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THE LÉO LESQUEREUX PALEOBOTANICAL COLLECTION OF THE MUSÉE RÉGIONAL DU VAL-DE-TRAVERS (NEUCHÂTEL, SWITZERLAND)

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Résumé

En 1867, Léo Lesquereux (1806-1889), aujourd'hui considéré comme l'un des pionniers de la paléobotanique américaine, donnait au Musée de son village d'origine, Fleurier (canton de Neuchâtel, Suisse), un lot de plantes fossiles provenant des bassins houillers des États-Unis. Cet article revient sur la donation, avant de s'attacher à la présentation des pièces les plus importantes, celles contenant dix espèces décrites par le savant entre 1854 et 1879. Deux échantillons sont particulièrement importants ; l'un d'une empreinte portant déjà le nom d'une espèce qu'il décrira en 1879 (*Pseudopecopteris dimorpha* Lesq. 1879), soit douze ans après le don et l'autre d'une plante non décrite (*Pecopteris* spec. nov.), mais dont l'étiquette porte la mention « *pas encore nommée* ». Plus ancien lot paléontologique arrivé en Europe du vivant de Lesquereux, cette collection mérite d'être reconnue d'importance nationale.

Abstract

In 1867, Léo Lesquereux (1806-1889), who is now considered one of the pioneers of American paleobotany, donated a batch of fossil plants from the coalfields of the United States to the Museum of his home village, Fleurier (canton of Neuchâtel, Switzerland). This article discusses the donation, before focussing on the presentation of the most important pieces which are those containing ten species described by the scientist between 1854 and 1879. Two specimens are particularly important ; one of an imprint already bearing the name of a species he described in 1879 (*Pseudopecopteris dimorpha* Lesq. 1879), twelve years after the donation, and the other of an undescribed plant (*Pecopteris* spec. nov.), but whose label bears the note “*not yet named*”. As the oldest palaeontological lot to arrive in Europe during Lesquereux's lifetime, this collection deserves to be recognised as being of national importance.

Zusammenfassung

1867 schenkte Léo Lesquereux (1806-1889), der heute als einer der Pioniere der amerikanischen Paläobotanik gilt, dem Museum seines Heimatdorfes Fleurier (Kanton Neuenburg, Schweiz) eine Reihe fossiler Pflanzen aus den Kohlefeldern der Vereinigten Staaten. Dieser Artikel rekapituliert die Geschichte der Schenkung, bevor er sich auf die Präsentation der wichtigsten Stücke konzentriert, die 10 von dem Wissenschaftler zwischen 1854 und 1879 beschriebenen Arten enthalten. Zwei Exemplare sind besonders wichtig ; eines von einem Abdruck, der bereits den Namen einer Art trägt, die er 1879 beschrieb (*Pseudopecopteris dimorpha* Lesq. 1879), zwölf Jahre nach der Schenkung, und das andere von einer unbeschriebenen Pflanze (*Pecopteris* spec. nov.), deren Etikett aber den Vermerk « *noch nicht benannt* » trägt. Diese Sammlung ist die älteste paläontologische Sammlung, die zu Lebzeiten von Lesquereux nach Europa gelangte und verdient, als national bedeutsam anerkannt zu werden.

Mots-clés

Lesquereux, plantes fossiles, Carbonifère, bassins houillers des États-Unis.

Keywords

Lesquereux, fossil plants, Carboniferous, US coalfields.

“Lesquereux in palaeobotany and Guyot in physical geography reached the top in their fields in America. These two, along with Pourtalès, were honoured by election to the National Academy of Sciences.”

R. H. Silliman (2007)

INTRODUCTION

In the spring of 1867, the Fleurier Museum (now the Musée régional du Val-de-Travers [MRVT]) received a batch of fossil plant samples from Léo Lesquereux (1806-1889), who lived in the state of Ohio (USA). This Swiss botanist and palaeobotanist, who was virtually unknown in his home country, is considered one of the greatest natural scientists of the 19th century in North America, as the quotation from Silliman in the frontispiece of this article attests.

This note reviews the contents of the collection deposited at the MRVT and revisits the importance of this gift, while reviving the memory of a Neuchâtel man considered to be the pioneer of American paleobotany.

BIOGRAPHY OF THE SCIENTIST UNTIL 1867, WHEN THE COLLECTION WAS DONATED

Léo Lesquereux was born on the 18th of November in 1806 in Fleurier (Switzerland), where he spent his childhood. His father, a watchmaker specialising in the manufacture of watch springs, had important professional connections with the Berthoud family's watchmaking business in the same village. Léo became friends with Fritz Berthoud (1812-1890), who was one of the founders of the Society of the Fleurier Museum [Société

du Musée de Fleurier] in 1859 (CLÉMENT-GRANDCOURT 2013), which later became the Musée régional d'histoire et d'artisanat du Val-de-Travers in 1869, and then, the Musée régional du Val-de-Travers in 2014.

After starting his professional career as a teacher, Léo Lesquereux had to give up teaching when he lost his hearing. He then helped his father in the family business, but developed a passion for botany, especially mosses, of which he became one of a few specialists. In 1845, his pioneering studies on peat bogs were rewarded with the prize of the Société d'émulation patriotique de Neuchâtel.

