NEBS Meeting News

Author: Hirschberg, Karen

Source: Rhodora, 124(997) : 106-116

Published By: New England Botanical Society

URL: https://doi.org/10.3119/0035-4902-124.997.106

NEBS MEETING NEWS

January 2022

The 1156th meeting of the New England Botanical Society was the 22nd annual "show and tell" meeting. It was held virtually on January 8, 2022, and titled "22nd Winter Warmth by Watching from Wherever the Work of Worthy Winners." This year featured presentations by three winners of research awards in 2020: Dr. Sarah T. Bois, Dr. Jay Wason III, and Jacob Suissa.

Dr. Sarah T. Bois, Director of Research and Education at the Linda Loring Nature Foundation in Nantucket, Massachusetts, who won a New England Botanical Society Les Mehrhoff Botanical Research Award noted that she had been mentored by Dr. Mehrhoff as a graduate student. Her presentation, "Naturalized Scotch Broom (*Cytisus scoparius*) on Nantucket Island," began with a discussion of how introduced plants may exist at low levels as "sleeper species" until they reach some threshold that allows them to have rapid population growth and potentially become invasive. For many species the threshold is related to climate. Scotch broom is a semideciduous woody legume with green, photosynthetic stems and seeds that are ballistically dispersed. It is invasive in most of its introduced range including the Pacific Northwest where it covers large areas of nutrient-poor habitats such as sandplains. Control of Scotch broom is expensive and labor intensive once it has colonized large areas; in Oregon $40 million was spent in one year for removal and management. Early Detection and Distribution Mapping System (EDDMapS) shows Scotch broom establishing along the Atlantic Coastal Plain in the eastern U.S. as far north as southern Maine. Nantucket has two records from around 1900. When Scotch broom was first proposed for listing as an invasive plant to the Massachusetts Invasive Plant Advisory Group (MIPAG) it was determined that there was a lack of data necessary for meeting the criteria for invasive species. Dr. Bois is collecting data on Scotch broom naturalizing in Nantucket, beginning with mapping occurrences in open space and minimally managed habitats, and documenting evidence of reproduction, dispersal across spatial gaps, and potential impacts. She documented populations in EDDMapS, recording evidence of reproduction such as prolific seed production and dispersal across spatial gaps. In 2020 she found 160 locations with nearly 500 individual plants in surveys of about 75% of the island. The results so far indicate that 74% of the occurrences are in minimally managed open space, including Nantucket's coastal shrub and sandplain grassland habitats. In December of 2021 MIPAG reviewed her findings and voted Scotch broom to be designated as likely invasive in Massachusetts. Next the Massachusetts Department of Agricultural Resources will review Scotch broom for state listing, but more information is needed on habitats and regional establishment. Dr. Bois encourages us to document occurrences of Scotch broom and other established, introduced species throughout the state in EDDMapS or *i*Naturalist. It was noted that herbarium specimen collections are also helpful.

RHODORA, Vol. 124, No. 997, pp. 106–114, 2022

Dr. Jay Wason III, Assistant Professor of Forest Ecosystem Physiology at the University of Maine, School of Forest Resources in Orono, Maine, is the winner of the 2020 New England Botanical Society Junior Faculty Award on the Flora of New England. Dr. Wason's presentation, "Drought Effects on Tree Physiology, Growth, and Survival" described a research project on drought timing impacts in Maine. Drought is relatively rare in the Northeast, but moisture availability limits tree growth. Black spruce growth ring records over a 100-year period compared with precipitation records indicate that the timing of drought affects the growth response of black spruce and that late season drought has a legacy effect where it impacts growth in subsequent growing seasons. Dr. Wason and his students conducted an experiment looking at effects of seasonal drought on regeneration, specifically height and diameter growth and the capacity for recovery within the same growing season. Saplings of six tree species were grown in buckets and given treatments representing spring, summer or fall drought and a control group with no drought. They measured physiology, soil moisture, height, and diameter weekly. They observed that *Betula papyrifera* (paper birch) generally died off within a week of moderate drought and was especially sensitive to spring drought. *Pinus strobus* (white pine) had reduced growth from spring drought and remained stunted through the growing season but was not much affected by summer or fall drought. *Acer rubrum* (red maple) had reduced growth from spring drought but recovered later in the season and was less affected by summer or fall drought. *Thuja occidentalis* (northern white cedar) was resilient to spring drought, recovering its growth by fall, but had significantly reduced growth from summer drought. These results demonstrate that tree responses to seasonal drought are variable and dynamic within the growing season, reflecting different stress responses and recovery strategies. This and similar experiments provide more detailed information about responses to drought than can be determined from examining growth rings, and give us a better idea of how tree species may respond to future climate conditions.

