Digitisation as a tool to promote transparency between collections: the case of the Baltic amber from the Königsberg collection at the Museum of Comparative Zoology

La digitalización como una herramienta para promover la transparencia entre colecciones: el ámbar del Báltico de la Colección Königsberg del Museo de Zoología Comparativa

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ABSTRACT

A total of 383 Baltic amber samples, including 43 type specimens, held at the Museum of Comparative Zoology (MCZ), Harvard University, for near a century were found to belong to the classic amber collection from the Albertus-Universität of Königsberg. This discovery was greatly facilitated by the public availability online of digital images produced during a four-year project that digitised the over 30,000 samples from the MCZ's fossil insect collection. The amber samples were hand carried and reincorporated to the portion of the original Königsberg collection that was saved from World War II, held at the Geowissenschaftliches Museum from the Geowissenschaftliches Zentrum of the Georg-August-Universität, Göttingen. This study showcases the importance of sharing collection data through public digitised records, and highlights the understanding of digitisation not only as a tool of education, public engagement, and research, but also of rediscovery, tracking, repatriation, and ultimately safeguard of the movable palaeontological heritage on a global scale.

Keywords: Digitisation, fossil insects, amber, Baltic, Königsberg.

RESUMEN

Un total de 383 muestras de ámbar del Báltico, incluyendo 43 ejemplares tipo, depositadas en el Museum of Comparative Zoology (MCZ), Harvard University, durante cerca de un siglo se reconocieron como pertenecientes a la colección de ámbar clásica de la Albertus-Universität de Königsberg. Este hallazgo fue posibilitado en gran medida por la disponibilidad pública online de imágenes digitales tomadas durante un proyecto que digitalizó los más de 30.000 ejemplares de la colección de insectos fósiles del MCZ. Las muestras de ámbar se transportaron en mano y se reincorporaron a la porción de la colección Königsberg original que se salvó tras la Segunda Guerra Mundial, depositada en el

Geowissenschaftliches Museum del Geowissenschaftliches Zentrum de la Georg-August-Universität, Göttingen. El presente estudio muestra la importancia de compartir datos de colección a través de registros digitalizados públicos, entendiendo la digitalización como una herramienta no solo enfocada a la educación, divulgación e investigación, sino también clave para redescubrir, rastrear, repatriar y, a la postre, salvaguardar el patrimonio paleontológico mueble a escala global.

Palabras clave: Digitalización, insectos fósiles, ámbar, Báltico, Königsberg.

1. INTRODUCTION

With about 33,000 catalogued specimens (plus an estimate of ~20,000 to 30,000 thousand uncatalogued specimens) and more than 3,000 types, the Museum of Comparative Zoology (MCZ), Harvard University (Cambridge, Massachusetts, USA), holds one of the most important fossil insect collections worldwide. The collection is largely composed by compression/impression fossils from the Wellington Fm. (Permian in age, localities of Elmo in Kansas and Midco in Oklahoma) and Florissant (late Eocene of Colorado), as well as from Baltic amber inclusions (mid to late Eocene), the latter mostly belonging to the William A. Haren and the Charles T. Brues collections. The MCZ fossil insect collection, also known as the Carpenter collection, includes iconic fossils such as the holotypes of the butterfly *Prodryas persephone* Scudder, 1878 from Florissant, and the Permian griffenfly *Meganeuropsis americana* Carpenter, 1947 from the Wellington Fm. (Scudder, 1878; Carpenter, 1947; Engel, 2015). Indeed, two of the main contributors to the collection through active acquisition, excavation, and study of the specimens were the distinguished

palaeoentomologists Samuel S. Scudder (1837-1911) (Mayor, 1919) and Frank M. Carpenter (1902-1994) (Furth, 1994).