At the invitation of his geologist friends Louis Agassiz (1807-1873) and Edouard Desor (1811-1882), he left for the United States, where he remained until his death on 25 October 1889 in Columbus, Ohio. Working first on mosses with the bryologist William Sullivant (1803-1873), Lesquereux soon learned about palaeobotany through a mining exploration campaign organised by his colleague Edouard Desor. The fact that he had become totally deaf before coming to America was a great handicap because he had never heard people speak English. At this time in his career, the help of Edouard Desor and Louis Agassiz was decisive, as he could read their lips when they spoke in French and then guess their intentions when they spoke in English. In

the field, he used a slate board and chalk to exchange ideas with his English-speaking colleagues (CLÉMENT-GRANDCOURT 2013).

In fact, Lesquereux took part in many geological missions organised by different states in the United States. These numerous assignments allowed him to remain independent and to support his family while maintaining, at least for a few years, a small watchmaker's business. His relations with Desor and Agassiz remained friendly, despite the split between these two scientists. Between 1868 and 1872, Lesquereux worked for a few months each year with the organisation and naming of the palaeobotanical collections of the Museum of Comparative Zoology at Harvard (Cambridge), which is today part of the Harvard Museum of Natural History.

In 1871, Lesquereux sold to the "Harvard Museum" his collection of four thousand fossil plant samples (CLÉMENT-GRANDCOURT 2013; p. 139-141)¹ that remain there today (DARRAH 1934). Late in life, he worked on the private collections of the famous fossil collector Ralph Dupuy Lacoe (1824-1901) in Pittston, Pennsylvania. Before he died, Lesquereux sold his plant fossil collection to Lacoe (DARRAH 1934; CLÉMENT-GRANDCOURT 2013), who later donated his entire collection to the United States National Museum (Smithsonian Institution). Therefore, different types of the taxa named by Lesquereux can be found at many different institutions, but notably the Harvard and Smithsonian Institutions (LENDEMER 2002).

¹ « Or il vient de vendre sa collection de plantes fossiles à un musée d'histoire naturelle de Cambridge [...] et il faut étiqueter et emballer avec soin les quelques quatre mille pièces et échantillons qu'elle comporte... » (p. 139); « Toujours est-il qu'en mars 1871, Léo est à Cambridge à la demande d'Agassiz pour débarrasser les quarante-deux caisses de la collection de fossiles et échantillons divers qu'il a vendue au Musée d'histoire naturelle et emballée un an auparavant, et installer le tout dans la nouvelle aile qu'Agassiz a fait construire afin d'augmenter l'espace disponible pour ses collections » (p. 141).

The first research with Desor took place in Pennsylvania from July to November 1851, under the direction of Henry-Darwin Rogers (1808-1866). It continued the following year and resulted in a first article in the *Boston Journal of Natural History* (LESQUEREUX 1854), followed by a 50-page-long palaeontological report (LESQUEREUX 1858a). Other surveys followed from 1857 to 1859 in Kentucky (LESQUEREUX 1857) and Arkansas (LESQUEREUX 1858b), under the direction of David Dale Owen (1806-1860). He carried out a new campaign in Indiana in April-May 1860, and then, in Illinois in June.

Despite the American Civil War (1861-1865), his paleobotanical research in Illinois continued, together with that of Amos Henry Worthen (1813-1888), resulting in two publications (LESQUEREUX 1866; LESQUEREUX 1870). Under the direction of F. W. Heyden (1829-1887), other work was carried out on the fossil plants of Mississippi (LESQUEREUX 1864).

In 1867, sixteen years after starting his paleontological research, Lesquereux wrote to his childhood friend, Fritz Berthoud, to inform him of his donation. In his letter on the third of March, he stated: "*In order to respond as much as I can to your desire and that of several other friends, I have sent the museum a box containing books, the collection of mosses from the United States (a fine work for science, but which no one will look at in Fleurier), fossil plants, samples of coal, and fossil woods*" [transl. B. Mulhauser]². The box was received in the Val-de-Travers during the spring of 1867 and its contents were catalogued. However, since then, the fossils have been largely ignored and have never been described in any scientific journal.

² « Pour répondre autant que je puis le faire à votre désir et celui de plusieurs autres de nos amis, j'ai envoyé au musée une caisse contenant des livres, la collection des mousses des États-Unis (un beau travail pour la science, mais que personne ne regardera à Fleurier), des plantes fossiles, des échantillons de houilles, des bois fossiles. »

DESCRIPTION OF THE PALEOBOTANICAL COLLECTION

During several visits in 2014, 2015, and 2020 to the MRVT repositories, I listed and photographed the pieces, before checking the determinations of the fossil plants and the possible crossing of original labels (fig. 1). I also checked the accuracy of the copied labels when the original label was missing. Further research at the Faculty of Sciences of the University of Neuchâtel, and then, in the collections of the Natural History Museum of Neuchâtel (MHNN) enabled me to find two lost pieces.



Figure 1. Some labels written by hand by Léo Lesquereux and bearing the donor's date stamp: LEO LESQUEREUX COLUMBUS O FEB 1867. Label sizes : 8,5 x 5 cm.

According to the numbering established by Lesquereux and affixed to the pieces with characteristic oval stamps (fig. 2), the donation must consist of 68 geological “subjects”, including one specified lot not numbered by the donor and two pieces bearing the same number “46”. The 68 records do not correspond to the number of items because several stamps (each representing a different species) may be glued to the same sample (fig. 3). Since some fossils are missing, it is difficult to be sure of the number of geological objects given.

STATE OF THE COLLECTION

Table 1 summarises the state of the geological donation. Eight numbered objects are missing (in yellow in table 1), but another five pieces, which undoubtedly belonged to the Lesquereux collection, are not numbered (marked with a “?” in Table 1). Based on several criteria of geological and paleontological analyses, these objects can be assigned to missing numbers (see the numbers in brackets in the first column of table 1). If we add the two pieces (totalling four numbers) that were found in the collections of the MHNN (in green in table 1), only three samples out of the whole donation had not been found at the time of publication of this article.

