Figure 1. Johann Natterer ca. 1817–1825. (Portrait in Vienna Museum.)

The importance of Natural History Collections and Taxonomy:

a tachinid species collected by Johann Natterer during the Austrian scientific expedition to Brazil (1817–1835)

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Practice without theory is blind. Theory without practice is sterile.
– Engels, Letter to F.A. Sorge, London, Nov. 29, 1886.

Before entering into the topic to be discussed, *I think a bit of background information would be welcome. Since last year, I have been a Postdoctoral Fellow at the Konrad Lorenz Institute for Evolution and Cognition Research (KLI), at Klosterneuberg, Austria (Fig. 2). For those unaware of this place, this is a Theoretical Biology Institute that supports research in evolutionary biology, with a focus on critically examining the conceptual foundations of biology, resolving longstanding theoretical disputes, and achieving an epistemic unification of particular fields of the life sciences.*

My own research aligns with this mission: I aim to bring the science of Phylogenetics into closer conversation with newer areas of evolutionary biology, such as Evolutionary Developmental Biology (Evo-Devo). In a recent paper (Santis 2024), for example, I argued that phylogenetic studies should include Evo-Devo data to help distinguish between parallel evolution (which can inform common ancestry) and convergent evolution (which does not). A key motivation behind this work is my concern that systematics has become overly molecular in recent decades. With the rise of DNA sequencing, emphasis has shifted from studying whole organisms to analyzing statistical models and algorithms. As a result, phylogenetics today often focuses primarily on molecules, new techniques, and computational pipelines, rather than on the biology of the organisms themselves. This trend is clear in systematics journals, where DNA-based phylogenies now dominate research across all kinds of life forms. Besides being a systematist, I am a taxonomist by training. Taxonomy also became involved in those gene-centric interpretations of organisms. Approaches like DNA taxonomy and DNA barcoding have gained prominence, supported by large funding initiatives. One example is the German Barcode of Life (GBOL) project, which has a budget of roughly €16 million and aims to build a DNA barcode reference library for Germany's animals, plants, and fungi. It is estimated to cover over 20,000 of the country's 48,000 known animal species. Such projects reflect a broader perspective: a systematist working mostly with molecular data may need deep technical expertise in sequencing and

bioinformatics—but not necessarily in-depth knowledge of the organisms themselves. While DNA-based methods haven't replaced traditional taxonomy entirely, they have shifted the field's priorities toward a more reductionist approach, where DNA data often drive species hypotheses (for more, see Britz et al. 2020, Wheeler 2024, Williams & Wheeler 2025). To be clear: this is not suggesting we reduce funding for molecular studies. They remain essential. But I do believe we should restore balance by also supporting other areas of systematics, taxonomy, and organismal biology, that engages directly with the form, development, and diversity of living things.

Figure 2. Front of Konrad Lorenz Institute for Evolution and Cognition Research (KLI) in Klosterneuberg, Austria. [https://commons.wikimedia.org/w/index.php?curid=32474240]

Since Klosterneuburg is very close to Vienna, I contacted Dr. Alexssandro Camargo, the current curator of Diptera at the Natural History Museum Vienna (NHMW) (Fig. 3) and a specialist in robber flies, to arrange a visit to the museum's collection. The NHMW's Diptera collection is historically rich, containing specimens from the 18th and 19th centuries (Fig. 4). These are particularly valuable because they represent organisms from a time when many environments were far less disturbed than they are today. Having the chance to study this collection has been extraordinary. (For more on the collection, with a special focus on Diptera, see O'Hara 2013.) Through the kindness of Dr. Camargo, I could get better knowledge of the tachinids stored there. Although I didn't start with a specific research goal, my long-standing interest in Neotropical Tachinidae, especially the subfamily Dexiinae, led me to begin examining drawers of Neotropical Dexiinae material. That exploration paid off. In short (as published in Santis & Camargo 2025), I discovered a new species of dexiine mixed in with specimens of two already described species. We named it *Chaetotheresia confusa* Santis & Camargo, 2025. The specimens had originally been collected nearly 200 years ago and were first studied by the German entomologist Christian Rudolph Wilhelm Wiedemann (1770–1840) (see Pont 1995 for more about his life and work). Later in 2025, another fascinating discovery emerged: I found another new species among miscellaneous Dexiini material collected by Johann Natterer (Fig. 5), a 19th-Century naturalist whose work is closely tied to the founding of the NHMW. In what follows, I'll explain more about the Natterer family's role in the museum's origins and detail Johann Natterer's remarkable expedition through Brazil in the early 1800s.

