Chris Thompson at the USNM

[Chris Thompson am United States National Museum]

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Abstract

This manuscript aims to provide an insight into Chris Thompson's work at the USNM by touching on a few key points and interests he developed while at the Smithsonian. I overlapped with Chris at the USNM for only a few years (2012–2019) but met him the first time when I was a research intern with my predecessor as Smithsonian dipterist Wayne Mathis in 2000. The following text should not be seen as an exhaustive list of Chris's work at the USNM, but focuses on select observations I think are of wider interest to the dipterological and entomological community.

Key words: Diptera, Syrphidae, collection curation, digitization, Smithsonian, Williston Fund

Zusammenfassung

Vorliegender Beitrag gibt einen Einblick in Chris Thompsons Arbeit am USNM, indem es auf einige Schlüsselpunkte und Interessen eingeht, die er während seiner Zeit am Smithsonian entwickelt hat. Ich habe nur wenige Jahre (2012–2019) mit Chris am USNM überschnitten, traf ihn aber das erste Mal, als ich im Jahr 2000 ein Forschungspraktikant bei meinem Vorgänger, dem Smithsonian Dipterist Wayne Mathis, war. Die Ausarbeitung ist nicht vollständig. Sie konzentriert sich auf ausgewählte Themenbereiche, die aus meiner Sicht für die dipterologische und entomologische Gemeinschaft von größerem Interesse sind.

Stichwörter: Diptera, Syrphidae, Sammlungskuration, Digitalisierung, Smithsonian, Williston Fund

USNM Diptera collection

The Smithsonian Diptera collection is housed in the Department of Entomology of the National Museum of Natural History (NMNH). The official abbreviation for citing this museum as a repository is USNM (referring to the former United States National Museum). The collection is administered by the Smithsonian Institution, but four separate U.S. government agencies provide research and curatorial staff, i.e., the Smithsonian (SI); the Systematic Entomology Laboratory (SEL) of the Agricultural Research Service, U.S. Department of Agriculture; the National Identification Service (NIS) of the Animal & Plant Health Inspection Service, U.S. Department of Agriculture; and the Walter Reed Biosystematic Unit (WRBU) of the Walter Reed Army Institute of Research, U.S. Department of Defense. The NIS, SI, and SEL dipterists and main collection are located at the NMNH in downtown Washington, D.C. The WRBU dipterists and collection of medically important fly families as well as Chironomidae, Limoniidae, and Tipulidae are situated a few miles southeast of Washington, D.C. at the Museum Support Center (MSC) in Suitland, Maryland.

Chris Thompson started as a researcher and curator in the Systematic Entomology Laboratory (SEL) in 1974 and was employed there until his retirement in 2008. After retirement, Chris kept the same schedule of working in his office and the collection every day until he

moved with his wife Betty to Florida in 2014. He continued to visit the USNM for a long weekend or a week at a time three to four times a year until the SARS-CoV-2 pandemic made access impossible in March 2020. Figures 1–4 show Chris, colleagues, and visitors at the USNM at different times of his career.

Chris became curator of the USNM Syrphidae collection starting with his SEL appointment in 1974. He oversaw and managed a much larger part of the Diptera collection though, totaling at various times of his career some 26 families from Nematocera (Anisopodidae, Axymyiidae, Bibionidae, Bolitophilidae, Diadocidiidae, Ditomyiidae, Hesperinidae, Keroplatidae, Lygistorrhinidae, Mycetophilidae, Pachyneuridae, Perissommatidae, and Rangomaramidae), to Asiloidea (Asilidae), to Phoroidea (Ironomyiidae, Lonchopteridae, Opetiidae, Phoridae, Platypezidae, Pipunculidae), to Syrphidae, to Conopidae, to acalyptrate taxa (Braulidae, Mormotomyiidae), and finally Calyptratae (Anthomyiidae, Scathophagidae).

