Bulletin of the
Purdue University Herbarium

January 1998 Volume I, Number I

Operations Manual

Anthony L. Swinehart, B.A., M.S., Ph.D.
Curator of the Herbarium from January 15, 1997, to August 19, 1998

Department of Botany & Plant Pathology

The *Bulletin of the Purdue University Herbarium* is an occasional publication and includes annual reports, special volumes such as the *Operations Manual*, and scientific and historical contributions relating to traditional botany and plant ecology. Prospective contributions may be sent to:*Curator, Purdue University Herbarium, Department of Botany & Plant Pathology, Lilly Hall of Life Sciences West Lafayette, Indiana 47907-1155 U.S.A.*

TABLE OF CONTENTS

LIST OF TABLES....iv

LIST OF FIGURES....v

CHAPTER 1 - INTRODUCTION....1

The Mission of the Purdue University Herbarium....1

The Joseph C. Arthur Herbarium [PUR]....2
Past Curators of the Arthur Herbarium....2
Dr. Joseph Charles Arthur....2
Dr. George Baker Cummins....5
Dr. Joe F. Hennen....5
Dr. R. G. Thorn....6
Dr. Gregory E. Shaner....6
Dr. Anthony L. Swinehart....6
The Purdue University Herbarium [PUL]....6
The Ralph M. Kriebel Herbarium....6
Other Collections....6
Ralph M. Kriebel....7
Past Curators of the Purdue University Herbarium....8
Dr. Stanley N. Coulter....8
Dr. Grady L. Webster....8
Dr. Morris Levy....8
Dr. Joe F. Hennen....8
Dr. R. G. Thorn....8
Dr. Gregory E. Shaner....8
Dr. Anthony L. Swinehart....8

CHAPTER 2 - FACILITIES....10

The Main Herbarium (Lilly 1-430)....10
History....10
Current Layout....10
Herbarium Annex (Bryophyte Herbarium, Lilly 1-103)....12
History....12
Current Layout....12

CHAPTER 3 - EQUIPMENT....14

Computers....14
Microscopes....14
Freeze Microtome & Histology....15
Freezer....15
Drying Cabinet....15
Other Equipment....15
Cot for Overnight Stay....15
Kodak Slide Projector & Carousels....15
Ladder....15
Mobile Map File....15
Paper Cutters....15
Plant Presses....15

Portable Light Table....15
Skyline Portable Display....15
Specimen Cart....15
Steam Iron....15
Stepping Stool....16
Two Wheel Dolly....16
Typewriters....16
Vascula....16

CHAPTER 4 - HERBARIUM LIBRARY....17

Description and Organization....17
Acquisition of New Volumes....17
Loan Guidelines....17
Maps....17

CHAPTER 5 - FACILITIES MANAGEMENT....18

Lobby....18
Work Areas....18
Floors....18
Sink....18

CHAPTER 6 - COLLECTIONS....20

The Arthur Herbarium....20
Curation Format....20
Arrangement of Specimens....20
Accession Numbers and Records....20
Microscope Slides....23
The Kriebel Herbarium....23
Curation Format....23
Arrangement of Specimens....23
Accession Numbers and Records....23
Restoration of Damaged or Deteriorated Specimens....25
Acid-based Paper....25
Depauperate or Inappropriate Labels....26
Improperly Attached Specimens....26
Loose Parts....26
Discarding Specimens....26

CHAPTER 7 - STANDARD FORMS AND LABELS....27

Letterhead....27
Facsimile Form....27
Loan Forms....27
Package Mailing Label....27
Reprint Request Form....27
Herbarium Specimen Labels....39
Stamps....39

CHAPTER 8 - PROCESSING PLANT SPECIMENS....42

Collecting New Specimens....42

What and How to Collect....42
Pressing....43
Processing New Specimens....43
Drying....43
Decontamination....43
Mounting Specimens....43
Types of Glue and Proper Application....43
Specimen Arrangement....45
Labeling: Typing, Attachment, and Placement....45
Ordering Supplies....46
Accessioning Specimens....46
Placement of Accession Numbers....46
Record Keeping....47
Computer Database....47
Deposition of Specimens in the Herbarium....47
Annotation....47
Credibility of Annotations....47
Annotation Labels....47
Placement of Annotated Specimens in the Herbarium....48

CHAPTER 9 - LOANS AND EXCHANGES....49

Guidelines for Loan of Specimens....49
Loan Procedure....50
Voucher Specimens and Exchanges....50

CHAPTER 10 - CORRESPONDENCE....53

CHAPTER 11 - PUBLICATIONS....54

Brochures....54
Web Page....54
Bulletin of the Purdue University Herbarium....54

APPENDIX A - Autobiography of Joseph Charles Arthur (1850 - 1942), written on February 15, 1916....55

APPENDIX B - Autobiography of George B. Cummins (1904 -), written on March 8, 1990....62

APPENDIX C - List of Species in the Arthur Herbarium....67

APPENDIX D - Proposal for Developing a Computer Database for the Purdue University Herbaria....129

CHAPTER 4

HERBARIUM LIBRARY

Description and Organization

Lilly room 1-430 houses the books and literature associated with the Herbarium. The large case near the curator's office is devoted to green plants (algae, bryophytes, and vascular plants). The smaller case next to the east end of the Arthur Herbarium (in the lobby) is devoted to fungi.

Altogether, there are approximately 1000 volumes in the Herbarium Library. Most of these are catalogued on a computer database (Endnote) under the file:

C:/Curator/Purdue Herbaria/Databases/Herbarium Books

There is currently no organized manner of placing books in the case. A numbering system and arrangement by subject is recommended for the future.

In addition to books, the Herbarium has more than 1500 scientifc journal reprints. These are located on the shelf next to the green plant library case. The articles are numbered and filed with Endnote computer software under the file:

C:/Curator/Purdue Herbaria/Databases/Herbarium Journals

Acquisition of New Volumes

When a new book is acquired by the Herbarium, it is to be stamped on the first several pages with the address stamp. Bibliographic information is then entered into the computer database.

New journal articles should be given a number (consecutive with the previously acquired article) written on the top right corner and preceded by the words, "Purdue Univ. Herb. #". Bibliographic information is then entered into the Endnote computer database. See Chapter 7 for information on reprint request forms.

Loan Guidelines

Books may be checked-out for two weeks by faculty and full-time staff in the Department of Botany & Plant Pathology. Loan forms for borrowing books are located in the green plant library case. All other patrons, including students and non-Botany employees of Purdue, must use the library materials in the Herbarium and may not remove such materials. All journal articles should remain in the Herbarium except to have photocopies made.

Maps

A collection of maps is located under the Arthur workbench. In addition, some maps and instructional charts are located on the mobile map file. United States Geological Survey topographic maps of Indiana may be purchased for $4.00 per quadrangle on the second floor of the Entomology Building (LARS).

CHAPTER 5

FACILITIES MANAGEMENT

A well kept herbarium is an herbarium worth keeping. The very nature of an herbarium demands meticulous organization and cleanliness, and a visibly pleasing environment is the best advertisment for patrons, both new and old. In the past, the herbarium and its curators was inconspicuous and secluded, however an "open door policy" was begun in 1997. With the re-organization and cleaning that took place, the springs were removed from the doors and they are now open during business hours. This simple change has resulted in unprecedented improvement in public relations and support for the herbaria. Bypassers, seeing the facility and the work going on inside are often drawn in as patrons, employees, or volunteers. It is imperative that the Herbarium remain pleasingly visible and service oriented, and that the activities conducted within demand the respect of faculty and administrators in order to dispell the myth that organismal botany and field ecology are antiquities and pseudosciences.

Lobby

The lobby is the first impression that patrons have of the Herbarium (it is also the first impression they have of the Herbarium staff). Of all areas, this should be kept clean and organized to facilitate library, map, specimen, and computer use. Due to heavy dust fallout, occasional cleaning of the computers, table surfaces, and other objects is necessary.

Work Areas

Although some projects will require that work materials be left in place for extended periods, it is recommended that work areas be left open and clean at the end of each day, as there will always be the unexpected visitor or class of students that will wish to tour or use the Herbarium. While work areas are appropriated for messy tasks, spills and other messes should be kept to a minimum. The Kriebel workbench had developed several layers of dryed glue and other solids until the Spring of 1997, when it was sanded and refinished. A similar restoration is recommended for the Arthur workbench. Refinished wood surfaces should be cleaned regularly, and wood polish should be applied at least once a month.

