Introduction

As the Garden celebrates 50 years in Claremont and prepares for it's 75th anniversary the text and cover photos included in this third issue of the Garden's Seed List are included to both document the evolution of seed storage practices at RSABG, and to recognize some of the principal collectors and program managers. Their efforts and foresight have been fundamental to the acquisition, cultivation, and preservation of these potential future sources of information and inspiration.

Many of the historical references for this summary were acquired from Dr. Lee Lenz's 50th anniversary issue of Aliso or from personal recollections that Dr. Lenz was generous in sharing. Additional information was gleaned from Garden Newsletters, Seed Program file records, and personal communications with Garden staff members. Those who are so inclined are invited to submit additional information that would enhance the value of this narrative. Clarification of any discrepancies or inaccuracies would also be greatly appreciated and will be included in future issues of the Seed List.

Why a Seed Bank

In the National Geographic publication Nature's Medicine Plants That Heal author Joel Swerdlow writes that nearly 400 years ago, William Shakespeare described plants as part of nature's "infinite book of secrecy." With the rapid advances in science and technology developed during the 20th century we are only now beginning to discover what secrets lie hidden within nature. Unfortunately, just as we are gaining the necessary technology and interest, the pages and text from this great 'book of secrets' are rapidly disappearing. In an effort to slow down this loss - government agencies, grassroots conservation organizations, and botanical institutions are investing heavily in the preservation of these pages of genetic information by maintaining living plant collections and the establishment of seed banks.

Seed Collecting and Storage at RSABG - 1927 to 1977

In a 1941 report, Carl Wolf, the Garden's first staff botanist, noted that between 27 April and 16 August of that year he had spent 57 days in the field and had traveled 8,000 miles, making 1,100 herbarium specimens and several hundred lots of propagation material. Later in his statement Mr. Wolf affirms, "As you read my report covering field work you may wonder that such large amounts of time and energy have been given over to this phase of the Garden's activities. However, it should be remembered, that, unlike many other botanic gardens, this one is greatly dependant upon fieldwork for the attainment of its goals. Therefore, nearly all the other Garden activities are more or less directly proportionate to the amount of field work, which includes the collection of data, specimens and propagation materials." Aliso, 1977 RSABG The First 50 years, pg. 65.

Carl Wolf, Edward K. Balls and Percy Everett, were three of the Garden's most prolific field collectors, and their names are the ones most frequently associated with the Garden's early collections. Edward K. Balls, a native of Yorkshire, England, came to the

Garden in 1949 first working as a groundsman and then horticulturist. According to Director Emeritus and Garden Historian Dr. Lee Lenz, Edward K. Balls was "A true collector in the best sense of the term. Under his direction the seed collection took on major proportions" (Aliso, 1977) and Edward Balls was "The best seed collector, the most broadly educated, cultured, and sadly underrated staff member we ever had." (per. comm.) Although these gentleman's seed collections are no longer in storage at RSABG, many treasured 'heritage plantings' still exist today and serve as living memorials to these venerated plantsmen who dedicated their careers and creative energy to building the collections of the Garden.

Although the collection of wild originated propagation materials has always been the foundation of the Garden's collections seeds have historically also been collected from plants cultivated at RSABG. Dr. Lenz, reflecting back upon his coming to the Garden said, "From the very beginning seed was collected in the Garden. The long rows of carefully cultivated godetias, poppies, etc. were a major attraction for visitors to the Garden, similar to the commercial fields around Lompoc, etc. We have never had anything equal to them since. The original field was perhaps a quarter acre in size, perhaps less. Allen Chickering, then chairman of the board, and I were standing in the wildflower field one beautiful evening in April when he offered me a position at the Garden." (L. Lenz per. comm.)

As at the old Garden site, in the early days at Claremont, large quantities of seed were harvested from the expansive annual cover plantings that served to fill in the open areas as the perennial plantings took hold and developed. These quite massive Garden collections, along with the smaller yet extensive wild collected seed lots, were stored until needed in large metal drums and glass mason jars in the seed storage room at the old Garden site in Santa Ana Canyon. Soon after the Garden moved to Claremont in 1951, the Stone House that was originally a rest room for the golf course, became the new Seed Storage building. Situated in the cool air sink area east of Indian Hill Mesa, this structure with its thick, insulating rock walls, was thought to afford a moderated storage environment ideal for seed storage. (per. comm. L. Lenz, W. Wisura)