Chris employed modern tools in collection curation such as utilizing a custom FileMaker Pro database to print header labels for the unit tray that houses all or some specimens of a particular species. In contrast to the majority of USNM curators, Chris did not insert new header labels directly into the unit tray (wedged between the foam and tray top), but placed them on the outside, on the top of the unit tray with written information visible above the tray (Figs 5–6). An example of such a printed, but not yet folded header label is shown in Fig. 6 (left) with the solid line being for folding the bottom part upward to place it underneath the unit tray and the dotted line for cutting the length of the entire card. This style of header label allows lifting the unit tray out of the drawer without needing to touch the unit tray itself and causing potential damage to specimens. One can also see that other information was directly included on the header label such as subfamily and tribe. A disadvantage of this approach is that the unit tray and header label can get disassociated and information lost.

Fig. 1: The USNM Diptera unit staff in 1978 and some visitors. Chris Thompson is back row 4th from right. Others: front row left to right: Sunthorn Sirivanakarn, Bill Wirth, Alan Stone, Curt Sabrosky, George Steyskal, Ray Gagné, Dick Foote; back row from left: Ed Peyton, Lloyd Knutson, Bill Grogan, Ron Ward, Laurene van Wie, Don Messersmith, Chris Thompson, Holly Williams, Michael Faran, Wayne Mathis. Photo: Victor Krantz, Smithsonian Institution.

Fig. 2: USNM Diptera unit in 2005. Chris Thompson is back row on left. Others: front row left to right: Holly Williams, Wayne Mathis, Diane Mathis, Lucrecia Rodriguez; middle row left to right: Gary Ouellette, Masahiro Sueyoshi, Allen Norrbom; back row left to right: Chris Thompson, Ray Gagné, Irina Brake with son Leon, Peter Brake, Norm Woodley. Photo: L. Rodriguez, 18 November 2015.

Chris was instrumental in establishing unique specimen identifiers (a.k.a. 'barcodes') in the Diptera and insect collection at the USNM (Fig. 6, center, see also below). He purchased the first batch of unique specimen identifier labels that used 'USDA SEL' as the institutional acronym/depository (Fig. 6, right). Since the collection belongs to the Smithsonian, the Smithsonian Entomology Chair immediately requested a change to represent each specimen by USNMENT followed by an eight-digit number, which formed what was then called a Darwin-Core Triplet of institutionCode (= USNM), collectionCode (= ENT), and catalogNumber (e.g., 01234567). This USNMENT number series started at 20,000 and an example of an early 'barcode' label is attached to the holotype of *Xylota analis* Williston, 1887 (USNMENT00022004, see http://n2t.net/ark:/65665/305fcf129-118c-448c-8c71-2218b7b6e92f). These early labels use a triple stack code-128 barcode, which is small and printed on a roll from which one can easily detach single labels (see Fig. 6, center). These labels are still found in the collection, but modern barcode scanners cannot read the triple stack barcodes anymore. However, the unique identifier with the USNMENT number is printed on the label so that it is accessible, and the department has several refurbished barcode scanners that can read all three types of barcodes used at the USNM. To this day, the numbering convention continues although the modern labels look quite different and use a 2D matrix barcode as can be seen in the holotype of *Citrogramma chola* Ghorpadé, 1994 (USNMENT01818022, see http://n2t.net/ark:/65665/3ab7e359e-f127-4b51-a88b-5c89741601c3).

Chris together with Wayne Mathis, the Smithsonian dipterist between 1976 and 2011, developed the idea of a species inventory. Under their leadership, the Diptera unit utilized vol-

