

SUNFLOWERS

America's Golden Daisies of the Sun

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Seeds of Change

In the spring and summer mornings, the sunflowers face east. Responding to the renewal of fertility that occurs each day with the rising of the sun and the warming up of the insects, the golden daisies that cross the North American continent from sea to shining sea open their petals, mature their pollen, extend their stigmas and welcome the rainbow light that streams from our star. The spinning of Gaia, the planetary living organism that is home to uncounted millions of living species of organisms lets us see the sunlight for only half a day. But the sunflowers know where and when it arises, daily celebrating the results of sprinkled cosmic dust like seeds in an infinite and mysterious cosmos.

Beauty that fills the eye of the beholder works like vigor in the garden to give us inspiration and direction in growing peace and wisdom. Almost a decade ago, Lon Rombough called me on the phone to say he was sending a mix of sunflower seeds developed in East Germany and to grow some. The 8'-10' plants were multi-branched, having 10-30 or more 4-6' flowering arms that held 6-8" flowers. What great flowers, lemon and golden flowers, several oranges occasionally marked with purple-red spots on the ray petals. Flowers marked with a purple spot of each petal give a red circular ring from the perspective of the whole flower. They look like the Gloriosa Daisy (*Rudbeckia hirta*), another species that belongs to the same tribe as the sunflowers. Hence we call the sunflower mix and the selections from it 'Gloriosa.' In the garden at the same time were some polypetalous sunflowers whose trade name is Lion's Mane. In one of Van Gogh's paintings of a vase with fourteen sunflowers, a double sunflower very similar to Lion's Mane, can be seen.

One sunny late-spring day, I moved some pollen from a Gloriosa to a Lion's Mane, marked the head and the part of it that was pollinated, saved the seeds, planted them the next spring and looked for seedlings in which the purple trait was transferred to the Lion's Mane. The Lion's Mane line has all green plants and all the golden yellow double flowers. Three plants showed the transfer of purple onto the green. They also had flowers intermediate between the single-petalled ones of Gloriosa and the multi-petalled ones of Lion's Mane. We now call these Tiger's Eye. Five generations later, these intermediates between the two patents have given rise to some remarkably beautiful and unique new sunflowers. The mix of purple and gold, pale yellow and red-orange, with disk and ray petals variegated in colors and hue of the autumn leaves makes a stroll through the fields a joy. A line of all golden flowers with large central eyes has been selected by Richard Pecoraro for Seeds of Change. It is called 'Sunshine'. Occasional flowers are completely double with the center petaloids dominating the flower, virtually hiding the outer ray petals. When these flowers are a blend of purple and gold, we call them Dragon's Fire. From this

beginning, all the possibilities of new kinds of sunflowers abound like mushrooms during a wet Pacific Northwest fall.

This article gives a broad background for becoming familiar with the sunflowers. I discuss the sunflowers first in terms of their biology. After considering the basic layout of the five kingdoms of living creatures, I relate the sunflowers to their place in the flowering plants, to the aster family, to their tribe and subtribe, to the genus *Helianthus* and its 50 species and to the major species *Helianthus annuus* which predominates in gardening, horticulture and agriculture. Then I discuss briefly some of the historical, political and nutritional aspects that contribute to the importance and interest of these wonderful plants.

One of the great existential mysteries that has perplexed human beings since they stood erect, fashioned a hoe and began gardening is the nature of diversity of living organisms. From the microscopic realm of tiny creatures invisible to our naked eyes to the leviathans of the ocean depths, this planet abounds with myriad forms of intelligence. Explorers and wanderers, nomads and adventurers, farmers and hippies have examined the earth by ranging from oceanic trenches deeper than the tallest mountains, navigating rivers as they emerge from alpine streams and become torrents of immense power and beauty. This earth is a treasure of treasures that has been the major resource-base for the emergence of many, many human civilizations. During the growth and expansion of our species, we have continually interacted with the other inhabitants that we encounter. In some cases we have killed and eaten them. In others we have used them to build shelters, make clothes, rafts, canoes, and toothpicks. Since our survival has been infinitely interwoven with our knowledge of our living companions, we have observed and collected biodiversity throughout our generations. Illnesses have been cured by using the right parts of the right plants at the right times. Transcendental insights have taken place by ingesting the appropriate sacraments reinforced by natural conjunctions of the seasons and the heavenly bodies of the solar system. We are a curious and acquisitive species, frequently destructive, sometimes loving, routinely stubborn and always learning about ourselves and our environment.