Floors

Cleaning of floors is handled by the custodial staff who arrive at approximately 10:45 or 11:00 pm on weeknights. They do a very general sweeping of the lobby area and the curators office. However, they do not sweep the aisles between the herbarium cabinets. It is important that these areas be swept so as to limit plant fragments and dirt from getting into the gears of the mobile cabinets.

The custodial staff will notify the curator in writing when the floors are to be waxed. To insure thorough waxing and to assist the custodians, all loose items such as chairs, trash cans, boxes, etc. should be taken up off the floor. The author recommends moving small tables, chairs, map file, microtome, *etc.*, into the open aisles of the herbaria cabinets (which do not really need to be waxed) to facilitate thorough waxing of the more visible parts of the Herbarium.

Sink

The sink should be cleaned regularly, and glue-laden plant parts should not be allowed to accumulate in the bottom of the sink or in the trap. Make sure the water is

completely turned off after each use. Dripping causes thick, rusty incrustations of calcium carbonate that requires concentrated hydrochloric acid to remove.

CHAPTER 6

COLLECTIONS

The Arthur Herbarium

Curation Format. Specimens in the Arthur Herbarium are limited to rust fungi (order Uredinales). Rust specimens are collected by removing "rusted" portions of the plant host (usually leaves) and placing them into bryophyte envelopes. Each envelope is labelled with all appropriate information, including accession number, such that several different specimens of the same species on the same host may be attached to the same sheet. Therefore sheets do not have the standard label at the bottom right corner. Instead, the rust species and the pathogen is written in pencil at the bottom right hand corner of the sheet. Other items such as photomicrographs, drawings, scientific descriptions, journal articles, and microscope slides may be associated with a given sheet. So, unlike a standard vascular plant sheet, sheets in the Arthur Herbarium may include multiple specimens and a variety of supporting documentation.

Arrangement of Specimens. Because of the host-pathogen relationship, rusts have a dual taxonomic organization in the herbarium--the first level is by rust, the second level is by host family. An additional level of organization is based on geographic location. Each genus of rust is assigned a number, following the arrangement given by Cummins and Hiratsuka, *Illustrated Genera of Rust Fungi*. Species within a genus are given a number which amounts to a "folder number" (To determine the folder number of a given species consult Appendix C). The numbering of species within a genus (the arrangement of species within a genus) is based upon the host family on which the pathogen occurs (see Table 1). Within the hierarchy of generic phylogeny and species-host relations, is the finest level of organization, that being geographic location of the specimen(s). Geographic location is identified by the color of the folder in which the specimens are kept (Figure 3).

Accession Numbers and Records. The first records of the Arthur Herbarium represent contributions to the Flora of North America Project and comprise five large volumes. The accession numbers in these volumes are from 1 to 43534. Additional records to the Flora project occur in six smaller volumes beginning with number 43535 and ending with 51239. A second set of accession numbers titled "extra North American Uredinales" occurs in two large volumes. These accession numbers are preceded by an F - because (presumably) they represent mostly foreign species (J. F. Hennen, pers. comm. 1997). The "F-series" volumes begin with F-1 and end with F-20000. Two other volumes resume the original numbering system because they are all North American records. These volumes begin with 51240 and end with 66900. The last page of these records includes a note written by J. F. Hennen in 1983 that suggests combining the 20,000 F- series with the 66,900 other numbers to begin future accession numbers at 86901. Hennen stated that he would use numbers 86901 through 88000 for 1983 and 1984 Brazilian collections, thus 88001 would be the next number. The author has no knowledge of any accession numbers or records subsequent to F-20000 or 66900. Several factors including proposed computerization as well as curatorial neglect have led to an absence of record keeping. Specimens lacking accession numbers have been deposited in the Arthur. To remedy this, the Author began a new accession numbering system; the "N-series" (N - for "new"). All new acquistions will be assigned an N- number beginning with N - 1 (in this case N -1 is the ISOTYPE of *Uredo maua*. Any specimens currently in the Arthur that lack accession numbers will be added to the "N-series" at such time that they are found. This emphasizes the importance of recording the date that the accession number was assigned (see record book for format), so that the user can infer delayed accessioning.

Table 1. Arrangement of Vascular Plant Families in the Arthur Herbarium

Acanthac. G32
Acerac. C67
Adoxac. G36
Aesculac. C68
Aizoac. C19
Alismac. M5
Alsinac. C20a
Altingiac. C41
Alliac. M18a
Allioniac. C18
Amaranthac. C16
Amaryllidac. M23
Ambrosiac. G42
Ampledidac. C74
Amygdalac. C45
Ammiac. C91
Anacardiac. C62
Anonac. C25
Apocynac. G17
Aquilfoliac. C64
Arac. M9
Araliac. C90
Aristolochiac. C13
Armeriac. G8
Artocarpac. C9
Asarac. C13
Asclepiadac. G18
Balsaminac. C70
Berberidac. C27
Betulac. C6
Bignoniac. G30
Bixaceae C78a
Bombac. C74a
Boraginac. G23
Brassic. C32
Bromeliac. M14
Burmanniac. M27
Burserac. C55a
Buxac. C60
Cactac. C82
Caesalpinac. C47
Calycanthac. C29
Calycerac. G40d
Callitrichac. C58
Campanulac. G40
Candolleac. G40c
Cannac. M26
Caprifoliac. G35
Capparidac. C33
Carduac. G43
Caryocaraceae. C75A
Caryopyllac. C21
Cassiac. C47
Celastrac. C65
Ceratopyllac. C23
Chenopodiac. C15
Cichoriac. G41
Cistac. C78
Clethrac. G1
Combretaceae. C86b
Composit. G43
Commelinac. M15
Convallariac. M20
Convolvulac. G19
Coriariaceae C60A
Cornac. C92.
Corylac. C63.
Crassulac. C38
Crucifer. C32
Cucurbitac. G39
Cupressaceac. Gym1A
Cuscutac. G20
Cyperac. M8
Cyrillac. C63
Daphnac. C83
Diapensiac. G6
Dichondrac. G19a
Dioscoreac. M24
Dipsac. G38
Droserac. C36
Drupac. C45
Ebenac. G10
Ehretiac. G23a
Elaeagnac. C84
Elaeocarpac. C73a
Elatinac. C77
Empetrac. C59
Epilobiac. C87
Ericac. G4
Eriocaulac. M13
Erythroxylac. C52a
Escalloniac. C39a
Euphorbiac. C57
Fabac. C49
Fagac. C7
Flacourtiaceae C79a
Frangulac. C71
Fumariac. C31a
Gentianac. G15
Geraniac. C50
Globulariac. G30a
Goodeniac. G40b
Gramin. M7
Grossulariac. C40
Gunnerac. C89
Guttiferae C75b
Haemodorac. M22
Halorragidac. C89
Hamamelidac. C41
Hederac. C90
Heliotropiac. G22a
Hippocrateac. C65a
Hippocastanc. C68
Hydroliac. G22
Hydrophyllac. G22
Hypericac. C76
Ilicac. C64
Iridac. M25
Ixiac. M25
Jasminac. G14a
Juglandac. C2
Juncac. M17
(Juniperac.)Gym.1a
(=Cupressaceae)
Krameriac. C48
Labiat. G25
Lamiac. G25
Lardizabalac.C26a
Laurac. C30
Lecythidac. C85a
Leguminos. C49
Leitneriac. C4
Lemnac. M10
Lentibulariac. G28
Leucojac. M23
Liliac. M19
Limnanthac. C61
Linac. C52
Loasac. C81
Lobeliac. G40a
Loganiac. G14
Loranthac. C11
Lythrac. C85
Magnoliac. C24
Malac. C44
Malpighiac. C53a
Malvac. C74
Marantac. M26a
Martyniac. G31
Mayacac. M11
Meliaceae. C55b
Melanthac. M18
Melastomac. C86
Menispermac. C28
Menyanthac. G16
Mimosac. C46
Montropac. G3
Morac. C9
Musac. M25a
Myoporac. G32a
Myricac. C3
Myrsinac. G6a
Myrtac. C86a
Naidac. M3
Nyctaginac. C18
Nymphaec. C22
Nyssac. C92
Ochnac. C74b
Oleac. G13
Onagrac. C87
Orchidac. M28
Orobanchac. G29
Oxalidac. C51
Palmae M8a
Papaverac. C31
Papilionac. C49
Parnassiac. C39a
Passiflorac. C80
Petiveriac. C17
Phrymac. G32
Phytolaccac. C17
Pinac. Gym.1
Piperac. C1a
Plantaginac. G33
Platanac. C42
Plumbagianac. G8
Poac. M7
Podophyllac. C27
Podostemac. C37
Polemoniac. G21
Polygalac. C56
Polygonac. C14
Pomac. C44
Ponterderiac. M16
Portulac. C20
Primulac. G7
Pyrolac. G2
Ranunculac. C26
Resedac. C34
Rhamnac. C71
Rhinanthac. G27
Rosac. C43
Rubiac. G34
Rutac. C54
Salicac. C5
Santalac. C12
Sapindac. C69
Sapotac. G9
Sarraceniac. C35
Saururac. C1
Saxifragac. C39
Scheuchzeriac. M4
Scitamin. M25a
Scrophulariac. G27
Sedac. C38
Simarubac. C55
Simlac. M21
Solanac. G26
Spandiac. C62
Sparganiac. M2
Staphyleac. C66
Sterculiac. C74a
Styrac. G12
Symplocac. G11
Tamariac. C77a
Taxac. Gym 2
Theac. C75
Thymeleac. C83
Tiliac. C73
Trapac. C88
Trigoniac. C53b
Typhac. M1
Tropaeolac. C51a
Ulmac. C8
Umbellifer. C91
Urticac. C10
Vacciniac. G5
Valerianac. G37
Vallisneriac. M6
Verbenac. G24
Violac. C79
Vitac. C72
Vochysiase C56a
Xyridac. M12
Zingiberac. M25b
Zygophyllac. C53