From 2013 to 2017, the catalogued part of the MCZ's fossil insect collection (type and non-type material) underwent digitisation. This namely entailed taking photographs of the fossil specimens and their tags, but also updating database entries, determining taxa, and curating some specimens both pre-emptively and remedially. More than 40,000 images that were taken from the ca. 33,000 fossil insect samples are to date primarily accessible through the MCZ's database, MCZbase (https://mczbase.mcz.harvard.edu/), by searching "PALE" in the field "number". Digitisation at the MCZ was a branch of the much larger "Fossil Insect Collaborative" Thematic Collections Network (TCN) project, funded by the US National Science Foundation and framed within the Advancing Digitization of Biodiversity Collections (ADBC) initiative (Smith *et al*., 2014).

The amber collection of the former Albertus-Universität of the city of Königsberg (the present day Kaliningrad), became the most extensive and remarkable amber collection in the world, dating back to the late 18th century and reaching more than 100,000 samples (Andrée, 1937; Grimaldi & Engel, 2005; Reich *et al*., 2015). One of the main parts of the collection was purchased in 1899 from the mining company "Stantien & Becker", which had the monopoly on the mining and trade of Baltic amber in the Sambia (Kaliningrad) Peninsula (also known as Samland) by that time (Klebs, 1890; Tornquist, 1911; Andrée, 1927). More amber holdings were added subsequently, both public, such as those from the Physikalisch-ökonomische Gesellschaft (a natural society based at Königsberg), and private. Among the latter, of special significance was the purchase in 1926 of the private collection from the geologist and pharmacologist Richard Klebs (1850-1911), who became famous for his research interest on amber and achieving the largest private collection of this material from his time (Andrée, 1927, 1937; Reich *et al*., 2015). In November 1944, due to World War II, a

part of the Königsberg collection was transferred to the University of Göttingen and subsequently stored in the potash mine of Volpriehausen together with other cultural heritage as safety measures. Although some of that heritage was destroyed due to explosions in the mine in September 1945, a significant portion of the evacuated material from the Königsberg collection was saved. Since 1958, that material is kept at the Geowissenschaftliches Museum from the Geowissenschaftliches Zentrum (GZG) of the Georg-August-Universität, and comprises about 18.000 objects (Reich *et al*., 2013, 2015). The amber that remained in Königsberg/Kaliningrad seems to have been destroyed during the war. Regarding material from the Königsberg collection that was on loan when WWII hit, some was destroyed in the borrowing institutions due to the war as well, some was sent to GZG during the following decades from different institutions, and some is likely still waiting to be reincorporated to the Königsberg collection from their borrowing institutions.

A research inquiry sent to one of us (A.G.) and a note from the 1930's found at the GZG about an open loan of Baltic amber samples to Charles T. Brues (1879−1955), eminent entomologist at Harvard (Melander & Carpenter, 1955), were the starting elements that led to the research and actions exposed in this work. Immediately after, the photographs from the digitised MCZ's fossil insect collection available online were crucial as initial evidence that samples belonging to the Königsberg/Klebs collection had been incorporated pre-WWII into the MCZ holdings and had remained there since then inadvertently.

2. MATERIAL AND METHODS

About 8,000 Baltic amber pieces from the MCZ's Carpenter fossil insect collection, mostly mounted on cover slides, were taken out from their zip-lock plastic bags and boxes and visually inspected against a lit background. Criteria used to determine that samples belonged

to the Königsberg/Klebs collection were as follows ("a" and "b" apply to both published and unpublished specimens, the remaining criteria only to published specimens, mostly type material): (a) numbers from the Königsberg/Klebs collection are carved or written in pen on amber pieces or preparations, i.e., numbers starting with letters "B", "IB", "IIB", "XIIIB", or "XXB" (former Stantien & Becker collection); "K", "X", or "α" (former Klebs collection); "IV" (former collection of the Physikalisch-ökonomische Gesellschaft); and "N" or "Z" (assignment to a specific part of the Königsberg University collection unresolved); b) original tags belonging to the Königsberg/Klebs collection are present, i.e., "B.S.d.Univers.", "Koenisberg.i/Pr.", "Koenisberg Mus. Klebs coll.", "Phys. Oek. Ges.", "Museum Stantien & Becker", "Dr. Richard Klebs", or "Klebs collection"; (c) the specimen's Königsberg/Klebs number is mentioned in the publication were the taxon was described (and matches the number carved or written in pen on the amber/preparation surface); (d) the specimen is mentioned as belonging to the Königsberg/Klebs collection in the publication were the taxon was described, e.g., "*Sembilanocera clavata*. Type: Collection of the University of Königsberg (without number)." (Brues, 1940a: 71); and (e) the drawings/photographs of the specimens provided in the original description match the specimen's habitus (for illustrated/photographed material).