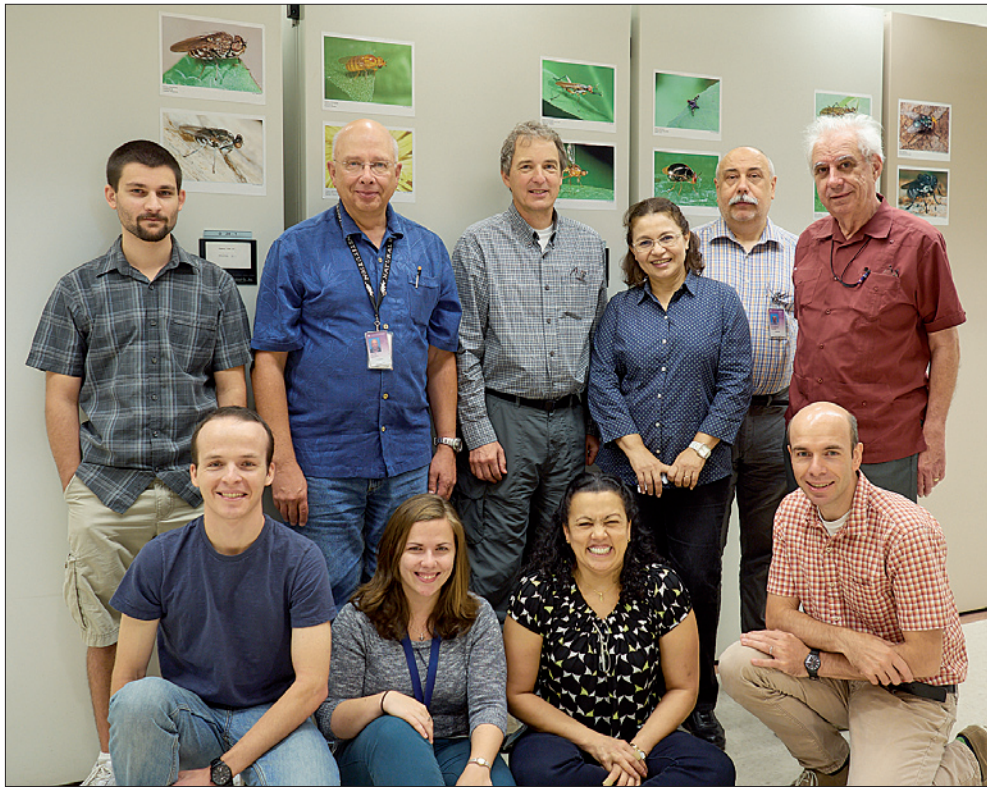


Fig. 3: USNM Diptera unit with visitors in 2013. Chris THOMPSON is back row on right. Others: front row left to right: Diego FACHIN, Erin KOLSKI, Lucrecia RODRIGUEZ, Torsten DIKOW; back row left to right: Chris COHEN, Wayne MATHIS, Allen NORRBOM, Rosaly ALE-ROCHA, Tadeusz ZARTWANICKI, Chris THOMPSON. Photo: T. DIKOW, 17 September 2013.

unteers and contractors to capture the species names present in the collection and it became the first such species inventory for a large insect taxon at the USNM. With additional funding from the Smithsonian, this inventory was updated by one contractor between 2013–2015 resulting in a comprehensive list and account of all species in the collection. It also includes the number of pinned specimens, the countries where these specimens have been collected in, and for the U.S.A. and Canada additionally the states/provinces. While other species inventories are accessible on the USNM collections portal, such as aquatic insects, for example, the Diptera species inventory is not yet publicly accessible, but will hopefully be searchable on the portal soon.

The USNM provides the opportunity for established curators at other natural history museums to take over the curatorial obligations of entire insect families at their home institution. Chris was influential in developing the program and getting the Diptera community involved. The first of these USNM Off-site Collections Enhancement Program loans were the Bombyliidae and Mythicomyiidae collections to Neal EVENHUIS at the Bernice Pauahi Bishop Museum (BPBM) in Honolulu, HI in 1990. Other Diptera taxa are the Celyphidae, Chamaemyiidae, and Lauxaniidae at the California State Collection of Arthropods (CSCA) in Sacramento, CA under the curatorial supervision of Steve GAIMARI (established in 2002), and Pipunculidae at the Canadian National Collection of Insects, Arachnids and Nematodes (CNC) in Ottawa, ON curated by Jeffrey H. SKEVINGTON (established in 2012).