CORN BELT (Illinois, Indiana, Kentucky, Michigan, Ohio, Wisconsin)

NORTH AMERICA (USA, Canada, Greenland)

MEXICO, CENTRAL AMERICA, WEST INDIES, BERMUDA and the BAHAMAS

SOUTH AMERICA, TRINIDAD and TOBAGO

EUROPE, ASIA, AFRICA, all of the PACIFIC ISLANDS (Hawaii)

AUSTRALIA

Figure 3. Folder color coding for geographic regions in the Arthur Herbarium.

I have decided to use this system rather than trying to determine what the last true accession number was (or assigning an arbitrary inflated number) because it is a better historical record and less likely to cause errors or future misunderstandings of accessioning format.

Microscope Slides. A large collection of microscope slide mounts of rust fungi is stored on a book case along the north wall of the Main Herbarium. These slides are not in any real organization, but are important, as they correspond with TYPE specimens and other accessioned material in the Arthur. Organization of these slides is recommended for the future, including relational information that alerts the user of a specimen to the existence of a corresponding slide in a separate location.

The Kriebel Herbarium

Curation Format. Vascular plant specimens in the Kriebel Herbarium follow the standard format, where pressed plants of a given individual (whole or in part) are taped or glued to a herbarium sheet(s) having a standard size of 16.5 x 11.5 inches. Specimen labels are attached to the lower right corner of the sheet (see Chapters 7 & 8). Loose parts such as seeds, or fragments of vegetative and reproductive parts may be included in envelopes attached to the sheet.

Bryophytes are placed loosely (not attached) in standard bryophyte envelopes, and these envelopes are attached to an herbarium sheet by staples. Several specimens of a given taxon may be mounted on the same sheet to save space. Sometimes sheets will include specimens of a taxon that are all from a similar locality, all specimens from a given county for instance.

Many algae are probably best stored in spirit collections (preferably 60% ethanol with a small amount of Glycerine added). Some of the macro algae can be "floated" onto an herbarium sheet in a pan of water to maintain aquatic habit. Otherwise, the filaments become clumped into amorphous clods.

Fungi (including lichens) are curated much like bryophytes when possible, however, large and voluminous specimens require that they be placed in appropriately sized boxes. These boxes are labeled and stored in a separate place in the herbarium. Blank sheets indicating the presence of a boxed specimen stored elsewhere may be placed with the mounted specimens. Some fungi are best kept in spirits to prevent loss of gross morphology as a result of drying.

Arrangement of Specimens. Specimens in the Kriebel Herbarium are arranged phylogenetically following the Engler & Prantl system. This is the same system used by Deam in his superior work, *Flora of Indiana*. Although most taxonomists now use updated phylogenies, the Kriebel shall continue to follow Engler & Prantl.

Accession Numbers & Records. Because the Kriebel Herbarium is an assembly of what may be several individual herbaria (The Purdue University Herbarium, the Kriebel collection, and the herbarium of the Purdue University Agricultural Experiment Station), precise records are essentially non-existent. The author tried desperately to find some kind of "Record of Collections" for the Purdue University Herbarium butwas unable to do so until a metal file full of note cards was found during the spring of 1997. Apparently, the Purdue University Herbarium records were not kept as notebooks, but rather as notecards. At first it appeared that these data cards were not associated with the Purdue Herbarium because the number at the top left corner did not match accession numbers of specimens in the herbarium as compared with data on the card. It was later discovered that the early curators of the Herbarium did not assign accession numbers! The note cards simply listed data on all specimens of a given taxon. However, somebody added accession numbers to the specimens and these numbers were not included on the notecards. These numbers, based on the fact that low numbers begin with seedless vascular plants and high numbers

end with the Compositae, were added all at once after specimens were arranged in cabinets following the Engler & Prantl system. At first, it was uncertain which came first, the notecard system or the accession number system, because when the specimens listed on a given card were placed in order of appearance, the accession numbers were correspondingly consecutive. For example, on the card for *Chamaedaphne calyculata*, the following specimen data are given:

5/17/08 Deam DeKalb Co.
Congdon Rhode Island
Western F. Seminary Mass.
'77 Barnes-Smith Michigan
Van Gorder-Deam
6/28/14 Deam Noble Co.

This represents six specimens. The accession numbers are, in order of the above list: 13898, 13899, 13900, 13901, 13902, 13903. However, a specimen from Smith dated 1873 from Hubbardston, Michigan, is not included on the notecard but has an accession number of 13896. Moreover, a Kriebel specimen dated 1937 from Porter County, Indiana, is also not listed on the note card but has an accession number of 13897, both numbers are smaller than the ones catalogued on notecards. Therefore, if the numbering system had occurred before the notecard system, the Smith and Kriebel specimens would have been written on the note card. The original specimens noted on the cards were probably placed in the folders in order, and later specimens were placed in the folder above or below them, which would explain the consecutive nature of the numbering and the fact that the 1873 and 1937 specimens had smaller accession numbers.

Once it was established that numbering was done after the notecards were made, the time at which numbering occurred needed to be identified. Based on the youngest specimen records in the notecard file, it is estimated that the notecard record-keeping was nearly abandoned around 1939 (all typed until then). And then in 1950, someone had again recorded specimens on the notecards (with colored pencil or pen) but this practice then ceased indefinitely. Due to the fact that Kriebel specimens bear accession numbers, and due to the fact that Purdue did not acquire such specimens until June 11, 1946, and due to the fact that someone was continuing to use the card system with no record of accession numbers up until at least 1950, it is deduced that accession numbers were attached very soon after 1950. And record keeping, in the form of specimen data, ceased from that point forward. Although the addition of accession numbers continued until the early 70's at which point organization in the Herbarium deteriorated to the point where unmounted, newspaper-clad specimens were added to the folders with hardly any supporting data.