The Lesquereux collection of the MRVT can be divided into three batches :

- sedimentary rocks (No. 1 to 14, excepted No. 11),
- plant fossils (No. 15 to 60),
- marine fauna fossils (No. 11, No. 62 to 66, as well as “without number”).

Since No. 61 is missing, we do not know if it should be attached to the 2nd or 3rd batches. This article thus focusses on the description of fossil plants, but the samples of coal, shale, and anthracites are valuable for a possible comparison of the fossil deposits.



Figure 2. Ideal case of a collector's item, the historical and scientific value of which remains intact. The specimen, stored in a box, is labelled with the names of the different species present in the fossil sample. The object is completed by the label and the original oval stamps, numbered by the donor's hand. Fossil piece No. 30/31/32/33.MRVT. Pennsylvania anthracite shale. Gift of Léo Lesquereux, February 1867. Label sizes : 8,5 x 5 cm.



Figure 3. Example of the didacticism of Léo Lesquereux. Each plant remnant on the fossil plate is identified by a number, or even an arrow, which makes it possible to distinguish it unequivocally. Fossil part No. 48/49/50/51/52/53/54/55/56/57. Sizes of the piece: 24 x 13 cm. MRVT. Rhode Island coal shale. Gift of Léo Lesquereux, February 1867.

Table 1. Reconstruction of the list of paleontological items donated by Léo Lesquereux to the Fleurier Museum in February 1867. Time period: ¹ on the original label by the hand of Lesquereux / ² on a copy label not by Lesquereux / ³ deducted by Mulhauser / ⁴ copy label at the Museum of Neuchâtel not correct, re-examined by Mulhauser / ⁵ Francis Creek Shale, Mazon Creek Formation, Middle Pennsylvanian (309 Ma), appraised by Mulhauser / ⁶ Middle/Lower Pennsylvanian; Pottsville Formation, Salem Vein (307 - 323.2 Ma), appraised by Mulhauser / ⁷ Middle Pennsylvanian; Rhode Island Formation, Narragansett Basin (307 - 315.2 Ma), appraised by Mulhauser.

Original No.	Depository institution	Original label	Category of specimen	Origin	Time period
1	missing				
2	MRVT		Stratified coal	Ohio	Carboniferous ²
3	MRVT		Stratified coal		Carboniferous ²
4	MRVT		Bituminous coal	Ohio	Carboniferous ²
5	MRVT		Bituminous shale	Ohio	Carboniferous ²
6	MRVT		Bituminous shale	Ohio	Devonian ²
7	MRVT		Anthracite	Pennsylvania	Carboniferous ²
8	MRVT		Shale anthracite	Pennsylvania	Carboniferous ²
9	MRVT		Anthracite	Pennsylvania	Carboniferous ²
10	MRVT		Iron anthracite	Pennsylvania	Carboniferous ²
11	MRVT	present	Fish scale	Ohio	Carboniferous ¹
12	missing				
13	missing				
14	MRVT		Fish tooth	Ohio	Carboniferous ³
? (1 ?)	MRVT		Mineral coal	Pennsylvania	Carboniferous ³
? (12 or 13 ?)	MRVT		Anthracite		Carboniferous ³
15	MRVT		Fossil plant	Illinois	Carboniferous ³
16	MRVT		Fossil plant	Illinois	Carboniferous ³
17	MHNN / UNI.1245		Fossil plant		Carboniferous ^{3,5}
18	missing				
19	MRVT		Fossil plant	Illinois	Carboniferous ⁵

Original No.	Depository institution	Original label	Category of specimen	Origin	Time period
20	MRVT		Fossil plant	Illinois	Carboniferous ⁵
21	missing				
22	MRVT		Fossil plant	Illinois	Carboniferous ⁵
? (18 or 21)	MRVT		Fossil plant	Illinois	Carboniferous ⁵
? (18 or 21)	MRVT		Fossil plant	Illinois	Carboniferous ⁵
? (24 or 38)	MRVT		Fossil plant		Carboniferous ³
23	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
24	missing				
25	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ^{1, 6}
26	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ^{1, 6}
27	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ^{1, 6}
28	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ^{1, 6}
29	MRVT		Fossil plant	Pennsylvania	Carboniferous ^{1, 6}
30	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
31	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
32	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
33	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
34	MHNN / UNI.5107		Fossil plant	Pennsylvania	Carboniferous ⁴
35	MHNN / UNI.5107		Fossil plant	Pennsylvania	Carboniferous ⁴
36	MHNN / UNI.5107		Fossil plant	Pennsylvania	Carboniferous ⁴
37	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
38	missing				
39	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
40	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
41	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
42	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
43	MRVT		Fossil plant	Pennsylvania	Carboniferous ³
44	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹

Original No.	Depository institution	Original label	Category of specimen	Origin	Time period
45	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
46	MRVT	present	Fossil plant	Illinois	Carboniferous ¹
W46	MRVT	present	Fossil plant	Arkansas	? (Cenozoic)
47	MRVT	present	Fossil plant	Rhode Island	Carboniferous ¹
48	MRVT	present	Fossil plant	Rhode Island	Carboniferous ^{1, 7}
49	MRVT	present	Fossil plant	Rhode Island	Carboniferous ^{1, 7}
50	MRVT	present	Fossil plant	Rhode Island	Carboniferous ^{1, 7}
51	MRVT	present	Fossil plant	Rhode Island	Carboniferous ^{1, 7}
52	MRVT	present	Fossil plant	Rhode Island	Carboniferous ^{1, 7}
53	MRVT	present	Fossil plant	Rhode Island	Carboniferous ^{1, 7}
54	MRVT	present	Fossil plant	Rhode Island	Carboniferous ^{1, 7}
55	MRVT	present	Fossil plant	Rhode Island	Carboniferous ^{1, 7}
56	MRVT	present	Fossil plant	Rhode Island	Carboniferous ^{1, 7}
57	MRVT	present	Fossil plant	Rhode Island	Carboniferous ^{1, 7}
58	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
59	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
60	MRVT	present	Fossil plant	Pennsylvania	Carboniferous ¹
61	missing				
62	MRVT	present	Brachiopods	Ohio	Silurian ¹
63	MRVT	present	Brachiopods	Kentucky	Silurian ¹
64	MRVT	present	Marine fauna	Ohio	Silurian ¹
65	MRVT	present	Corals	Kentucky	Silurian ¹
66	MRVT	present	Brachiopods	Ohio	Carboniferous ¹
without number	MRVT	present	Crinoids	Tennessee	Carboniferous ¹

Table 2 lists the plant fossils that were recovered, as well as their provenances. The inventory numbers are those proposed by Lesquereux both on the original labels (fig. 1) and on the oval stamps placed next to the fossilised imprints (fig. 2; fig. 3). In historical perspective, as the nomenclature has changed for many species, the original names and names of the synthesis on coal flora of Lesquereux (1880-1884) are listed in table 2. Of the 25 taxa represented, nine are species which were described by Lesquereux and one would concern a new species (*Pecopteris* spec. nov.), i. e., which were not described at the time of the donation (1867). These specimens in particular significantly increase the scientific value of the collection.

Table 2. Fossil plants found, identified and donated by Léo Lesquereux to the Fleurier Museum in February of 1867. The first column gives the names of original labels in MRVT. The second column reports the monumental synthesis of Lesquereux. The “?” corresponds to pieces that have lost their numbers; by deduction, it could be 18 or 21 for *Annularia longifolia* and *Pecopteris villosa* from Illinois and 24, 38, or 61 for *Pecopteris miltoni* in Pennsylvania. The general determination was performed by B. Mulhauser.

Name on original label	Current name in Lesquereux 1880-1884	Author	Illinois	Pennsylvania	Rhode Island
Lycophyta					
<i>Sigillaria</i> sp.	<i>Sigillaria</i> sp.			33	50**
<i>Stigmara</i> sp.	<i>Stigmara</i> sp.				50**
Sphenophyta					
<i>Annularia longifolia</i>	<i>Annularia longifolia</i>	Brgt 1828	?	37*	
<i>Calamites suckovii</i>	<i>Calamites suckovii</i>	Brgt 1828		30	
<i>Asterophyllites equisetiformis</i>	<i>Asterophyllites equisetiformis</i>	Brgt			56
<i>Asterophyllites sublaevis</i>	<i>Asterophyllites sublaevis</i>	Lesq. 1854			48
Filicophyta					
<i>Pecopteris arborescens</i>	<i>Pecopteris (Cyatheites) arborescens</i>	(Schloth.) St. 1825		23	
<i>Pecopteris arguta</i>	<i>Pecopteris (Goniopteris) arguta</i>	St. 1825			52
<i>Pecopteris cyathea</i>	<i>Pecopteris (Cyatheites) arborescens</i>	(Schloth.) Brgt 1828		36	47 / 49 / 51
<i>Pecopteris dentata</i>	<i>Pecopteris (Cyatheites) dentata</i>	(Laristie) Brgt 1836	17		
<i>Alethopteris miltoni</i>	<i>Pecopteris (Cyatheites) miltoni</i>	(Artis) Brgt 1828		37* / 39 / 43 / ?	
<i>Pecopteris</i> sp.	<i>Pecopteris</i> sp.			44	
<i>Pecopteris</i> spec. nov.	<i>Pecopteris</i> sp.			27	

Name on original label	Current name in Lesquereux 1880-1884	Author	Illinois	Pennsylvania	Rhode Island
<i>Pecopteris unita</i>	<i>Pecopteris (Goniopteris) unita</i>	Brgt 1836			55 / 57
<i>Pecopteris villosa</i>	<i>Pecopteris (Villous) villosa?</i>	Brgt 1836	15 / 16 / 22 / ?		
<i>Pecopteris dimorpha</i>	<i>Pseudopecopteris dimorpha</i>	Lesq. 1879			53
<i>Hymenophyllites hirsutus</i>	<i>Rhacophyllum hirsutum</i>	(Lesq.) 1854		29	
Pteridospermatophyta					
<i>Alethopteris lonchitica</i>	<i>Alethopteris lonchitica</i>	Schloth. 1804		32 / 60	
<i>Alethopteris pennsylvanica</i>	<i>Alethopteris pennsylvanica</i>	Lesq. 1854		28	
<i>Alethopteris owenii</i>	<i>Callipteridium owenii</i>	Lesq. 1858	19		
<i>Alethopteris sullivantii</i>	<i>Callipteridium sullivantii</i>	(Lesq.) 1854	46		
<i>Neuropteris desorii</i>	<i>Neuropteris desorii</i>	Lesq. 1854		26	
<i>Neuropteris hirsuta</i>	<i>Neuropteris hirsuta</i>	Lesq. 1854	20		
<i>Neuropteris loschii</i>	<i>Neuropteris loschii</i>	Brgt 1836		31 / 58 / 59	
<i>Neuropteris rogersi</i>	<i>Neuropteris rogersi</i>	(Lesq.) 1854		25 / 45	

* Species listed as No. 37 with *Annularia longifolia*.