Fig. 4: USNM Diptera unit with visitors in 2015. Chris Thompson is back row 4th from right. Others: front row left to right: Tatiana Sepulveda, Kevin Moran, Erin Kolski; back row left to right: Marcoandre Savaris, Silvana Lampert, Mauren Turcatel, Luciane Marinoni, Mark Schutze, Wayne Mathis, Chris Thompson, Diego Souza, Allen Norrbom, Torsten Dikow. Photo: T. Dikow, 5 May 2015.

USNM Syrphidae collection

Chris was eager to both curate the Syrphidae collection and utilize it in his research. His research resulted in 25 new Syrphidae genera and 165 new species (data from Systema Dipterorum as of 20 May 2022, http://www.diptera.org) of which 40 species are represented by holotypes in the USNM. Chris organized the collection by subfamily followed by tribe and then alphabetically by genus. He borrowed primary type specimens, other interesting specimens, or the entire holdings of Syrphidae from other museums and university collections for study. Unfortunately, these specimens were, at least in part, physically placed in the main USNM collection in the same unit tray of the respective species. Because not all instances of specimens from other museums are documented properly, for example through a label indicating the original owning museum collection, without subject-matter expertise it is a complex task to decipher which specimens are borrowed and which belong to the USNM (the same method of non-USNM specimen placement was also done in the Chloropidae, Tephritidae and several other families by earlier USNM Diptera curators). Fortunately, through members of the Syrphidae community such as Jeffrey H. Skevington and Kevin Moran, the USNM has received support for returning borrowed specimens to the correct owning institutions in August 2022 and future visits by Jeffrey H. Skevington are planned.

Chris invested personal funds to pay contractors to photograph the USNM primary type specimens of Syrphidae, USNM Syrphidae specimens used in his research, and type specimens he had on loan from other institutions. The majority of the USNM specimen photos were not added to the institutional database (EMu) and therefore have not been

made accessible online. Since I joined the USNM and assumed the official responsibilities of the Syrphidae collection in 2012, I asked Chris repeatedly to review the primary type database, which originated in the 1960s along with the physical movement of all Diptera primary types into a special collection housed alongside the main collection. The task was to highlight any types that represented yet unpublished manuscript names, did not belong to the USNM, or locate specimens that for some reason had not been placed in the type collection yet. Unfortunately, Chris was busy with so many other projects that he didn't review this list, which included some 554 records of Syrphidae primary types. Systema Dipterorum lists 523 primary types of Syrphidae that should be deposited at the USNM based on a review of the published literature. Many of these primary types have been photographed under Chris's oversight over the years.

However, the SI Diptera team made an effort to fill the gaps and we are now able to share photographs of 521 Syrphidae types on the USNM collections portal (https://collections.nmnh.si.edu/search/ento/, Type search tab) from where they are downloadable in full resolution. All images of specimens from the Smithsonian Institution are in the public domain (Creative Commons license CC0) and therefore can be used and published in manuscripts, shared with colleagues and online, or made openly accessible otherwise. Acknowledging that the specimen is from the USNM and Smithsonian Institution with its unique specimen identifier (USNMENTXXXXXXXX) would be greatly appreciated. The photos can also be accessed on the Smithsonian Open-Access Portal (https://www.si.edu/openaccess) from where they can be downloaded more straightforwardly. Searching for the USNMENT identifier or original species name (original generic combination) will suffice to locate the record.

In addition to photos of Syrphidae species, Taina Litwak, a SEL illustrator, was commissioned on many occasions to digitally draw Syrphidae species published in Chris's manuscripts. Some of these illustrations have been reproduced in this issue.