Some idea of the growth rate of the Kriebel Herbarium might be gleaned from this record-keeping chaos. Since it is known that accession numbers were placed consecutively on specimens already in the cabinet, one can go to the last character of the alphabet representing genera and species in the family Compositae (the last family in the Engler & Prantl system), and search for the last evidence of consecutive numbering of miscellaneous specimens. The results of this show that there were approximately 19523 specimens in the early 1950's. This would indicate that the Herbarium, prior to the purchase of Kriebel's collection in 1946, had around 9000 specimens. It also suggests that the Herbarium grew substantially between the years of 1950 and the present. It is uncertain how many specimens are currently present in the Kriebel Herbarium. Someone estimated the number to be 55,000 based on the largest known accession numbers. However, there are so many specimens without accession numbers that the value is likely much higher. The author conducted some random sampling and counting, and based on that exercise estimated the actual number to be closer to 75,000 specimens.

Now, in 1995, then curator R.G. Thorn instructed the curatorial assistants to accession new specimens beginning with number 60,000. This was an arbitrary number

presumed to be higher than any previous accession numbers. The assistants numbered approximately 650 specimens with these new numbers, and all of them used a stamp with blue ink. It is the opinion of the author that this practice be undone. Accession numbers can serve both as documentation devices and historical markers. If there is no conspicuous way to alert future curators and patrons to the changing accessioning and record keeping patterns through time, huge misunderstandings can result. For instance, if all of the data for specimens in the Kriebel were entered into a computer database and there was a gap between accession number 55,000 and 60,000, the conclusion might be that there are 5,000 specimens missing from the Herbarium. However, if there was a way to distinguish new accessions from old accessions, this mistake would be avoided. Therefore, on October 2, 1997, the author began accessioning all new specimens with an "N-" number beginning with N-1 (N for "new"). In addition, a "hard" record book was instated. New accessions are recorded in a record book with all appropriate data, and the date that the specimens were accessioned is also included. So even though a very old specimen from 1930 is accessioned in 1998, patrons will be able to see from the date that it was accessioned only recently. This "N-" numbering system should be used for all new accessions until such time that a computer database is devised and the last number of the original accession numbering system is determined. At such point new accessions may follow that number. Any specimen with an accession number attached with a blue stamp (60,000 or higher) should be regarded as illegitimate and replaced with an N-number.

Restoration of Damaged or Deteriorated Specimens. The topic of restoration is perhaps one of the most pertinent considerations for the Curator of the Kriebel Herbarium, and perhaps any herbarium for that matter. The oldest specimens in the Kriebel date back to the 1830's, and many are becoming depauperate. Even some of the more recently collected specimens need work due to improper mounting techniques and overall neglect. The policy established by the author has been to give attention to restoration of specimens on a situation basis. In other words, when a folder is pulled, for whatever reason, specimens needing restoration are attended at that time. This method will limit the task to something manageable until a more direct endeavor can be initiated. Additionally, it will insure that NO specimens will EVER leave Purdue on loan unless they meet the highest possible standards of quality and excellence that characterize Purdue University. Hopefully, time and resources in the future will allow for a more direct and comprehensive approach to restore our deteriorating specimens.

Acid-based paper. Most of the specimens in the Kriebel Herbarium have been mounted on acid-based paper. The acid used in the papermaking process, is now resulting in the disintegration of the cellulose fibers that make up the matrix of the paper. There is need for concern not only for individual specimens, but also other specimens stored in the same folder, because acid can leach from page to page. Evidence of acid deterioration includes yellowing, blackening, and brittleness/fragmentation. Sheets showing significant symptoms of acid deterioration should be remounted. This is done in one of two ways. If the plant is attached by tape, it can be removed from the old sheet, entirely, and remounted on new paper. If the specimen is tenaciously bound to the paper by glue, as much of the old paper as possible can be cut away and then the specimen and remaining paper can be glued to a new sheet. It is imperative that all labels and any form of writing on the sheet be cut out and saved (many of our specimens were checked by N. L. Britton and are signed in pencil by him). These items can either be placed in a glasine envelope and attached to the sheet, or they may be glued directly on the new sheet in the appropriate places. To determine whether a new sheet is suitable for mounting (non-acid based), use a pH testing pen. A color change to yellow inidcates an acid reaction, a color change to blue or purple indicates a basic reaction.

Depauperate or inappropriate labels. Some labels are of very poor quality. They range from notecards to scraps of paper to no label at all (scribble directly on the sheet). If such labels are associated with a specimen slated for a new sheet, the old label should be cut off and put in a glasine envelope (attached to sheet), and a new label should be attached (following the guidelines presented in Chapters 7 & 8). Generally, typeset or printed labels from other individuals or herbaria are always appropriate, for example labels that say, *Ex Herbarium of Delzie Demaree* or *Herbarium of Indiana State Teachers College.* Moreover, any label from an historically significant collector or associated with an historically significant collection should not be removed or tampered with unless in a necessary restoration.

Improperly attached specimens. It is always embarrassing to see a specimen in the Purdue Herbarium that someone has attached to a sheet with transparent tape used for gift wrapping. No matter how good the tape looks at first, it is always destined to become an unattractive, useless, yellow scab on an otherwise worthy specimen. What's more embarrassing is learning the name of the person who did the atrocity (especially for the person responsible). The crime is furthered by putting the specimen in the Herbarium alongside more worthy counterparts. Even standard herbarium-quality cloth tapes can become detached, thus requiring adhesive. The good news is that most of these specimens can be restored by cutting the tape and removing the specimen and attaching it to a new sheet using a good quality, reversable, white glue (see Chapter 8 for details on mounting procedures).

Loose parts. Fragmented plant remains are always a problem, especially with poorly mounted specimens. Large, meaningful fragments such as leaves and reproductive structures are generally placed in glasine envelopes and attached to the sheet. Sometimes, it is desirable to take very fragile fragments (that would otherwise become broken in an envelope) and re-glue them to the sheet either in the original place prior to breakage (if that can be determined) or on another area of the sheet.

Discarding specimens. If the herbarium had been properly curated from its beginnings, the topic of discarding specimens would be needless. However, carelessness has allowed a number of worthless specimens to work their way into the Kriebel Herbarium. The primary consideration here is whether or not the curator should justify the space (both physical and in terms of computer memory when the herbarium is put on database) that these specimens occupy. Most literature on herbarium curation including the excellent *Herbarium Handbook* by Bridson and Forman does not discuss the "unthinkable" topic of discarding specimens. However, it is the opinion of the author that there are certain instances when it is justifiable to discard a specimen, just as there are times when libraries discard books. The following list outlines criteria for discarding specimens. They are meant to be as conservative as appropriate for our herbarium. All of the criteria must be met before the specimen(s) can be discarded.

1. The specimens has no date.
2. The specimen has absolutely no location data.
3. The specimen does not have a label that says Purdue University Herbarium with a typeset date category as follows "187__.", where the blank space has not been filled-in.

4. The specimen was not collected or identified by a reknowned or noteworthy collector (including R. M. Kriebel, J.C. Arthur, G.B. Cummins, C.C. Deam, R.C. Friesner, J.E. Potzger, A.A. Lindsey, S.N. Coulter, J.M. Coulter, and others).
5. The specimen is not particularly rare or infrequent in the natural world.
6. There are at least five specimens of the same taxon of the specimen in question already in the Kriebel Herbarium.

Procedures for discarding a specimen (once the above criteria have been met) are as follows.

1. Remove the specimen from the Herbarium.
2. Begin a notebook for discarded specimens.
3. Enter the accession number of the specimen and any information about the specimen in the notebook. Include justification for discard.
4. If the specimen has been recorded in a "Record of Collections" and or on a computer database, make note that the specimen has been discarded.
5. Discard the specimen.

CHAPTER 7

STANDARD FORMS & LABELS

In many cases, the first impression that another institution has of Purdue University and the Herbarium, is based on a letter or even a specimen sent through the mail. Therefore, it is extremely important that the design of printed materials reflect the high degree of excellence and professionalism that characterize this institution. The following forms and labels have been established in an attempt to meet these standards.

Letterhead. The letterhead for the Purdue University Herbarium is distinct from the standard departmental letterhead, and it is always printed on paper with a Purdue watermark, preferably 100% cotton bond (8.5 x 11 inches). Two forms have been used since January of 1997 (see Figures 4 & 5). The earliest version (Fig. 4) is nearly identical to the Departmental letterhead with the exception of the addition of the word "Herbarium" at the top. The most recent version (Fig. 5), used at present, lists the faculty and staff associated with the Herbarium on the left margin of the page. This adds an element of credibility to the facility by showing the various faculty that support the Herbarium. Note that in both versions, that the words "Purdue" and "University" are written with capital letters and that the "P" in Purdue and the "U" in University are 2 pts larger than the other letters. This should be standard whenever "Purdue University" is included in a form, stamp, or label.