** *Sigillaria* and *Stigmara* named together in the original label.

No. 18, 21, 24, 38, and 61 are missing from the collection. No. 34 and 35 have not yet been identified.

Lesq. is the standard botanical abbreviation recognised by the international scientific community.

COAL SHALE OF ILLINOIS

With the exception of piece No. 46.MRVT, the samples from Illinois are fossil imprints enclosed in siderite nodules which have been separated into two parts, thus showing a positive imprint and its mirror negative (plate I). For some samples - such as those of *Neuropteris hirsuta* - one of the two halves of the nodule is unrepresentative. It is unknown whether the original donation did contain the other halves or not. All the pieces come from the locality of Morris, with the exception of the unnumbered sample of *Pecopteris villosa*, which bears the inscription Grundy and the name of the county in which Morris is located.

Morris's body of fossil flora and fauna is known as the "Mazon Creek Lagerstätte" (CLEMENTS *et al.* 2019). The concretions are located in the lower part of the Francis Creek Shale. The Smithsonian National Museum of Natural History (USA) gives the following description: "The Francis Creek Shale is of Middle Pennsylvanian age, approximately 309 million years old, which is part of the late Moscovian Stage in the latest international terminology for the Carboniferous System (ICS), or the Desmoinesian Stage in regional North American terminology" (SNMNH 2021).

Out of nine pieces offered by Léo Lesquereux, three contain plants described by him. These are "seed ferns" or Pteridospermatophyta:

Neuropteris hirsuta Lesq. 1854

This species was described in 1854 in the *Boston Journal of Natural History* (BJNH) (LESQUEREUX 1854). In 1858, the author completed his description by adding numerous engravings, because, from his own observations, the species is very polymorphic: "*Neuropteris hirsuta* Lesqx. Frond bi, tripinnate; primary pinnae very large, secondary

divisions alternate, oblique, lanceolate; ultimate pinnae trifoliate in the lower part of the branches; becoming simple in the upper part; middle leaflets large, lanceolate, obtuse, entire or undulate; cordate and sessile to the rachis when simple; pedicellate when compound or bearing one or two small round or oval leaflets at the base; lower surface hairy; costa distinct, strong, and ascending to three fourths of the lamina in the middle pinnules only; veins dichotomous, arched, thin and close, flabellate from the base in the lateral or basilar leaflets, with rarely a trace of a midrib" (LESQUEREUX 1858).

The species is found in "...most of the coal beds from the base to the upper part of the middle coal measures. Extremely abundant at the Pittsburgh coal, the Salem vein, etc., and there sometimes mixed with the following; less predominant in the low coal of Ill.[inois], Morris; very rare at Mazon Creek, where it is superseded by *Neuropteris decipiens*. I have never seen it from the sub-conglomerate measures" (LESQUEREUX 1880-1884).

Callipteridium owenii Lesq. (1858)

This plant was first placed in the genus *Alethopteris* when it was first described in the Geological Report of Arkansas (LESQUEREUX 1858b) before being listed under that of *Callipteridium* in 1880-1884: "Frond tripinnate; pinnae large, in right angle to the broad rachis, distant; pinnules lanceolate, obtuse, rarely acute, connate near the rachis in obtuse sinuses, often decurring; borders undulate; medial nerve distinct to above the middle; veins dichotomous, distant, thin and curved." The paleobotanist concedes, moreover, that: "the general facies of this Fern is that of an *Alethopteris*. As all the veins, except the basilar ones, are generally forking twice and curved, its place is with *Callipteridium*. Schimper remarks of this species that it resembles *Alethopteris taeniopteroides*, but this last plant, as far as I know it, has none of the basilar veins attached to



Plate I. Fossil plants from the Morris area (Illinois). The upper prints (*Neuropteris hirsuta*, No. 20. MRVT on the left and *Callipteridium owenii*, No. 19. MRVT on the right) are related to the Francis Creek Shale, Mazon Creek Formation, and Middle Pennsylvanian (309 Ma). The bottom piece, *Callipteridium sullivantii*, No. 46. MRVT, although labelled “Morris, Illinois” has an uncertain origin. The black line represents a scale of 1 cm on the full-sized object.

the rachis, and is, therefore, a Pecopteris, as seen also by its fructifications" (LESQUEREUX 1880-1884).

Callipteridium sullivantii (Lesq.) 1854

The species was first presented by Lesquereux under the genus *Callipteris*: "*Callipteris sullivantii (spec. nov.). Frond bipinnate; pinnae lanceolate; pinnules alternate, oblique, obovate or oblong, nearly contiguous, slightly decurrent, and united together near the base by a slightly obtuse sinus; medial nerve broad, canaliculate, disappearing at the middle; secondary nerves arched, slender, close, many times forking*" (LESQUEREUX 1854). In 1869, Schimper placed it in the genus *Alethopteris* before Lesquereux placed it under the genus *Callipteridium* in his synthesis on the flora of the Carboniferous era (LESQUEREUX 1880-1884).

The specimen of this species donated to the Fleurier Museum does not belong to the Mazon Creek siderite nodule group as can be seen at a first glance from the image on plate III. According to the paleobotanist, the type locality of this species is: "*the Lower coal bed of Shamokin, Penn' a [Pennsylvania], just above the Conglomerate. Roof shale of Colchester and Morris coal; nodules of Mazon Creek, Ill. [Illinois] — Dr. J. H. Britts has sent specimens of it in nodules of Carbonate of Iron, from near Clinton, Mo. [Montana, which w]as also found at Cannelton, Pa. [Pennsylvania]*" (LESQUEREUX 1880-1884).

