THE HERBARIUM OF RUDOLF M. SCHUSTER:
UNLOCKING OVER A HALF A CENTURY OF BOTANICAL EXPLORATION

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Abstract

The esteemed scholar, bryologist, and botanist, Prof. Rudolf M. Schuster, was a prolific collector and author of over 300 scientific publications. His staggering number of collections, reliably estimated at over 80,000 specimens, span almost six decades of fieldwork in over 38 countries. For almost his entire career, over two thirds of R. M. Schuster's herbarium was largely inaccessible at his private residence. In 2013 his herbarium, in its entirety, was transferred to Field Museum. A detailed overview of the herbarium of R. M. Schuster is provided, including a description of the collections, the geographical extent, and status of curation and accessibility. This is complemented by tabulations and summary data representing the number of liverwort taxa R. M. Schuster described during his career and appended with a complete list of publications associated with liverworts and hornworts. Supplementary material provides a complete list of validly and legitimately published names at all ranks, from species to order, coupled with their original publication. This is the only publication that attempts to centralize and summarize the collections, publications, and exhaustive list of described taxa representing the career of the pre-eminent scientist, Prof. R. M. Schuster.

Keywords: Rudolf M. Schuster, herbarium, collections, liverworts, taxa, volunteers

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INTRODUCTION

Dr. Schuster, Professor Schuster, or Rudy – to all who knew him – was born April 8, 1921, in Altmühldorf, Germany (Fig. 1). Rudolf M. Schuster was an eminent botanist, hepaticologist, scholar, and world explorer, with a stunning career that spanned over six decades and represented one of the foremost classical scholars of our time in botany. Over the course of his career, he was awarded two Guggenheim Fellowships and a Fulbright U.S. scholar grant to conduct botanical research in New Zealand. His fieldwork took him all over the world and led to numerous scientific discoveries and novelties from the rank of form to order. It is difficult to name another contemporary botanist who discovered this much new diversity of a major clade of land plants (Qiu et al., 2013). Schuster’s research has had far reaching implications beyond bryology including his being one of the first botanists who recognized the importance of Wallace’s Line in plant biogeography (Schuster 1972).

The International Association for Plant Taxonomy awarded him the Engler Medal in Silver in 1992 recognizing his illustrious scientific contributions. Since his passing on the 16th of November 2012, there have been several obituaries and biographies that provide an in-depth account of R. M. Schuster’s life, from early childhood to his death, e.g., Qiu et al. (2013) and Long (2015).

Earlier, Engel & Klekowski (1988) provided an extensive account of the life and travels of R. M. Schuster as part of a Festschrift in celebration of his distinguished scholarship. Readers are referred to these accounts for his biographic background.

The object of this paper is to provide, for the first time, a detailed account of his exhaustive herbarium, and centralized information about all of his publications as they relate to liverworts and hornworts (Appendix 1) as well providing summary information about new taxa to science that he validly and legitimately described (Table 1). This is supplemented by a complete list, as we know it, of all taxa representing all ranks; this is confined to validly and legitimately names coupled with the original publication (Supplement 1). Our ambition with this paper is to provide thorough information about this important collection along with his exhaustive publications and novelties, which we hope will stimulate future research and continue the legacy of Prof. Rudolf M. Schuster.

OVERVIEW OF THE HERBARIUM OF R. M. SCHUSTER

In 1982, Field Museum purchased the entire herbarium of R. M. Schuster through the efforts of now Emeritus Curator John Engel. As part of the contractual agreement, the vast majority of R. M. Schuster’s herbarium remained at his residence up until his passing to enable him to pursue his research. However, some 25,000 specimens, mainly from North America, were physically transferred to Field Museum where they were curated and databased. It was not until February 2013, that Field Museum acquired the remaining portion of what was then estimated to be approximately 35,000 specimens (Fig. 2).

Upon the packing and transfer of the herbarium of R. M. Schuster, it was abundantly clear that over a third of the collection was in critical need of curation ranging from specimens in original newspaper and brown paper bags to original collecting packets (Fig. 3C, D, F). There was also vital type material that required urgent attention, some of which was in glass vials and on microscopic slides. This was a major undertaking. Shortly after the acquisition, Field Museum Collections Spending Fund and later in 2015 the National Science Foundation (NSF Award No. 1115002) provided support for curation, sorting, barcoding, databasing and digitizing significant portions of the collection in order to make it accessible.

Throughout the past eight years, the collection has been widely used by visiting scholars and through loan activity. This period was also concurrent with a large-scale databasing initiative – the NSF funded Thematic Collection Network North American lichen and bryophyte consortium; a project imaging about 2.3 million North American lichen and bryophyte specimens from more than 60 U.S. herbaria to address questions of how species distributions change after major environmental events, both in the past and projected into the future. With the collection of R.M. Schuster being worldwide in scope, this effort continues with a similar NSF funded
digitization effort - Building a global consortium of bryophytes and lichens: keystones of cryptobiotic communities (NSF Award No. 2001509). This latter digitization effort offers the opportunity to also capture digital images of the physical specimen itself as well as label data.