Chris developed many projects throughout his career using the existing collection at the USNM to better understand regional faunas. Two projects, the Syrphidae/Diptera of Plummer's Island and DelMarVa come to mind. Plummer's Island (38°58'11" N 077°10'35" W) is an island in the Potomac River, which separates Maryland and Washington, D.C. from Virginia. It has been sampled extensively for fauna and flora by the Washington Biologist's Field Club since 1899 and is referred to as "the most thoroughly studied island in North America" (see https://en.wikipedia.org/wiki/Plummers_Island). DelMarVa represents the Delmarva Peninsula composed of Delaware as well as the eastern parts of Maryland and Virginia between the Atlantic Ocean and the Chesapeake Bay and is only a short drive east of Washington, D.C. (see https://en.wikipedia.org/wiki/Delmarva_Peninsula). There are numerous specimens in the Syrphidae collection and a few other families that have been 'barcoded' (received a unique specimen identifier, see above) or hand-written labels are placed inside the unit tray indicating that specimens originate from these two places. Chris surveyed the collection for these localities and was setting the specimens up for future study and he likely captured the occurrence data in a custom FileMaker Pro database. However, no scientific publication on Syrphidae resulted from the analysis of the specimens from Plummer's Island and DelMarVa, and no specimen data were entered into the museum-wide EMu database; the few records of Syrphidae from Plummer's Island available from the USNM at GBIF (https://www.gbif.org) originated from a 2019 conservation-focused data capture project.

Natural history museum specimen data

Evenhuis et al. (2023) provide an overview of Chris's forward-thinking approach to species data capture that resulted in the invaluable Systema Dipterorum portal. Chris was deeply

Fig. 5: The unit tray containing all specimens of *Palpada bistellata* Hull, 1935 showing the header label placed outside at the top of the unit tray with the species name and zoogeographic region visible. This additional height allows for lifting the tray and moving it out of the drawer.

interested in developing new tools for entomological data management and was invited to organize a workshop on and produce a data standard for Systematic Entomology entitled, "Automatic Data Processing for Systematic Entomology: Promises and Problems, a report for the Entomological Collections Network" (1 December 1990, Baton Rouge, LA) as well as speak on "Electronic publishing: Delivering the goods to the public" (Entomological Society of America, "Computer and software tools for improving and speeding biodiversity studies" symposium, 11 December 1996, Louisville, KY).

Chris also developed a poster in the USNM Diptera collection on "Digitizing and Disseminating Diptera Diversity (D^4)" (Fig. 7) in the mid-2000s. This poster provides a forward-looking approach to specimen-level data capture using unique specimen identifiers and utilizing the digital data record as well as external data and media to aggregate a species page on the Encyclopedia of Life (EoL, https://eol.org) from where the information is accessible to the dipterological community and the public-at-large.

This is one initiative to share species and specimen data today, but Chris, in my understanding, did not put resources into the specimen-level data capture toward the institutional database (EMu in the case of the USNM) although his custom database might have the specimen data available. As becomes clear also when looking at Bionomia (see below), very few USNM Syrphidae specimens have been data-captured, added to EMu, and made available to the Global Biodiversity Information Facility (GBIF, https://www.gbif.org) for use by all scientists and the public. As of December 2022, of the 96,000 Syrphidae specimens in the USNM collection, only 3348 specimen-level records are accessible at GBIF (see https://www.gbif.org/occurrence/map?dataset_key=821cc27a-e3bb-4bc5-ac34-89ada245069d&taxon_key=6920),