Facsimile Form. See Figure 6.

Loan Forms. Loans of specimens from the Purdue University Herbarium to other institutions are accompanied by three copies of a loan agreement that outline the terms of the loan and a list of the specimens being sent (Figures 7 - 9). There are three copies of the loan form. The white copy is for the records of the borrowing institution, the pink copy is to be signed by the borrower and returned to Purdue to inform us that the loan was received in good order, and the yellow copy is to be returned when the specimens are returned, and it will then be signed by Purdue and sent to the borrower as a return voucher.

Package Mailing Label. See Figure 10.

Reprint Request Form. See Figure 11.

PURDUE UNIVERSITY HERBARIUM

DEPARTMENT OF BOTANY
AND PLANT PATHOLOGY

1155 LILLY HALL OF LIFE SCIENCES • WEST LAFAYETTE, IN 47907-1155 • USA
(317) 494-4623 • FAX (317) 494-0363

Figure 4. Original version of the letterhead for the Purdue University Herbarium (15% smaller than original).

THE HERBARIA OF PURDUE UNIVERSITY

DEPARTMENT OF BOTANY
AND PLANT PATHOLOGY

DR. GREGORY E. SHANER
Director
Purdue University
Department of Botany
West Lafayette, IN 47907-1155
(765) 494-4651
(Plant Disease Epidemiology)

DR. ANTHONY L. SWINEHART
Curator
Purdue University Herbarium
Department of Botany
West Lafayette, IN 47907-1155
(765) 494-4623 FAX: (765) 494-0363
E-mail: swinehart@bmy.purdue.edu
http://www.bmy.purdue.edu/Staff/swinehart.html
(Quaternary Wetland Ecology)

Faculty Advisory Board

DR. JO ANN BANKS
Developmental Biology of Pteridophytes
Department of Botany
Purdue University
(765) 494-5895

DR. CAROLE A. LEMBI
Phycology & Aquatic Vascular Plants
Department of Botany
Purdue University
(765) 494-7887

DR. GEORGE R. PARKER
Dendrology
Dept. of Forestry & Nat. Resources
Purdue University
West Lafayette, IN 47907-1159
(765) 494-3602

The Joseph C. Arthur Herbarium [PUR]
Fungi: Uredinales
Established 1888

The Ralph M. Kriebel Herbarium [PUL]
Vascular Plants, Algae, Fungi & Lichens
Established 1873

The Purdue University Bryophyte Herbarium
Mosses, Liverworts & Hornworts
Dedicated 1997

Subfossil & Reference Collection of A. L. Swinehart
Plants, Animals & Fungi
Established 1990

~Providing Research & Service in the Botanical Sciences for Over 100 Years~

Figure 5. Current letterhead of the Purdue University Herbarium (15% smaller than original size).

Figure 6. Facsimile form, Purdue University Herbarium

The Herbaria of PURDUE UNIVERSITY

DEPARTMENT OF BOTANY
AND PLANT PATHOLOGY

FAX COVER SHEET

MITA LDC-650
(765) 494-0363

PLEASE DELIVER TO →

FAX NUMBER: _____

NAME: _____

TITLE: _____

TELEPHONE: _____

COMPANY/BUILDING: _____

DEPARTMENT: _____

ADDRESS: _____

CITY, STATE ZIP CODE: _____

COUNTRY: _____

TOTAL NUMBER OF PAGES IN THIS TRANSMISSION (INCLUDING THIS COVER): _____

FROM: _____ TELEPHONE:

Should you experience problems with receipt of this telecopy, please call (765) 494-4614 as soon as possible. Thank you.

MESSAGE:

OPERATOR: _____ DATE: _____ TIME: _____

THE ARTHUR HERBARIUM [PUR] (Fungi: Uredinales)
THE KRIEBEL HERBARIUM [PUL] (Vascular Plants, Bryophytes & Algae; Fungi & Lichens)

1155 LILLY HALL OF LIFE SCIENCES • WEST LAFAYETTE, IN 47907-1155 • U.S.A.
(765) 494-4623 • FAX (765) 494-0363

Figure 7. Loan Form (white copy), Purdue University Herbarium

Specimens from the Herbaria of

PURDUE UNIVERSITY

THE ARTHUR HERBARIUM (Fungi: Uredinales)
THE KRIEBEL HERBARIUM (Vascular Plants, Algae, Fungi and Lichens)
Purdue University, Department of Botany and Plant Pathology
1155 Lilly Hall of Life Sciences, West Lafayette, IN 47907-1155, U.S.A.

DATE:

TO:

The material listed below is being sent to you via air mail contained in one package(s).

( ) EXCHANGE[1]
( ) A LOAN, for one year, at your request
( ) FOR EXAMINATION, at our request
( ) GIFT
( ) RETURN OF LOAN
( ) RETURN OF MATERIAL, sent for examination or identification

[1] NOTE: Our records indicate a balance of _____ specimens in your / our favor. Please advise us if this figure does not agree with your records.

LIST OR DESCRIPTION OF SPECIMENS

Correspondence and specimens should be sent to:

Dr. Anthony L. Swinehart
Purdue University Herbarium
Department of Botany & Plant Pathology
1155 Lilly Hall of Life Sciences
West Lafayette, IN 47907-1155, U.S.A.
Phone: (765) 494-4623 FAX: (765) 494-0363 E-Mail: swinehart@btny.purdue.edu

---

White copy for your records.

Specimens from the Herbaria of

PURDUE UNIVERSITY

THE ARTHUR HERBARIUM (Fungi: Uredinales)
THE KRIEBEL HERBARIUM (Vascular Plants, Bryophytes, Algae, Fungi and Lichens)
Purdue University, Department of Botany and Plant Pathology
1155 Lilly Hall of Life Sciences, West Lafayette, IN 47907-1155, U.S.A.

DATE:

TO:

The material listed below is being sent to you via air mail contained in one package(s).

( ) EXCHANGE[1]
( ) A LOAN, for one year, at your request
( ) FOR EXAMINATION, at our request
( ) GIFT
( ) RETURN OF LOAN
( ) RETURN OF MATERIAL, sent for examination or identification

[1] NOTE: Our records indicate a balance of _____ specimens in your / our favor. Please advise us if this figure does not agree with your records.

LIST OR DESCRIPTION OF SPECIMENS

Correspondence and specimens should be sent to:

Dr. Anthony L. Swinehart
Purdue University Herbarium
Department of Botany & Plant Pathology
1155 Lilly Hall of Life Sciences
West Lafayette, IN 47907-1155, U.S.A.
Phone: 765-494-4623 FAX: 765-494-0363 E-Mail: swinehart@btny.purdue.edu

---

Enclose Yellow copy (unsigned) when specimens are returned to Purdue.

Received the above in good condition:_____ Date:_____
Curator, Purdue University

PURDUE UNIVERSITY HERBARIA

Department of Botany & Plant Pathology
1155 Lilly Hall of Life Sciences
West Lafayette, Indiana 47907-1155

Herbarium Specimens!

Figure 10. Purdue University Herbarium package label. Printed on gold card stock.

Anthony L. Swinehart, Assoc. Curator
PURDUE UNIVERSITY HERBARIUM
Dept. of Botany & Plant Pathology
1155 Lilly Hall of Life Sciences
West Lafayette, Indiana 47907-1155 U.S.A.

Cut here for return address.

Dear Colleague:

I would greatly appreciate receiving a copy of the following article, if available for distribution:

_____
_____
_____
_____
_____
_____

Please advise if there is a charge for this material. I thank you.

Yours Sincerely,
Anthony L. Swinehart

Figure 11. Purdue University Herbarium reprint request card. Printed on gold card stock.