An examination of the fossil exhibit 46.MRVT confirms that it does indeed belong to the species *Callipteridium sullivantii*. However, I suggest considering the listing of the locality on the label with caution.

ANTHRACITE SHALE OF PENNSYLVANIA

Most of Lesquereux's work on the Carboniferous flora was carried out in Pennsylvania, as evidenced by the exact title of his monumental work in three volumes and an atlas: *Description of the coal flora of the Carboniferous formation in Pennsylvania and throughout the United States* (LESQUEREUX 1879; LESQUEREUX 1880-1884). This American state is located between New York and Columbus, the city in Ohio where Lesquereux lived.

Ten fossils from Pennsylvania were a part of a donation made to the Fleurier Museum in 1867. Unfortunately, the indications of their origins, stipulating the nature of the rock (anthracite schist), are incomplete as to the location of the formations from which the samples were taken. However, out of 14 species determined (tab. 2), five were described by Lesquereux, which gives us a serious lead to try to specify the age and the place of discovery of these fossils. A remarkable piece is No. 25/26/27/28, which contains four of these five species (plate II).

Rhacophyllum hirsutum (Lesq. 1854)

This species of fern (Filicophyta) was described in 1854 as *Pachyphyllum hirsutum* (spec. nov.) with the following brief description: “*Frond bipinnately divided, dichotomous, pinnae decurrent, divisions short, oval, acute; nerves obsolete; surface and margins covered with long glandular hairs*” (LESQUEREUX 1854). In 1858, the author used the same terms from his first description and added a drawing. He then indicated the type locality as “Gate Vein, Westwood” (LESQUEREUX 1858). Schimper then attached the species to the genus *Rhacophyllum* in his treatise on plant palaeontology (SCHIMPER 1869). Finally, in his synthesis work, Lesquereux completed the description in these terms: “*Primary rachis or lamina broad, flexuous, bipinnately*



Figure 4. *Rhacophyllum hirsutum* (Lesq. 1854), specimen No. 29.MRVT from Pottsville, Pennsylvania. Sizes of the piece: 10 x 7 cm. Carboniferous, Middle/Lower Pennsylvanian; Pottsville Formation, Salem Vein: 307 - 323.2 Ma).

dichotomous; pinnae oblique, either pinnately divided into short, triangular, entire, obtusely pointed lobes, or cut in irregular linear-lanceolate acuminate laciniae; surface covered with long distinct hairs or scales; veins in parallel fascicles. Locality: Salem Vein near Pottsville, Pennsylvania, upper Coal” (LESQUEREUX 1880).

Alethopteris pennsylvanica Lesq. 1854

This plant belongs to the division of Pteridospermatophytes, a group which became extinct during the Cretaceous period (MULHAUSER & TRITZ 2016). Lesquereux described the species in these terms: “*Alethopteris pennsylvanica* (spec. nov.). *Inferior pinnae bipinnatifid, with short, round pinnules, united half their length; superior pinnae pinnate only, with long lanceolate-linear and undulate pinnules, slightly decurrent on the rachis, and united at the base; median nerve large, canaliculated; nerves perpendicular, thin, close together, simple or dichotomous*” (LESQUEREUX 1854). In 1868, he repeated this description, word for word, adding the following comment: “*Perhaps this*



Plate II. Fossil plants from the Pottsville Shale Deposit, Pennsylvania. Carboniferous, Middle/Lower Pennsylvanian era; Pottsville Formation, Salem Vein: 307 - 323.2 Ma. Top left, upper side of sample No. 25/26/27/28.MRVT revealing the first three imprints; on the right, the lower side of the same sample with the imprint No. 28. In the middle, the label written in February of 1867 by Lesquereux's hand for the donation to the Fleurier Museum where No. 25 *Neuropteris rogersi* Lqx, No. 26 *Neuropteris desorii* Lqx, No. 27 *Pecopteris spec. nov.* (detailed at the lower left), and No. 28 *Alethopteris pennsylvanica* Lqx (detailed at the lower right) are inscribed. The black line corresponds to 1 cm of scale on the full-sized object. Label sizes: 8,5 x 5 cm.

is only a variety of the former species, for it has exactly the same general appearance, and the same nervation. Nevertheless, as we have never seen, in the true *Alethopteris lonchitidis*, any trace of the lower bipinnate frond, and have never seen any undulate-serrulate pinnules [...]; we could not unite the [2] species” (LESQUEREUX 1868).

Like the previous species, the type locality of this plant is Salem Vein (Pottsville).

Neuropteris desorii Lesq. 1854

Described in honour of his colleague Edouard Desor, Lesquereux detailed the characteristics of this Pteridospermatophyta as follows: “*Neuropteris desorii* (spec. nov.). Frond bipinnate: pinnules opposite, either oblong oval, or obovate, entire, or irregularly lacinate from the base, sometimes pinnately divided in long linear teeth; nerves flabellate, dichotomous, very thin above, thickened at the base” (LESQUEREUX 1854).

The author found this species in several localities: “Habitat: Upper beds of the anthracite; Salem and Gate vein, near Pottsville; Blakely vein near Archbald; Wilkesbarre, not rare at these localities; found also at Cannelton, by Mr. I. F. Mansfield; not seen in Illinois” (LESQUEREUX 1879).

