Gene Dreams

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These are difficult times, for all of us who are alive and aware, who care for discovery, beauty and loving adventure. Our human inhabitation of the earth is profoundly destructive. We are born, grown and developed under many influences whose true nature may never become apparent to us.

Enlightening interaction with other species who also live and abide here can be a source of inspiration, of insight and re-deification. Yet, we rarely perceive the growing of plants in this way. To transform us from aggressive controllers into interactive participants in a world ecology requires an education in sensitivity.

When you begin to collect the gene-pool, to take on directly the growing and maintenance of many plants, mostly in pots, of a tiny subset of the world flora, of plants that have arisen during 400 million years, the meaning of life begins to change.

When I was eight years old, my father took me to a night course about orchids at the local botanical garden. Every week for three months, we were introduced to several species and had the chance to divide and pot up a few of them, into several growing media. The garden had a fine orchid collection, which now in retrospect I estimate to have held about 4000 pots with an estimated 2500 species from many of the planetary tropical ecosystems.

Our biological world is disappearing from incomprehensible forests of organisms into small subset collections. These collections, whether botanical gardens of table top gardens, are the response of one, or a few or even a modest million people to a phenomenon of destruction that is beyond our ken, beyond our general capacity to understand. As the reality of habitats and societies, civilizations and lifelines, families and phenomena disappearing captures each of us, we are robbed of our power to love and be kind, able and responsible, devout and relaxed.

As I wander each night through a greenhouse plant collection, as diverse as I have been able to put together during the past decade, it is clear to me that a solitary yet committed individual or family can energetically work to create an alternative to the widespread ecological destruction by developing a collection of diverse plants.

My evening time wanders, flashlight in hand, focuses in part on the need to pick the molluscs that like to eat flowerbuds, seedlings and young growths and leaves. Scrutinizing each plant, paying attention to whether or not it is growing, how well, continually reflects on how well I am able to provide a healthy environment for the growth of each and every one. The Paphiopedilum collection has months of flowers that unfold 45 species from a genus of 65 with hybrids that example human ingenuity developed only during the past 130 years. As I deeply lament the chainsaw-bulldozer system for disappearing habitats, I walk through beauty, wisdom, love and genius in unassuming monocots with unforgettable flowers, a small greenhouse garden unlike any natural habitat with multigenerational hybrids containing traits of 6 or more species that never lived in the wild and in some cases that are as rare or even rarer than the rarest species. Pasternak said ‘Gregarious is

the refuge of mediocrity…only individuals seek the truth.' Yet truth that individuals hold gives rise to Truth, a reality held by all.

I urge you to look into gene pool diversity and grow a few friends!

There are a variety of ways to look at collections. A monoculture agricultural field is a group of generally very similar organisms, which in 'well-run' chemically managed fields includes few weeds, microorganisms, insects, rodents, molluscs, worms and other kinds that also live here. From a DNA centered view, each individual is likely to differ by a few nucleotides out of billions. If all the plants are cloned from a single individual, then even the genetic level of variation is reduced, though not eliminated for making sure that variation does continue to occur.

The planetary biosphere is a collection and a puzzle. We all have common ancestors, from our cells to our muscles and brains. Carbon life having grown for 3+ billion years, with major events that have changed the number, kinds and distribution of organisms, is at a major junction. The fine nature of diversity brings us about 1/3 of a million plant species, as many as 20 million animals, and an uncountable and immense number of microorganisms. Life is a fabric woven from material whose origin is still unknown. Yet we destroy habitats and extinct our kin. From the future we will be looking back into museums, herbaria and the records of natural wonder as if paradise is lost once again. So we make collections of stamps, ideas, symphonies and memories.

One way to get a direct experience by which we grow, develop and diversify is to collect a moderate sized genus in depth. For a genus like Paphiopedilum with 65 species or Aloe with 330 species, or Astragalus of more than 2000, there are clusters of related species that form subsections of sections in these genera. Yet the validity of each species is that it resembles a note on a cosmic scale. It is unique, distinct and yet blends in discrete ways with other close species. The changes extend further to related genera. Species arise when a group of similar interbreeders no longer mixes genetically with another similar group. Isolation can happen from a variety of causes. Beyond these concepts is the simple process of assembling a living collection and observing the members grow and flower, individually and together, examining them again and again in quest of the secrets of change within the stability of generations.