Jacob Suissa is a Harvard University Ph.D. student in Organismic and Evolutionary Biology and a winner of the 2020 Graduate Student Research Award. He has a popular Instagram series called Let's Botanize. His presentation "Untangling the Elaborate Evolution of the Fern Vascular System" is about his research into how xylem and phloem evolved to produce plant species with an internal vascular system. Xylem evolved in plants about 425 million years ago and diversified in the next 50 million years, allowing the evolution of a great variety of ferns and related plants in the Carboniferous. This important innovation allowed land plants to photosynthesize more and grow larger, increasing carbon dioxide sequestration and oxygenation, and ultimately changing the environment of the Earth. Ferns today have striking diversity in vascular patterning, raising the question of why this variation exists and how it evolved. The traditional view is that fern vascular architecture evolved in a stepwise sequence from simple to complex. With the help of undergraduate research assistants, Suissa tested this hypothesis using modern comparative phylogenetic methodologies. They collected anatomical data from 3339 extant fern species (~32% of species, 85% of genera, 96% of families, and all fern orders) and 12 extinct fossil species. He used an existing fern phylogeny to test various models of character evolution. Quantitative analyses of the data support five distinctive vascular architectures and one polymorphism, where two architectures occur in the same stem. His analyses did not support the hypothesis of simple stepwise vascular evolution, but showed that the evolutionary process is complex, with multiple evolutionary reversions where characters evolve and then are lost. Looking next at climate data he found that changes in vascular architecture are driven not by climate in the form of hydraulic demands but by changes in body size. Larger stems (thicker than 5 mm) are correlated with development of a pith, a change from protostele to solenostele. The development of pith likely sparked the development of the other types of vascular architecture. Using phylogenetic comparisons, he determined that vascular evolution could be characterized by two rate regimes, slow and fast. There was a fast rate of vascular evolution associated with early fern diversification during the Carboniferous and a slow rate during the second major diversification event in the Cretaceous. Suissa concluded that fern vascular evolution was characterized by a rapid burst of phenotypic innovation during the Carboniferous and seemed to be decoupled from fern speciation during the Cretaceous.

February 2022

Jesse Bellemare opened the 1157th New England Botanical Society meeting via Zoom on Saturday, February 5, 2022, and introduced the speaker, Dr. Valerie Pence, Director of Plant Research, Center for Conservation and Research of Endangered Wildlife (CREW), at the Cincinnati Zoo & Botanical Garden, Cincinnati, OH. The CREW facility houses ex situ collections of plant samples and animal gametes in a cryobiobank.

Dr. Pence gave a presentation about the groundbreaking work in plant cryopreservation titled "Saving All Plants: Technologies to Extend ex situ Conservation to All Plant Species." Ex situ conservation includes living collections at botanic gardens, seed banks, in vitro collections, and cryobanks. Dr. Pence gave some examples of plants brought into cultivation shortly prior to becoming extinct in the wild. *Franklinia alatamaha* was found near extinction in the 1700s, and propagated by John Bartram. *Sophora toromiro*, an endemic legume on Rapa Nui (Easter Island), was grown from seed collections before the last tree on the island was cut in 1960. It is now being studied for possible reintroduction in the wild. The 2020 State of the World's Plants & Fungi report from KEW estimates that roughly two of every five plants are threatened with extinction. Ex situ collections become more important as threats to vulnerable plant species increase. The Global Conservation Consortia is an initiative of Botanic Gardens Conservation International and the Morton Arboretum to coordinate collections, managing them as metacollections, particularly for certain groups such as cycads. Seed banking has become important over the last 100 years as a more efficient way to preserve many taxa in a small space. The standard practice is to dry seeds to 10% moisture and store at 18–20°C and 15% relative humidity to achieve solidified cytoplasm (glass) without lethal ice formation. The seeds must be able to be germinated following storage.