The archive associated to the MCZ's fossil insect collection (including the old ledger), the MCZ's Ernst Mayr Library, and the Harvard Archives (Pusey Library) were searched for written records that could shed light on a loan from the Königsberg collection material to Brues (or Wheeler) during the first decades of the 20th century or about the loaned nature of the material.

Specimen photographs were taken with a Canon EOS 6D mounted to a Leica MZ16 stereomicroscope; photographs taken at successive focal depths were stacked with the software Helicon Focus Pro 6.0 (HeliconSoft Ltd.).

3. RESULTS

Examination throughout the amber holdings from the MCZ's fossil insect collection revealed a total of 383 amber preparations/pieces belonging to the Königsberg collection. A few of the amber preparations/pieces (8%) contained more than one bioinclusion. A total of 85% of samples had numbers carved or written in pen, whereas 22% of the samples preserved their original labels. The material included 43 type specimens: 29 holotypes, seven paratypes, six cotypes, and one allotype. The types are namely apocritan hymenopterans belonging to ants (Formicidae) and the parasitic families Megaspilidae, Proctotrupidae, and Platygastridae, but also include a wood wasp (Siricidae), three snakeflies (Raphidioptera: Raphidiidae and Inocelliidae), one larval owlfly (Neuroptera: Ascalaphidae), and one scorpionfly (Mecoptera: Panorpidae) (Fig. 1, Table 1). On the other hand, the non-type material mostly represents (1) parasitic hymenopterans, namely ichneumonoids (Ichneumonidae and Braconidae) but also chalcidoids (Aphelinidae, Eulophidae, Eupelmidae, Mymaridae, Pteromalidae, Torymidae, and Trichogrammatidae), mymarommatids, and further platygastrids and proctotrupids (accounting for about 170 specimens in total), (2) nematoceran flies (Diptera) largely belonging to long-legged flies (Dolichopodidae) but also to a few other groups (about 80 specimens), and (3) polyphagan beetles (Coleoptera: Polyphaga) belonging to the families Scirtidae, Nitidulidae, and Ptinidae, among several others (about 50 specimens). Other hymenopterans, such as aculeate apocritans including apoids (Ampulicidae, Crabronidae), chrysidoids, vespoids (Pompilidae), and further ants, as well as one horntail (Symphyta: Siricidae) were also found (about 30 specimens). Six additional scorpionflies and three further snakeflies were detected. Moreover, two scale insects (Hemiptera: Coccoidea), one caddisfly (Trichoptera), one true bug (Heteroptera), one termite (Isoptera) were recognised as

belonging to the Königsberg collection. Lastly, a few arachnids were detected as syninclusions of the material above, i.e., a jumping spider (Salticidae) and several mites.

Regarding written records, no trace of a loan to Brues or Wheeler from the University of Königsberg or Richard Klebs in the form of loan forms, paperwork, or correspondence, was found among the records kept at the MCZ left together with the Carpenter collection. Likewise, no significant information was found associated to the specimen's entries written on the old ledger from the fossil insect collection. Moreover, no relevant records of Brues were found at the Ernst Mayr Library, either. Additionally, although the Harvard Archives hold correspondence between Thomas Barbour, former director of the MCZ, and both C. T. Brues and F. M. Carpenter between 1928 and 1940 (code UAV.298.19; 72-I-4), and correspondence between Harvard University's President Abbott L. Lowell and faculty members regarding Brues (codes UAI.5.160 1919-22 and UAI.5.160 1925-1928), these documents are of no relevance for the matter of interest here.

All the amber samples mentioned above were packed in 17 plastic boxes and hand carried from the MCZ to the GZG by the first author during June 2017 (Fig. 2). The samples were reunited therein with the remaining portion of the Königsberg collection that survived WWII.

