Linnean Society **189**(4), 311–352. doi:10.1093/botlinnean/boz002

Dietrich, F. G., 1829: Handlexikon der Gärtnerei und Botanik oder alphabetische Beschreibung vom Bau, Wartung u. Nutzen (…). Berlin: Bethge.

Engler, A., 1892: Syllabus der Vorlesungen über specielle und medicinisch-pharmaceutische Botanik. Eine Übersicht über das gesammte Pflanzensystem mit Berücksichtigung der Medicinal- und Nutzpflanzen (1st ed.). Berlin: Gebrüder Bornträger Verlag.

Engler, A. & Prantl, K. eds., 1887–: Die Natürlichen Pflanzenfamilien nebst ihren Gattungen und wichtigeren Arten, insbesondere den Nutzpflanzen, unter Mitwirkung zahlreicher hervorragender Fachgelehrten (in German; 33 parts in 23 volumes). Leipzig: W. Engelmann.

Ettinger, J., 1892: Botanički vrt kr. sveučilišta Franje Josipa I. u Zagrebu. Šumarski list **9-10**, 409-422.

Flora Croatica Database (FCD), 2021: http://hirc.botanic.hr/fcd. [accessed December 2021]

GBIF Backbone Taxonomy. *Gymnogramma gloriosa* Hort. (in Tab. 1) https://www.gbif.org/es/species/6035185. Accessed via GBIF.org December 2021]

Hassler, M. & Schmitt, B., 2020: Thelypteridaceae. Checklist of Ferns and Lycophytes of the World. 8.20. [accessed December 2021]

Heinz, A., 1892: Über *Scolopendrium hybridum* Milde. Berichte der Deutschen Botanischen Gesellschaft **10**, 413-422.

Heinz, A., 1895-96: Kr. Botanički vrt u Zagrebu. Glasnik Hrvatskoga naravoslovnoga družtva **8**(1-6), 1-54.

Hidalgo, O., Pellicer, J., Christenhusz, M.J. M., Schneider, H. & Leitch, I.J., 2017: Genomic gigantism in the whisk-fern family (Psilotaceae): Tmesipteris obliqua challenges record holder Paris japonica. Botanical Journal of the Linnean Society **183**(4), 509–514.

Hirc, D., 1903: *Hymenophyllum tunbrigense*. Glasnik Hrvatskoga naravoslovnoga družtva **14**, 455.

Hooker, W.J., 1785-1865: Species filicum; being descriptions of the known ferns, particularly of such as exist in the author's herbarium(…). London, W. Pamplin.

Kovačić, S., 2015: Plethora of plants – Collections of the Botanical Garden, Faculty of Science, University of Zagreb (1): Temperate glasshouse exotics – historic overview. Natura Croatica **24**(2), 361-428 (397*).

Kovačić, S., 2017: Tankolisni golič (*Anogramma leptophylla* (L.) Link) u uzgoju Botaničkog vrta PMF-a u Zagrebu. Glasnik Hrvatskog botaničkog društva **5**(2), 14-17.

Kovačić, S., 2018: "Lost Worlds of Archaic Gardens" – 2018 Exhibition in the Botanical Garden of the Faculty of Science, University of Zagreb. Acta Botanica Croatica 77(1), S1-S2.

Mendoza, A., Pérez-García, B. & Rib, R., 1999: Morfología y anatomía del gametofito de *Didymochlaena truncatula* (Dryopteridaceae). Revista de Biología Tropical **47**(1-2), 93-99. (in Tab. 1)

Pteridophyte Phylogeny Group (PPG-1), 2016: "A community-derived classification for extant lycophytes and ferns". Journal of Systematics and Evolution **54**(6): 563–603. doi:10.1111/jse.12229

Schlosser, J.C.K. & Vukotinović, Lj., 1869: Flora Croatica. Sumptibus et auspiciis academiae scientiarum et articum slavorum meridionalium. Zagreb, I-CXLI, 1-1362.

Schuettpelz, E., Rouhan, G., Pryer, K.M., Rothfels, C. J., Prado, J., Sundue, M.A., Windham, M.D., Moran, R.C. & Smith, A.R., 2018: Are there too many fern genera? Taxon **67**(3), 473–480. doi:10.12705/673.1

Smith, A.R., Pryer, K.M., Schuettpelz, E., Korall, P., Schneider, H. & Wolf, P.G., 2006: A classification for extant ferns. Taxon **55**(3), 705–731.

Trinajstić, I., 1995: Samoborsko gorje, a Refuge of various floral elements between the Alps and the Dinaric Mountains. Acta Botanica Croatica **54**(1), 47-62.

Trinajstić, I. & Španjol, Ž., 1994: *Cyrtomium falcatum* (L. fil.) C. Presl. (Polystichaceae), a newcomer to Croatian flora. Natura Croatica **3**, 87-90.

World Flora Online (WFO, 2021): Published on the Internet; http://www.worldfloraonline.org/. [accessed December 2021]

Photo-tables 6-26 are available in Supplement, only in online version of this article.

All photos were taken by the Author.

Photo-tab. 6: Early predecessors of horsetails: ab) *Sphenophyllum alatifolium* had large, whorled, and sometimes deeply lobed leaves with dichotomous venation, suggesting that the tiny leaves of extant *Equisetum* may be reduced megaphylls, rather than true microphylls. (Detail from the Garden exhibition in 2018). Famous c) *Annularia stellata* d) and *Astrophyllites equisetiformis* were already *Equisetum*-like plants (Fossils from the Garden collection, originating from Spain).

Photo-tab. 7: Horsetails in the Garden: a) *Equisetum arvense* was subjected to various investigations during the centuries; a1) non-photosynthetic strobili, produced early in spring. b) *E. telmateia,* with its b1) "unkempt", hair-like long leaves arranged in whorls. c) *E. fluviatile* is the first recorded horsetail in our collection; c1) whorls of short ascending and spreading branches, c2) strobili on top of the photosynthetic branches. d) *E. giganteum* 'El Tabacal' with a backdrop of *Matteucia struthiopteris* in our *fernarium*.

Photo-tab. 8: a) Diorama of the Rhynie chert in Scotland, with home-made prototaxite and a geyser. b) Detail of Devonic diorama with "rhinias". c) Branch of *Psilotum nudum*, perfectly – though falsely – imitating dichotomous branching of the earliest land plants.

Photo-tab. 9: Marattiales: a) Mature specimen of *Angiopteris evecta* in collection of ancient plants of the Jardin botanique de la Ville de Paris. b) Gametophytes (prothalia) of *A. evecta* grown in our Garden laboratory (sadly, never produced sporophytes). c) *Polymorphopteris magdalenae* and d) *Seftenbergia grunerii*, some of the extinct marattiaceous ferns in the Botanical Garden fossil collection.

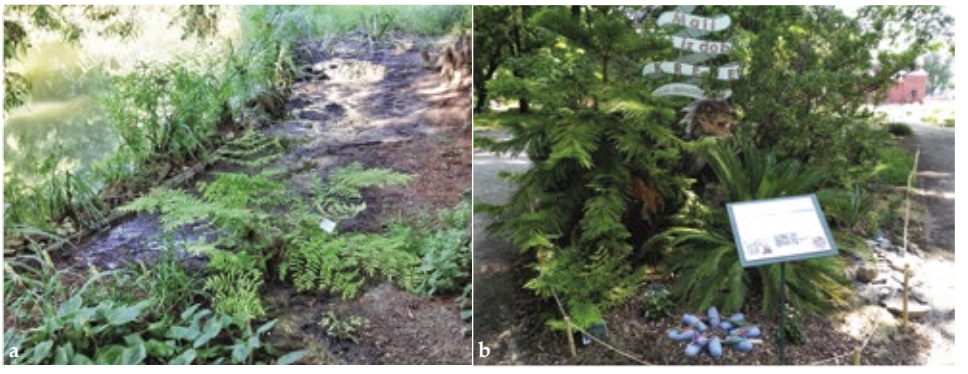

Photo-tab. 10: Osmundales: a) *Osmunda regalis* lives happily in our Garden *fernarium*, as well as in several other places outdoors, though never reaching the 3-meter-height, as in nature. b) In the Exhibition of 2018, the "royal fern" gets a special place (bottom left) in our little "Cretaceous garden", with other ancient plants from our collections.

Photo-tab. 11: Schizeales: a) *Lygodium japonicum* (Lygodiaceae) climbing from the hanging baskets of the Garden's *Victoria house*. **Salviniales**: b) *Salvinia natans* and *Azolla filiculoides* (Salviniaceae) together in the *Victoria house*. c) *Marsilea quadrifolia* and d) *Regnellidium diphyllum* (Marsileaceae) are inhabitants of the outdoor basins.

Photo-tab. 12: Cyatheaceae: a) *Dicksonia antarctica* in the Garden fernarium overwinters indoors. cd) *Cibotium regale, Dicksonia antarctica* and *Sphaeropteris (Cyathea) cooperi* grown in our Garden laboratory.

Photo-tab. 13: Dennstaedtiaceae: a) Croatian native, *Pteridium aquilinum* lives in the Garden fernarium. b) *Hypolepis millefolium* and c) *Histiopteris incisa* grown in our Garden laboratory, live indoors.

Photo-tab. 14: Pteridaceae: The "maidenhair ferns" prefer moist, well-drained sites: a) *Adiantum caudatum,* b) *A. macrophyllum,* c) *A. trapeziforme* and d) *Bolbitis heteroclita.* So-called "cheilanthoid ferns", some 400 or more species, can grow in very dry conditions: e) *Cheilanthes lanosa,* f) *Cryptogramma acrostichoides,* g) *Hemionitis palmata* and h) *Llavea cordifolia.* Many are epiphytes, preferably grown in terrariums: i) *Microgramma pilloseloides* and j) *Pellaea rotundifolia.* Some species hyperaccumulate arsenic, while other could be invasive: k) *Pteris cretica* 'Albolineata' and l) *Pteris multifida.*

Photo-tab. 15: Polypodiaceae 1: a-d) Data-cards of *Microsorum punctatum* and *Niphidium* (*Campyloneurum*) *crassifolium*, with many synonyms in WFO/PoWO databases each, changed their names in our Garden database no fewer than six times. The synonymy between *Polypodium-Phyamatodes-Selliguea-Microsorum-Cochlidium* taxa is very hard to navigate – even worse is the synonymy of *Polypodium-Phyamatodes-Pessopteris-Pleuririum-Niphidium-Campyloneurum*. e) *Microsorum punctatum* and f) *Niphidium* (*Campyloneurum*) *crassifolium*.

Photo-tab. 16: Polypodiaceae 2: Three taxa of bright green stag horns in our collection: a) *Platycerium bifurcatum*, b) *P. alcicorne* and c) *P. willinckii* are epiphytic, as well as bluish d) *Belvisia* (*Lepisorus*) *platyrhynchos* and e) *Phlebodium aureum* 'Umbellatum'. Two Croatian native polypodiums: f) *P. vulgare* and g) *P. cambricum* might be similar in appearance, but differ in lifestyle (evergreen vs. deciduous).

Photo-tab. 17: Dryopteridaceae 1: ***Dryopteris***: brightly coloured East-Asian a) *D. erythrosora,* Croatian native b) *D. filix-mas;* American c) *D. goldieana* and subtropical d) *D. pseudocaenopteris* (*Peranema aspidioides*) with hairy young leaves, living in the greenhouse.

Photo-tab. 18: Dryopteridaceae 2.: ***Polystichum***: Croatian native species (c) clearly differ during the wintertime: a) *P. setiferum* is mostly deciduous, while b) *P. aculeatum* is evergreen. The famous ornamental d) *P. setiferum* 'Plumosum Densum' rarely overwinters with fronds.

Photo-tab. 19: Davalliaceae: a) *Davallia solida* ('Superba'), b) *D. (Humata) pectinata*, c) *D. embolostegia* grown from spores. **Tectariaceae**: d) *Tectaria (Quercifilix) zeylanica* grown from spores, e) *T. cicutaria* bearing button-like bulbils (propagules) at pinnae axils.