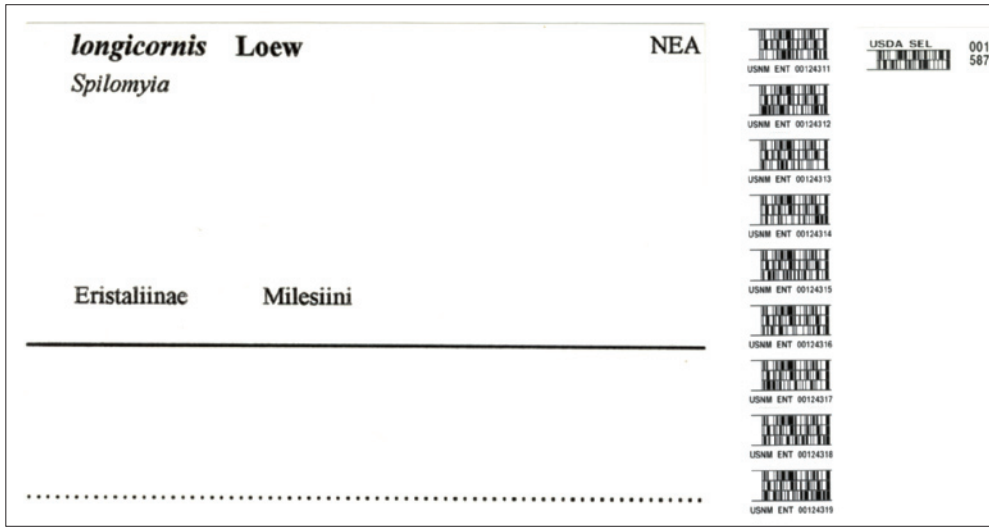


Fig. 6: Left: A printed but unused unit tray header label from Chris's database. Center: A set of early 'barcode' labels initiated by Chris Thompson (triple-stack code 128 with perforation between each label for easy detachment and use). Right: A 'USDA SEL' unique specimen identifier label (acronym never officially used at USNM).

which include all primary type specimens with photos and the majority of the other specimen records that were added in the past several years through digitization projects in-house. The hope is to obtain access to Chris's specimen-level database to add the digital data to EMu and make them accessible online, but so far only an older copy has been located (circa 2011) with some 3000 USNM specimens.

Smithsonian

Although Chris was an SEL employee, he was very much involved in Smithsonian issues. His employer, the U.S. Department of Agriculture (USDA) is a federal government agency while the Smithsonian (called a quasi-official entity and not officially part of the executive branch of the U.S. government) is not entirely federally funded and therefore might have some less-stringent protocols. For example, establishing a research endowment for Diptera (see Williston Fund below) was certainly not possible within USDA but easily accomplished within the Smithsonian Institution where this endowment fund is being held for perpetuity. Likewise, Chris was a generous supporter of the Smithsonian Natural History Library. He served on the NMNH library committee as a strong advocate for the print collection and contributed annually to the Entomology library until his retirement. He and his wife Betty set up an endowment fund to help sustain natural history serial subscriptions [see https://library.si.edu/donate/endowments/serials-acquisition-and-preservation) and several of his rare books were also donated to the Smithsonian library recently (see Evenhuis et al. 2023)].

Chris also made regular 'rounds' to Smithsonian administrators and was asked to contribute to departmental and museum-wide initiatives. He also received a permanent appointment as Research Associate from then Smithsonian Secretary S. Dillon Ripley in 1981 (Fig. 8).