4. DISCUSSION

After studying the material loaned from the University of Königsberg and publishing four papers on hymenopterans in 1926 and 1940 (Brues, 1926, 1940a, 1940b, 1940c), Brues' loan was never sent back to the Albertus University of Königsberg. Although no records have been found shedding light on why the material remained in the US, it seems obvious to assume this was a consequence of World War II and the subsequent years of turmoil in

Europe. On the other hand, the ant inclusions, at least those studied by William M. Wheeler, allegedly arrived to the MCZ at least a couple of decades before Brues brought the material he had loaned from the Königsberg collection, as they were sent there by Klebs in 1908 (Wheeler, 1915), so before his collection was purchased by the Albertus University. In any case, it is fortunate that having shipped small parts of the collection overseas ended up saving parts of the original Königsberg holdings.

In his works describing Baltic amber material held at the MCZ, Carpenter does not mention the origin of the samples he studied nor provides any Königsberg/Klebs numbers (Carpenter, 1954, 1956). However, MacLeod (1970), when describing *Neadelphus protae* (Fig. 1a), recognised the specimen as originally belonging to the Königsberg or Klebs collection thanks to its preserved tag and number, but simply stated that the means by which the specimen had arrived to the MCZ were unknown. MacLeod (1970) further noted that the larval specimen he described could actually represent that reported by Klebs (1910). In 2003, 30 amber pieces namely containing neuropterans that MacLeod had (officially?) loaned from the MCZ (including a piece loaned from the GZG by Carpenter in 1968) and that he had kept at the University of Illinois at Urbana-Champaign until his passing in 1997 were recognised as belonging to the Königsberg collection by Donald W. Webb and sent to the GZG.

Apart from the multiple advantages that digitising museum specimens has for educational, public engagement, and research purposes, as well as preventing potential damage to a collection and preserving multiple virtual copies of it (e.g., Cook *et al*., 2014; Antell, 2018; Nelson & Ellis, 2018), it has been recently shown how digitisation "mitigates some of the challenges associated to the dispersion of specimens" (Antell, 2018). In our particular case, the digitised photographs of the specimens, some of them showing the original Königsberg/Klebs collection numbers or tags, that had been recently made public online thanks to the "Fossil Insect Collaborative" digitisation project at the MCZ, triggered

the contact between the authors of the present study and caused the subsequent developments. Instances like the one exposed herein highlight the importance that digitising a natural history collection, palaeontological in this case, holds when used as a tool for promoting transparency and indirectly sharing data between collections, leading to the rediscovery of lost specimens, detecting and claiming back long-forgotten, pre-digital age loans, and ultimately safeguarding the movable palaeontological heritage. Surely many more specimens that are thought lost forever are awaiting to be found while sitting on the drawers from palaeontological collections across the globe. Digitisation has proven to provide an effective way to save them from oblivion.

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TABLE CAPTION

Table 1. Type material reincorporated from the MCZ to the Königsberg collection at the GZG. Numbers are visible on the amber piece\preparation unless marked with an asterisk (underlined numbers are unclear). Combinations different from the original ones, as listed in the PBDB (http://fossilworks.org), are marked with "^". Ref. (references): 1) Wheeler (1915); 2) Wheeler (1910); 3) Mayr (1868); 4) Brues (1940a); 5) Brues (1940b); 6), Brues (1940c); 7) Brues (1926); 8) Carpenter (1956); 9) Engel (1995); 10) MacLeod (1970); 11) Carpenter (1954).