Photo-tab. 20: Nephrolepidaceae: a) *Nephrolepis exaltata* 'Selecta' lives in our collection since 1963, and along the regular fronds it sprouts b), the feathery ones. c) Old *N. exaltata* planted permanently in our *fernarium*. d) *N. exaltata* aff. 'Curly Locks' sprouted in 2016, among germinating spores. e) *N. cordifolia* aff. 'Duffii', popular "Lemon Button Fern".

Photo-tab. 21: Aspleniaceae: abc) *Asplenium ruta-muraria* on the stone-walls of our Faculty building. d) *A. adiantum-nigrum* and *A. trichomanes-ramosum* (*A. viride*) are sensitive species of Croatian flora, while e) *A. trichomanes* is even frost-tolerant. f) *A. scolopendrium* lives in our *fernarium* "since forever". g) *A. hybridum* is a stenoendemic of NE Adriatic islands, grown from spores for our glasshouse collection, where exotic spleenworts permanently live: for example, h) large *A. nidus* or i) invasive *A. viviparum*, etc.

Photo-tab. 22: Cystopteridaceae: a) *Cystopteris tasmanica* grown from spores. **Woodsiaceae**: b) young plants grown from spores. c) Young *Woodsia plummerae*. d) Older individuals of *W. plummerae* planted in our *fernarium* are deciduous.

Photo-tab. 23: Athyriaceae: a) *Athyrium filix-femina* growing side-by-side with its famous cultivar b) 'Frizelliae'. c) *A.* (*Anisocampium*) *niponicum* 'Metallicum', with beautifully coloured fronds.

Photo-tab. 24: Onocleaceae: Life cycle of *Matteucia (Onoclea) struthiopteris*: sterile fronds in ab) Spring, and cd) Summer. ef) Young and mature fertile fronds.

Photo-tab. 25: Blechnaceae: a) *Blechnum brasiliense* grown from spores b) in 2016 have lovely reddish c) young fronds. d) Croatian native, *B. spicant* is a characteristic species of dark fir forests (*Blechno-Abietetum*) in the mountain region. e) *B. penna-marina* grown from spores, as well as f) young *Woodwardia orientalis*.

Photo-tab. 26: Thelypteridaceae: a) Croatian native *Thelypteris palustris*. b) *Th. cordata* was purchased, while from spores were grown c) *Th. (Parathelypteris) beddomei* and d) *Th. kunthii*.

Tab. 1.

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Order/clade & Family: **EQUISETALES – Equisetaceae** (PPG-1, 2016 via APweb, 2021)							
Equisetum L.	Equisetum L.	Equisetum spp.	*yes*				"various, by the Grotto"
Equisetum arvense L.	Equisetum arvense L.	E. arvense L.				Zagreb, Sava river banks 2018	spreading locally
Equisetum fluviatile L.	Equisetum fluviatile L.	E. limosum				1958	
		E. fluviatile L. (= E- limosum L."				Zagreb Nursery 1961	
Equisetum giganteum L. (cult.)	Equisetum giganteum L. (cult.)	E. 'El Tabacal'				Vodnjan Nursery 2018	Equisetum giganteum L. 'El Tabacal'
Equisetum hyemale L.	Equisetum hyemale L.	Equisetum hiemale L.		*1917*			Hand-written inventoy of Medicinal plants
Equisetum pratense Ehrh.	Equisetum pratense Ehrh.	E. pratense Ehrh.				NP Medvednica 2021	
Equisetum sylvaticum L.	Equisetum sylvaticum L.	E. silvaticum L.				Tabačka ravan (Bosnia & Herc.) 1972	
		E. sylvaticum L.				Zalesina 1977	
Equisetum telmateia Ehrh.	Equisetum telmateia Ehrh.	E. telmateia Ehrh.				Ivanščica Mt 2004	
		E. telmateia Ehrh.				NP Žumberak 2018	
		E. telmateia Ehrh.				Zagreb, Sava river banks 2021	
Order/clade & Family: **PSILOTALES – Psilotaceae** (PPG-1, 2016 via APweb, 2021)							
Psilotum nudum (L.) P. Beauv.	Psilotum nudum (L.) P. Beauv.	Psilotum nudum	*yes*				listed in Registry of spores, 1925/26
		P. nudum (L.) P. Beauv.				ELTE Budapest (Hungary) 2017	
Order/clade & Family: **OPHIOGLOSSALES – Ophioglossaceae** (PPG-1, 2016 via APweb, 2021)							
Botrychium lunaria (L.) Sw.	Botrychium lunaria (L.) Sw.	B. lunaria Swartz				NP Velebit 1975	short living above-ground
Ophioglossum vulgatum L.	Ophioglossum vulgatum L.	O. vulgatum L.				NP Velebit 2013	short living above-ground
		O. vulgatum L.					Several before, uninventorized
Order/clade & Family: **MARATTIALES – Marattiaceae** (PPG-1, 2016 via APweb, 2021)							
Angiopteris evecta (G. Forst.) Hoffm.	Angiopteris evecta (G. Forst.) Hoffm.	Angiopteris longifolia	*yes*				
		A. evecta Hoffm.				Vienna-Belvedere (Austria) 2017	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Order/clade & Family: **OSMUNDALES – Osmundaceae** (PPG-1, 2016 via APweb, 2021)							
Osmunda claytoniana L.	Osmunda claytoniana L.	O. claytoniana		*1926*			sprouted in 1926 (register of spores)
Osmunda regalis L.	Osmunda regalis L.	Osmunda regalis		*1904*			
		O. regalis	*yes*				"outdoors"
		O. regalis L.				Borlin, Karlovac 1962	
		O. regalis L.				Glina, Banovina 2016	in 2018: new plants from those spores
Osmunda spectabilis Willd.	Osmunda gracilis Link (ambig.)	O. gracile		*1904*			
Osmundastrum cinnamomeum (L.) C.Presl	Osmundastrum cinnamomeum (L.) C.Presl	Osmunda cinnamomea		*1904*			
Todea Willd.	Todea Willd. ex Bernh.	Todea spp.	*yes*				
Order/clade & Family: **HYMENOPHYLLALES – Hymenophyllaceae** (PPG-1, 2016 via APweb, 2021)							
Hymenophyllum tunbrigense (L.) Sm.	Hymenophyllum tunbrigense (L.) Sm.	Hymenophylum tunbridgense	*yes*				extinct in Croatia
Trichomanes radicans Sw.	Vandenboschia radicans (Sw.) Copel.	Trichomanes radicans	*yes*				
Order/clade & Family: **SCHIZEALES – Anemiaceae** (PPG-1, 2016 via APweb, 2021)							
Anemia phyllitidis (L.) Sw. (Schizeaceae)	Anemia phyllitidis (L.) Sw.	Aneimia Phyllitidis	*yes*	*1904 191?*			
Anemia mexicana Klotzsch (Schizeaceae)	Anemia mexicana Klotzsch	A. mexicana Klotzsch				München (Germany) 2016	
Anemia rotundifolia Schrad. (Schizeaceae)	Anemia rotundifolia Schrad.	A. rotundifolia Schrad.			*yes*		
Order/clade & Family: **SCHIZEALES – Lygodiaceae** (PPG-1, 2016 via APweb, 2021)							
Lygodium japonicum (Thunb.) Sw. (Schizeaceae)	Lygodium japonicum (Thunb.) Sw.	Lygodium japonicum (Sw.)		*1904 191?*			
		L. japonicum (Thunb.) Sw.			*yes*		
		L. japonicum (Thunb.) Sw.				Vienna-Belvedere (Austria) 2016	
Lygodium palmatum (Bernh.) Sw. (Schizeaceae)	Lygodium palmatum (Bernh.) Sw.	Ligodium palmatum		*1922*		1932	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Order/clade & Family: **SALVINIALES – Salviniaceae** (PPG-1, 2016 via APweb, 2021)							
Azolla Lam.	Azolla Lam.	Asolla	*yes*				
Azolla caroliniana Willd.	Azolla caroliniana Willd.	Azolla caroliniana Willd.		*1920*			Hand-written inventory
		Azolla caroliniana Willd.		*1948*		Oslo 1948	Living specimen
		A. filiculoides Lam.				1961	
		A. filiculoides Lam.				Basel (Germany) 1971	
Salvinia auriculata Aubl.	Salvinia auriculata Aubl.	S. auriculata		*1920* *1938*			Hand-written inventory
		S. auriculata Aubl.*				1963	*changed to S. molesta D.S.Mitch. acc. to TROPICOS
Salvinia minima Baker	Salvinia minima Baker	S. minima Baker				Berlin-Dahlem (Germany) 2013	
Salvinia natans (L.) All.	Salvinia natans (L.) All.	Salvinia natans	*yes*			"from Osijek vicinity"	
		S. natans All.		*1948*		Oslo 1948	Living specimen
		S. natans Hoffm.				1961	
Order/clade & Family: **SALVINIALES – Marsileaceae** (PPG-1, 2016 via APweb, 2021)							
Marsilea L.	Marsilea L.	Marsilia	*yes*				"fam. Marsiliaceae"
Marsilea drummondii A. Braun	Marsilea drummondii A. Braun	Marsilia drummondii A. Br.				1961	
		Marsilia drummondii A. Br.				Strassbourg (France) 1965	
		Marsilea drummondii A. Br.				Göttingen (Germany) 1969	
Marsilea hirsuta R. Br.	Marsilea hirsuta R. Br.	M. hirsuta R. Br.				Göttingen (Germany) 1969	
Marsilea macropoda Engelm. ex A. Braun	Marsilea macropoda Engelm. ex A. Braun	Marsilia macropoda Engelm.				Strassbourg (France) 1965	reconstructed card
Marsilea quadrifolia L.	Marsilea quadrifolia L.	Marsilia quadrifolia	*yes*				
		M. quadrifolia L.				1961	
Marsilea strigosa Willd.	Marsilea pubescens Ten. (ambig.)	Marsilia pubescens Ten.				1961	
	Marsilea strigosa Willd. (amb.)	M. strigosa Willd.				Padova (Italy)1985	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Regnellidium diphyllum Lindm.	Regnellidium diphyllum Lindm.	Regnellidium diphyllum Lindm.				Bonn (Germany) 2021	
Order/clade & Family: **CYATHEALES – Cibotiaceae** (PPG-1, 2016 via APweb, 2021)							
unknown sp.* (gen. Cibotium = fam. Cyatheaceae)	Cibotium regale Verschaff. & Lem.	Cibotium Regale		*191?*			
		C. regale Verschaff. & Lem.				Tübingen (Germany) 2016	*probably from horticulture (syn. "Cibotium spectabile (Hort.)")
Cibotium schiedei Schltdl. & Cham.	Cibotium schiedei Schltdl. & Cham.	Cibotium Schiedei		*191?*			
Order/clade & Family: **CYATHEALES – Cyatheaceae** (PPG-1, 2016 via APweb, 2021)							
Alsophila R.Br.	Alsophila R.Br.	Alsophila	*yes*				
Alsophila australis R.Br.	Alsophila australis R.Br. (ambig.)	Alsophylla australis Br.		*1904*			
		Alsophila australis		*191? 1925*			
		A. australis R.Br.			*p.p.*		(in Kovačić, 2015 as Cyathea australis Domin)
	Cyathea australis Domin (amb.)	C. australis Domin			*yes*		
Alsophila leichhardtiana F. Muell.	Alsophila leichhardtiana F. Muell (ambig.)	A. Leichhardtiana F.Muell.			*yes*		
Cyathea dealbata (G.Forst.) Sw.	Cyathea dealbata Sw. (ambig.)	C. dealbata		*191?*			
		C. dealbata Sw.			*yes*		
Gymnosphaera glabra Blume	Cyathea glabra (Blume) Copel.	Alsophila glabra		*191?*			
Sphaeropteris cooperi (F. Muell.) R.M. Tryon	Sphaeropteris cooperi (F. Muell.) R.M. Tryon	S. cooperi (F. Muell.) R.M. Tryon				Brno (Czech Republic) 2016	
		Cyathea cooperi (Hook. ex F. Muell.) Domin				Tübingen (Germany) 2016	
Sphaeropteris myosuroides (Liebm.) R.M.Tryon	Alsophila aurea Fée (ambig.)	Alsophila aurea		*191?*			marked with "?"
Order/clade & Family: **CYATHEALES – Dicksoniaceae** (PPG-1, 2016 via APweb, 2021)							
Dicksonia L'Hér. (Cyatheaceae)	Dicksonia L'Hér.	Dicksonia	*yes*				"fam. Cyatheaceae"