Species that cannot be preserved in seed banks are called exceptional species. There are four exceptionality factors: 1) species that seed cannot be collected from; 2) seeds that are desiccation sensitive; 3) seeds that are freeze sensitive; and 4) seeds that do not recover well. Examples are: *Hedeoma todsenii*, a federally endangered mint in New Mexico that flowers but does not produce seed (factor one); *Quercus hinckleyi*, whose acorns are desiccation sensitive (factor two); *Cyrtandra gracilis*, a Hawaiian endemic that tolerates drying but not freezing (factor three); and *Ilex paraguariensis,* whose seeds have deep dormancy and are difficult to germinate (factor four). Assuming a world flora around 305,000 species, it is estimated that 8% (~24,000), largely tropical woody species, are desiccation sensitive, and 50% of species are predicted to be short lived in the freezer. There are currently no models for predicting how many species are deeply dormant. Sara Helm-Wallace published her thesis on developing a list of North American exceptional plant species in 2015, and Dr. Pence and colleagues subsequently began the Exceptional Plant Conservation Network (EPCN) and initiated The Global Working List of Exceptional Plants, now available online at the Cincinnati Zoo Website.

Dr. Pence described alternative technologies for ex-situ conservation of exceptional plants. In-vitro conservation is using plant tissue culture to conduct clonal propagation and micropropagation starting with shoots or buds collected in the wild. The bud or shoot is grown on sterile nutrient medium that stimulates lateral bud outgrowth. The resulting lateral shoots can be cryopreserved, or rooted and grown. In some species, somatic embryos can be produced in vitro with similar methods, and these can be cryopreserved and germinated. Cryopreservation is the storage of tissues in liquid nitrogen or liquid nitrogen vapor, after being protected by drying or with cryoprotectant solutions. A wide range of plant tissues, including shoot tips, dormant buds, somatic embryos, zygotic embryos, gametophytes (ferns, mosses), pollen, and spores can be preserved this way. Freeze-sensitive species that do not survive standard seed banking can often be preserved in liquid nitrogen. Liquid nitrogen has been demonstrated to extend the viability of short-lived seeds, such as those of *Populus* species. Species with seeds that are desiccation sensitive have been preserved by removing and cryopreserving the embryo.

Experiments with *Ilex* species show that the immature embryo can be removed from the seed and germinated in vitro, overcoming the problem of deep dormancy. Some species with desiccation-sensitive seeds such as cold-hardy oaks can be preserved by removing the embryo axis, drying, freezing, and then recovering in vitro. *Juglans nigra* embryos were stored for 23 years in liquid nitrogen with a high success rate. *Ziziphus celata*, a species in which few genotypes produce seed, is propagated from collected shoots which are grown in vitro in sterile nutrient medium. The shoot tips are dissected, cryopreserved, and then recovered in vitro.

In summary, cryopreservation and in-vitro technologies work well with a wide range of tissues from many species and can be used to fill in gaps where living collections and standard seed banking are not practicable. The outlook for cryopreservation is good and future research can extend ex situ conservation to all plant species. Dr. Pence ended with examples of her recent work in preserving threatened species.

March 2022

President Jesse Bellemare convened the 1158th meeting of the New England Botanical Society via Zoom on Saturday, March 5, 2022. Robert Wernerehl introduced the speaker, Dr. Alan S. Weakley, Adjunct Associate Professor, University of North Carolina, and Director, University of North Carolina-Chapel Hill Herbarium, Chapel Hill, North Carolina, who gave a presentation titled “Taxonomy, Floras, and Plant Identification Tools for Biodiversity Conservation in the 2020s.”

Dr. Weakley has been working on a new set of regional floras for the southeastern United States and developing new tools and methods to find, map, and manage the rich and dynamic biodiversity of this area. This work is crucial to improve stewardship and conservation on public and private lands. The shift from a typological (based on appearance) to an evolutionary (based on lineage) species concept has led to a reevaluation of taxonomic treatments. For example, recent DNA sequencing revealed that *Viburnum nudum*, *V. cassinoides*, and *V. nitidum* represent three distinct evolutionary lineages, though they had been treated variously as conspecific or varieties by previous authors.

Research in the *Baptisia australis* complex has shown three distinct species with genetic, morphological, and geographic differences. These are *B. australis*, found in river scour communities, *B. minor*, a Midwest prairie species, and *B. aberrans*, with a southern distribution in limestone glades and barrens. *Marshallia grandiflora* has been separated into three species based on a combination of DNA research, morphology, geographic range, ecology, and phenology. *Marshallia grandiflora* is apparently extinct; *M. legrandii*, identified by Weakley in 2012, is rare and now protected in a State of Virginia preserve; and newly discovered *M. pulchra* is rare.