Taxa (current combination)	Königsberg\ Klebs #	Type material	Ref.	Family
Drymomyrmex claripennis	X20	Holotype	1	Formicidae
Electromyrmex klebsi	K2658	Holotype	1, 2	Formicidae
Formica phaethusa	α229	Cotype	1	Formicidae
Hypoponera atavia^	K3537	Cotype	1, 3	Formicidae
Platythyrea primaeva^	K5122*	Holotype	1	Formicidae
Procerapachys annosus	K5793	Cotype	1	Formicidae
Prodimorphomyrmex primigenius	α57	Holotype	1	Formicidae
Yantaromyrmex samlandicus^	α134	Cotype	1	Formicidae
Yantaromyrmex samlandicus^	α87	Cotype	1	Formicidae
Yantaromyrmex samlandicus^	K1045	Cotype	1	Formicidae
Archaeoscelio rugosus	XIIIB929	Holotype	4	Platygastridae
Calliscelio caudatus^	XIIIB937	Holotype	4	Platygastridae
Calliscelio succinophilus^	?	Holotype	4	Platygastridae
Gryon dubitatum^	?	Holotype	4	Platygastridae
Mirotelenomus angulatus	10590*	Holotype	4	Platygastridae
Parabaeus pusillus	9024*	Holotype	4	Platygastridae
Proplatyscelio depressus	4224*	Holotype	4	Platygastridae
Pseudobaeus fecundulus	6728*	Holotype	4	Platygastridae
Sembilanocera clavata	?	Holotype	4	Platygastridae
Sembilanocera clavata	V141	Paratype	4	Platygastridae
Sparaison simplicifrons	B14548	Holotype	4	Platygastridae

Telenomus electrus^	?	Holotype	4	Platygastridae
Trachelopteron angulipenne	XIIIB922	Holotype	4	Platygastridae
Uroteleia synthetic	B5241	Holotype	4	Platygastridae
Conostigmus succinalis	XXB1349	Holotype	5	Megaspilidae
Conostigmus juvenilis	?	Holotype	5	Megaspilidae
Conostigmus juvenilis	11036*	Paratype	5	Megaspilidae
Conostigmus resinae	?	Holotype	5	Megaspilidae
Conostigmus succinalis	Z1196	Paratype	5	Megaspilidae
Lagynodes electriphilus	?	Holotype	5	Megaspilidae
Lagynodes primordialis	?	Allotype	5	Megaspilidae
Lagynodes primordialis	?	Paratype	5	Megaspilidae
Lagynodes primordialis	?	Paratype	5	Megaspilidae
Lagynodes primordialis	?	Paratype	5	Megaspilidae
Mischoserphus gracilis^	11024*	Holotype	6	Proctotrupidae
Oxyserphus obsolescens^	XXB967	Holotype	6	Proctotrupidae
Oxyserphus obsolescens^	Z128	Paratype	6	Proctotrupidae
Eoxeris klebsi^	3B674	Holotype	7	Siricidae
Electrinocellia peculiaris^	B14…	Holotype	8	Inocelliidae
Fibla carpenteri	3B712	Holotype	9	Inocelliidae
Raphidia baltica	B272	Holotype	8	Raphidiidae
Neadelphus protae	N27*	Holotype	10	Ascalaphidae
Panorpa mortua	K…	Holotype	11	Panorpidae

FIGURE CAPTIONS

Figure 1. Selection of type specimens reincorporated from the Museum of Comparative Zoology (MCZ) to the Königsberg collection at the Geowissenschaftliches Zentrum (GZG). **a)** *Neadelphus protae* MacLeod, 1970 (Neuroptera: Ascalaphidae), holotype. **b)** *Fibla carpenteri* Engel, 1995 (Raphidioptera: Inocelliidae), holotype. **c)** *Yantaromyrmex samlandicus* Wheeler, 1915 (Hymenoptera: Formicidae), cotype. **d)** *Panorpa mortua* Carpenter, 1954 (Mecoptera: Panorpidae), holotype. **e)** *Conostigmus succinalis* Brues, 1940 (Hymenoptera: Megaspilidae), holotype. Scale bars: a, c = 1 mm; b, d = 4 mm; e = 0.25 mm. All images are ©President and Fellows of Harvard College.

Figure 2. The 383 Baltic amber samples from the Königsberg collection that had been held for at least 80 years at the MCZ, packed in plastic boxes right after they were reunited with the remainder of the collection at the GZG, June 2017.

Fig. 1


DIPTERA: Brachycera: Dolichopodidae
B56
B70
B65
B59
Box L: From cabinet 11.11
Box K: From cabinet 11.16
Box N: From cabinet 11.14

Fig. 2