Reflecting through our long history of exploration and discovery, we assign relationships. The great scientific minds whose names are passed on through the generations worked on how to substantiate these insights. From eras when the earth was flat and the universe revolved around the earth, from the times when all creatures were either animals or plants and when all life was at best several thousands of years old we have developed a detailed cosmology, a many layered deep map of reality that extends our awareness from our bodies and its awareness to the fabric of biodiversity and the forces and patterns of existence.

Our cognition of the relationships and patterns inherent in the biodiversity of living organisms began with what they look like. We have used visible similarities and differences to order our understanding of the myriad creatures that we encounter.

The development of lenses and microscopes unveiled an unseen universe, one filled with millions of species of microscopic organisms, many of which are still unknown and un-described today. However, it has provided a platform for

constructing working relationships that underlie our modern ordering of the diversity of creatures that inhabit the biosphere.

During the past several decades, insights based on the chemical patterns of the molecules that make up the cells and organs of many organisms have provided another way to analyze relationships.

The combination of visible and invisible characteristics has given us maps of relationships providing true lineages for the historical process of life that is now called evolution.

Remarkably, bacteria are the ancient ancestors of all the living plants, animals, fungi, and algae that we behold during our lives. They are inside all our cells as energy generators known as mitochondria. They are inside the leaves and stems of all plants giving them their green color and acting as the primary biological link between sunlight, water, carbon dioxide and the making of sugars for the building of cells and the making of bodies. We call them chloroplasts. Our current conceptualization of life begins with the bacteria, which constitute the First Kingdom called Monera. Some bacteria, the oldest ones, can be traced to rock strata 3.8 billion years old. Since the earth is about 4.6 billion years old, the earth as we currently understand it has been inhabited by living creatures for at least 4/5 of its life. In addition to the archaebacteria, there are more recent or eubacteria. They are major inhabitants of the soil, of our intestines and are widely distributed throughout the biosphere. Cyanobacteria, often mis-named as blue-green algae are familiar members of this group. They are ancestral to the chloroplasts of the plants. They include fermenters that give us sauerkraut, nitrogen fixers that inhabit the soil and noxious ones that give us sore throats.

During the billions of years that bacteria were the only inhabitants of the earth, they pooled their talents and organized their structures to develop more complex and able kinds of cells which are called eukaryotic cells or ones having true nuclei. These cells are generally larger, have new molecular talents and give rise to the collection of organisms of the Second Kingdom, the Protists. These include many aquatic organisms, most predominant of which are the giant kelps and their many algal relatives. Included in this kingdom are the free-swimming microorganisms called protozoa or first animals.

Both bacteria and protists, the first two kingdoms are predominantly aquatic. The combination of their talents has given rise to the lineages of terrestrial organisms. The Third Kingdom is the Animals. They have arisen from watery environments, which is still reflected in their lifecycles. Sea anemones, jellyfish, true bony fish and amphibians are water dwellers. Their more recent relatives, the reptiles, birds and mammals have taken to the dry land ecosystems, although some such as the dolphins and whales have returned to water. In terms of number of species, the most successful animals on the earth are the insects and the nematode worms. Their millions of species inhabit niches deep within the earth and occasionally high in the atmosphere. The arthropods which includes the insects also includes the lobsters, crayfish and crabs, spiders, centipedes and millipedes. Echinoderms are also animals, many of which are tightly linked to aquatic ecosystems. These include the starfish, the clams and other molluscs. The annelids, segmented worms are also widespread and diverse. From the vertebrate lineage has

arisen the mammals. Collectively there are more known animals than all of the species in the other kindoms combined. However, since we humans are the most recent success form the mammalian vertebrate line, we tend to study and explore our own nearest descendants and their kin first and with greater enthusiasm. Hence the bacteria with only 5-10,000 known species are actually the largest group of organisms with estimates of their size ranging up to 100 million species or from 5-50 times larger than the animals.

The 100,000 or so known species of Fungi constitute the Fourth Kindom. For many years, they are considered to be a branch of the Fifth Kindom, the Plants. However, they are not simply non-green plants, they have a unity and integral set of characteristics giving them a well deserved separate kindom. We generally know them as the mushrooms. They include bracken fungi, bread molds like *Neurospora*, fruit molds like *Penicillium*, fermenters used to make bread, wine, tamari (soy sauce), miso and tempeh.