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Dicksonia antarctica Labill.	Balantium antarcticum (Labill.) C. Presl	Dicksonia antarctica (Labill.)		*191? 1932*	*yes*		also sprouted in 1926 (register of spores)
		D. antarctica Labill.				Tübingen (Germany) 2016	
		D. antarctica Labill.				Zagreb Nursery 2021	bought, with a permit of Australian government
Order/clade & Family: **POLYPODIALES – Aspleniaceae** (PPG-1, 2016 via APweb, 2021)							
Asplenium L.	Asplenium L.	Asplenium spp.	*yes*				"By the Grotto", fam. Polypodiaceae
Asplenium L.	Ceterach Willd.	Ceterach spp.	*yes*	*191?*			"By the Grotto", fam. Polypodiaceae
Asplenium L. (p.p.)	Asplenium L. (p.p.)	Scolopendrium spp.	*yes*				"By the Grotto", fam. Polypodiaceae, probably Croatian native species
Asplenium adiantum-nigrum L.	Asplenium adiantum-nigrum L.	A. adiantum-nigrum L.				Naples (Italy) 1959	
		A. adiantum-nigrum L.				Vršac (Serbia) 1965	
		A. adiantum-nigrum L.				Lim channel 1966	
		A. adiantum-nigrum L.				Koločep 1970	
		A. adiantum-nigrum L.				Matka (North Macedonia) 1973	
		A. adiantum-nigrum L.				Orjen Mt (Montenegro) 1978	
		A. adiantum-nigrum L.				NP Velebit 2003	
		A. adiantum-nigrum L.				NP Učka 2016	brought as a living plant
Asplenium australasicum Hook.	Asplenium nidus L.	A. nidus var. australasicum Hook.				1955	in hand-written inventory of glasshouse in 1955
Asplenium bulbiferum G. Forst.	Asplenium bulbiferum G. Forst.	(?)	*yes*				"Palaeotropic Asplenium species' with bulbils atop of their fronds", fam. Polypodiaceae
		A. "bulbi/forme"		*1904 191? 1932*			(perhaps of some other bulbiform taxon)

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
		A. bulbiferum Forst.			*yes*		
Asplenium ceterach L.	Ceterach officinarum Willd.	C. officinalis		*yes*			in hand-written inventories in 1950-ies
		C. officinalis Willd. var. crenatum Moore		*yes*		"Alps" 1950	Orig. author (Willd.) was changed to"DC." acc. to "Analytic Flora of Yugoslavia"
		C. officinarum DC.				Mali Lošinj 1955	
		C. officinarum DC.				Osor 1962	
		C. officinarum DC.				Mosor Mt 1962	
		C. officinarum DC.				Svilaja Mt 1963	
		C. officinarum DC.				Dinara Mt 1963	
		C. officinarum DC.				NP Plitvice 1964	
		C. officinarum DC.				Vis 1964	
		C. officinarum DC.				NP Medvednica 1965	
		C. officinarum DC.				Kopaonik (Serbia) 1965	
		C. officinarum DC.				Lišani 1967	
		C. officinarum DC.				NP Mljet 1968	
		C. officinarum DC.				Orebić 1969	
		C. officinarum DC.				Orjen Mt (Montenegro) 1970	
		Asplenium ceterach L.				Pelješac 1971	
		A. ceterach L.				Sućeška (Bosnia & Herc.) 1973	
		A. ceterach L.				Đerdap (Serbia) 1975	
		A. ceterach L.				NP Biokovo 1975	
		A. ceterach L.				Mosor Mt 1977	
		A. ceterach L.				Lovćen Mt (Montenegro) 1978	
		A. ceterach L.				Brač 1978	
		A. ceterach L.				Koločep 1979	
		A. ceterach L.				NP Mljet 1979	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
		A. ceterach L.				Olib 1983	
		A. ceterach L.				NP Učka 2005	
		A. ceterach L.				Murter 2010	
		A. ceterach L.				Konavle 2011	
Asplenium daucifolium Lam.	Asplenium viviparum (L. f.) C. Presl	Ceanopteris (?) viviparum		*1904*			probably (illegible) Caenopteris vivipara P.J.Bergius
Asplenium dimorphum Kunze	Asplenium dimorphum Kunze (ambig.)	A. dimorphum Kunze			*yes*		
		A. dimorphum Kunze				Berlin-Späth (Germany) 2021	Living specimen
Asplenium fissum Kit.	Asplenium fissum Kit. (ambig.)	A. fissum Kit. ex Willd.				NP Risnjak 1965	
		A. fissum Kit. ex Willd.				NP Velebit 1975	
		A. fissum Kit. ex Willd.				NP Velebit 2003	
Asplenium hybridum (Milde) Bange	Phyllitopsis hybrida (Milde) T. Reichst.	Scolopendrium hybridum	*yes*			"from Lošinj island"	fam. Polypodiaceae
		Asplenium hybridum (Milde) Bange				Olib 2015	
		A. hybridum (Milde) Bange				Rab 2016	(grown from spores)
	Phyllitis hybrida (ambig.)	Phyllitis hybrida		*191? 1932*			Croatian subendemic
Asplenium marinum L.	Asplenium sulcatum Lam.	Asplenium marinum L.		*1904*			
Asplenium nidus L. (cult.?)	Asplenium nidus L. (cult.?)	A. "Nidus A/avis"		*1904 191? 1932*			Probably this species; acc. To Parey, A. Nidus-avis is a culton (hort.)
		A. nidus L.			*yes*		
Asplenium nidus L. (cult.)	Asplenium nidus L. (cult.)	A. nidus L. 'Osaka'			*yes*		
Asplenium ruta-muraria L.	Asplenium ruta-muraria L.	A. ruta muraria		*yes*			in hand-written inventories of glasshouse in 1950-ies
		A. ruta-muraria L.				NP Učka 1963	
		A. ruta-muraria L.				NP Velebit 1964	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
		A. ruta-muraria L.				Jajce (Bosnia & Herc.) 1966	
		A. ruta-muraria L.				Pelješac 1969	
		A. ruta-muraria L.				Martin Brod 1969	
		A. ruta-muraria L.				Pelješac 1971	
		A. ruta-muraria L.				Soteska (Slovenia) 1971	
		A. ruta-muraria L.				NP Žumberak 1972	
		A. ruta-muraria L.				Prokletije (Montenegro) 1973	
		A. ruta-muraria L.				Lovćen (Montenegro) 1978	
		A. ruta-muraria L.				Ravna Gora 1988	
		A. ruta-muraria L.				NP Velebit 2003	
		A. ruta-muraria L.				unknown	spreads locally
Asplenium sagittatum (DC.) Bange	Asplenium sagittatum (DC.) Bunge	A. sagittatum (DC.) Bange				Rab 2017	
Asplenium scolopendrium L.	Asplenium scolopendrium L.	Scolopendrium spp.	*yes*				
		Phyllitis scolopendrium (L.) Newman				1958	
		Ph. scolopendrium (L.) Newman				Jasenak 1971	
		Ph. scolopendrium (L.) Newman				Strahinjčica Mt 1971	
		Asplenium scolopendrium L.				Kašina 1993	
		A. scolopendrium L.				NP Žumberak 2001	
Asplenium scolopendrium L. subsp. scolopendrium	Scolopendrium officinale DC. (ambig.)	Scolopendrium officinale		*1904*			
Asplenium scolopendrium L. (cult.)	Asplenium scolopendrium L. (cult.)	A. scolopendrium L. 'Crispum Cristatum'			*yes*		
		A. undulatum		*1904*			probably A. scolopendrium 'Undulatum' (group)
Asplenium septentrionale (L.) Hoffm.	Asplenium septentrionale (L.) Hoffm.	A. septentrionale (L.) Hoffm.				Vršac (Serbia) 1965	reconstructed card

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Asplenium stellatum Colla	Asplenium fernandezianum Kunze (ambig.)	Asplenium fernandezianum					
Asplenium trichomanes L.	Asplenium trichomanes L.	A. trichomanes		*yes*			in hand-written inventories of glasshouse in 1950-ies
		A. trichomanes L.				Klek 1961	
		A. trichomanes L.				Bohinj (Slovenia) 197	
		A. trichomanes L.				NP Plitvice 1964	
		A. trichomanes L.				Badanj 1964	
		A. trichomanes L.				Vršac (Serbia) 1965	
		A. trichomanes L.				Lim channel 1966	
		A. trichomanes L.				Pelješac 1969	
		A. trichomanes L.				Matka (North Macedonia) 1973	
		A. trichomanes L.				Bled (Slovenia) 1971	
		A. trichomanes L.				Strahinjčica Mt 1979	
		A. trichomanes L.				NP Mljet 1982	
		A. trichomanes L.				Plomin 1982	
		A. trichomanes L.				Olib 1983	
		A. trichomanes L.				Samobor 2002	
		A. trichomanes L.				Vukova Gorica 2008	
Asplenium viride Huds.	Asplenium viride Huds.	A. viride Huds.				NP Velebit 1959	
		A. viride Huds.				Bijele stijene 1961	
		A. viride Huds.				Troglav (Slovenia) 1963	
		A. viride Huds.				Badanj 1964	
		A. trichomanes-ramosum L.				Bled (Slovenia) 1971	
		A. trichomanes-ramosum L.				Samarske stijene 1972	
		A. trichomanes-ramosum L.				Strahinjčica Mt 1973	
		A. trichomanes-ramosum L.				NP Velebit 1973	
		A. trichomanes-ramosum L.				Prokletije Mt (Montenegro) 1973	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
		A. trichomanes-ramosum L.				Julian Alps (Slovenia) 1982	
		A. trichomanes-ramosum L.				Savica 1985	
		A. trichomanes-ramosum L.				Kostel 1990	
		A. trichomanes-ramosum L.				Dubovac, Karlovac 2016	
unknown (A. viviparum Blume – val. A. daucifolium Lam.)	Asplenium viviparum (L.f.) C. Presl	(?)	*yes*		*yes*		"Palaeotropic Asplenium species' with bulbils atop of their fronds" fam. Polypodiaceae
		Caenopteris vivipara		*1904*			
		Asplenium lineatum var. viviparum (syn. Darea vivipara)		*yes*			unknown combination; in hand-written inventores of glasshouse in 1950-ies
Order/clade & Family: **POLYPODIALES – Athyriaceae** (PPG-1, 2016 via APweb, 2021)							
Athyrium Roth (Aspleniaceae)	Athyrium Roth	Athyrium	*yes*				"By the Grotto" fam. Polypodiaceae
		Athyrium "Pri(t/r?)churense cristata"		*1904*			unknown (illegible handwriting)
Athyrium filix-femina (L.) Roth	Athyrium filix-femina (L.) Roth	A. filix-femina (L.) Rth.				Samarske stijene 1963	FCD: Woodsiaceae
		A. filix-femina (L.) Roth				Strahinjčica Mt 1973	
		A. filix-femina (L.) Roth				Sunger 2010	
Athyrium filix-femina (L.) Roth (cult.)	Athyrium filix-femina (L.) Roth (cult.)	Athyrium crispatum		*1904*			probably Athyrium filix-femina 'Crispata'
		Athyrium Frizeliae		*1904*			
		A. 'Fritzeliae'				Buzet Nursery 2006	val. Athyrium filix-femina (L.) Roth 'Frizelliae'
		val. Athyrium filix-femina (L.) Roth 'Frizelliae'				Zagreb Nursery 2021	
Athyrium niponicum (Mett.) Hance (cult.)	Anisocampium niponicum (Mett.) Y.C.Liu, W.L. Chiou & M. Kato (cult.)	Athyrium niponicum 'Metallicum'				Buzet Nursery 2006	val. Athyrium niponicum (Mett.) Hance 'Metallicum'
(?)	(?)	Athyrium goringianum pictum		*1904*			Perpaps A. niponicum var. Pictum 'Metallicum'