Neuropteris rogersii, Lesq. (1854)

This plant was first described in 1854 as *Neuropteris speciosa*: “(spec. nov.). Pinnae or pinnules large, oval, or ovate-lanceolate, obtuse, or obtusely pointed, even slightly cuspidate, deeply cordate or distinctly auricled, entire; veins dichotomous from the base or from a thin middle vein, flabellate, slightly arched, very distinct, turning upwards in reaching the borders” (LESQUEREUX 1854).

The name change took place in 1858, in the report on the geology of Pennsylvania (LESQUEREUX 1858). The author later justified

this new attribution in his summary work on the flora of the Carboniferous: “The change of name was made with the assent of Professor Henry D. Rogers, the director of the survey of 1858, to whom the finest species then known from the coal flora of this country was appropriately dedicated” (LESQUEREUX 1880-1884).

While adding engravings of the species, the paleobotanist took the opportunity to refine his description: “The pinnules vary in size from four and a half to fourteen centimeters long, and from three to six centimeters broad, below the middle, where they are the widest. Some of them, [...], are oblong-lanceolate, comparatively narrow; others, [...], are much shorter, comparatively broad, nearly oval, generally with a symmetrical base, but sometimes with one side slightly more enlarged and prolonged downward. This character, [...], indicates that these pinnules are not simple, but were originally attached to a common rachis, though all have been found isolated. The nervation is rather [of type] neuropterid, as generally the pinnules have a narrow costa, not thicker than the lateral veins, appearing like a continuation of them. But in some specimens, in the small leaflets especially, the veins are all flabellate from the base. This species is not comparable to any of the congeners. From *Neuropteris hirsuta* and *Neuropteris angustifolia*, both species very variable in the form of the leaflets, it differs by the more distant equal, sharp veins, not inflated or fasciculate toward the base, abruptly turned up along the borders, and equi-distant in their whole length; by the thin substance of the leaflets, their smooth shining surface and the deeply cordate auricled base, always marked by a comparatively small circular point of attachment” (LESQUEREUX 1880-1884).

Lesquereux ended his description with an aesthetic appreciation: “It is one of the most beautiful and most rare of the American species of *Neuropteris*” before specifying the type locality as: “South Salem vein, behind

Port Carbon, Pa., found in roof shale from an abandoned shaft, just north of the village, and also opposite on the other side of the creek in the same vein, from a thin bed of coal which was still worked in 1868 [...]. Recently, 1879, two specimens of this species have been sent from Cannelton, Pa., by Mr. I. F. Mansfield" (LESQUEREUX 1880-1884).

This last information was crucial to specify the origin of the piece gathering the No. 25/26/27/28 which, in accordance with the description of the three previous species, turned out to be a Salem Vein near Pottsville, just like the piece No. 29 (*Rhacophyllum hirsutum*).

Pecopteris sp. [quoted at spec. nov. by Lesquereux in the original label of 1867]

The imprint of this species of fern (Filicophyta) is present on piece No. 25/26/27/28.MRVT.

We can therefore confirm that it comes from the Salem Vein in Pottsville. On the original label of the donation (plate II), it was specified by the hand of Lesquereux that the species was "*pas encore nommée*" [not yet named].

Assuming that, if the species had been confirmed as new by the paleontologist, its final description must necessarily have been written after 1867. The report named *Essays on the Coal-Formation and its Fossils* published in 1868, only repeats the previous descriptions of 1854 and 1858. We must therefore finally refer to the publication of the synthesis on the fossil flora of the Carboniferous era to hope to find this possible new species (LESQUEREUX 1879; LESQUEREUX 1880-1884).

Unfortunately, despite extensive research, it has not been possible to associate the sample given to Fleurier with one of the *Pecopteris* species described after 1867 by Lesquereux.

RHODE ISLAND COALS

Eight species cited in table 2 derive from the state of Rhode Island, but belong to only two pieces, one of which groups seven taxa on both sides (fig. 3). In this lot, two species were described by Lesquereux: *Asterophyllites sublaevis* and *Pseudopecopteris dimorpha*.

According to the given indications and the literature (in particular LESQUEREUX 1879; LESQUEREUX 1880-1884), the samples come from the carboniferous shale site of Mount Hope, near Newport, dating from the middle Pennsylvanian era (QUINN 1971; Rhode Island Formation, Narragansett Basin: 307 - 315.2 Ma).

Asterophyllites sublaevis (Lesq. 1854)

Lesquereux described this species in 1854 in the *Boston Journal of Natural History* (BJNH), but without a drawing. The text is as follows: “*Asterophyllites sublaevis* (spec. nov.). Stem thick, nearly smooth, slightly undulate above and below the inflated joints, branching at the articulations; leaves verticillate, half open, shorter than the distance between the joints; branches short and thick, with very short leaves” (LESQUEREUX 1854).

He completed his description in 1858 with a drawing and an additional diagnosis: “*Asterophyllites sublaevis*, Lesq., Plate I, fig. 3. Branches thick; articulations close, equidistant; surface of the stem smooth, merely undulate lengthwise below the inflated articulations; leaves short, linear, gradually acuminate; branches short, with two to four whorls of short leaves. This species is easily known by its comparatively broad (five to ten millimeters), smooth stems; the short internodes, thirteen to fifteen millimeters; the short leaves, half as long as the internodes, flat, half open, gradually narrowed from the base to the acumen; and the short branches generally placed on the same side of the stem, none longer than the internodes, oblique, with

two or three whorls of short open leaves” (LESQUEREUX 1858).