Although not as large in terms of species as either the animals or the bacteria, the 250,000 known species of plants are dominant organisms of the terran biosphere and constitute the fifth kindom. Ranging from mosses, liverworts, ferns and their allies to the conifers and flowering plants, they provide food, shelter, and ambiance for the members of the other kindoms.

It is relevant that viruses grown in all the five kindoms. Perhaps they deserve their own kindom. In this sense though, they bridge to the molecules, which also may as well require recognition of their integrity as another kindom. The first five kindoms are organisms most of whom are free-living. The viruses propogate only by virtue of their interaction with living cells and the protein synthesis system inherent to all cells. Thus the viruses serve as a bridge between the cellular organisms, which build them.

The Sunflower Alliance among the Flowering Plants

Within the kinship domain of the plants, the flowering plants are the most recent to develop on earth, having arisen during the past 120 million years. What is now considered a major transition in the biosphere occurred about 65 million years ago. The dinosaurs disappeared, many new insect and bird species arose and the mammals began to adaptively radiate lineages one of which gave rise to us. Analysis of relationships among the plants begun several thousand years ago focused first on easily visible characteristics such as the structure of the stems, leaves, roots, flowers and fruits. During the past several decades, with the aid of light and electron microscopes in combination with molecular analyses of genetic materials, DNA and RNA, proteins, other large polymers and the simple building blocks that are used to make them, the fine details of kinship have been increasingly well defined.

The flowering plants are distinguished by their seeds, which are protectively wrapped in modified leaves. When the seeds germinate, they give rise to primary leaves called cotyledons. About $\frac{1}{4}$ of the flowering plants have a single cotyledon (monocots). The rest have two (dicots). This is one of the primary distinguishing features of the flowering plants.

Within the dicots, there are 24 major groups called superorders by botanists Rolf and Gertrude Dahlgren. The Asteranae or Aster Superorder contains two orders, the Asterales and Campanulales. The Asterales consist of one major family, known for generations as the composites, the Asteraceae. The major families in the Campanulales are the Campanulaceae, the bellflowers, the Lobeliaceae, the lobelias.

Relationship to the Daisies to the Umbels

The primary distinguishing feature of the daisy family is the organization of many tiny flowers, called florets, into a capitulum or head. This is familiar to us in garden flowers such as zinnias, cosmos, marigolds and particularly sunflowers. Close relatives to the daisy family are members of next near-neighbor superorder, the Araliae, the carrot-ginseng alliance, which includes the Apiaceae, the carrot-parsnip-celery family. Flower tops of dill, parsnips, carrots, caraway and angelica have clusters of tiny flowers similar in many ways to those of yarrow, chamomile, tansy and chrysanthemum. Biochemically, the two groups have many distinguishing molecules in common. Ecologically, the carrot and aster families include species that predominantly inhabit the temperate zone or cooler montane ecosystems of the tropics.

The Biogeography and Speciation of Sunflowers

Sunflowers are daisies, members of the Aster family, which together with the orchids are the two largest families of plants on earth. Within the confines of botanical science having to do with collecting, cataloging, and analyzing the bewildering diversity of life that grows on the planet, we find daisies of many kinds in many environments. From the cold fringe edges of snowy mountain and ice fiends to hot jungle thickets and virtually waterless sand deserts, there are plants with composite flowers made up of small florets clustered together into flattened or hemispherical arrays. Familiar plants like lettuce, chamomile and dandelion belong to this grand, well-adapted and hugely successful group of organisms. In current terms, there are from 14-17 tribes of daisies including more than 23,000 species whose worldwide distribution, vigor and attractiveness have made them the favorite flowers of gardeners and farmers. The golden yellow-orange corona of our small star is reflected in the petals of sunflowers.

The Sunflower Tribe in the Daisy Family

In a recent study of the DNA in the chloroplasts of members of the daisy family, a remarkable discovery was made. In all but a few closely related members of this large family, a large piece of the chloroplast DNA was inverted. This gave support to the concept that a group of shrubby plants endemic to northern South America were ancestral to all the other daisies.