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Diplazium celtidifolium Kunze (Aspleniaceae)	Diplazium celtidifolium Kunze	Asplenium celtidifolium		*1904*			
Order/clade & Family: **POLYPODIALES – Blechnaceae** (PPG-1, 2016 via APweb, 2021)							
Blechnum L. (Aspleniaceae)	Blechnum L.	Blechnum	*yes*				"By the Grotto", fam. Polypodiaceae
Blechnum brasiliense Desv.	Blechnum brasiliense Desv.	B. brasiliense		*1904 191?*			
		B. brasiliense Desv.			*yes*	1955	
		B. brasiliense Desv.				Riga (Latvia) 2016	
Blechnum castaneum (Makino) Makino & Nemoto	Blechnum castaneum Makino & Nemoto (ambig.)	B. castaneum Makino				Chemnitz (Germany) 2016	
Blechnum gibbum (Labill.) Mett.	Lomaria gibba Labill. (ambig.)	Lomaria Gibba	*yes*				fam. Polypodiaceae
Blechnum gibbum (Labill.) Mett. ? (cult.)	Blechnum gibbum Mett. (ambig.; ? cult.)	Blechnum 'Silver Lady'			*yes*		B. gibbum 'Silver Lady'
Blechnum hastatum Kaulf.	Blechnum hastatum Kaulf.	Blechnum "pastatum v. minimum" (? Perhaps B. hastatum?)		*191?*			probably was misspelle: crossed and weitten over as "B. occidentalis"
Blechnum microphyllum (Goldm.) C.V. Morton	Blechnum penna-marina (Poir.) Kuhn	B. penna-marina subsp. microphyllum				Chemnitz (Germany) 2016	
Blechnum moorei C.Chr.	Blechnum moorei C.Chr. (ambig.)	B. moorei C.Chr.			*yes*		
Blechnum neohollandicum Christenh.	Doodia aspera R.Br. (ambig.)	Doodia aspera R.Br.			*yes*	1954	as "Doodya" in older records
Blechnum occidentale L.	Blechnum occidentale L.	Blechnum occidentale		*191?*			
Blechnum penna-marina (Maxon & C.V.Morton) Kuhn subsp. alpinum (R.Br.) T.C.Chambers & P.A.Farrant	Blechnum penna-marina (Poir.) Kuhn (unknown subsp.)	B. penna-marina subsp. alpina				Chemnitz (Germany) 2016	
Blechnum penna-marina (Maxon & C.V.Morton) Kuhn subsp. microphyllum (Goldm.) T.C.Chambers & P.A.Farrant	Blechnum penna-marina (Poir.) Kuhn (unknown subsp.)	B. penna-marina subsp. microphylla				Chemnitz (Germany) 2016	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Blechnum penna-marina (Maxon & C.V.Morton) Kuhn subsp. penna-marina	Blechnum penna-marina (Poir.) Kuhn (unknown subsp.)	B. penna-marina subsp. penna-marina				Chemnitz (Germany) 2016	
Blechnum spicant (L.) Roth	Blechnum spicant (L.) Sm.	B. spicant (L.) Roth*				Bijele stijene 1961	*(never lived longer than two years)
		B. spicant (L.) Roth				Zalesina 1963	
		B. spicant (L.) Roth				Štirovac 1964	
		B. spicant (L.) Roth				Strahinjčica Mt 1973	
		B. spicant (L.) Roth				Kupa 2000	
		B. spicant (L.) Roth				Delnice 2004	
		B. spicant (L.) Roth				Sunger 2010	
		B. spicant (L.) Roth				Samobor 2018	
		B. spicant (L.) Roth				Sunger 2018	
		B. spicant (L.) Roth				Zagreb Nursery 2021	
Blechnum spinulosum Poir.	Doodia caudata (Cav.) R. Br.	Do(o)dia caudata Br.		*1904*			
		Woodwardia caudata		*1904*			
Lomariopsis tenuifolia (Desv.) Christ (Polypodiaceae)	Stenochlaena tenuifolia (Desv.) Moore	Stenochlaena tenuifolia (Desv.) Moore			*yes*		
Stenochlaena palustris (Burm. f.) Bedd. (Aspleniaceae)	Stenochlaena palustris (Burm. f.) Bedd.	S. palustris Bedd.			*yes*		
Woodwardia orientalis (Sw.) Sw. (Aspleniaceae)	Woodwardia orientalis Sw.	W. orientalis Sw.				Vienna-Belvedere (Austria) 2016	
Order/clade & Family: **POLYPODIALES – Cystopteridaceae** (PPG-1, 2016 via APweb, 2021)							
Cystopteris alpina (Lam.) Desv. (Aspleniaceae)	Cystopteris alpina (Jacq.) Desv.	Cystopteris alpina		*yes*			in hand-written inventories of Karstic rockery in 1950-ies
Cystopteris bulbifera (L.) Bernh. (Aspleniaceae)	Cystopteris bulbifera (L.) Bernh.	C. bulbifera (L.) Bernh.		*yes*	*yes*		
Cystopteris fragilis (L.) Bernh. (Aspleniaceae)	Cystopteris fragilis (L.) Bernh.	C. fragilis (L.) Bernh.				"Alps" 1949	reconstructed card; acc. to FCD belongs to Woodsiaceae
		C. fragilis (L.) Bernh.				Medak 1959	
		C. fragilis (L.) Bernh.				Bijele stijene 1961	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
		C. fragilis (L.) Bernh.				NP Risnjak 1965	
		C. fragilis (L.) Bernh.				Troglav Mt (Slovenia) 1963	
		C. fragilis (L.) Bernh.				NP Učka 1973	
		C. fragilis (L.) Bernh.				Strahinjčica Mt 1973	
		C. fragilis (L.) Bernh.				Vrbas (Bosnia & Herc.) 1966	
		C. fragilis (L.) Bernh.				Idrijca (Slovenija) 1967	
		C. fragilis (L.) Bernh.				Donačka gora (Slovenia) 1988	
		C. fragilis (L.) Bernh.				NP Velebit 2003	
Cystopteris tasmanica Hook. (Aspleniaceae)	Cystopteris tasmanica Hook. (ambig.)	C. tasmanica Hook.				Chemnitz (Germany) 2016	
Gymnocarpium robertianum (Hoffm.) Newman (Aspleniaceae)	Nephrodium robertianum Prantl (ambig.)	Nephrodium robertianum (Hoffm.) Prantl				NP Učka 1963	FCD: Woodsiaceae
		N. robertianum (Hoffm.) Prantl				NP Risnjak 1965	
	Gymnocarpium robertianum (Hoffm.) Newman	Gymnocarpium robertianum (Hoffm.) Newman				Bonn (Germany) 1994	
		G. robertianum (Hoffm.) Newman				NP Velebit 2003	
Order/clade & Family: **POLYPODIALES – Davalliaceae** (PPG-1, 2016 via APweb, 2021)							
Davallia Sm. (Polypodiaceae)	Davallia Sm.	Davallia	*yes*				fam. Polypodiaceae
Davallia denticulata (Burm. f.) Mett.	Davallia denticulata (Burm. f.) Mett. ex Kuhn	D. denticulata (Burm.) Mett.			*yes*		
Davallia embolostegia Copel.	Davallia embolostegia Copel. (ambig.)	D. embolostegia Copel.				Vienna-Belvedere (Austria) 2016	
Davallia heterophylla Sm.	Humata heterophylla (Sm.) Desv.	Humata heterophylla		*191?*			
Davallia pectinata Sm.	Davallia pectinata Sm.	Humata pectinata (Sm.) Desv.				München (Germany) 2016	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Davallia solida (G. Forst.) Sw.	Davallia solida (G. Forst.) Sw.	D. solida Sw.			*yes*	Tübingen (Germany) 1971	
Davallia solida (G. Forst.) Sw. (cult.)	Davallia solida (G. Forst.) Sw. (cult.)	Davallia solida Sw. 'Superba'			*yes*		
Davallia tyermannii (T.Moore) H.J.Veitch	Humata griffithiana (Hook.) C. Chr. var. tyermannii (T. Moore) Tagawa (ambig.)	H. tyermannii Moore				Antwerp (Belgium) 1973	*incorrect (Tectaria cicutaria)
		H. tyermannii Moore				Antwerp (Belgium) 1980	
		H. tyermannii Moore				Zagreb Nursery 2019	
Order/clade & Family: **POLYPODIALES – Dennstaedtiaceae** (PPG-1, 2016 via APweb, 2021)							
Dennstaedtia adiantoides (Willd.) T.Moore	Dennstaedtia adiantoides (Willd.) T.Moore	Denstaedtia adiantoides		*191?*			
two different authors to Dicksonia cicutaria	Dennstaedtia cicutaria (Sw.) T. Moore	Dicksonia cicutaria		*191?*			
		"Denstadenia cicularis"/ "Denstadmia sicularis"?		*1932*			illegible handwriting: perhaps misspelled "Dennstaedtia cicutaria"
Dennstaedtia punctilobula (Michx.) T.Moore	Dennstaedtia punctilobula (Michx.) T. Moore (unknown syn.)	Dicksonia punctilobula		*1926*			sprouted in 1926 (register of spores)
Histiopteris incisa (Thunb.) J. Sm.	Histiopteris incisa (Thunb.) J. Sm.	H. incisa (Thunb.) J. Sm.				Vienna-Belvedere (Austria) 2016	
Hypolepis millefolium Hook.	Hypolepis millefolium Hook. (ambig.)	H. millefolium Hook.				Chemnitz (Germany) 2016	
Microlepia cult.	Microlepia cult.	Microlepia hirta cristata (probably cultivar, acc. to older hort. Literature)		*1904*			M. hirta and M. cristata are separate taxa: ambig. (WFO) or with separate valid names (PoWO)
Microlepia speluncae (L.) T. Moore	Microlepia speluncae (L.) T. Moore	Davallia speluncae		*1904*			
		M. speluncae (L.) Moore			*yes*		
Pteridium aquilinum (L.) Kuhn	Pteridium aquilinum (L.) Kuhn	P. aquilinum (L.) Kuhn				Cesargrad Mt 1969	FCD: Hypolepidaceae

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
		P. aquilinum (L.) Kuhn				NP Medvednica 1985	
		P. aquilinum (L.) Kuhn				Rudanovac 2015	
Order/clade & Family: **POLYPODIALES – Didymochlaenaceae** (PPG-1, 2016 via APweb, 2021)							
Didymochlaena Desv. (Polypodiaceae)	Didymochlaena (**Hypodematiaceae**)	Didimochlaena	*yes*				fam. Polypodiaceae
Didymochlaena truncatula (Sw.) J.Sm.	Didymochlaena truncatula (Sw.) J.Sm.	Didymochlaena sinuata Desv.		*1904*			as syn. of D.sinuosa Desv. Mendoza et al., 1999
Order/clade & Family: **POLYPODIALES – Dryopteridaceae** (PPG-1, 2016 via APweb, 2021)							
Arachniodes aristata (G. Forst.) Tindale (Polypodiaceae)	Arachniodes aristata (G. Forst.) Tindale	Polystichum aristatum Swartz. (unknown author*)			*yes*		*from basionym Aspidium aristatum (G. Forster) Sw. (Swartz), fam. Aspidiaceae?
Bolbitis heteroclita (C. Presl) Ching (Polypodiaceae)	Bolbitis heteroclita (C. Presl) Ching	B. heteroclita (C. Presl) Ching (Lomariopsidaceae)			*yes*		
Cyrtomium falcatum (L. f.) C. Presl (Polypodiaceae)	Cyrtomium falcatum (L. f.) C. Presl	C. falcatum L. fil.			*yes*		val. C. falcatum (L. f.) C.Presl
		Polystichum falcatum (L.f.) Diels		*1932*			also in hand-written inventories of glasshouse in 1950-ies
Cyrtomium falcatum (L. f.) C. Presl (cult.)	Cyrtomium falcatum (L. f.) C. Presl (cult.)	C. falcatum L. f. 'Rochfordianum'			*yes*		
Cyrtomium fortunei J.Sm. (Polypodiaceae)	Cyrtomium fortunei J.Sm.	Cyrtomium Fortunei		*1904*			
Cyrtomium lonchitoides (Christ) Christ (Polypodiaceae)	Cyrtomium lonchitoides (Christ) Christ	Polystichum lonchitoides (Christ) Diels		*yes*	*yes*		in hand-written inventories of glasshouse in 1950-ies
Dryopteris Adans. (p.p.; Polypodiaceae)	Dryopteris Adans. (p.p.)	Nephrodium	*yes*				fam. Polypodiaceae
Dryopteris carthusiana (Vill.) H.P. Fuchs	Dryopteris carthusiana (Vill.) H.P. Fuchs	D. carthusiana (Vill.) Fuchs				Strahinjčica Mt 1973	1975
Dryopteris carthusiana (Vill.) H.P. Fuchs var. carthusiana	Dryopteris carthusiana (Vill.) H.P. Fuchs	Aspidium "spin.(ulosum?) interm.(edium?)"		*1904*			Probably this species
Dryopteris dilatata (Hoffm.) A.Gray	Dryopteris dilatata (Hoffm.) A.Gray	Aspidium dilatatum		*1904*			