Joseph Natterer Sr. (1754–1823) began a career in falconry in Laxenburg, Austria in 1772, at the age of 18. He developed a strong interest in taxidermy and over the years amassed a large collection of stuffed vertebrates. His talents and collection came to the attention of the Holy Roman Emperor Francis II, and in 1794 he moved to Vienna with his wife, two sons (Joseph Jr. and Johann) and stuffed animals to become the first custodian of the Emperor's newly established 'animal cabinet' (Fischer et al. 1976, Weber 2025).

Figure 3. The interior of the Natural History Museum Vienna (NHMW).

After the Emperor's death (1765), Empress Maria Theresa, his widow, included this natural history collection in her so-called Augustinian Walk of the Hofburg Palace (Fischer et al. 1976). In 1806, when the collection was renamed as "Vereinigtes k.k. Naturalien-Cabinet" (United Imperial Royal Natural History Cabinet), Karl Franz Anton Schreibers (1775–1852), the institution's director, appointed Joseph Natterer Sr. as the first inspector of the zoology department. From that point on, one of his son's, Joseph Natterer Jr., assumed responsibility for the bird and mammal collections. After several years and further changes, this Augustinian Walk was reconstituted in 1810 as the "Die Vereinigten k.k. Naturalien-Cabinette" (United Imperial Royal Natural History Cabinet). Von Schreibers was responsible for the reorganization and expansion of the animal cabinet. Years later, in 1817, he was appointed to lead a major naturalist expedition to Brazil (Santos 2018). This expedition was initiated on the occasion of the royal wedding between the Austrian archduchess Carolina Josefa Leopoldina of Habsburg-Lorraine, daughter of Austria's Emperor Francis I and Empress Maria Tereza and the crown prince regent of Portugal, Brazil and the Algarves, Pedro de Alcântara (1798–1834). Among those chosen to join the famous Austrian scientific expedition to Brazil (1817–1835) was Johann Baptist Natterer (1787–1843) (Fig. 1), son of Joseph Natterer Sr.; one of fourteen naturalists selected (Santos 2018).

Johann Natterer spent 18 years in Brazil (1817–1835), during which he made 10 trips within Brazilian territory (Vanzolini 1993), traversing the country's central plains through the regions of Goiás and Cuiabá, as well as the western province of Mato Grosso. Despite enduring harsh conditions and illnesses, he succeeded in reaching the Amazon basin. He even explored numerous northern tributaries, including the Rio Negro and Rio Branco, journeying as far as the borders with Colombia and Venezuela (Vanzolini 1993). In total, his travels spanned several thousand kilometers across Brazil. The scientific result from the Brazilian expedition was substantial, requiring twelve large shipments for transport back to Vienna. Natterer's final sum of organisms was equally remarkable: 1,146 mammals, 12,293 birds, 1,678 amphibians, 1,621 fish, 32,825 insects, and 1,729 glass jars containing preserved specimens of intestinal worms (Schmutzer 2012). These acquisitions instantly elevated the Vienna Animal Cabinet to possess the most comprehensive collection of South American fauna in the world at that time.

Figure 4. A drawer of Australasian Rutiliini (Dexiinae) in the NHMW.

The sheer volume of material arriving overwhelmed the existing cabinet rooms, making storage and display very difficult. Consequently, in 1821, the Emperor ordered the establishment of a dedicated Brazilian Museum for the Brazilian collections in the Harrach Palace, which existed until 1836. This became the center of all activities related to the Austrian expedition to Brazil (Schmutzer & Feest 2014). After the Museum closed, the natural history objects went to the Imperial Cabinet of Natural History. Some years after Natterer's passing in 1843, tragedy struck on October 31, 1848, when a major fire devastated this storage area. The blaze consumed the skeleton collection, duplicate mammals and birds, Natterer's invaluable field diaries and personal Brazilian collection including his butterfly and other insect collections (Fischer et al. 1976). Years later, the decision was made to no longer house scientific collections within the palace. In 1871, construction began on the monumental, purpose-built Imperial Natural History Museum and on August 10, 1889, Emperor Franz Joseph I presided over its official opening (Fischer et al. 1976). After World War I, the museum officially became the "Naturhistorisches Museum Wien". Therefore, almost 200 years after Natterer travelled in Brazil, having survived transport on mules within Brazil, transatlantic shipments to Vienna, fire at the Palace and two World Wars, I could see these specimens he collected! I will describe the specimens referred to above as a new species in the genus *Prophorostoma* Townsend. Something worth mentioning is that I have seen many specimens of this genus before, mainly *P. pulchra* Townsend, 1927, but had never spotted any collected by Natterer. A possibility arises that the species is already extinct given that the region where they were collected is severely deforested and has suffered greatly from urbanization.