Pseudopecopteris dimorpha Lesq. 1879

The fossil print of this species donated to the Fleurier Museum represents a very interesting case. Indeed, the paleobotanist seems to have described this species only in 1879, when he wrote his synthesis on the fossil plants of the Carboniferous formations of Pennsylvania and the United States (LESQUEREUX 1879; LANDEMER 2002).

How can we then explain the inscription *Pecopteris dimorpha* Lsq. on the original label received in 1867 in Fleurier (plate III)? The most likely hypothesis is that of a handwritten description made in the mid-1850s but which was not published in the *Boston Journal of Natural History* with those of the other discovered species.

At that time, Lesquereux may have still been in doubt because of the marked dimorphism of the plant, which may have been due to the compression of the rock. He mentioned this characteristic in his 1879 description: “The leaflets are also of different size on each side of each pinna, contracted, larger and obtuse on one side, elongated and lanceolate acuminate on the other. As all the specimens are from the Coal of Rhode Island where this peculiar deformation is remarked upon other species, it may be omitted or mentioned as of casual occurrence. But the size, the distance of the pinnules, more distinctly lobate, especially the lower ones, seem to be valid and permanent characters” (LESQUEREUX 1879).

Its general description of the species is as followed: “Fronde divided like that of the former [implied *Pseudopecopteris nervosa*]; ultimate pinnae long sublinear; pinnules disjoined to the base, generally distant, oblong, obtuse, more or less distinctly undulately lobed; slightly decurrent by the narrowed base, unequal in size on each side of the



Plate III. Fossil plants from the Mount Hope deposit (Newport, Rhode Island). Carboniferous, Middle Pennsylvanian; Rhode Island Formation, Narragansett Basin: 307 - 315.2 Ma. At the top left, figure 6 of *Pseudoplectopteris dimorpha* Lesq. 1879, used for the description of the species (from LESQUEREUX 1879). At the middle left, the label written in February 1867 by Lesquereux's hand for the donation to the Fleurier Museum where *Asterophyllites sublaevis* Lqx and *Pecopteris dimorpha* Lqx were mentioned. The species visible on the photographs: No. 48.MRVT *Asterophyllites sublaevis* Lesq. 1854 / No. 49.MRVT *Pecopteris cyathea* (Schloth.) Brt 1828 / No. 53.MRVT *Pseudoplectopteris dimorpha* Lesq. 1879. The black line corresponds to 1 cm on the full-sized object. Label sizes : 8,5 x 5 cm.

pinnae; medial nerve thick, divided under the apex; venation distinct, of the same character as in the former [P. nervosa]" (LESQUEREUX 1879).

He completed the diagnosis by stating that: "*The frond was evidently large, and [...] irregularly divided or dichotomous. The primary rachis is large, comparatively to that of the pinnae which, though very long, have a narrow half round rachis. The pinnules, taken altogether, are much larger than in the former species and generally distant; the lower, on the inferior side of each pinna is more or less distinctly lobed as in Pseudopecopteris nervosa*" (LESQUEREUX 1879).

It should also be noted that the fragment No. 53 of the MRVT collection (plate I) was very similar to drawing No. 6 of the plate XXXV, which was used as a figure in the description by LESQUEREUX (1879), confirming the synonymy between *Pecopteris dimorpha* Lsq. 1867 and *Pseudopecopteris dimorpha* Lesq. 1879. Lesquereux stated that "*the fragment, plate XXXV, f. 6, is however very similar to f. 1 of Pseudopecopteris pluckneti, Brgt.*"

While the types of *Pseudopecopteris dimorpha* were deposited by Lesquereux at the Cambridge Museum of Comparative Zoology founded by Louis Agassiz, the MRVT copy of *Pecopteris dimorpha* Lsqu. revealed the enigmatic history of an early description which, according to the International Code of Nomenclature, should have taken precedence over subsequent descriptions. However, since the author of the description was the same (Lqx = Lesq. = Léo Lesquereux), the changes were of minor importance. However, it is necessary to pay special attention to this piece, and to keep it under controlled climatic conditions in order to determine its status.

CONCLUSIONS

The Léo Lesquereux collection of the Regional Museum of Val-de-Travers, with around fifty pieces - three of which could not be found and two which are currently kept at the Natural History Museum of Neuchâtel - owes its precious originality to plants fossils sent by the botanist, at a time when he was not yet recognised by all of his peers.

The 25 species constituting the paleobotanical batch come from three coalfields of the Upper Carboniferous (or Pennsylvanian), dated between 307 and 323.2 Ma, from Illinois, Pennsylvania, and Rhode Island (USA). Ten of these were described by Lesquereux between 1854 and 1879.

Two pieces are of particular interest in the history of this discipline because they bear witness to a discovery which was made several years earlier than their official descriptions. The entire collection is, moreover, made up of the oldest pieces deposited in a European museum by the paleontologist himself.

In 1969, Darrah wrote: "*Lesquereux's Coal Flora can be considered the foundation of American Carboniferous paleobotany*" (DARRAH 1969). Still unknown in Europe, Lesquereux is considered a pioneer of American paleobotany. His scientific writings from the second half of the 19th century are still regularly cited in current articles such as, for example, the monumental summary works *Paleobotany. The Biology and Evolution of Fossil Plants* where no less than eight of his works have been listed in general bibliography (TAYLOR *et al.* 2009).

On reading the above, we can therefore consider this collection as being one of national importance due to the major contributions of the scientist of Swiss origin, Léo Lesquereux, in paleontology. Despite its importance, the Lesquereux collection is invisible in the small regional museum of the Val-de-Travers, whose vocation is to present

the local agricultural and industrial history. However, it deserves to be clearly highlighted to the public.

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