Molecular studies, morphology, geography, phenology, and ecology are all important in determining separate lineages. Statistical analysis of morphological and micromorphological characters provides new insight for many taxa. *Packera serpenticola* was identified based on its distinct morphology and isolation in serpentine barrens. Species in the *Carex novae-angliae* complex can be separated using habitat. Phenology helps to separate the *Marshallia* species. Genetic analyses of *C. pensylvanica* revealed two new species with different genetic lineages, morphology, chromosome numbers, habitats, and geographic ranges. Dr. Weakley concludes that bringing together all sources of evidence gives us a new synthesis of taxonomy. However, separate lineages do not always evolve characters to enable distinction in the field.

The native flora of the southeastern United States includes about 6,000 species of which 600 have been named since 1960. Many of these are rare narrow endemics (G1, G2 or G3) with more being described every year, due in part to new taxonomic tools. The North American Coastal Plain was recently designated as a biodiversity hotspot with a high degree of endemism, yet there has been poor documentation of biodiversity across the southeast. Mississippi and Alabama have no state floras despite Alabama being one of the most biodiversity-rich states in the country. The existing floras of the southeast are mostly out of date with 19th century formats. There is a need for new revisable and accessible floras, plant guides, apps, and websites to provide information on biodiversity. Weakley is working with collaborators to reinvent the flora as a 21st century tool for biodiversity inventory. The Flora of Virginia (2013) was the first done in 250 years. The flora was created using a Microsoft Access-based database called FloraManager with traits, keys, maps, cross references to other floras, synonymy, and the ability to revise and add taxa and other information. This database is allowing Weakley and colleagues to create 27 floras at different scales for the Southeast, including five physiographic regions and 22 states. The floras are downloadable (open access) from the University of North Carolina Website. Weakley noted that Pennsylvania used the floras to list rare species for protection.

Derivative and collaborative projects include The Flora of Delaware, a Guide to the Flora of Arkansas, a Flora of Georgia, an Ecological Flora of Florida, and customized floras for national parks such as Shenandoah National Park. The Flora of Virginia app is downloadable for offline use and contains nearly all content from the Flora of Virginia (3164 species), including dichotomous and graphic keys. North Carolina Botanical Garden (NCBG) has also produced a new user-friendly paperback wildflower guide, *Wildflowers of the Atlantic Southeast*.

Future floras need to be updatable to reflect current taxonomy, to allow use of alternative taxonomic systems, and to provide useful information for the professional. Keys should be based as much as possible on obvious vegetative features and should allow one to narrow down choices before requiring more technical examination. Dr. Weakley's plans for the future are to work on more identification apps for the southeast using graphic keys, a North Carolina Botanical Garden website for native and naturalized flora, the new Southeastern Flora, and a Flora of Delaware. His collaborators include botanists (three of these, Bruce Sorrie, Richard LeBlonde, and Scott Ward, have done botanical work in the Northeast), computer scientists, photographers and many others across the region. He hopes these efforts will help to build botanical capacity and facilitate conservation of biodiversity.

April 2022

Jesse Bellemare opened the 1159th New England Botanical Society meeting via Zoom on Saturday, April 2, 2022, and introduced the speaker, paleobotanist Dr. Peter Wilf, Professor of Geosciences, Pennsylvania State University, University Park, Pennsylvania.

Dr. Wilf opened his presentation "Origins and Paleoconservation of Southeast Asian Rainforests" with a beautiful photo of Mount Kinabalu, Malaysia, on the island of Borneo, one of the great biodiversity hot spots in the world. Kinabalu was created by collisional tectonics and has a mix of Asiatic (80 *Rhododendron* spp.) and Australian (e.g., *Agathis* in Auraucariaceae and members of the Podocarpaceae) elements with Gondwanan influences. He is working with a multinational team of paleobotanists to uncover the biogeographic history of Southeast Asian rainforest floras. Southeast Asia is at the epicenter of the biodiversity crisis; roughly 54% of assessed tree species are threatened.