Most of the daisies belong to either the Chicory or Aster Subfamilies. The Chicory Subfamily includes the Thistle Tribe with members like globe artichokes, cardoons, scotch, bull and milk thistles, safflower and bachelor buttons. The

lettuces, dandelions, and chicories are the main constituents of another group, the Lettuce Tribe. The Vernonia Tribe, the ironweeds are found mostly in Brazil with some in Africa. There are several smaller tribes in this subfamily including the South American Mutisia Tribe, likely ancestral to the rest of the daisies. In the Aster Subfamily, we find many familiar garden plants. These are also distributed in tribes. The Inula Tribe includes such everlastings such as strawflowers and medicinals such as elecampane. The Calendula Tribe has the pot marigold and several other African genera. The Aster Tribe includes goldenrod, fleabane, gumweed, turfing daisies and asters. In the Anthemis Tribe we find chrysanthemums, tansy, roman and tea chamomiles, yarrow and mugwort. The Senecio Tribe includes the succulent daisies, and the largest composite genus of about 1500 species, Senecio. The Eupatorium Tribe, largely South American includes joe-pye weed and the garden perennial Ageratum. The marigolds, genus Tagetes, together with several other smaller genera are sometimes considered their own tribe. Sometimes they are included in other tribes including the Sunflower Tribe. The Sunflower Tribe, the Heliantheae, comprises about 250 genera and 4000 species. The genera can be distributed into about 26 subtribal groups of which the core group, the Sunflower Subtribe or Helianthinae contains about 28 genera and 430 species. The major genera in this subtribe are *Viguiera* with 150 species and *Helianthus*, the sunflowers, with 50 species.

In addition to *Helianthus*, the genus of sunflowers, the sunflower tribe contains many genera and species familiar to temperate zone gardeners. Some are pestiferous weeds like cocklebur, *Xanthium strumarium*, whose fruits catch on our clothes and bind tightly to the fur of passing animals. Others have tickseeds or sticktight-like *Bidens* and *Coreopsis*. Some are beautiful garden flowers: *Cosmos*, *Dahlia*, *Gaillardia* (the blanket flowers), *Tithonia* (the Mexican sunflower) and *Zinnia*. Others are attractive wildflowers sometimes included in species and conservatory gardens. These include the Oregon sunflowers *Wyethia* and *Balsamorhiza*, the new Mexican desert marigold *Baileya*, the tarweeds of the genus *Madia*, the creeping zinnia *Sanvitalia*, the coneflowers *Dracopsis*, *Ratibida* and *Rudbeckia*, the medicinal herbs *Echinacea* and *Spilanthes*, the paper daisy *Psilostrophe*, the rosinweeds *Silphium*, the niger seed *Guizotia* and *Berlandiera*, the chocolate daisy. Tuberous rooted foodplants are found in two genera in the sunflower tribe; *Polymnia sonchifolia*, the Yacon of South America and *Helianthus tuberosus*, the Jerusalem Artichoke or Sunroot from the Mississippi basin of the United States.

The Genus *Helianthus*, the Sunflower Species of the US

From the Atlantic to the Pacific oceans, the golden yellow daisies of the sun grow in the soils of North America. From the wet, mucky soils of Florida to the dry open prairies of the Great Plains, from the deep, dry sands of the Mojave desert to the montane woodlands of Oregon, from southern Canada to Baja California and central Mexico, grow the 50 species of *Helianthus*, collectively known as sunflowers. Some only grow for a single season, called annuals. Most grow as perennials, living for several years. None get old like trees but tuberous ones are vegetatively

propagated without seeds for generations. The sunflower heads are generally composed of several hundred florets, each of which gives one seed. The largest sunflower heads have as many as 8000 florets.

Population sizes and number of individuals vary widely. In the urbanization of Los Angeles, the Parish subspecies of Nuttall's sunflower which lives in the wet swamps of coastal California has not been found for several years and is likely extinct. Two species, *H. exilis* and *H. paradoxus* and one natural hybrid *H. x multiflorus* are endangered. Seven species are rare, existing in small, isolated populations.

Detailed examination of the species reveals a diversity of chromosome numbers, in multiples of 17, the basic number. While most species have 17 chromosome pairs in their diploid cells, for at least 10 of them, $n=34$ or 51 . Thus there are tetraploid and hexaploid species. That many of the species of *Helianthus* are interfertile has given wonderful opportunity for transferring important agronomic and horticultural characteristics from one species to another.