Herbarium Specimen Labels. Perhaps the most important written document in the Herbarium is the specimen label. Figures 12 & 13 show the label in current use for specimens in the Arthur & Kriebel Herbaria. We currently have 5000 of the former and 8000 of the latter. These are currently stored in a box under the Kriebel workbench. Re-ordering can be done through Purdue University, Printing Services, order #803719. Proofs are on file in Herbarium File #2 in the folder titled "Herbarium Labels". See Chapter

Stamps. Regularly used, special stamps include:

Address stamp (Figure 14) used in new books, as a return address on blank envelopes and reprint requests, and items needing identification of ownership.

The Kriebel accession label (Figure 15) and the Arthur accession label (Figure 16) are stamped either on specimen envelopes (in the case of rusts) or on the bottom left corner of green plant specimen sheets. The accession number of the respective specimen is placed next to the herbarium acronym within the box.

"TYPE" stamps are used to identify various kinds of TYPE specimens. The Arthur Herbarium has many thousands of TYPE specimens, while the Kriebel has only two.

Other stamps used in the Herbarium are the typical office type, including such things as "COPY", "RECEIVED", "ORIGINAL", "DUPLICATE", etc.

PURDUE UNIVERSITY

Joseph C. Arthur Herbarium

PUR # Family:

Taxon:

Notes:

Coll: Date:

Det:

Figure 12. Specimen label, Joseph C. Arthur Herbarium.

PURDUE UNIVERSITY

Ralph M. Kriebel Herbarium

PUL # Family:

Taxon:

Notes:

Coll: Date:

Det:

Figure 13. Specimen label, Ralph M. Kriebel Herbarium

PURDUE UNIVERSITY HERBARIUM
Dept. of Botany & Plant Pathology
West Lafayette, Indiana
47907-1155

Figure 14. Address stamp, Purdue Uni. Herb.

The Kriebel Herbarium
Purdue University

PUL

Figure. 15. Accession label, Kriebel Herbarium.

The Arthur Herbarium
Purdue University

PUR

Figure 16. Accession label, Arthur Herbarium.

TYPE

ISOTYPE

PARATYPE

Figure 17. Various "TYPE" stamps.

CHAPTER 8

PROCESSING PLANT SPECIMENS

Collecting New Specimens

Addition of specimens to the Kriebel Herbarium will involve plants associated with specific field studies as well as plants collected simply to add to the diversity of the collection. In the latter case, there should be some degree of subjectivity. Given the relatively small size of the Kriebel, the focus should be diversity before quantity. For instance, it probably would not be justifiable to collect such things as *Trillium recurvatum, Antennaria* spp., and *Dicentra* spp. from Tippecanoe County, Indiana, as the Herbarium has multitudes of these and other local wildflowers. However, at the same time, there are some common plants that are surprisingly few in the Herbarium. Therefore, it is a good idea to have some kind of an idea of what would be useful additions to the Kriebel. In general, any plant from outside of the few counties surrounding Tippecanoe County, Indiana, would be needed. Plants from other parts of the nation and world are even more valuable additions.

Collections from field studies are especially important. The flora of a local wetland for instance will tell future scientists much about natural succession as well as human disturbance/destruction. For instance, there is a specimen of leatherleaf (*Chamaedaphne calyculata*) in the Kriebel, collected by Charles C. Deam in 1916 in a bog in Dekalb County, Indiana. The specimen is now the only indication of the natural ecology of the site, because the area was later destroyed by peat mining.

What and How to Collect. When a specimen is ready to be collected, several things need to be considered before the "harvest." First, is it legal and/or ethical to take a specimen of a given species in a given location? Check with local laws about plant collecting on public and private land. Some species are protected by law, and regardless of the status, all plants and other natural features are protected in State Nature Preserves. Collecting permits are often granted for legitimate projects and requests. These may be solicited by writing the State Department of Natural Resources. However, even when collecting is legal, the collector must impose upon himself some personal standards. Some botanists will not take a specimen if less than six are present in a local area. Thirty is perhaps a safer number. Other considerations include proximity of similar sites with similar species, relative rarity of the plants, *etc.*

The next consideration is which plant to collect. Some botanists mistakenly collect the biggest and best of a group. The problem with this practice is that instead of collecting a representative sample, an abberant specimen is taken. Regardless of whether an individual has an unusually good habit or an unusually bad habit, it is still aberrant. Therefore, select an average specimen, representative of the group. Much is to be gained from this practice, as herbarium specimens can be of use to more than just taxonomic botanists. Plants damaged by fungi, insects, and other organisms tell much about the ecology of the system both spatially and temporally. Whenever possible, collect reproductive structures, flowers and or fruits.

Once a plant has been selected, write down as much information about its situation as possible in a field notebook. Assign a collection number to the plant (preferably with a string and tag) and then collect the specimen. A trowel can be employed to acquire roots in addition to the obvious stem, leaves, and reproductive parts. Not all herbarium specimens will have roots, while these are not ideal, they are still worthwhile. Certainly, large, woody trees will not allow roots to be collected, but a carefully removed sample of the bark is not difficult to take.

After the plant has been taken, it should be wrapped in moist newsprint and placed in a vasculum. A vasculum is a rigid metal, cylindrical container with a shoulder strap. It

protects the specimens from being smashed, etc, and keeps them nice and moist and unwilted. Some botanists use plastic bags to collect, but doing this in a marsh dominated by swamp rose (*Rosa palustris*) or other shrubs will result in a trail of specimens marking the path of a collector with a torn garbage sack.

Pressing. Fresh, unwilted specimens are ready for immediate pressing. Wilted specimens will need to be soaked in water to soften the leaves and flowers. A press consists of blotters, newsprint, and supporting pieces of cardboard, sandwiched between two hardwood latices. Plants are placed in a folded piece of newsprint (preferably without ink, as this ink can rub-off on specimens) and arranged so that when flattened and mounted, as many key features as possible will be exposed. Some leaves should be facing up, others down. Tall specimens should be folded in an "N" shape to facilitate placement on a standard herbarium sheet (some large specimens will need to be broken and glued to more than one sheet). Specimen data should either be written on the newsprint, or included as a separate piece of paper with the plant. The specimen, now in a piece of folded newsprint, is placed between two blotters. About 10 specimens with blotters are sandwiched between pieces of cardboard (for support). As many as 50 plants, depending on their thickness, may be pressed at once. After the specimens, blotters and cardboard inserts have been placed between the wood lattices, the press is put under pressure by sitting on the apparatus and tightening the two straps. Most plants dry within about a week. Changing of blotters may be necessary on the third day.

Processing New Specimens

Drying. Presses full of fresh plants are placed into the drying cabinet which accelerates drying. Both heaters and a fan contribute to the drying process. Presses should be set on end to facilitate escape of water vapor.

Decontamination. Eradication of prospective insect pests is conducted by deep-freezing the specimens. This is done after drying. Freezing before drying may damage internal structures of a specimen by means of ice-crystal formation. Most destructive insects in the herbarium are tropical, and all stages of their life cycles succomb quickly to freezing. Dried plants should be frozen for at least 24 hours before placement in the Herbarium. However, to insure that these and other pests do not endure and propogate in the herbarium, paradichlorobenzene tablets (moth balls) are placed in containers in each cabinet. This is the pleasant, familiar aroma that characterizes the Herbarium (much to the dismay of the molecular "biologists", other reductionists, and non-scientists).

Mounting Specimens

Types of Glue & Proper Application. Experience has shown that gluing specimens to the herbarium sheet is superior to other methods of attachment, at least in terms of durability. Several types of glues have been used in the past, but white glue has proven to be the best. Many herbaria use white wood glue, or the "Elmers" type, however, the best type of white glues are made especially for mounting plants. Most of these glues are flexible, water soluble, and reversible. The glue used at the Purdue University Herbarium is the Missouri Botanical Garden Type. This is a white, plasticized PVC resin that does not become brittle with age. The method of application is the "Glass Plate Method". A quantity of glue is poured onto a plate of glass and an appropriate amount of water is added to the glue to reduce the viscosity to roughly the consistency of maple syrup. The glue is then spread out in a thin layer over the glass plate. At this point, an assembly line is established in the following order: unmounted specimens, glass plate, herbarium paper, cardboard support, stacked supports with mounted specimens (Figure 18). The following procedure is conducted.

1. A specimen is removed from the newsprint folder and carefully placed on the glued plate (it is a good idea to make sure the plant will fit the herbarium sheet before gluing).