Dr. Wilf and international collaborators are using two approaches to collecting paleobotanical information for Southeast Asia: 1) paleobotanical investigations of Gondwana, Indian Plate, continental Eurasia and Malay Archipelago fossils; and 2) automated fossil leaf identification. Macrofossils are scarce in the Southeast Asian tropics and are mostly known from the contributing terranes (e.g., Australia, India). The supercontinent Gondwana ended in a hothouse climate 52 million years ago (Ma). Antarctica then separated from South America and Australia, which moved north and was a life-raft for temperate rainforest species that later transferred to the Malay Archipelago, mainland Asia, and oceanic islands.

Dr. Wilf examines rainforest macrofossils from an ancient caldera in the Patagonian steppe of southern Argentina, Laguna del Hunco. This ancient crater lake preserved fossils for 200 plant species with good time resolution (52–52.5 Ma) in the early Eocene. Many fossil genera from Patagonia (e.g., *Agathis, Araucaria, Castanopsis, Ceratopetalum,* *Dacrycarpus, Gymnostoma, Papuacedrus, Phyllocladus, Podocarpus, Todea,* and genera in Engelhardioideae which is a subfamily of Juglandaceae) have living descendants in the Malay Archipelago or Australasia. Dr. Wilf showed comparison photos of fossils found in Patagonia and the living related taxa in Borneo, explaining the characters used to place the fossils in families and genera. Fossils of *Dacrycarpus puertae* from Patagonia, showing the seed cones with fleshy receptacles, are nearly identical to *D. imbricatus* (Podocarpaceae), collected at Mount Kinabalu. *Agathis zamunerae* (Araucariaceae) in Patagonia, is strikingly similar to extant *Agathis*, large rainforest trees whose current range is from Sumatra to New Zealand. *Castanopsis rothwellii* (Fagaceae) in Patagonia is related to *C. cuspidata* of Japan. Australia's iconic tree, *Eucalyptus*, was also a dominant tree in Patagonia based on numerous fossil remains.

Dr. Wilf visited Sumatra in 2014 to collect late Eocene–early Oligocene floras, Vietnam in 2019 to find leaf fossils that were the first macroflora from south Indochina, and Pakistan in 2000 to collect early Eocene fossils of the India-Asia contact. In 2015 Dr. Wilf explored Brunei with his student Michael Donovan and other paleobotanists, finding two new macrofossil sites with the first fossil-leaf floras from that country. The macrofossils from these sites were primarily in the Dipterocarpaceae (79%), showing that dipterocarps dominated the Pliocene flora of this area (5 Ma), as they do today. These macrofossils provide the first demonstration of dipterocarp dominance in the ancient Malesian rainforest. Dipterocarp pollen is fragile and so is scarce in the fossil record. Present-day Borneo has 267 species of dipterocarps, of which 167 are endemic and 99 (62%) are threatened with extinction. The dipterocarps are the dominant large trees in Southeast Asia, forming the vertical structure of the rainforest, but are now under threat by land conversion for agro-industrial plantations and unsustainable logging.

Four dipterocarp species in three genera were found at the new sites in Brunei. Two of these are similar to two living but threatened endemic species, *Dipterocarpus humeratus* and *D. confertus*, and another is similar to *Dryobalanops fusca*, which is critically endangered. Fossils of the fourth species showed a distinctive winged fruit, placing it in the genus *Shorea*. The team also found the first fossil leaves clearly identifiable as family Melastomataceae in Malesia, similar to living *Pternandra* species. Fossilized leaves in the Rhamnaceae were identified as *Ziziphus* sp., similar to *Z. kunstleri*. Another fossil leaf has perforations similar to the extant genus *Rhaphidophora* (Araceae), which are lowland rainforest lianas. These were all new finds for this region and indicate that the structural, compositional, and environmental features of northern Borneo's dipterocarp-dominated coastal lowland forests 5 Ma were similar to today.

Wilf and collaborators have assembled a dataset of 396 fossil rainforest genera including 87 survivor Paleo-Antarctic genera from Gondwanan fossil sites in Australia, New Zealand, Antarctica, and Patagonia. With the IUCN Global Tree Assessment team, Wilf is developing a "paleo red list" of Gondwanan tree lineages, many of which survive in the Gondwana rainforests of eastern Australia and other threatened areas. Many of these lineages that have survived for 100 million years are projected to become extinct within the next 100 years.

Work is in progress on an app for automated identification of fossil leaves with an image database of 30,000 cleared, x-rayed, living and fossil leaves vetted to plant family.