The basic taxonomy and many aspects of sunflower biology have been developed by Dr. Charles Heiser and his students during a lifetime of enquiring and thoughtful work. The accompanying Table 1: Sunflower species of the US is a summary of the species in the genus *Helianthus*, including Latin and common names, encapsulating geographic distribution using the postal code abbreviations for states, their condition, ecology and most of the known chromosome numbers.

For greater depth discussions, we suggest the very excellent book by Rogers, Thompson and Seiler [Sunflower Species of the United States](#) and the paper by Schilling and Heiser.

Sunflower Species in Cultivation

Perennial Species

Among the 30 species of perennial sunflowers, two are somewhat widespread in cultivation. Probably the most widely cultivated of these perennial species is the foodplant *Helianthus tuberosus*. Known as the Jerusalem Artichoke,, Sunchoke or Sunroot, several varieties of this species are grown by backyard gardeners, market gardeners and commercial agriculturists. Most popular are the French Mammoth with white skinned, white-fleshed knobby tubers produced in great abundance. In 1974, at a farmers market in southern Oregon, I saw two folks in their 70's excitedly picking through a flat of unusually shaped tubers. I asked them what they were and why they were so delighted by them. They replied that they are Jerusalem Artichokes, choice foods for them since they were both diabetics. I bought 5 pounds and have been growing them ever since.

The tubers of *Helianthus tuberosus* contain inulin as their storage polysaccharide. Unlike potato starch, which is made up solely of glucose, the sunroot inulin is more than 95% polymer bound fructose. In fact the inulin is a polymer made up of 35-40 molecules of fructose chemically linked together with one terminal glucose residue. This biochemical polysaccharide digests slowly enough to alleviate blood sugar problems of diabetics.

I have learned that it is unwise to rototill patches of sunroots since even tiny pieces of tuber will sprout and that they can spread aggressively. During the past decade several other varieties have become available. Seeds Blum introduced the Fuseau, a variety with elongated tubers with pale yellow skins and yellowish flesh. They are easier to clean than the French Mammoth and have a little more aromatic taste. Very attractive is the Magenta Sunroot, a purple skinned, white fleshed cultivar that is not as productive or vigorous as the other two but has an excellent flavor and a lovely appearance.

Helianthus maximiliana is probably the most widely grown perennial ornamental sunflower species. It grows 6-8' tall with attractive foliage and clusters of small yellow flowers in the fall. *H. decapetalus*, *H. salicifolius* and the natural hybrids *H. x laetiflorus* and *H. x multiflorus* are attractive perennials grown occasionally for their flowers and foliage. Alan Wade of Prairie Moon Nursery in Winona MN offers plants of *H. grosseserratus*, *H. hirsutus*, *H. x laetiflorus*, *H. maximiliani*, *H. mollis*, *H. occidentalis*, and *H. strumosus*. I have grown *H. mollis* and *H. x laetiflorus* in the clay soils of my backyard garden in Oregon for many years. They continue to thrive, flower abundantly and set fertile seeds every year.

Annual Species (other than *H. annuus*)

The silverleaf sunflower, *Helianthus argophyllus* and the Italian White, a pale yellow flowered variety of *H. debilis* are worthy and popular annual sunflowers. The former rapidly grows into expansive 4-6' shrubby bushes, which flower profusely for months and have small seeds very attractive to finches and other seed eating birds. The leaves are thickly covered with soft hairs making them velvety and pleasant to the touch. The 3-4" flowers are good in bouquets. The flowers of the Italian White sunflower are reminiscent of cactus-flowered Dahlias. They make 5-6' slender plants good for borders and attractive for the delicacy and coloration of their flowers.

***Helianthus annuus* Its Hybrids and Varieties**

Undoubtedly the most popular sunflower species in cultivation is the annual species *Helianthus annuus*. There are many hybrids and varieties derived from this species. *H. annuus* has been crossed to all of the other annual species except *H. deserticola* and *H. agrestis*. A cross of *H. annuus* to *H. petiolaris* resulted in flowers without pollen resulting from a genetic phenomenon called cytoplasmic male sterility. This generation of male sterile lines has been used to improve the oil content, pest resistance and productivity of commercial oilseed sunflowers.