2. All portions of the plant are gently pushed into the glue with tweezers.

3. The plant is carefully removed from the glass plate and placed on an herbarium sheet. Make absolutely sure that there is enough room on the herbarium sheet in the lower right corner for the specimen labe. Labels must be FREE AND CLEAR from the specimen.

4. Place any seeds or other loose fragments in a glasine envelope and glue the envelope to the herbarium sheet, preferably above where the specimen label will be fixed.

5. Place the mounted specimen on the cardboard support.

6. Place several metal washers on the plant to assure attachment of the specimen to the paper.

7. Attach temporary label (scrap of paper with data) to the sheet with a paperclip.

8. Stack the cardboard supports/specimens (with wooden spacers) and let the glue dry for about 20 minutes before removing the weights for the next cycle.

Specimen Arrangement. The main considerations in arranging specimens on a sheet are assuring visibility of important features of the plant, seeing to it that the plant does not exceed the margins of the sheet. There is also an artistic element in the way a plant is arranged. One does not just randomly place a specimen on a shhet, even if the above considerations are met. Bridson & Forman's (1992) *Herbarium Handbook* is recommended reading for good information and illustrations relating to mounting specimens.

Labeling: Typing, Attachment & Placement. Labels should be neatly *typed* (insurance of archival quality) and without errors. Family name should be in ALL CAPITAL letters. Genus and species should be underlined.

Examples of corrctly written scientific names are:

Sphagnum wulfianum Girg.
(note that there is NO underline between genus and species)

Sphagnum recurvum var.brevifolium (Lindberg *ex* Braithwaite) Warnstorf
(note "var." and authors names are NOT underlined)

Sphagnum sp.
(note "sp." refers to an undetermined species in the singular sense. "spp." is plural and would never be used on a normal Herbarium specimen, because generally only one taxon is included per sheet or envelope. "sp." and "spp." are NEVER underlined)

Examples of incorrectly written scientific names inlcude:

Sphagnum wulfianum Girg.
(do NOT underline space between genus and species. Do NOT underline the author's name(s))

Sphagnum recurvum var. brevifolium (Lindberg *ex* Braithwaite) Warnstorf
(Do NOT underline "var." or "forma")

Sphagnum sp. (Always underline genus and species)

Climacium Americanum
(Although Deam adimately supported capitalization of proper specific epithets, it is not accepted by the International Code of Botanical Nomenclature)

The "Notes:" on the specimen label was deliberately designed as a very general category, because the kind of data taken varies with investigator. Having a separate category for elevetion, township and range, city, county, country, etc. would end up wasting space and appearing sloppy, because in many cases one or more of these data were not collected. The proper way of filling-out the notes section is to start with the most detailed aspect of the location and work up to the most general aspect of the location. Other details such as elevation and associated species can be included afterward. Example:

South facing slope of the riparian zone of the Elkhart River, T35N., R6E., Sec. 2, Elkhart County, Indiana, U.S.A. Elevation: 804 ft. Growing among Impatiens capensis.

Make sure to include county wherever possible (most state floras use the county as the smallest unit of distribution and range), and always include State and Country. While U.S.A. may be obvious to an American, a foreigner may have no idea what country Indiana is in.

The collector's name should be written out in entirety.

The date should include up to the first four letters of the month, followed by the date and year. Examples:

June 12, 1970
Aug. 15, 1984

Do not use numbers to represent months. It is too confusing because American and European sequences and notations are different (*e.g.* 1.2.97 means February 1, 1997, in Europe, and 1-2-97 means January 2, 1997, in America, *etc., etc.*).

The determiner's name should be written out if it is different from the collector's name. If the collector determined the specimen, then only the initials of the collector are needed in the "Det:" category.

Labels are attached with spray adhesive to the lower right corner of the herbarium sheet. Spray the label and then affix it to the sheet (not *visa versa*). There should be no more or no less than 3 mm of space between the edges of the label and the edge of the sheet. Labels should be straightly aligned, not crooked.

Ordering Supplies. The Purdue University Herbarium orders most of its supplies from the *Herbarium Supply Company*, 3483 Edison Way, Menlo Park, California 94025, U.S.A. A catalogue of supplies may be obtained by written request.

Accessioning Specimens

Placement of Accession Numbers. An accession label (Figs. 15 & 16) is placed either on the specimen envelope (in the case of rusts, bryophytes, *etc.*) or on the lower left

corner of the herbarium sheet. The accession number of the specimen is stamped in the box next to the acronym using a *Sparco* brand number stamp. Re-inking of the stamper should occur the night before the next accession, because the ink is viscous and takes time to absorb into the pad. Prefixes to the accession number such as "N" are NEATLY added with a black ink pen. In addition to placing an accession number on the sheet or envelope, there is also a space to stamp on the label itself. This is done in case the label ever becomes separated from the sheet. Having accession numbers on both will help in rematching the label to the sheet/specimen.

Record Keeping. Magnetic storage alone is not an acceptable means of record keeping. There MUST be some form of a "hard" copy to protect records from being erased and lost. Reliance on computers has resulted in sloppy record keeping, and in the case of the Arthur Herbarium, record keeping ceased altogether due to the assumption that computerization would occur. Computerization is still only in the planning stage. A traditional record book has been reinstated for both the Arthur and the Kriebel Herbarium. Accession numbers and specimen data are to be recorded in these volumes whenever new specimens are processed and added to the Herbarium. Make sure to include the date the specimen was accessioned when adding information to the record book. Record data neatly and cleanly. Follow the format of previous entries.

Computer Database. Establishing a computer database for the Arthur and Kriebel Herbaria will be a great service to scientists that use these collections, because it will allow keyword searches. This will save much time, both on the part of the patron and the curator and his assistants. Unfortunately, computerization of 175,000 specimens is a monumental task, especially when 100,000 of those specimens have a host plant associated with them, requiring further data input. The endeavor requires a relational database with a user friendly input and output format, a large memory capacity, and an internet interface. This will require the services of a professional programmer. A proposal for development of the database is included as Appendix D (see Bob Mitchell for details).

Deposition of Specimens in the Herbarium. Once a specimen has been assigned an accession number and the appropriate record keeping has been conducted, the specimen is ready for decontamination and placement into the Herbarium. In the Kriebel Herbarium, there is an "in-process" cabinet filled with red family folders. New specimens can be placed in these folders by family, and as several specimens begin to accumulate, they can be added to the respective locations in the herbarium stacks. This saves time and limits handling of specimens by reducing the number of trips to the stacks. Make sure that the folders in the herbarium have been checked to see if there is a distinction between "Indiana" specimens vs. all others so that they will not be mixed up.

Annotation

Credibility of Annotations. Determining the credibility of someones ability to reliably annotate a specimen is rather subjective. Generally, annotation of specimens from the Purdue University Herbarium should be conducted by professionals with demonstrated skill in taxonomic botany. This may include graduate students, professors, non-academic scientists, and exceptional undergraduate students and plant enthusiasts. The decision to grant authority to annotate specimens is at the discretion of the curator.

Annotation Labels. An annotation label should be relatively inconspicuous and should not detract from the appearance of the sheet/specimen. In general, annotation labels should be limited in size to no larger than 5 x 10 cm. They may be placed above or beside the original specimen label or where space will allow if the former locations not feasible. Annotation labels should include the name of the annotator, associated institution or

project, date, and the full scientific name for which the specimen should be referred along with other pertinent notes. Annotation labels for use by Purdue botanists (Kriebel Herbarium) are stored in a box under the Kriebel workbench.

Placement of Annotated Specimens in the Herbarium. Assuming credible annotations, any specimens which is referred to a truly different taxon than previously labelled should be moved to the correct folder. However, minor changes, such as some of the splitting that has been going on, are probably best left in the folders of the original taxon (e.g. *Ledum groenlandicum* now called *Rhododendron groenlandicum* by some, should probably be kept in the *Ledum* folder for now). Additionally, splitting of family names has been more or less ignored in the Kriebel. The new family name is written on the label, but the specimen is placed in the old family folder, for instance *Trillium* is now placed in the Trilliaceae, but it is still stored in the Liliaceae in the Kriebel. This should remain the practice until some future curator can devote time to updating the phylogenetic arrangement of the whole collection.