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Dryopteris erythrosora (D.C. Eaton) Kuntze	Dryopteris erythrosora (D.C. Eaton) Kuntze	Dryopteris Erythrosora				Zagreb Nursery 2018	val. D. erythrosora (D.C. Eaton) Kuntze
Dryopteris filix-mas (L.) Schott	Dryopteris filix-mas (L.) Schott	Aspidium filix-mas	*yes*	*1904*			
		Nephrodium Filix mas		*1917*			Hand-written inventoy of Medicinal plants
		"Dipteris filis mas" (?)		*1932*			unknown combination: I presume it was this taxon (*Dipteris* (Gleicheniales) is native to tropical Asia)
		Nephrodium filix-mas (L.) Rich.		*yes*		Strahinjčica Mt 1973	noted as growing in Karstic rockery in the 1950-ies
		Dryopteris filix-mas (L.) Schott					from other localities, unregistered, spreads locally
Dryopteris filix-mas (L.) Schott (cult.)	Dryopteris filix-mas (L.) Schott (cult.)	Dryopteris cult.				Zagreb Nursery 2021	(small cult.)
Dryopteris goeringiana (Kunze) Koidz.	Athyrium goeringianum (Kunze) T. Moore	Athyrium goringianum		*1904*			
		Athyrium goringianum pictum		*1904*			Perhaps Athyrium niponicum 'Pictum'
Dryopteris goldi**ea**na (Hook. ex Goldie) A.Gray	Dryopteris goldiana (Hook. ex Goldie) A. Gray	D. goldiana (Hook. ex Goldie) A. Gray				Tübingen (Germany) 2016	
Dryopteris pallida (Bory) Maire & Petitm.	unknown	"Nephrodium villarii (Bell) Beck subsp. pallida (Bory) Hayek = Dryopteris pallida (Bory) C. Chr. ex Maire et Petitmengin"					original card is lost; remaind a small card with this synonymy
Dryopteris pseudocaenopteris (Kunze) Li Bing Zhang	Peranema aspidioides (Blume) Mett.	Diacalpe aspidioides Blume		*yes*	*yes*		
Dryopteris pseudosieboldii Hayata	Aspidium sieboldii Van Houtte ex Mett. (ambig.)	Aspidium Sieboldi van Houtte		*1904*			
Dryopteris villarii (Bellardi) Woyn. ex Schinz & Thell.	Dryopteris midshelkensis Pavlov	D. villarii (Bellardi) Woynar				Mosor Mt 1977	
Elaphoglossum crinitum (L.) Christ (Polypodiaceae)	Chrysodium crinitum Mett.; Fil. (ambig.; Pteridaceae)	Chrysodium crinitum	*yes*				fam. Polypodiaceae

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Polybotrya sp. (Polypodiaceae)	Polybotrya sp.	Polybotrya numina/minima (?)		*1904*			illegible handwriting, both unknown
		Polybotrya minima (?)		*191? 1932*			unknown species
Polystichum sp. (Polypodiaceae)	Polystichum sp.	Polystichum "grandidentatum"		*1904*			unknown taxon, probably culton
Polystichum aculeatum (L.) Roth	Polystichum aculeatum (L.) Roth ex Mert.	P. lobatum (Huds.) C. Presl var. longilobum Milde				?	reconstructed card, illegible source & year
		P. lobatum var. auriculatum				1958	
		P. lobatum (Huds.) Presl.		*yes*		1962	
		P. lobatum (Huds.) Presl.				Troglav Mt (Slovenia) 1963	
		P. aculeatum (L.) Roth				Strahinjčica Mt 1973	val. P. aculeatum (L.) Roth (acc. to FCD)
		P. aculeatum (L.) Roth				Visibaba 1975	
		P. aculeatum (L.) Roth				NP Učka 1973	
		P. aculeatum (L.) Roth				Kašina 1993	
		P. aculeatum (L.) Roth				Sunger 2010	
Polystichum braunii (Spenn.) Fée	Polystichum braunii (Spenn.) Fée	P. braunii (Spennet) Fée		*yes*	*yes*		
Polystichum heterolepis Fée	Aspidium viviparum Mett. (ambig.)	Aspidium viviparum Fée		*1904*			syn. Dryopteris vivipara (Fée) Kuntze
Polystichum × illyricum Hahne	Polystichum illyricum Hahne (ambig.)	P. illyricum Borbás				Strahinjčica Mt 1972	val. P. x illyricum (Borbás) Hahne (acc. to FCD)
Polystichum lonchitis (L.) Roth	Polystichum lonchitis (L.) Roth	P. lonchitis (L.) Roth				Kalnik Mt 1961	
		P. lonchitis (L.) Roth				Medak 1963	
		P. lonchitis (L.) Roth				Treskavica (Bosnia & Herc.) 1962	
		P. lonchitis (L.) Roth				Badanj, Dinara Mt 1964	
		P. lonchitis (L.) Roth				Prokletije (Montenegro) 1973	
		P. lonchitis (L.) Roth				NP Velebit 1975	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
		P. lonchitis (L.) Roth				NP Velebit 1983	
		P. lonchitis (L.) Roth				Komna (Slovenia) 1985	
Polystichum munitum (Kaulf.) C.Presl	Polystichum munitum (Kaulf.) C. Presl	Aspidium munitum Kaulf.		*1904*			
Polystichum polyblepharum (Roem. ex Kunze) C. Presl	Polystichum polyblepharum (Roem. ex Kunze) C. Presl	?			*yes*		card is missing
Polystichum proliferum (R.Br.) C.Presl	Aspidium proliferum R. Br. (ambig.)	Aspidium proliferum Br.					
Polystichum setiferum (Forssk.) T.Moore ex Woynar	Polystichum setiferum (Forssk.) Moore ex Woyn.	Polystichum angulare		*1904*			
		P. setiferum (Forsskål) Woynar				Bosiljevo 2008	val. P. setiferum (Forssk.) Woyn. (acc. to FCD)
		P. setiferum (Forsskål) Woynar				Strahinjčica Mt 1979	val. P. setiferum (Forssk.) Woyn. (acc. to FCD)
Polystichum setiferum (Forssk.) T.Moore ex Woynar (cult.)	Polystichum setiferum (Forssk.) Moore ex Woyn. (cult.)	P. setiferum 'Plumosum Densum'				Buzet Nursery 2006	P. setiferum (Forssk.) Moore ex Woyn. 'Plumosum Densum'
		Polystichum (angulare?) proliferum Wollastoni		*1904*			P. setiferum (Forssk.) Moore ex Woyn. 'Proliferum Wollastonii'
Order/clade & Family: **POLYPODIALES – Lonchitiaceae** (PPG-1, 2016 via APweb, 2021)							
Lonchitis hirsuta L.	unknown	Pteris laciniata Willd.				Szeged (Hungary) 1954	in hand-written inventory of glasshouse
Order/clade & Family: **POLYPODIALES – Nephrolepidaceae** (PPG-1, 2016 via APweb, 2021)							
Nephrolepis Schott (Polypodiaceae)	Nephrolepis	?	*?*				Not existing at the time (Heinz, 1895-6)? Perhaps under some other name
Nephrolepis biserrata (Sw.) Schott	Nephrolepis biserrata (Sw.) Schott	N. biserrata Sw.		*yes*		Cambridge (UK) 1954	reconstructed card
		N. rufescens		*191? 1932*			
		N. biserrata Schott.				Coimbra (Spain) 1955	in hand-written inventory of glasshouse in 1955

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Nephrolepis biserrata (Sw.) Schott (cult.)	Nephrolepis biserrata (Sw.) Schott (cult.)	N. biserrata (Sw.) Schott 'Furcans'			*yes*		
Nephrolepis bostoniensis Anon. (unplaced)	Nephrolepis bostoniensis (ambig.)	Nephrolepis Bostoniensis		*191? 1932*			Probably a cultivar of N. exaltata (Bostoniensis')
unknown	unknown	N. cordata Presl 'Compacta'				Sofia (Bulgaria) 1982	reconstructed card; probably cult. of N. exaltata group
Nephrolepis cordifolia (L.) C. Presl	Nephrolepis cordifolia (L.) C. Presl	N. cordifolia (L.) Presl			*yes*	2016	new sprouted with others during growing from spores
Nephrolepis cordifolia (L.) C. Presl var. cordifolia	Nephrolepis imbricata C.Presl (ambig.)	Nephrolepis imbricata				1955	in hand-written inventory of glasshouse
Nephrolepis cordifolia (L.) C. Presl (cult.)	Nephrolepis cordifolia (L.) C. Presl (cult.)	N. 'Pearls of Living' (?)			*yes*	gift 2016	unknown cultivar; perhaps of N. cordifolia 'Duffii' group; the "Lemon Button Fern"
Nephrolepis exaltata (L.) Schott	Nephrolepis exaltata (L.) Schott	N. exaltata (Schott)		*1904 191?*			
		N. exaltata Schott		*yes*	*yes*		Also in all inventories during 1950-ies. Planted outdoors in 2018
Nephrolepis exaltata (L.) Schott (cult.)	Nephrolepis exaltata (L.) Schott (cult.)	N. exaltata Schott var. selecta			*yes*		N. exaltata (L.) Schott 'Selecta'
Nephrolepis exaltata (L.) Schott (cult.)	Nephrolepis exaltata (L.) Schott (cult.)	N. exaltata hort.				1958	
Nephrolepis exaltata (L.) Schott (cult.)	Nephrolepis exaltata (L.) Schott (cult.)	N. exaltata (L.) Schott (cult.)				2016	new sprouted with others during growing from spores, aff. 'Curly Locks'
Nephrolepis exaltata (L.) Schott (cult.)	Nephrolepis exaltata (L.) Schott (cult.)	N. exaltata crispa		*1904*			Nephrolepis exaltata 'Crispa'
Nephrolepis exaltata (L.) Schott (cult.)	Nephrolepis exaltata (L.) Schott (cult.)	N. "sesqu.filium." (?)		*1904*			illegible handwriting
Nephrolepis exaltata (L.) Schott (cult.)	Nephrolepis exaltata (L.) Schott (cult.)	N. exaltata 'Teddy'				Opeka Castle 1963	reconstructed card
Nephrolepis exaltata (L.) Schott (cult.)	Nephrolepis exaltata (L.) Schott (cult.)	N. exaltata 'Teddy Junior'				Lada Nursery (Slovenia) 1964	reconstructed card