This work includes creating synthetic fossils from cleared-leaf images for training AI (artificial intelligence) to identify uploaded images of fossils to plant family.

May 2022

Sara Helm-Wallace opened the 1160th New England Botanical Society meeting via Zoom on Saturday, May 2, 2022, and introduced the speaker, William (Bill) Cullina, who is the F. Otto Haas Executive Director of the Morris Arboretum at the University of Pennsylvania, Philadelphia, PA.

Bill was previously the CEO of Coastal Maine Botanical Gardens and before that worked at Native Plant Trust where he developed a native plant propagation, breeding and introduction program. He is also a well-known author and has published books on growing and propagating native plants (*Wildflowers*; *Native Trees, Shrubs, & Vines*; and *Native Ferns, Moss, & Grasses*) and other horticultural topics.

Bill's presentation titled "Public Gardens in Today's World" explored the role that public gardens play in society. He began with the changing relationship between humans and their natural world, from early humans living in nature to the present day when many live in urban environments disconnected from nature. In the later part of the 19th century, there was a growing awareness of the need for natural open spaces being available to the public, and in North America many philanthropists of the Gilded Age deeded great estates (e.g., Biltmore, Longwood, Morris Arboretum) to the public to serve as public gardens. Garden in the Woods began as a private estate. Coastal Maine Botanical Gardens began as a grass-roots effort to provide a public garden with an emphasis on education and conservation.

Biophilia or "love of life," is the idea that humans need a connection with nature and other living things like they need art and music. Recent research has shown numerous mental and physical health benefits (lower stress and anxiety, improved self-esteem, and increased capacity for learning and social engagement) from being in nature. People seek accessible natural areas such as botanical gardens provide. These gardens provide spaces and trails where people can stroll or sit and enjoy nature. They are used for social gatherings and for celebrations of milestones in our lives: weddings, birthday parties, and celebrations of life, seasons and holidays. Botanical gardens are also important for celebrating plants and biodiversity, helping people to connect with plants and nature on a more personal level.

Horticultural research, particularly of noncommercial species, is of great importance. Bill has worked on identifying and breeding native species for garden use to better support natural biodiversity. Mt Cuba Center is doing horticultural trials for wild hydrangeas to determine which cultivars best support a diversity of native pollinators, in addition to being beautiful. Public gardens are also centers for botanical research and conservation including propagation and seed banking. Basic research is crucial for species such as *Wollemia nobilis*, the Wollemi pine, which has fewer than 100 adult plants surviving in the wild. The forests of eastern North America are under threat from the hemlock wooly adelgid, the emerald ash borer and other pests and diseases. Botanical gardens are conducting research to find resistant individuals of hemlock and ash and identifying genetic traits that provide resistance, so the biodiversity of our forests is not lost. Climate change is driving changes in our flora. Research at botanical gardens will help to inform us as we make difficult decisions such as whether or when to undertake assisted migration to help species move to new suitable habitats. Species with present day southern ranges such as *Torreya taxifolia* and *Magnolia ashei*, which formerly inhabited the Great Smoky and Blue Ridge Mountains, are seemingly in the process of going extinct because they cannot migrate to suitable habitat as the climate warms. The Morris Arboretum is growing and conducting research on *Torreya* and experimentally planting it in suitable habitats in the Great Smoky Mountains. Bill noted that assisted migration is a controversial issue and much research is needed in this area.

Botanical Gardens serve many important functions in the present day. Botanical research programs have dramatically decreased at universities in recent years but are continuing or increasing at many botanical gardens. Bill believes the botanical gardens are providing a refuge for field botany and floristics. The two largest herbaria in the United States are at botanical gardens (such as New York Botanical Garden and Missouri Botanical Garden). The Morris Arboretum recently digitized its herbarium, making it available online. Botanical gardens are updating their interface with the public. For instance, they include food plants and increasingly provide the public with information on how food plants are grown, harvested and prepared, even having food-related events. Public gardens fill an important role in increasing science literacy. They provide outdoor education for school children, adult education, and needed professional development courses and training in botanical and horticultural fields. They are even an economic benefit. An economic impact study for the greater Philadelphia area showed a substantial benefit from the public gardens in both economic output and job creation.

Bill is looking forward to having a molecular lab at Morris Arboretum to research some of the more challenging questions surrounding native plant genetics and breeding such as the effect of garden cultivars on pollinators.

—Karen Hirschberg, *Recording Secretary*