Early Index Seminum Program at RSABG

Participating in what is close to a 300 year old botanic garden tradition (the first Index Seminum was circulated by Jacob Bobart, the Younger, in 1702) the Garden also utilized these extensive seed collections for distribution in the Garden's own Index Seminum or seed exchange program. A 1954 seed list is the oldest record of the Garden's Index Seminum Program on file. Dr. Lenz said, "It is unknown when the first Index Seminum was published but they were originally done on a mimeograph machine with a very limited distribution". In the 1954 Index, 587 taxa are listed - a truly extensive offering for such a young institution. A 1957 Seed List was the first to identify wild and garden collected seed accessions. The total number of species offered in this Index was 525 taxa; 162 identified as wild collected and 363 species collected from plants in cultivation at RSA. Although they were most likely responsible for earlier indexes, the 1966 Index Seminum was the first to note Percy Everett and Dr. Lenz as producers of the Index.

(University of Oxford Botanic Garden Seed List 1999)

The oldest of the Garden's seed collections still in existence are those that, as part of the Went/Munz long- term seed longevity experiment, now reside at the U.S.D.A. National Seed Storage Laboratory in Fort Collins, CO. In 1998, after 50 years in storage, viability tests on these seeds were conducted. Staff at the nation's federal germplasm repository are currently in the process of preparing their findings for publication and a summary of their results along with the reference for this publication will be noted in the next Seed List.

Seed Collecting and Storage - 1977 to the Present

Certainly the three most prominent Garden collectors since the mid 1970's were Walter Wisura, Orlando Mistretta and Bart O'Brien. Traveling and collecting extensively throughout the state, the Southern Channel Islands and Baja California, these three individuals have contributed or were indirectly responsible for the bulk of the collections that are in the Seed Bank today.

In search of a replacement for Warren Sullivan, long-serving plant propagator and nursery manager from 1945 – 1974, Walter Wisura was persuaded to leave behind a prominent and very successful horticultural and botanical position in South Africa at the prestigious Kirstenbosch Botanic Garden and join the Garden staff at RSABG. During his 18 year tenure at RSABG (1977 – 1995) Mr. Wisura served principally as Plant Propagator and as Curator of the Living Collections. Classically trained in the European botanic garden traditions, he was dedicated to incorporating the high curatorial standards that make the Garden's collections the scientific assets they are today. Prior to the establishment of an Endangered Species Program Walter Wisura also initiated and coordinated many of the Garden's early conservation seed collections.

The Index Seminum Program - 1977 to the Present

In 1977, at the request of Horticulturist Clarence 'Dick' Tilforth, Walter Wisura took on the responsibility of managing the Garden's Index Seminum program. From 1977 until his retirement in 1995 Mr. Wisura collected much of the seed, coordinated the distribution of the Index to hundreds of botanic gardens, and processed the many requests for these high quality and well documented seed collections.

The 1996 Index Seminum was the last printed version to be distributed. In 1997, with the assistance of Garden associate professor Dr. Curtis Clark, the Index Seminum that now included the entire seed collection would from this point forward be published on the Garden's internet website. In implementing the new 'Electronic' Seed Index, the Garden sought to reduce production and distribution costs associated with this activity. At the same time this would improve accessibility to the collections by research, conservation and botanical institutions worldwide.

The Beginnings of a Seed Bank at RSABG

In 1984, under the leadership of Executive Director Dr. Tom Elias, the Garden was prominently involved in the establishment of the Center for Plant Conservation - a national coalition of botanic gardens operating programs in plant conservation. In 1988, Orlando Mistretta, a recent graduate of the Claremont Graduate School in Botany, was offered the position as Endangered Species Coordinator. Mr. Mistretta should be acknowledged as the principal botanist at RSABG responsible for researching and initiating improved seed storage practices, for laying the foundation and setting the course that the Garden would follow in establishing a seed bank and other conservation programs. A compassionate and energetic individual, he was from the beginning actively involved in the development of the CPC program and was highly respected among his peers in the early development of the botanic garden conservation movement.

In 1988, to extend the longevity of the Garden's rapidly growing and increasingly valuable seed collections, an upright refrigeration unit and a chest style freezer were purchased and installed in the stone house. (RSA Annual Report, 1987 - 1988) At this point Walter Wisura coordinated the transfer of the horticultural seed collections from the glass Mason jars into double sealed plastic storage bottles. These seed collections were then placed into medium term storage (MTS) conditions (5 ^{o}C / 41 ^{o}F). Orlando Mistretta, assisted by technicians Mike Hammitt and later Kitty Blassey, processed the seed collections of rare, threatened or endangered species that, following 2 to 3 weeks storage at 12% relative humidity, were packaged and sealed in "Crystal Springs" storage pouches and placed into long term storage (LTS) conditions (-18 ^{o}C / 0 ^{o}F). It was customary during this period for seed collections of rare but non-listed plant species to be split between the Horticulture MTS collections and the Endangered Species Program LTS collections.