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Nephrolepis hirsutula (G. Forst.) C. Presl	Nephrolepis hirsutula (G. Forst.) C. Presl	N. hirsutula (G. Forst.) Presl			*yes*		
Nephrolepis muscosa Clute (unplaced name)	Nephrolepis muscosa Clute (ambig.)	N. muscosa Pierson			*p.p.*		
		N. muscosa				Szeged (Hungary) 1955	in hand-written inventory of glasshouse
Nephrolepis piersonii Anon. (unplaced name)	Nephrolepis exaltata (L.) Schott (cult.)	N. exaltata Schott var. piersonii F.R.Pierson			*yes*		N. exaltata (L.) Schott 'Piersonii'
		N. Piersonii		*191? 1932*			
		N. Piersonii		*yes*			in hand-written inventories of glasshouse in 1950-ies
Nephrolepis piersonii Anon. (unplaced name)	Nephrolepis exaltata (L.) Schott (cult.)	N. Piersonii fragrantissima		*191?*			
Nephrolepis whitmani Anon. (unplaced name)	Nephrolepis exaltata (L.) Schott (cult.)	N. exaltata Schott var. whitmannii Barrows			*yes*		N. exaltata (L.) Schott 'Whitmannii'
Nephrolepis sp. (unknown)	Nephrolepis sp. (unknown)	Nephrolepis Sieboldii		*1904*			unknown Combination
Nephrolepis sp. (unknown)	Nephrolepis sp. (unknown)	Nephrolepis Barousi		*191?*			unknown
Nephrolepis sp. (unknown)	Nephrolepis sp. (unknown)	Nephrolepis Witmanii		*191? 1932*			old cultivar from the Garden catalogues in 1902-ies; perhaps misspelled N. whitmani
Nephrolepis sp. (unknown)	Nephrolepis sp. (unknown)	Nephrolepis "Reppei" or "Zeppei" (illegible)		*1904*			unknown
Nephrolepis sp. (unknown)	Nephrolepis sp. (unknown)	Nephrolepis "Philippiensis"		*1904*			unknown culton from horticultural literature (e.g. Birkenhead, 1892)
Order/clade & Family: **POLYPODIALES – Onocleaceae** (PPG-1, 2016 via APweb, 2021)							
Onoclea sensibilis L. (Aspleniaceae)	Onoclea sensibilis L.	O. sensibilis		*1904*			
		O. sensibilis L.			*yes*	Vodnjan Nursery 2021	new plants purchased in 2020
Onoclea struthiopteris (L.) Roth (Aspleniaceae)	Matteuccia struthiopteris (L.) Tod.	Onoclea struthiopteris		*1904*			FCD: Woodsiaceae

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
		Matteuccia struthiopteris (L.) Tod.				Arilja (Serbia) 1987	
		M. struthiopteris (L.) Tod.				Buzet Nursery 2006	
		M. struthiopteris (L.) Tod.				Vukova Gorica 2008	
		M. struthiopteris (L.) Tod.				Macelj Mt 2012	
Order/clade & Family: **POLYPODIALES – Polypodiaceae** (PPG-1, 2016 via APweb, 2021)							
Campyloneurum crassifolium (L.) Christenh.	Niphidium crassifolium (L.) Lellinger	Pleopeltis crassifolium (L.) Moore/P. crassifolia T.Moore/ = Polypodium crassifolium L.			*(p.p.)*		plant labelled as "Polypodium polycarpon (P. punctatum)" (no author)=val. Microsorum punctatum (L.) Copel.
Ctenitis sloanei (Poepp. ex Spreng.) C.V.Morton	Aspidium furcatum Klotzsch (ambig.) (Tectariaceae)	Aspidium furcatum		*1904*			
Drynaria drynarioides (Hook.) Christenh.	Aglaomorpha drynarioides (Hook.) M.C. Roos	Aglaomorpha drynarioides (Hook.) Roos				Vienna-Belvedere (Austria) 2016	
Drynaria meyeniana (Schott) Christenh.	Aglaomorpha meyeniana Schott	Aglaomorpha meyeniana Schott				Vienna-Belvedere (Austria) 2016	
Drynaria quercifolia (L.) J. Sm.	Polypodium morbillosum C. Presl (ambig.)	Polypodium morbilosum		*1904*			
	Drynaria quercifolia (L.) J.Sm.	D. quercifolia (L.) J.Sm.			*yes*		*incorrect; Drynaria J. Smith = Aglaomorpha Schott (APG)
Goniophlebium subauriculatum (Blume) C.Presl	Schellolepis subauriculata (Blume) J. Sm.	Goniophlebium subauriculatum (Blume) C.Presl				Vienna-Belvedere (Austria) 2016	
Two different authors, two different valid names (one of them is Goniophlebium subauriculatum (Blume) C. Presl)	Oreogrammitis reinwardtii (Blume) Parris	Polypodium Reinwartdi/i		*1904* *191?* *1932*			
Lepisorus longifolius (Blume) Holttum	unknown (P. longifolium Cav.*)	Polypodium longifolium Mett.			*(p.p.)*	1950-ies	*P. longifolium Cav. = Niphidium longifolium (Cav.) C.V. Morton & Lellinger (WFO)
Four different authors and valid synonyms	(?)	Polypodium longifolium		*1932*			

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Lepisorus platyrhynchos (Kunze) Li Wang	Belvisia platyrhynchos (Kunze) Copel.	Belvisia platyrhynchos (Kunze) Copel.				München (Germany) 2016	
Leptochilus pteropus (Blume) Fraser-Jenk.	Microsorum pteropus (Blume) Copel.	Microsorium pteropos (no author)				1964	
		M. pteropus (no author)				1981	
		M. pteropus (no author)				1982	
Microgramma piloselloides (L.) Copel.	Microgramma piloselloides (L.) Copel.	M. piloselloides (L.) Copel.				Riga (Latvia) 2016	
Microsorum cuspidatum (D. Don) Tagawa	Polypodium leiorhizum Wall. (ambig.)	Polypodium leiorhizum Wall.			*yes*		*incorrect: Pteris sp.
Microsorum musifolium Copel. 'Crocodyllus'	Microsorum musifolium Copel. (ambig.) 'Crocodyllus'	Microsorum 'Crocodyllus'				private collector (Germany) 2020	
Microsorum punctatum (L.) Copel.	unknown (P. punctatum Thunb. = val. Cochlidium punctatum (Raddi) L.E. Bishop)	Polypodium punctatum Sw.				1955	in hand-written inventory of glasshouse
		Polypodium punctatum Sw. (=P.p. (L.) Sw.); changed to P. polycarpon Cav.			*(p.p.)*	1958	Polypodium polycarpon Cav.= Microsor(i)um punctatum (L.) Copel. (WFO); Ple(i)opeltis crassifolium (L.) Moore = val. Niphidium c. (L.) Lellinger)!
	Microsorum punctatum (L.) Copel.	Microsorium punctatum (L.) Cop.; changed to Polypodium punctatum (no author)			*(p.p.)*		this plant was labelled as P. longifolium Mett.= val. Lepisorus longifolius (Blume) Holttum (Kew)
Phlebodium areolatum (Willd.) J.Sm. (cult.)	Phlebodium pseudoaureum (Cav.) Lellinger (cult.)	Phlebodium 'Pseudoaureum'				2016	sprouted among others; aff. 'Blue Star'
Phlebodium aureum (L.) J.Sm.	Phlebodium aureum (L.) J. Sm.	Polypodium aureum L.		*yes*	*yes*		
Phlebodium aureum (L.) J. Sm. (cult.?)	Phlebodium aureum (L.) J. Sm. (cult.?)	Polypodium aureum L. var. umbellatum			*yes*		Ph. aureum (L.) J. Sm. 'Umbellatum' (?) – unknown (cult.)/var.; I cannot see the difference between sp. and cv.
Platycerium alcicorne (P. Willemet) Desv.	Platycerium alcicorne Desv. (ambig.)	Platycerium alcicorne Desv.		*1904*			

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
		Platycerium alcicorne	*yes*	*191? 1932*	*(p.p.)*		
		P. alcicorne (Willemet) Desv.		*yes*	*(p.p.)*	1961	
Platycerium sp. (unknown)	Platycerium sp. (unknown)	"Platycerium bicorne" (probably P. x 'Bicorne') – perhaps "biforme"?		*yes*			in hand-written inventories of glasshouse in 1950-ies; hybrid of P. Bifurcatum x P. Alcicorne
Platycerium bifurcatum (Cav.) C.Chr.	Platycerium bifurcatum (Cav.) C. Chr.	Platycerium bifurcatum			*(p.p.)*	Zagreb Nursery 2009	I cannot see the difference; P. alcicorne is often sold as "P. bifurcatum of gardens"
Platycerium hillii T.Moore	Platycerium hillii T.Moore (ambig.)	Platycerium Hillei		*1904 191? 1932*			
Platycerium bifurcatum (Cav.) C.Chr. subsp. willinckii (T. Moore) Hennipman & M.C.Roos	Platycerium willinckii T.Moore (ambig.)	Platycerium Willinski		*1904*			
		Platycerium Willinkii		*191?*			
		Platycerium willinckii T.Moore				Riga (Latvia) 2016	
Platycerium vassei Anon. (unplaced name)	Platycerium alcicorne Desv. (ambig.)	P.vassei; changed to P. sp.			*(p.p.)*	Zagreb Nursery 2001	plant looks like P. alcicorne
Platycerium wallichii Hook.	Platycerium wallichii Hook.	Platycerium Wallichi		*191?*			
Platycerium wilhelminae-reginae Alderw. (unplaced)	Platycerium wilhelminae Reginae v.A.v.R. (ambig.)	P. wilhelminae-reginae v.A.v.R.			*yes*		probably Platycerium 'Queen Wilhelmina'
Polypodium L.	Polypodium L.	Polypodium spp.	*yes*		*OK*		"by the Grotto" (also in glasshouses)
Polypodium sp. (?)	Polypodium sp. (?)	Polypodium argenteum		*1904 191?*			Perhaps P. argenteum Jacq.? Acc. Dietrich, 1837
Polypodium sp. (?)	Polypodium sp. (?)	Polypodium grandifolium Mett. (unknown author)				1958	in hand-written inventory of glasshouse in 1958
Polypodium sp. (?)	Polypodium sp. (?)	Polypodium sagilifolia		*1904*			unknown
Polypodium sp. (?)	Polypodium sp. (?)	Polypodium pygnosurum		*191?*			Perhaps P. pycnosorus?
Four different authors and four different val. syn.	Lophosoria quadripinnata (J.F. Gmel.) C. Chr. (Dicksoniaceae)	P. glaucum		*191?*			
Polypodium cambricum L.	Polypodium cambricum L.	P. vulgare L. ssp. serratum Willd.				Kukuljanovo 1968	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
		P. australe Fée				Dubrovnik 1978	
		P. vulgare L. ssp. serratum Willd.				Lapad 1969	
		P. vulgare L. ssp. serratum Willd.				Pelješac 1971	
		P. australe Fée				Polače 1979	
		P. cambricum L.				Dubrovnik 2001	
Polypodium vulgare L.	Polypodium vulgare L.	P. vulgare L.		*1917*			Hand-written inventory of Medicinal plants
		P. vulgare L.		*yes*			in hand-written inventories of Karstic rockery in 1950-ies
		P. vulgare L.				Klek 1961	
		P. vulgare L.				Rovinj 1963	(glasshouse)
		P. vulgare L.				NP Medvednica 1969	
		P. vulgare L.				Treskavica (Bosnia & Herc.) 1962	
		P. vulgare L.				Vinica 1969	
		P. vulgare L.				Brezovica 1970	
		P. vulgare L.				Samobor 1980	
		P. vulgare L.				Vukova Gorica 2008	
Pyrrosia abbreviata (Zoll.) Tagawa	Cyclophorus abbreviatus C. Chr. (ambig.)	Cyclophorus abbreviatus C.Cr.				Antwerp (Belgium) 1965	reconstructed card
		Cyclophorus abbreviatus C.Cr.				Tübingen (Germany) 1971, 1973, 1979	
Pyrrosia adnascens (Sw.) Ching	Pyrrosia lanceolata (L.) Farw.	Nipholobus adnascens Klf. /(Sw) Kaulf./				Frankfurt (Germany) 1958	lost or overwritten card
Pyrrosia christii (Giesenh.) Ching	Pyrrosia christii (Giesenh.) Ching	P. christii (Giesenh.) Ching				Leiden (the Netherlands) 1985	reconstructed card
Pyrrosia lingua (Thunb.) Farw.	Pyrrosia lingua (Thunb.) Farw.	Polypodium lingua Sw.		*1904*			
Pyrrosia nummulariifolia (Sw.) Ching	Pyrrosia nummulariifolia (Sw.) Ching	P. nummulariifolia (Sw.) Ching			*yes*		