Many sunflower species and within *Helianthus annuus* in particular, the plants are outbreeders. They are adapted to accept pollen from neighboring plants with a different genetic constitution than their own. This phenomenon of self-incompatibility makes breeding of new horticultural lines a talent that combines good observational skills, patience and perseverance. In the development of

attractive sunflowers for gardeners, variation in the color of the petals, and structure of the flowers has been most important. Also the stature and shape of the plants has allowed for a variety of sizes of plants and their flowers to accommodate the circumstances available to gardeners.

While most of the wild sunflower species have golden petals, selections for other colors and patterns has occurred for centuries. Most of the sunflowers have ray petals, ones radiating out from the edges of the flowers. The florets in the center, the disk florets are usually barren of petals. However, in Van Gogh's vase of 14 sunflowers there are ones with many petals, both on the outer ring as well as in the center. These double or multiple petal types are popular and beautiful horticultural types. Most striking in this regard are Supermane, originally developed in Turkey and part of the USDA sunflower seed germplasm collection. Although it is the largest and thickest of the Lion's Mane type sunflowers, it is poorly fertile and securing large amounts of fertile seeds is difficult.

Occasionally in our growouts of double sunflowers, we have found rare plants where the disk petals are tubular. The same phenomenon is found in *Cosmos bipinnatus*, the annual garden cosmos which is usually a mixture of three flower colors, white, dark purple and pink. Selected from this species is the variety called Sea Shell Cosmos where the petals are tubular rather than flat. So, although unselected as yet, we can see Sea Shell Sunflowers in the future of garden flowers. *Helianthus laciniatus*, one of the perennial sunflower species, has ray petals that are tubular for part of their length and flattened and enlarged at the distal ends. They look somewhat like oars or propellers. A similar petal morphology is found in some *Osteospermum eklonis* cultivars, a daisy family species in the *Calendula* tribe. *H. laciniatus* is known to cross with *H. niveus* which is known to cross with *H. annuus* so we can envisage the emergence of yet another spectacular kind of sunflower.

Within populations of golden-petalled sunflowers, one can find flowers with pale yellow petals, (lemon), purple petals, red petals, or deep orange petals. Some plants have red or purple blotches in the middle of the golden petals and since the petals form a ring, the flowers look like the flowers of the Gloriosa Daisy or Black-eyed Susan, *Rudbeckia hirtia*.

Occasionally there are other flower types in the sunflower fields. Spontaneous crosses of the giant singleheaded sunflowers of the Russian Mammoth type to double flowered Lion's Mane kinds give rise to giant plants with large single heads having intermediate sized disk petals covering the surface of the huge flowers. So far, none of these has been fertile. We continue to look for a Giant's Mane in our gardens.

In addition to flower type variation, there are interesting variations in the structure of the plants. Of particular interest to us comes from the observation that some plants have branches with many flowers clustered along the length of the branch. Once in a rare while the phenomenon is observed along the central stalk of the plant. Rather than having branches, the entire plant resembles a column of flowers and we call it a Flower Tower Sunflower.

The Gloriosa and Lion's Mane sunflowers have many branches. The plants frequently grow to 8' in height and have as many as 30 branches with one to several flowers per branch. On one occasion, we found a cross of the Israeli 6' singleheaded

variety with the silverleaved sunflower *Helianthus argophyllus*. The plant was 12' tall. Its children were 8' tall, exceedingly vigorous and had more than 50 sturdy flowered branches per plant. In the other direction, dwarf sunflowers like Sunspot with large single heads on diminutive 2' plants make a new component to interweave among the vegetables. They fill a niche in small gardens where tall plants overdominate and where the occasional big flower is well appreciated. Combinations between the dwarf statured plants and ones with purple and gold flowers having large central eyes is an attractive direction for the future.

Since the annual sunflower species are infertile, and since *Helianthus annuus* has so many beautiful colorful cultivars, there is a world of plant breeding waiting for the curious, ingenious and patient gardener who would like to explore beauty and genetics in the development of variety.

Another feature of annual sunflowers that is rarely appreciated is their great honey-like fragrance. Many times I have marveled at the sweet scent that accompanies the beauty of the flowers. Some lines and varieties are more fragrant than others and this characteristic also remains to be developed in the horticulture of sunflowers.