In 1990, Bart O'Brien was hired as Director of Horticulture. A talented and intuitive plantsman Mr. O'Brien brought to the Garden a strong knowledge of horticulture, the California flora and considerable interest in, and enthusiasm for, the unique mission and collections at RSABG. Like many of his predecessors, Mr. O'Brien traveled and collected extensively throughout the state. During this time, the early to mid 1990's, the seed bank collection grew rapidly. He continues today to add to the Garden's ever-expanding and valuable plant and seed collections.

New Staff and Directions in the Seed Program

The mid to late 1990's were also a period of considerable change in the operations and management of the budding seed storage program. With the completion of the new Horticulture Complex in 1995, both the MTS cold storage and the LTS sub-zero storage units were moved into the new and spacious Fletcher Jones Seed Storage facility. Curation and management of both the Horticulture and Endangered Species Program seed collections were now primarily under the stewardship of Orlando Mistretta and newly hired part time Seed Technologist Mark Elvin. Soon after returning from a trip to the Royal Botanic Gardens at Kew and the seed storage facilities at Wakehurst Place,

Mistretta and Elvin initiated moisture permeability tests comparing the 'Crystal Springs' and the heavy duty foil plastic laminate storage pouches used at 'Kew Gardens'. At the same time Dr. Ed Guerrant at the Berry Botanic Garden conducted parallel tests on these seed storage pouches. With the superior performance of the 'Kew' bags confirmed by both institutions, Seed Program staff began the transfer of the LTS seed collections into the new 'Kew' storage bags. It was during this period and through 1996, that Seed Technician Elvin also placed many of the LTS collections into heat sealed Pyrex test tubes.

In late 1995, soon after Walter Wisura retired from his position as Curator of the Living Collections, RSABG Horticulturist Michael Wall was offered the position of Seed Curator. In 1996 Endangered Species Coordinator Orlando Mistretta resigned his position at the Garden and Mark Elvin was promoted to manage the Program. In 1997, upon Mr. Elvin's departure, Mr. Wall took over as Seed Program Manager. During this tumultuous but productive period, institutional support for the program never waned and improvements in the curation and management of the collections continued. In 1998 two additional freezers were purchased and the Horticulture MTS collections were placed into LTS -18 ^{o} C storage conditions. The transfer of the older LTS collections from the 'Crystal Springs' storage pouches was completed. Soon thereafter, with the computer network of the Horticultural Complex, seed collection record keeping and data management was greatly enhanced. Due to high material costs, accessibility limitations, and in an effort to implement a single standardized packaging protocol for rare species, the use of the Pyrex tubes for seed storage was discontinued.

A brief summary of current storage protocols at the RSABG Seed Bank are as follows:

- Following cleaning, samples of seeds are dissected and examined under magnification to assess potential viability and the quality of the seed collection.

- CNPS list species seed collections are packaged in foil plastic laminate heat-sealed 'Kew' bags while non-CNPS list species seeds are placed into double-sealed screw cap plastic storage bottles. Depending on the quantity and rarity of the collection, some seed accessions are split into active, base, and back-up components. A sample for initial viability testing is also set aside at this time. Follow-up viability testing is conducted as time, opportunity and resources permit.

- Open containers of seeds are then placed into closed chambers over Calcium Sulfate desiccant for a minimum of two to three weeks storage at 12% RH before being sealed and placed into the Program freezers.

- The 3 Seed Bank freezers are set at their lowest range of between -18^{o} and -20^{o} centigrade. These units are connected to a back up generator that starts automatically and will supply electricity to keep the freezers in operation in the event of a power outage.

Today at RSABG, the development, operation and management of the Garden's Seed Program, including the acquisition of collections, is truly a cross-programmatic endeavor. It is this collaborative and cooperative work among Garden staff, volunteers, and increasingly, Garden associations outside the institution, that is the strength and support

behind the production of this Seed List, the curation of the collection, and the overall value and success of the program.

28 February, 2002

Michael Wall
Curator and Seed Program Manager