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Four different authors leading to four genera!	Lophosoria quadripinnata (J.F. Gmel.) C. Chr.	Polypodium glaucum (changed to Phymatodes glaucum; authors missing)			*p.p.*	Cluj-Napoca (Romania) 1968	card is lost; most probably orig. Polypodium glaucum (Brack) Kuntze (syn. Phymatodes glauca (Brack.) J. Sm.)
Serpocaulon triseriale (Sw.) A.R.Sm. (?)	Polypodium pycnosorum Link (ambig.)	Polypodium "pycnorosum" (?)		*1904*			Probably misspelled
Order/clade & Family: **POLYPODIALES – Pteridaceae** (PPG-1, 2016 via APweb, 2021)							
Actiniopteris radiata (Sw.) Link	Actiniopteris radiata (Sw.) Link	Actiniopteris radiata				private collector (Germany) 2021	
		Actiniopteris radiata (Sw.) Link				Vienna-Belvedere (Austria) 2016	
Adiantum L.	Adiantum L.	Adiantum spp.	*yes*				"various"; FCD: Adiantaceae
Adiantum sp.	Adiantum sp.	Adiantum sp. cult.				1954	reconstructed card
		Adiantum sp. cult.				Vienna-Belvedere (Austria) 2016	various, among others
		Adiantum sp. cult.				ELTE Budapest (Hungary) 2017	young plantlets (gift)
Adiantum aethiopicum L.	Adiantum chilense Kaulf. var. sulphureum (Kaulf.) Kuntze ex Hicken	Adiantum aethiopicum		*191?*			
Adiantum bausei T.Moore (unplaced)	Adiantum bausei T.Moore (ambig.)	Adiantum Bausei		*1904 191?*			"Gartenwelt" from 1904 names this taxon as hyb. of A. trapeziforme x A. decorum (val. A: raddianum)
Adiantum chilense Kaulf. var. sulphureum (Kaulf.) Kuntze ex Hicken	Adiantum williamsii Moore (ambig.)	Adiantum Wiliamsii		*1904*			
Adiantum capillus-veneris L.	Adiantum capillus-veneris L.	Adiantum capillus-veneris	*yes*	*191?*			
		Adiantum capillus Veneris	*yes*	*1932*			
		A. capillus Veneris		*yes*			in hand-written inventories of glasshouse during 1950-ies
		A. capillus-veneris L.				2016	among others

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Adiantum capillus-veneris L. (cult.)	Adiantum capillus-veneris L. (cult.)	A. capillus-veneris L.				(several different) 2016	among others, aff. 'Yellow Petticoat'
Adiantum caudatum L.	Adiantum caudatum L.	A. raddianum				Zagreb Nursery 2012	*incorrect (A. caudatum L.)
Adiantum concinnum Humb. & Bonpl. ex Willd.	Adiantum concinnum Humb. & Bonpl. ex Willd.	Adiantum concinum		*1904* *191?*			
		Adianthum concinum		*1932*			
Adiantum diaphanum Blume	Adiantum diaphanum Blume	Adiantum diaphanum Blume		*1904*			
		Adiantum Diaphanum		*191?*			
		A. diaphanum Blume				Vienna-Belvedere (Austria) 2016	
Adiantum edgeworthii Hook.	Adiantum edgeworthii Hook.	Adiantum Edgevvoiti		*1904*			
		Adiantum Egeworthii		*191?*			
Adiantum elegantissimum Anon. (unplaced)	Adiantum elegantissimum ht. (ambig.)	Adiantum elegantissima/um		*1904* *191?*			
Adiantum gracillimum T.Moore (unplaced)	Adiantum gracillimum T. Moore (ambig.)	Adiantum Gracilimum/ gracillinum		*1904*			
		A. gracilimum		*191?* *1932*			
Adiantum groenewegenianum Regel (unplaced)	Adiantum groenewegenianum Regel (ambig.)	Adiantum graenevegenianum		*1904*			
		A. groenevegenianum		*191?*			
Adiantum hispidulum Sw.	Adiantum hispidulum Sw.	A. hispidulum Sw.				Vienna-Belvedere (Austria) 2016	
		A. hispidulum Sw.				Riga (Latvia) 2016	
Adiantum macrophyllum Sw.	Adiantum macrophyllum Sw.	A. macrophyllum Sw.				Vienna-Belvedere (Austria) 2016	
Adiantum monochlamys D.C.Eaton	Adiantum monochlamys D.C.Eaton	Adiantum Veitchii		*1904*			Adiantum veitchii Hance
		Adiantum Veitchi		*191?*			
Adiantum moorei Baker	Adiantum raddianum C. Presl	Adiantum "Morellii"		*1904*			
		Adiantum "moorelli"		*191?* *1932*			

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Adiantum legrandii Veitch (unplaced)	Adiantum legrandii ht. Veitch (ambig.)	Adiantum legrande		*1904*			
Adiantum patens Willd.	Adiantum patens Willd.	Adiantum patens Willd.		*1904*			
		A. patens		*191? 1932*			
Adiantum pedatum L.	Adiantum pedatum L.	A. pedatum L.				Cluj-Napoca (Romania) 1969	
		A. pedatum L.				Oslo (Norway) 1980	*incorrect
		A. pedatum L.				Stockholm (Sweden) 1982	
Adiantum peruvianum Klotzsch	Adiantum peruvianum Klotzsch	Adiantum peruvianum Klotzsch		*1904*			
Adiantum polyphyllum Willd.	Adiantum grande (ambig.)	Adiantum grande		*1904 191? 1932*			
three different authors (none of which is Schkuhr), with different valid names!	Adiantum pubescens Schkuhr	Adiantum pubescens		*1904*			
Adiantum raddianum C. Presl	Adiantum raddianum C. Presl	Adiantum cuneatum Langd.	*yes*	*1904*			
		A. Cuneatum		*yes*			fam. Polypodiaceae; in hand-written inventories in 1950-ies
		A. raddianum C. Presl			*yes*	Vienna-Belvedere (Austria) 2016	
Adiantum raddianum C. Presl (cult.)	Adiantum raddianum C. Presl (cult.)	A. brillantelse			*yes*		A. raddianum C. Presl 'Brilliantelse'
Adiantum raddianum C. Presl (cult.)	Adiantum raddianum C. Presl (cult.)	A. cuneatum var. gracillimum			*yes*		A. raddianum C. Presl 'Gracillimum'
Adiantum raddianum C. Presl (cult.)	Adiantum raddianum C. Presl (cult.)	A. decorum Moore 'Magnificum'			*yes*		A. decorum Moore 'Magnificum'
Adiantum raddianum C. Presl (cult.)	Adiantum raddianum C. Presl (cult.)	A. raddianum Presl 'Microphyllum'				Vienna-Belvedere (Austria) 2016	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Adiantum raddianum C. Presl (cult.)	Adiantum raddianum C. Presl (cult.)	Adiantum cuneatum fol. var.		*1904 191?*			
		A. raddianum Presl 'Variegatum'				Vienna-Belvedere (Austria) 2016	also sprouted among others
Adiantum rhodophyllum T. Moore (unplaced)	Adiantum rhodophyllum T. Moore (ambig.)	Adiantum rhodophyllum		*1904*			
Adiantum tenerum Sw.	Adiantum farleyense T.Moore (ambig.)	Adiantum Farleyense	*yes*	*1904 191?*			A. tenerum Sw. 'Farleyense'?
	Adiantum fergusonii T.Moore (ambig.)	Adiantum Fergusonti		*1904*			
		Adiantum Fergusonthi		*191?*			
Adiantum tenerum Sw. (cult.)?	Adiantum tenerum Sw. (cult.)?	A. tenerum var. scutatum hort f. roseum			*yes*		
Adiantum tetraphyllum Humb. & Bonpl. ex Willd.	Adiantum tetraphyllum Humb. & Bonpl. ex Willd.	A. tetraphyllum Willd. *			*yes*		*incorrect (A. capillus-veneris)
Adiantum trapeziforme L.	Adiantum trapeziforme L.	Adiantum trapeziforme L.		*1904*			
		Adiantum trapesiforme	*yes*				
		A. trapeziforme L.			*yes*	Vienna-Belvedere (Austria) 2016	
Anogramma leptophylla (L.) Link	Anogramma leptophylla (L.) Link	A. leptophylla (L.) Link				NP Mljet 2016	withdrew in 2018
Ceratopteris thalictroides (L.) Brongn.	Ceratopteris thalictroides (L.) Brongn.	Ceratopteris thalictroides	*yes*	*1904 191?*			
		C. thalictroides (L.) Brongn.				1961	
Cerosora argentea (Willd.) Hennequin & H.Schneid. var. aurea (Willd.) Hennequin & H.Schneid.	Pityrogramma argentea (Willd.) Domin	Gymnogramme aurea		*191?*			val. Name for Gymnogramma aurea (Willd.) Desv., fam. Polypodiaceae
Cryptogramma acrostichoides R. Br.	Cryptogramma acrostichoides R. Br.	Cryptogramma acrostichoides R.Br.				Chemnitz (Germany) 2016	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Hemionitis L. (p.p.)	Hemionitis L. (p.p.)	Gymnogramme spp.	*yes*				Gymnogramme = Gymnogramma Desv. fam. Polypodiaceae
Hemionitis achariorum Christenh.	Doryopteris pedata (L.) Fée var. palmata (Willd.) Hicken	Pteris palmata Willd.		*1904*			
		Doryopteris palmata 'Pedata'				Zagreb Nursery 2017	
Hemionitis atropurpurea (L.) Christenh.	Pellaea atropurpurea (L.) Link	P. atropurpurea (L.) Link			*yes*		
Hemionitis calomelanos (Sw.) Christenh.	Pellaea calomelanos (Sw.) Link	Pellaea hastata Prantl.			*no*	1958	in hand-written inventory of glasshouse
Hemionitis lanosa (Michx.) Christenh.	Cheilanthes lanosa (Michx.) D.C. Eaton	Cheilanthes lanosa				Zagreb Nursery 2016	Myriopteris lanosa (Michx.) Grusz & Windham
		Cheilanthes lanosa				Zagreb Nursery 2020	
Hemionitis marantae (L.) Christenh.	Paraceterach marantae (L.) R.M. Tryon	Notholaena marantae (L.) R.Br. (changed to Cheilanthes marantae (L.) Domin)				Kopaonik Mt (Serbia) 1963	(Serpentine species)
Hemionitis palmata L.	Hemionitis palmata L.	Hemionitis palmata		*1932*			
						Prague (Czech Republic) 1964	reconstructed card
						Vienna-Belvedere (Austria) 2016	
Hemionitis rotundifolia (G. Forst.) Christenh.	Allosorus rotundifolius Kunze (ambig.)	Allosurus rotundifolia		*1904*			
	Pellaea rotundifolia (G.Forst.) Hook	Pellaea rotundifolia Hook.		*yes*	*yes*	Vienna-Belvedere (Austria) 2016	
Hemionitis seticaulis (Hook.) ined.	Pellaea falcata Fée	Pellaea falcata (R.Br.) Fée				Riga (Latvia) 2016	
Hemionitis viridis (Forssk.) Christenh.	Pellaea viridis (Forssk.) Prantl	Pellaea viridis (Fors.) Prantl				Vienna-Belvedere (Austria) 2016	
Bolbitis repanda (Blume) Schott. (Polypodiaceae)	unknown	Gymnopteris repanda				Hamburg 1958	in a hand-written inventory of greenhouse in 1958. "Gymnopteris" could be a synonym of Hemionitis or Leptochilus