Figure 5. A new species found among miscellaneous Dexiini in the NHMW, collected two hundred years ago in Brazil by Johann Natterer.

Reflections on Systematics

I think there are some take-home messages from what I have learned from my personal experiences. Scholarships for taxonomic works are rarer than ever. Today, proposing a taxonomic or phylogenetics study that is not firmly based on DNA data stands little chance of being funded. The work I described above was only possible because I had secured a postdoctoral fellowship from the KLI. Without that support, my taxonomic research, like that of many others, would not have been funded. It reflects that many interesting taxonomic works are being relegated to a volunteer effort, carried out informally without dedicated research funding. Today, we can see the effects of a profound commoditization of science, where research is increasingly interpreted through the lens of the market economy. Scientific inquiry is often treated as a business investment (see Levins & Lewontin 1985, Macfarlane 2019, Oliveira 2013). One practical consequence is that expensive technology and high-throughput methods are prioritized over foundational taxonomic work; because describing a new species from a few specimens can be relatively inexpensive compared to large-scale molecular studies. Thus, many times, for species already extinct, as is likely for the new species of *Prophorostoma* I discussed above, can be overlooked. This pattern is particularly pernicious for tachinids, mainly, but certainly not only, from areas like the Neotropics that we know so little about. There are many new species awaiting discovery through both new collection efforts and by study of old specimens in reference museums like the NHMW. When funding neglects such groups, we risk losing the chance to document biodiversity before it disappears.

The diversity of remarkable characters found on tachinid flies has always amazed me. I end by referencing a discovery made some years ago. During my Master's study (2014–2016) I was dissecting females of *Euoestrophasia* Townsend, along with related genera such as *Oestrophasia* B. & B. and *Cenosoma* Wulp. At first, I was not aware that those pretty small things within them were eggs. After some time, I realized they were eggs and larvae. The literature did not mention the existence of microtype eggs in Dexiinae, so at first I did not consider this possibility. But after some deeper analysis and SEM imaging, they in fact turned out to be the rare microtype eggs (Fig. 6) previously known only from a different tachinid subfamily, the Exoristinae. Based on these findings, I began to suspect that this group was quite distinct from its relatives and that its current classification within its tribe might be questionable (as indeed it revealed that way, in which the tribe Oestrophasiini was revalidated, because of the apomorphic eggs, see Santis & Nihei 2022). What this small but significant discovery highlights is the enduring value of morphological study. So much remains hidden, often overlooked in today's molecular-dominated research, sometimes for centuries, preserved in museum drawers, awaiting someone with the time, training, and curiosity to look. Hence preserving anatomical research within tachinid systematics is fundamental, but also calls for more balanced funding and stable career pathways for taxonomists. Supporting such work is about safeguarding our ability to discover, describe, and understand biodiversity in all its forms.

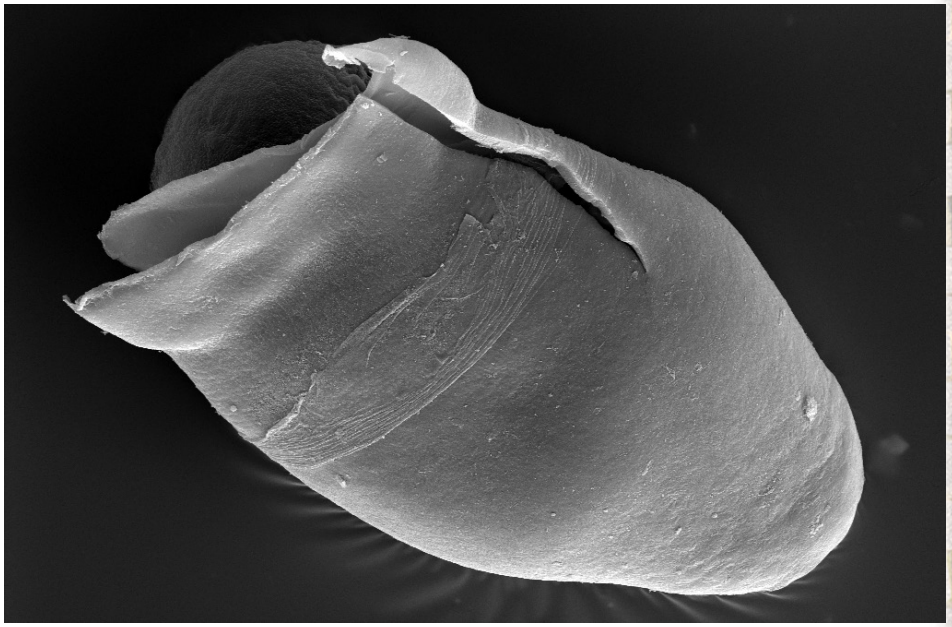

Figure 6. Microtype egg of *Oestrophasia* sp.