CHAPTER 9

LOANS & EXCHANGES

The curators and staff of the Purdue University Herbarium encourage the free exchange of information and resources between our facility and other similar facilities throughout the world. In order to facilitate this exchange it is often necessary to send specimens through the mail so that they can be studied without extensive travel expense, *etc.* Therefore, the following guidelines have been developed to assist patrons in proper borrowing procedures and appropriate care and handling of specimens.

Guidelines for Loan of Specimens (Partially written by R. G. Thorn)

1. Loans are made between the Herbaria of Purdue University and another institution, such as an herbarium, research institute, or university department. If the individual requesting loan of specimens is associated with an herbarium, the loan application should be signed by the herbarium curator. If the individual is a member of a university department, the loan application (written on departmental stationery) makes the loan the responsibility of both the investigator and his / her department.

2. By signing the loan agreement, the borrower promises to treat the borrowed specimens with care and respect and to follow the guidelines presented herein.

3. With all loans, specimens from the Purdue University Herbaria used in research must be clearly cited in any resulting publications. Citation should include the acronym of the host herbarium (PUR, PUL] and the accession number(s) of the specimen(s). A complimentary copy or reprint of the publication(s) must be sent to the Purdue University Herbarium. Any annotations of the specimen (including investigators name, affiliation, and date) should be included on a small, archival quality label that is attached to the herbarium sheet with a paper clip (permanent attachment will be conducted at Purdue).

4. Especially with specimens of fungi, it is understood that *some* destructive sampling will be necessary for scientific study (*e.g.* preparation of microscopic mounts). Modern methods of chemotaxonomy and molecular analysis may require destructive sampling of tissues from both plants and fungi. Such sampling shall always be kept to the minimum necessary for the study.

5. Investigators who need to conduct extensive destructive sampling are encouraged to collect fresh material that has been positively identified using the appropriate reference specimens or other material. If extensive destructive sampling of an herbarium specimen is absolutely necessary, the investigator MUST indicate so in the letter requesting the loan, including the justification and the protocol for such sampling.

6. Under no circumstances will authorization be given for destructive sampling of particularly valuable specimens such as types (holotypes or otherwise), exsiccati, or specimens of taxa for which there are three or fewer collections in the Herbarium.

7. Application for a loan of specimens from the Purdue University Herbaria implies an understanding of the conditions presented herein as well as willingness to comply with them. Failure to do so will result in a loss of borrowing privileges to the investigator, and possibly his / her host institution.

Loan Procedure

1. Retrieve requested specimens from the respective herbarium. Do not retrieve the genus folders, leave those in the herbarium.

2. Make a descriptive list of the specimens requested including the accession number, taxon, location (for Kriebel specimens lacking an "N-number" only), and the number of packets vs. the number of sheets (for rusts, bryophytes, etc.). If the specimen is a TYPE specimen, write "TYPE" next to the accession number.

3. Prepare white, pink, and yellow copies of the loan agreement. Loans are generally for one year. Attach loan list to each copy. Make one copy of the white form (plus loan list) for our records and place it in the "RECORD OF LOANS (OUT)" box.

4. Record details of the loan in the LOAN RECORD BOOK following the format of previous entries.

5. Carefully package the specimens (INCLUDING the three copies of the loan agreement and a copy of the GUIDELINES FOR BORROWING SPECIMENS brochure) in a standard specimen mailer or mailers. Don't smash the specimens. Use cardboard for support. Tape the box, wrap it in brown butcher paper, and tape again securely. Attach label (Fig. 10) with address (including Purdue curators name on return address), and take the package to the Botany Dept. main office for mailing. All oversees packages need to be sent AIR MAIL. Send a separate letter notifying the borrower that the specimens are on their way, and indicate the procedures for handling the pink and yellow copies of the loan form.

6. When the pink confirmation form is returned in the mail, staple it to the Purdue copy of the loan agreement (white) in the RECORD OF LOANS (OUT) box. If it doesn't come back, remind the borrower to send it. If the specimens did not arrive, contact the post office.

7. Keep track of loan deadlines and notify borrowers by letter when loans become overdue. They may ask for extensions of loans by making written request to the Curator.

8. When the specimens return to Purdue, sign and return the yellow copy of the loan agreement to inform the borrower that specimens were received by Purdue in good order. Immediately go to the original loan form and write LOAN CLOSED on it and then write the date received and sign it. Place the loan form in the RECORD OF LOANS (CLOSED) box. These closed loans are to be placed in order of date into a three-ring binder at the end of each year.

9. Place the specimens in decontamination (freezer) for at least 24 hours and them replace them in their respective locations in the herbarium.

Voucher Specimens and Exchanges

The Arthur & Kriebel Herbaria are active collections. Properly identified voucher specimens (mounted *or* unmounted) associated with research projects and floral inventories are welcome. A small collection of plants for exchange programs with other herbaria should be maintained. Keep this in mind when collecting for Purdue. Trading or exchanging specimens with other herbaria is the most efficient way of increasing our collections without leaving Indiana. Records of early exchanges with other herbaria are kept in Herbarium file #2. Newer exchanges are now recorded in the EXCHANGE RECORD book in the curator's

office with the other record books. A standard loan form is used to document exchanges. Additionally, an exchange summary is kept for each herbarium for which exchange has occurred (Fig. 19).

The Herbaria of
PURDUE UNIVERSITY

The Joseph C. Arthur Herbarium [PUR] (Fungi: Uredinales)
The Ralph M. Kriebel Herbarium [PUL] (Green Plants, Fungi & Lichens)
Department of Botany & Plant Pathology
1155 Lilly Hall of Life Sciences
West Lafayette, Indiana 47907-1155

RECORD OF EXCHANGES

NAME OF INSTITUTION University of Michigan Herbarium (MICH)

ADDRESS North University Bldg., Ann Arbor, Michigan 48109

RECEIVED		SENT		
Date	No. Spec.	Date	No. Spec.	Balance*
				-49
10 Feb. 1959	49 spec.	8 Mar. 1962	85 spec.	+ 36
		1 Apr 1963	72 spec.	+108
		8 Apr 1964	301 spec.	+409
		16 Dec 1965	41 spec.	+450
		3 Oct 1997	76 spec.	+526

* A "+" indicates a balance in the favour of Purdue, a "-" indicates a balance in favour of correspondent.

Figure 19. Example of specimen exchange form.

CHAPTER 10

CORRESPONDENCE

The written correspondence of an herbarium is an extremely important and interesting aspect of herbarium operations. It represents an historical record of not only the herbarium and its scientists, but of plant taxonomy and scientific culture as well. Unfortunately, there has not been a strong effort to file correspondence of the herbaria here at Purdue. The author has assembled what he could find of historic correspondence and filed it by date in three-ring binders. Original letters from outside of Purdue and copies of all letters (including e-mail) sent out by the Purdue Herbarium (especially those directly dealing with the Purdue University Herbarium and its daily procedures and exchanges) should be placed in three-ring binders at the end of each year. Binders are stored in the curator's office.

CHAPTER 11

PUBLICATIONS

Brochures

An information brochure has been printed which includes the mission and description of the Purdue University Herbarium. Copies of the brochure are stored in the curator's office. These are given to new patrons and borrowers. The text is stored in the computer files as:

C://Curator/Purdue Herbaria/Internal Publications/Brochure

Web Page

The web page is written and updated by the curator and managed by the departmental computer admisitrator. It is perhaps the most important publication of the Purdue University Herbarium, because it is our link to the international scientific community. Its text and illustrations permit a virtual tour of our facilities and a familiarity with faculty and staff associated with the Herbarium. The current events category and the annual report page should be maintained at least annually by the curator. The World Wide Web address for the main page of the Purdue University Herbarium is:

http://www.btny.purdue.edu/Herbaria/herbaria.html

Bulletin of the Purdue University Herbarium

The *Bulletin of the Purdue University Herbarium* is an occasional publication and includes annual reports, special volumes such as the Operations Manual, and scientific and historical contributions relating to traditional botany and plant ecology. Prospective contributions may be sent to: *Curator, Purdue University Herbarium, Department of Botany & Plant Pathology, Lilly Hall of Life Sciences, West Lafayette, Indiana 47907-1155 U.S.A.*