As Clear as a Memory Can Be:
Paramo Palatera and the Loss of Innocence
January 10, 1993

During the 1960's, I was fortunate to travel to Colombia, South America four times. On the first visit I was a young student with an interest in orchids in the entourage of a world-renowned professor. The second time, a friend and I drove from New York to Bogota. The third and fourth times, I flew.

It has taken more than 25 years for me to appreciate the magnitude of importance of certain observations that happened during and between the journeys had in determining the fate and activities of my middle and later years.

When Dr. Leslie Garay, Head of the Oakes Ames Orchid Herbarium of Harvard University took me, at age 18, in my junior year at Yale, from the safe

confines of New Haven, Connecticut to the Andean wilds of northern South America, I was at one of those life-determining crossroads. Rather than studying, I was playing cards, not just casually, but as a consuming passion. It provided intellectual challenge, ego-fulfillment, some pocket money and master points. My interest in flowers, orchids in particular, had been dwindling. My devotion to molecules and genetics wasn't dormant, but neither was it flourishing. I was tired of classes, grades and exams. I had begun to drink hard liquor, to frequent hard-dancing night clubs, to visit nearby women's colleges and to make grand slams at the bridge table. Little did I know that a casual trip to collect orchids would contribute to a major change in the philosophical orientation of my 30's, 40's and 50's.

During the two months that we travelled in search of orchids, we took several long and circular journeys. My love for orchids was quickly rekindled as virtually everywhere we went there were kinds I had never seen. What was particularly great was collecting with Garay. He could recognize and identify an incredible number of different genera and species. My active young mind would indelibly remember the names he assigned to our collections. We made specimens every night after each day's collection in the wonderland of cloud forests that encompass the three chains of mountains that split up tin the south of Colombia and travel north to the Caribbean. I learned the routine of plant collecting, became accomplished at identifying most any orchid to genus and could remember the species identification of any plant having seen it but once. I began spending time in the National University herbarium in Bogota, in part because botanist and head of the Institute of Natural Sciences, Dr. Alvaro Fernandez, a kind and fatherly man took me under his wing and also because there were many correctly-identified specimens that I studied which served me well when we were collecting in the field. This first journey provided me with an experiential map of the countryside, a friend and ally in the university and the desire to return under my own direction.

Several years later, as a graduate student in molecular biology and life sciences at Rockefeller University, Vince Hascall and I hopped in a Renault Dauphine and drove the Pan American highway to Colon, the northern port of eastern Panama where we put the car on a boat to Cartajena. From there on a flat barge we made our way to Bogota, the herbarium and Fernandez. Then we left for a collecting trip that wound its way to a 9000' high mountain meadow like nothing I had ever seen, and like I have never seen again.

In most of the collecting, we had driven down small and difficult roads stopping frequently to walk for miles examining the road cuts and collecting in second growth areas. We continually looked for as many kinds as possible. Since the orchid flora of Colombia, a country somewhat larger than Oregon, has more orchid species than Oregon has flowering plants, it was easy for us to be satisfied in almost any montane locale. So somewhat serendipitously we followed a particularly difficult dirt track to a high plateau where signs of human incursion were minimal. The orchids were incredible. My introduction to orchids in the Brooklyn Botanical Garden in my pre-teens had resulted in an affection for species with tiny flowers. Among the groups that abound in Colombia's montane cloudforests are members of the Pleurothallis Alliance, a diverse, intricately small-flowered group of genera and species. One of the genera, Lepanthes, are generally tiny plants, several inches high,

with 1/8-1/2" characteristic bowtie-like distinctive blooms. We wandered into Lepanthes 3-5' tall, with thousands of flowers, where our tracks through the density of epiphytes made it impossible not to step on unique and startling plants in every step. We were in a wonderland of diversity and since at least to some degree we were familiar with orchids, it was staggering to us to find dozens of species we had never seen growing with a vigor and beauty like none we had ever seen. Take a couple of city kids and put them in a natural flower garden untouched by people and they think it is heaven on earth. We collected for a few days and then returned to more mainstream and hence worked over, partially destroyed environments. Three years later we returned, equipped with a good camera and a strobe flash to record some of the plants on site. They were gone. For miles around there were almost none to be seen. I found a couple small remnants of the tall stately Lepanthes, 6" high pieces, and no others. Cattle had been given free range grazing in the area. What was left were hoofprints and cowpies.

Notes on Kingrams
January 7, 1993

I am primarily a gardener and began my journey into growing plant diversity from the position of a person with a shovel, a bucket and a watering can. At the same time I was raised a scientist. The two continue to mingle and during the past decade, I have been interested in both the fabric of diversity and the how, what and why of conservation. The work of all plant collectors and taxonomic botanists provides the basic framework for our kinship and diversity knowledge of the plants. Relationship as a fabric exists in the genfo (genetic information). Kinship gardens unveil the fabric.