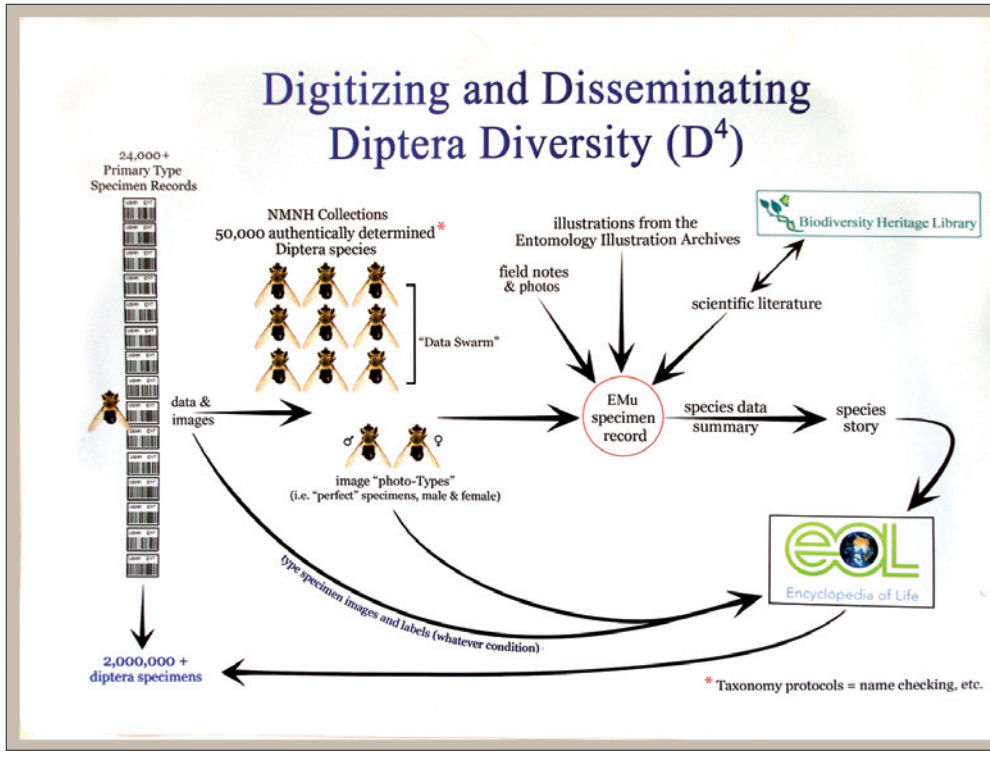
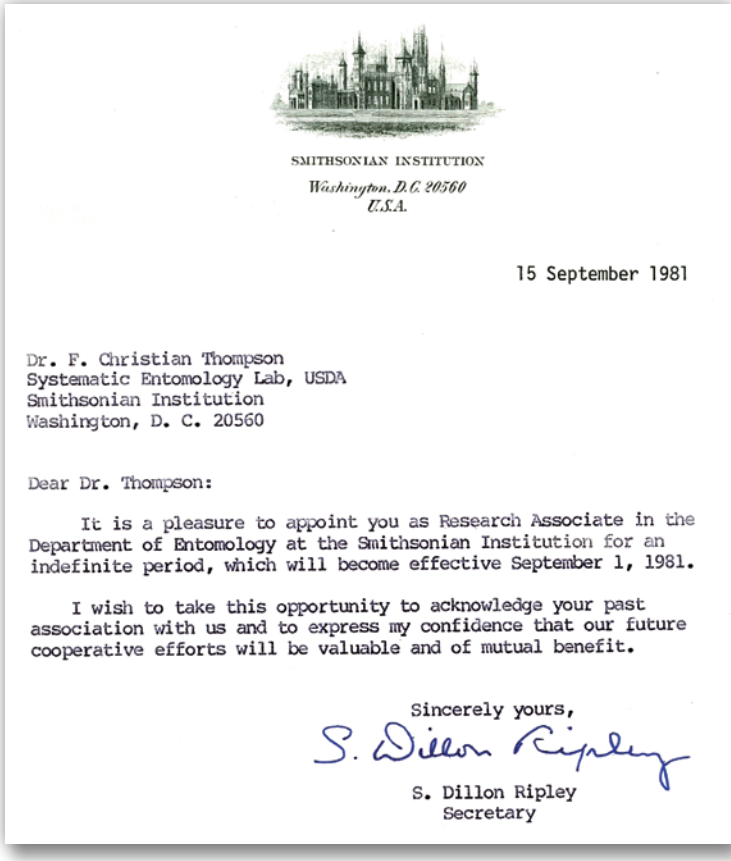


Fig. 7: Poster on "Digitizing and Disseminating Diptera Diversity (D4)" developed by Chris Thompson in the mid-2000s and posted on the wall of the Diptera collection.

Williston Diptera Research Fund

Chris Thompson was a great supporter of dipterists coming through the Washington, D.C. area (see Evenhuis et al. 2023), but also reached out to the international community. The S. W. Williston Diptera Research Fund (Fig. 9) was initiated by Chris in the mid-1970s and has grown to its current size primarily through his contributions. It is the only endowment in the NMNH Department of Entomology that is publicly announced and invites applications from outside the department. Chris was very deliberate when setting this endowment fund up so that it can only be used for "the increase and diffusion of knowledge about Diptera".