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References

Britz, R., Hundsdörfer, A. & Fritz, U. 2020. Funding, training, permits—the three big challenges of taxonomy. Megataxa 1: 49–52. https://doi.org/10.11646/megataxa.1.1.10

Fischer, M., Moschner, I. & Schönmann, R. 1976. Das Naturhistorisches Museum in Wien und seine Geschichte. Annalen des Naturhistorischen Museums in Wien 80: 1–24.

Levins, R. & Lewontin, R. 1985. The dialectical biologist. Harvard University Press, Cambridge, MA. 303 pp.

Macfarlane, B. 2019. The neoliberal academic: illustrating shifting academic norms in an age of hyper-performativity. Educational Philosophy and Theory 53: 459–468. https://doi.org/10.1080/00131857.2019.1684262

O'Hara, J.E. 2013. A visit to the Vienna Museum with a brief history of the tachinid collection. The Tachinid Times 26: 30–38. https://www.uoguelph.ca/nadsfly/Tach/WorldTachs/TTimes/Tach26.html

Oliveira, M.B. de. 2013. On the commodification of science: the programmatic dimension. Science & Education 22: 2463–2483. https://doi.org/10.1007/s11191-012-9455-7

Pont, A.C. 1995. The dipterist C.R.W. Wiedemann (1770–1840). His life, work and collections. Steenstrupia 21: 125–154.

Santis, M.D. de. 2024. Homoplasy as an evolutionary process: an optimistic view on the recurrence of similarity in evolution. Biological Theory 19: 267–278. https://doi.org/10.1007/s13752-024-00470-8

Santis, M.D. de & Camargo, A. 2025. Lost between types: a new species of *Chaetotheresia* Townsend, 1931 (Diptera: Tachinidae: Dexiinae) discovered 200 years after collecting. Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen 77: 115–122.

Santis, M.D. de & Nihei, S.S. 2022. Phylogenetic analysis of the tribe Dufouriini (Diptera, Tachinidae) using a total evidence approach based on adult and immature stages. Arthropod Systematics & Phylogeny 80 (Article e69618): 38 pp.

Santos, R.C.M. 2018. Sobre crânios, idiomas e artefatos indígenas: o colecionismo e a História Natural na viagem de Johann Natterer ao Brasil (1817-1835). Sociedade e Cultura 21: 10–26.

Schmutzer, K. 2012. Metamorphosis between field and museum: collections in the making. *In*: Klemun, M., ed., Moved Natural Objects. Spaces in Between. Journal of History of Science and Technology 5: 68–83.

Schmutzer, K. 2016. Naturalists at work: expeditions, collections and the creation of "epistemic things". Pp. 97–119. *In*: Klemun, M. & Spring, U., eds., Expeditions as experiments. Practising Observation and Documentation. Palgrave Studies in the History of Science and Technology. Palgrave Macmillan London. 294 pp. https://doi.org/10.1057/978-1-137-58106-8_5

Schmutzer, K. & Feest, C.F. 2014. Brazil in Vienna: encounters with a distant world. Archiv Weltmuseum Wien 63–64: 266–285.

Vanzolini, P.E. 1993. As viagens de Johann Natterer no Brasil, 1817–1835. Papéis Avulsos de Zoologia 38 (3): 17–60.

Weber, N. 2025. Rulers and raptors. Falcons in courtly Europe, 1600–1793. Oxford University Press, Oxford. xv + 288 pp.
https://doi.org/10.1093/9780198937364.003.0001 [Introduction]

Wheeler, Q. 2023. Species, science and society. The role of systematic biology. Routledge, Oxon. xix + 266 pp.

Williams, D.M. & Wheeler, Q.D., eds. 2025. The new taxonomy: a science reimagined. CRC Press, Taylor & Francis Group. Boca Raton, London & New York. xiv + 247 pp.
https://doi.org/10.1201/b22822