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Llavea cordifolia Lag.	Llavea cordifolia Lag.	Llavea cordifolia Lag.				Vienna-Belvedere (Austria) 2016	
Pityrogramma calomelanos (L.) Link	Pityrogramma calomelanos (L.) Link	Gymnogramme calomelanos (Kaulf.); changed to Ceratopteris calomelanos Und.		*1904* *191?*	*yes*		
	Gymnogramma massonii Loud. (ambig.)	Gymnogramme massonium		*1904*			Probably this species
Pityrogramma chrysoconia Maxon ex Domin	Gymnogramma decomposita Baker (ambig.)	Gymnogramme decomposistum		*1904*			Probably this species
Pityrogramma chrysophylla Link var. chrysophylla	Gymnogramma chrysophyllum Kaulf. (ambig.)	Gymnogramme chrysophylla		*1904* *191?*			
Pityrogramma schizophylla (Baker) Maxon (syn. Gymnogramma schizophylla Baker) (cult.)	Pityrogramma schizophylla (Baker ex Jenman) Maxon (perhaps **Gymnogramma gloriosa Hort.**, acc. to GBIF, 2021)	Gymnogramme gloriosa		*1904*			In horticultural magazines of 19the century as Gymnogramma schizophyllum var. gloriosa
	Gymnogramma laucheana K.Koch (ambig.)*	Gymnogramme Laucheana		*191?*			*also Gymnogramma laucheana hort.
Pityrogramma sulphurea (Sw.) Maxon	Pityrogramma sulphurea (Sw.) Maxon				*yes*		
		Gymnogramme sulfurea		*191?* *1932*			
		Gymnogramme sulphurea Desv.				Berlin (Germany) 1955	in hand-written inventory of glasshouse in 1955
Pteris L.	Pteris L.	Pteris spp.	*yes*				"By the Grotto", in the glasshouses; "fam. Polypoidaceae"
Pteris argyraea T.Moore	Pteris argyraea T.Moore (ambig.)	P. argyraea		*1904* *191?*			
		P. argyraea Moore		*1932*	*yes*		
Pteris sp.	Pteris sp.	P. argyraea crispa		*191?*			Perhaps Pteris crispa?
Pteris sp.	Pteris sp.	P. argyraea v. grandis		*191?*			Perhaps Pteris grandis?

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
(four P. arguta with different authors)	(three P. arguta with different authors)	"Pteris arguta"				1951	in hand-written inventory of glasshouse
Pteris biaurita L.	Pteris biaurita L.	P. biaurita L.			*yes*		
Pteris cretica L.	Pteris cretica L.	Pteris cretica	*yes*	*1932*			fam. Polypodiaceae
		P. cretica L.			*yes*	2016	new sprouted among others grown from spores
Pteris cretica L. (cult.)	Pteris cretica L. (cult.)	P. cretica v. albolineata		*1904* *191?*			
Pteris cretica L. (cult.)	Pteris cretica L. (cult.)	P. cretica var. albolineata Hook.		*yes*			in hand-written inventories of glasshouse in 1950-ies
Pteris cretica L. (cult.)	Pteris cretica L. (cult.)	P. cretica L. 'Albo-Lineata'			*yes*	2016	Hort: P. cretica L. 'Albolineata'; new sprouted among others
Pteris cretica L. (cult.)	Pteris cretica L. (cult.)	P. cretica L. var. cristata hort.		*yes*	*yes*	2016	Hort: P. cretica L. 'Cristata'; new sprouted among others grown from spores
Pteris cretica L. (cult.)	Pteris cretica L. (cult.)	P. cretica major		*191?* *1932*			probably P. cretica 'Major'
Pteris cretica L. (cult.)	Pteris gauthieri hort. (ambig.)	P. cretica L. var. gauthieri hort.			*yes*		Hort: P. cretica L. 'Gauthieri'
Pteris cretica L. (cult.)	Pteris cretica L. (cult.)	P. cretica L. var. roweri hort.			*yes*		Hort: Pteris cretica L. 'Roweri'/'Roeweri'
Pteris cretica L. (cult.)	Pteris wimsettii ht. (ambig.)	P. cretica L. var. wimsettii hort.			*yes*		Hort.: Pteris cretica L. 'Wimsetti'/Wimsettii'
	Pteris wimsettii ht. (ambig.)	P. Wimsetti		*1904* *191?*			
Pteris ensiformis Burm.f.	Pteris ensiformis Burm.f.	Pteris ensiformis Burm.		*1904*			
		Pteris ensiformis		*191?*			
Pteris ensiformis Burm.f. var. ensiformis	Pteris victoriae ht. (ambig.)	Pteris Victoria*		*1904*			*Probably Pteris victoriae (W.Bull ex Ridl.) W. Bull
Pteris longifolia L.	Pteris longifolia L.	Pteris longifolia/us	*yes*	*1904* *191?* *1932*			fam. Polypodiaceae

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
		Pteris longifolia L.		*yes*			in hand-written inventories of glasshouse in 1950-ies
		"=P. longifolia L., acc. to Ehrendorfer"			*yes*		In our database P. longifolia was once considered to be a synonim of P. vittata (Kovačić, 2015)
Pteris multifida Poir.	unknown (Pteris serrulata Forssk. – ambig.)	Pteris serrulata L.F.		*1904*			
		P. serrulata	*yes*	*191?*			(without an author, but we can presume it was L.f. as in 1904; fam. Polypodiaceae)
		P. multifida		*yes*			in hand-written inventories of glasshouse in 1950-ies
		P. serrulata		*yes*		Szeged (Hungary) 1954	in hand-written inventories of glasshouse in 1950-ies
		P. serrulata L.f.; changed to P. multifida Poir.			*yes*		
Pteris cristata Anon. (unplaced)	Pteris cristata hort. (ambig)	Pteris serrulata cristata		*1904*			
		Pteris serrulata var. cristata		*yes*			in hand-written inventories of glasshouse in 1950-ies
Pteris sp.	Pteris sp.	Pteris serrulata grandis L.f.		*1904*			perhaps Pteris grandis?
Pteris multifida Poir. 'Cristata'	unknown (only Pteris serrulata Forssk. – ambig.)	Pteris multifida Poir. 'Cristata'			*yes*		
Pteris quadriaurita Retz.	Pteris quadriaurita Retz.	P. quadriaurita Retz.			*yes*		err. in Kovačić, 2015: "Histiopteris incisa (Thunb.) J. Sm. – arrived as syn. Pteris quadriaurita (Pteridaceae)"
Pteris vittata L.	Pteris vittata L.	P. vittata L.			*yes*	Vienna-Belvedere (Austria) 2016	new sprouted among others grown from spores; spreading locally
Order/clade & Family: **POLYPODIALES – Tectariaceae** (PPG-1, 2016 via APweb, 2021)							
Hypoderris brownii J.Sm. (Polypodiaceae)	Hypoderris brownii J. Sm. ex Hook.	Hypoderis browni		*191?* *1932*			

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Tectaria aspidioides Copel. (Polypodiaceae)	Polypodium philippinum Hook. (ambig.)	Polypodium Phillipense		*191?*			I am not sure that this is the valid name(s) of the original taxon
Tectaria aurita (Sw.) S.Chandra (Polypodiaceae)	Stenosemia aurita (Sw.) C. Presl	Polybotrya aurita		*1904*			
Tectaria cicutaria (L.) Copel. (Polypodiaceae)	Tectaria cicutaria (L.) Copel.	Tectaria cicutaria (L.) Copel.			*yes*		
two different authors and two diffrerent species of Tectaria	Tectaria mexicana (Fée) C.V. Morton	Aspidium latifolium		*1904*			
Tectaria zeilanica (Houtt.) Sledge (Polypodiaceae)	Tectaria zeylanica (Houtt.) Sledge	Quercifilix zeylanica (Houtt.) Copel.				Vienna-Belvedere (Austria) 2016	
Order/clade & Family: **POLYPODIALES – Thelypteridaceae** (PPG-1, 2016 via APweb, 2021)							
Thelypteris beddomei (Baker) Ching (Aspleniaceae)	Parathelypteris beddomei (Baker) Ching	Parathelypteris beddomei (Baker) Ching				Chemnitz (Germany) 2016	
Thelypteris balbisii (Spreng.) Ching (Aspleniaceae)	Thelypteris balbisii (Spreng.) Ching	Aspidium Balbisii		*1904*			
Thelypteris cordata (Fée) Proctor (Aspleniaceae)	Thelypteris cordata (Fée) Proctor	Th. cordata (Fée) Proctor				private collector (Germany) 2020	
Thelypteris kunthii (Desv.) C.V.Morton (Aspleniaceae)	Thelypteris kunthii (Desv.) C.V.Morton	Th. kunthii (Desv.) C.V.Morton				Antwerp (Belgium) 2016	
Thelypteris noveboracensis (L.) Nieuwl. (Aspleniaceae)	Thelypteris noveboracensis (L.) Nieuwl.	Aspidium novaeboracense		*1904*			
Thelypteris palustris Schott (Aspleniaceae)	unknown (Nephrodium/ Dryopteris thelypteris = val. Thelypteris confluens (Thunb.) C.V.Morton)	Dryopteris thelypteris A.Gray		*yes*		1955	hand-written inventories of Alpinum rockery in 1950-ies
		Nephrodium thelypteris (L.) Strempel – Dryopteridaceae				1962	Thelypteris palustris Schott (FCD)
unknown	unknown	*Phegopteris "cunata" Mett. (misspelled?)					perhaps Ph.cruciata (Willd.) Mett.?
Order/clade & Family: **POLYPODIALES – Woodsiaceae** (PPG-1, 2016 via APweb, 2021)							
Woodsia obtusa (Spreng.) Torr. (Aspleniaceae)	Woodsia obtusa Torr.	W. obtusa Torr.				Chemnitz (Germany) 2016	

Tab. 1. Continued

PoWO (Kew):	**WFO:**	Original name in the Garden Database:	Heinz, 1895-6	1904 – 1948	Kovačić, 2015	**Source** (in Croatia, if not stated otherwise) **and year** of obtainig. Empty box = unknown	Comment
Woodsia plummerae Lemmon (Aspleniaceae)	Woodsia plummerae Lemmon	W. plummerae Lemmon				Chemnitz (Germany) 2016	
Woodsia scopulina D.C. Eaton subsp. laurentiana Windham (Aspleniaceae)	Woodsia scopulina D.C. Eaton (unknown subsp.)	Woodsia scopulina subsp. laurentiana				Chemnitz (Germany) 2016	
Order/clade & Family: various, undeterminated							
Aspidium spp. (p.p. synonym of Tectaria Cav.; Tectariaceae)	Aspidium spp. (synonym of Tectaria Cav.; Polypodiaceae)	Aspidium spp.	*yes*			various	probably Croatian native, as they grew "by the Grotto", but some perhaps also of Tectaria genus; today "Aspidium"-s are scattered to various families

Tab. 1. Ferns inventoried in Botanical Garden of the Faculty of Science, University of Zagreb, between 1895 and 2021, including "hidden" entries retrieved from the reused paper-cards and hand-written lists. **Column 1** "PoWO (Kew)" depicts the views of each fern-name (December, 2021) as seen in the Plants of the World Online, compared to the "WFO" (**2nd column**), showing the same name according to the World Flora Online, and (3rd column) "Original name in the Garden Database".

Columns 4, 5 and **6** contain the original sources of information for each fern: published in Heinz (1895-6) and/or Kovačić (2015), or unpublished (hand-written inventories between 1904 and 1948). **Column 7** carries the information on the source of plant material and year of its obtaining (if such exist). Last column depicts additional data on each fern (for Croatian native species, Flora Croatica Database was consulted). Affiliations to Orders/Clades and Families are arranged in rows separating groups of ferns, according to The Pterydophyte Phylogeny Group (2016; via APweb, 2021).

Four seasons in the Garden *fernarium*: majority of species are planted outdoors, while tropical ones are brought out with pots in May, to over-summer. 1) Spring. 2) Summer. 3) Autumn. 4) Winter.