THE UNLOCKING OF SIX DECADES OF COLLECTIONS

The following describes the effort from several key individuals, including co-authors Laura Briscoe, Yarency Rodriguez, Mike Niezgoda with numerous assistance from volunteers and interns throughout the past eight years. Originally, ten’s of thousands of specimens were in paper bags and newspaper (Fig. 3 C, D, E, F). Typically, R. M. Schuster would collect specimens in packets in the field, transfer these to individual newspaper sheets then into bundles, with locality information for later curation and processing (Fig. 3E, F). An estimated 30,000 specimens had already been at least partially curated, labelled and packeted (Fig. 3B). Over 20,000 specimens were in critical need to be transferred from newspaper to packets for accessibility. This was largely achieved by assistance from volunteers, including Field Museum Collection Club members - a group of volunteers that meet every quarter (Fig. 4A). Through these combined efforts spanning several years, the collections have finally become accessible to scientists worldwide that have otherwise been largely inaccessible for several decades.
Figure 4B, C & D indicate the final curated specimens. Many specimens came with adequately archived label data that was glued directly onto archival packets (3B). A complete inventory of R. M. Schuster’s herbarium was performed by Collection Club members after it had been immaculately sorted and curated by staff and volunteers over the years. A staggering 58,974 specimens were counted and inventoried. The lots themselves had been earlier carefully surveyed by Laura Briscoe and Mike Niezgoda to determine level of curation, e.g., presence/absence...
of label data, identification, and level of processing in order to establish priorities. Together with material already in the main herbarium we count 80,273 specimens representing collections from 35 countries (Fig. 5). This includes approximately 5,000 specimens that are either gifts, exchange or exsiccate sets. Unfortunately, close to 10,000 specimens have either no label data at all, or limited label data, or only the country is known.

The R. M. Schuster collection also has a significant number of specimens in FAA glass vials (549) and important microscopic slides (over 600) that have been inventoried and available upon request (Fig. 4E, F, G). Some the newly described species by R. M. Schuster were only reported from the type collection from slides or FAA (von Konrat et al. 2006) so these represent a valuable resource. Field Museum also has over 1,000 of R.
Unlocking of the herbarium of Rudolf M. Schuster

M. Schuster’s original illustration plates that have yet to be completely inventoried, although John Engel has done a partial analysis. The collection also has 399 type fragments or “collectotypes” from various type collections R. M. Schuster studied.

Herbaria have long been recognized as a major frontier for species discovery and distribution patterns with studies indicating a vast majority of undescribed species that have already been collected and are stored in herbaria (Bebber et al., 2010). This also extends to range extensions and distribution patterns. Since 2013, the curation of R. M. Schuster’s herbarium has contributed to a plethora of such discoveries, and in many cases his collections remain unique because of the extremely isolated regions collected and the era in which they were collected. Some noteworthy examples include the first bryofloristic analysis for a Brazilian mountain in the Amazonian rainforest (Costa et al., 2017), ongoing floristic studies of New Zealand, including the first ever modern liverwort and hornwort flora for the region (Engel & Glenny 2019a,b), many new records from Fiji (von Konrat et al. 2014, Pócs et al. 2018), and new species to science from New Caledonia (Larraín et al., 2018). These examples and more underscore that effort, funding, and research focus should, therefore, be directed as much to examining extant herbarium material as collecting new material in the field (Bebber et al. 2010).

ENUMERATION OF TAXA DESCRIBED BY R. M. SCHUSTER

Rudy’s major contribution to botany and hepaticology lies in the astounding new diversity of liverworts he added to our knowledge. Mostly by himself and through collaboration with a small number of colleagues, he described 455 taxa at the rank of species or below, 97 genera and 343 infragenetic taxa, 75 higher taxa, including 16 families, 16 suborders and one order (Table 1). These discoveries were made in his land-combing floristic surveys of hepatics in eastern North America, Greenland, New Zealand, and other parts of the world. As noted by Godfrey & Godfrey (2012), R. M Schuster particularly emphasized the importance of examining hepatic specimens while they are still fresh, recording taxonomic characters associated with oilbodies – cellular structures that typically disappear upon drying. A complete list of all taxa described by R. M. Schuster is provided as Supplementary Material, which includes the original citation. This exhaustive list of over 900 taxa is restricted to those that were validly and legitimately published. As commented by Godfrey & Godfrey (2012) and others, R. M. Schuster had had little or no patience with the practice of designating new taxa through the exercise of nomenclatural revision.

Table 1. Taxa described by R.M. Schuster (see complete lists in Summplementary Materials)

| Form   | Genera |
|--------|--------|
| 23     | 97     |
| Varieties | Tribes  |
| 73     | 8      |
| Subspecies | Subfamilies |
| 57     | 34     |
| Species | Families |
| 302    | 16     |
| Subsections | Suborders |
| 40     | 16     |
| Sections | Order  |
| 181    | 1      |
| Subgenera | 122     |

BIBLIOGRAPHY OF R. M. SCHUSTER

R. M. Schuster has authored or co-authored 256 publications that focus on bryology. Perhaps the most noteworthy are the multi-volume books: the Hepaticae and Anthocerotae of North America, east of the hundredth meridian (The Big Green), and three volumes of Austral Hepaticae. These floras are not mere conventional compilations of taxonomic diversity, but are also encyclopedic treatments of liverworts and hornworts as well as their biology (Qiu et al., 2013). Engel et al. (2015) previously provided this exhaustive list of publications, which we slightly modify and include here as Appendix 1 to provide a central source of R. M. Schuster’s scholarly contribution to bryology.