Dahlgren's bubble maps introduced a graphical system giving a better understanding of relationships. The bubble maps form working models for current plants. Their accuracy depends on continual updating of new information on how our plants have come to be, how we arrived at the plants we now grow, and ultimately on how the genetic information (genfo) actually expresses the forms we behold.

The bubble maps are used to represent relationships: **Kin**ship.

They are historical dia**gram**s portraying lineages of inheritance: **Kin-grams**.

While Dahlgren's layout did not distinguish older groups from more recent ones, where data are available and relevant, it is preferable to put the older taxa in the center, I used this in the layout for the coniferophyta with the Taxodiaceae inside the Cupressaceae. This newly emerged groups, whether genera, species, cultivars and their hybrids are arranged radially. A good example is the radial diagram for the Fabaceae developed by Geesink. For species and varieties the distribution is then arranged geographically, corresponding to natural habitats on the planet arranged in the standard NS-EW matrix.

The ongoing progress in analyzing relationships is increasingly using molecular characteristics. Years ago molecular phylogenies were derived using comparisons between sequences of amino acids found in proteins. Proteins with the same function in different organisms differ in ways that can be used to track bio-

history. Differences in amino acid sequences are a consequence of differences in nucleic acid base sequences. Comparisons of RNA sequences for ribosomal RNA have made important discoveries about bacteria and their lineages. It has revealed two major groups of bacteria, one considerably older and more rugged than the other, extending at least to the time when this earth is still an infant or, at most, a toddler, a hot and anoxic one at that.

In plants, the chloroplast DNA and rubisco, one of the key proteins in the photosynthetic apparatus which performs the 5 + 1 carbon combination to produce aldohexoses (6 carbon sugars), have been studied for their evolutionary history in a variety of herbaceous dicots.

In the Dahlgren layout of the world's plants, the northwest quadrant comprises the herbaceous dicots, which includes the daisies, umbels, bellflowers, solanums, phlox, morning glories, verbenas, mulleins, mints, and borages. It is a marvelous puzzle of interactions and their consequences. Part of the result are vegetables including artichokes, potatoes, peppers, herbs such as caraway, dill, fennel, parsley, rosemary, thyme, mints, amidst flowers such as marigolds, zinnias, dahlias, chrysanthemums, yarrows, eryngiums, angelicas, teasels, morning glories, nicotiana, petunias, snapdragons, verbenas, and salvias.

Increasing delineation is taking place at all levels of understanding. Misplaced genera are finding the right subtribes and tribes. The tribes are nesting in clusters of clades, groups with sequential common ancestors. The different tribes are defining families and their integration into orders. The clusters of orders form better defined and biologically more accurate superorders.

It is amazing to see the confluence of many techniques and discoveries into a river of knowledge and synthesis that helps define kinship gardens. Although gardening and horticulture, the growing of plants, have minimal impact on the academic science and understanding of life, I suspect and hope that gardens arranged and developed with phylogeny in mind will lead to new discoveries and insights overlooked in the sifting of minutiae.

Yet, in the very small we reach the very large. Microscopy has led us to cells and from there to the atoms that build the molecules that are us. Genes of encoded four-armed tetrons (tetrahedral carbons) have their own and specific ways of generating memory, of remembering how to function. The muted properties of amino acids are exalted in proteins where they can be organized to reproducibly function together, for example, to build an oil like domain that fits in the cell membrane to provide a carrier and a channel for transport between the outside and the inside, between the inside and the outside.

Movement across domains implies areas of differentiation for both molecules and organisms. These areas provide shelter for the development of diversity. The mid-altitude montane valleys in the Andes of South America rarely freeze, have abundant seasonal moisture and are locale to deep diversity of several groups of organisms, from ants to orchids.

In examining the maps we made for several major taxa, we applied Dahlgren's style and concept with the increasing addition of molecular biological, particularly nucleic acid based, information. This unravels the layers of information, simultaneously present in ourselves. Cladograms derived from computer analyses of

many kinds of traits can be converted into Dahlgren style layouts by combining the topological terrains with circles proportional to number. This generates interesting gardens having what appear to be fractal-like apparently disproportionate changes, in signature as well, where new properties of size appear and life emerges from the microscopic realm fed by the engines of creation that also feed the sun.