Samuel Wendell Williston (1851–1918, https://en.wikipedia.org/wiki/Samuel_Wendell_Williston) was a distinguished biologist who made significant contributions to paleontology, entomology, medicine, and education. He was the first native dipterist in the U.S.A., the first to produce generic monographs of Nearctic Diptera as well as three editions of the Manual of North American Diptera, the first to curate and study the Diptera of the USNM, and the first to contribute to that collection (his types of Nearctic Syrphidae). It was only fitting that Chris named this endowment fund to honor the contributions Williston made to the USNM Diptera collection and dipterology in general. Until 2012, Chris served on the Williston endowment fund committee and has overseen the financial support of many dipterists young and old. The fund remains active and supports the travel of graduate students to the International Congresses of Dipterology (http://www.nadsdiptera.org/ICD/ICDhome.htm), to the USNM for collections-based research, and more recently for students and naturalists to participate in



SMITHSONIAN INSTITUTION
Washington, D.C. 20560
U.S.A.

15 September 1981

Dr. F. Christian Thompson
Systematic Entomology Lab, USDA
Smithsonian Institution
Washington, D. C. 20560

Dear Dr. Thompson:

It is a pleasure to appoint you as Research Associate in the Department of Entomology at the Smithsonian Institution for an indefinite period, which will become effective September 1, 1981.

I wish to take this opportunity to acknowledge your past association with us and to express my confidence that our future cooperative efforts will be valuable and of mutual benefit.

Sincerely yours,

S. Dillon Ripley

S. Dillon Ripley
Secretary

Fig. 8: Letter from former Smithsonian Secretary S. Dillon RIPLEY granting a permanent Research Associate appointment to Chris THOMPSON.

FlySchool. The fund has also supported field-work for taxonomic or systematic research, especially for attending the North American Dipterists Society (http://dipterists.org) bi-annual field meetings. The fund web-site (http://bit.ly/WillistonFund) is kept up-to-date with an annual proposal call on December 1st.

Bionomia

Bionomia (https://bionomia.net/) is an analysis tool summarizing specimen data from the Global Biodiversity Information Facility (GBIF) and attributing them to people. These attributions focus on specimens collected by and identified by an individual and provide a great overview of the impact a scientist has had in the field, especially in natural history museum settings and field-collecting. The aggregated data are based on digitized specimen records from museums around the world that have been uploaded to GBIF and therefore provide only a snapshot of the digitally accessible records at a given time. Many more specimens, especially insects, await data capture in museum collections before they can be shared through GBIF for open access by the scientific community and the public at large. The Bionomia record for Chris THOMPSON can be accessed at https://bionomia.net/Q22111516. Currently (as of 2 December 2022), the available digital data include 2248 specimens from 19 countries collected and 26,784 specimens from 45 countries identified by Chris. From the USNM, 820 specimens are included ("deposited at") which represent only a very small percentage of the

Fig. 9: Williston Diptera Research Fund logo. Design by Burgert Muller in 2017.

collection and ongoing digitization efforts on the Diptera collection will increase this number considerably. This Bionomia record also provides a glimpse at Chris's field-work in which he was very often accompanied by his wife Betty who is, when label data are captured, included as a co-collector such as this specimen of *Anu una* Thompson, 2008 from New Zealand (USNMENT00035218, http://n2t.net/ark:/65665/30641e417-f048-4907-9b4d-0bc101b6c121).
In summary, Chris Thompson has contributed in many ways to the Diptera collection at the USNM, other initiatives at the National Museum of Natural History and Smithsonian in general, served on committees and supported the Smithsonian library, and utilized the collection and infrastructure for his research and developing Systema Dipterorum.

Acknowledgments

I would like to thank my Diptera colleagues at the USNM, Ray Gagné, Allen Norrbom, and Norm Woodley, for critically reading a manuscript draft and suggesting improvements; Richard Greene (Smithsonian Natural History Library) and Dave Furth (Smithsonian Entomology Collections Manager, retired) for providing background information; and Neal Evenhuis (Bernice P. Bishop Museum, Honolulu, HI) for sharing his biography of Chris before publication.

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