The Sunflowers of Vincent Van Gogh

Van Gogh had more success in his love affair with sunflowers than he had with women, the society he lived in and life in general. Beginning in 1886, and for the last three years of his short 37 years, he painted sunflowers. He began by painting sunflowers from Montmartre gardens in Paris. From an exhibition in a popular restaurant where many of his still lifes were shown, his brother traded two small sunflower paintings with Paul Gaughin for a Martinique landscape. One of these was later sold to Edgar Degas. Gaughin visited Van Gogh in the south of France in the fall of 1888 and painted Van Gogh Painting Sunflowers in Arles during their stay together.

In a letter to his brother Theo, Vincent Van Gogh wrote on January 28, 1889, "During your visit I think you must have noticed the two size 30 canvases of sunflowers in Gaughin's room. I have just put the finishing touches to the copies, absolutely identical replicas of them." And in a letter to Theo on May 22 of the same year, two months before his death, he says "Gaughin himself liked the sunflowers better later on when he had been looking at them for a good while". (quote 1 Auden pg 339; quote 2 Auden pg 356).

The visionary painter Vincent Van Gogh created more than fifteen sunflower paintings. Cezanne didn't do a single one; neither did Picasso. He was a century ahead of the current gardening and fashion craze that has recently captured the fancy of European, Japanese and American flower growers and horticulturists. In one of his most famous paintings picturing a vase with 14 sunflowers, there are both single and double petalled types anticipating the popularity of Lion's Mane, Teddy Bear, and Supermane. Eleven years before Van Gogh's death, Gaughin, in Tahiti, paid his final homage with 3 still lifes of sunflowers, a memory to his brilliant and tormented friend who loved sunflowers and immortalized their size, beauty and structure with a series of unforgettable paintings. Ironically, one of Van Gogh's

paintings of sunflowers was sold for the highest price of any painting in art history, 50 million dollars. Van Gogh was impoverished and destitute for much of his adult life, barely able to pay rent and buy paints and canvas.

The Heroic Journey of an American Weed

“One man gathers what another man spills”
-Robert Hunter

Before Thomas Jefferson bestowed upon us the wise dictum that the best thing a person can do for their country is to introduce a new food plant into agriculture, in fact, before the United States was a country and at the time when it was a small British colony, what was to become the Kansas state flower and its relatives, sunflowers all, were being cultivated throughout Europe as a consequence of Columbus's journeys to the new world.

Weeds in one place become treasures in another. This statement updated from Jefferson's has been repeated biologically innumerable times. While 'familiarity breeds contempt' may be too harsh, there is no doubt that the value of weeds common in one ecosystem can be overlooked by local citizens, while when they are transported to another locale, they become noticed, developed and even celebrated. Peppers are Bolivian weeds and they are now essential condiments in Asian, Mexican, Italian, and Mideast cuisines. Central Asian rosaceous trees with small hard fruits have been selected by generations of horticulturists and apples are now distributed worldwide and cherished by temperate zone gardeners. The American sunflower has a similar history.

Exploration on the new world following the Nina, the Pinta and the Santa Maria led to discoveries of the three sisters, corn, beans and squash. These staple crops together with the fourth sister group, the nightshades, which includes tomatoes, peppers, potatoes, tomatillos and tobacco were essential in milpa gardens of many American tribal peoples. Less heralded but nutritionally important were the sunflowers that thrived on the margins of their camps and within the borders of their gardens and gave edible, nutritious seeds. The fruit of the sunflower consists of an internal kernel and an outer hull. Scientific terminology calls this combination an achene. There are remnants of sunflower achenes in many Amerindian sites. Some found in a site in North Dakota are longer and thinner than either those of wild species or modern cultivars and likely have a unique origin and probably a more ancient history. Sometimes the receptacles of sunflower heads as well as the achenes have been found; for example, in the Newt Kash Hollow Shelter archaeological site in Kentucky. Field evidence and C-14 dating indicates that cultivation may go back to several thousand years BC in New Mexico, Arizona and the Missouri-Mississippi basin. There are many species of sunflowers native to temperate North America. Botanically, the genus *Helianthus* contains about 50 species. They are native to the USA and northern Mexico. South American species are assigned to the genus *Helianthopsis* are mostly native to Peru. Native Americans of a diverse group of tribes extending virtually across the whole country used sunflower seeds in one way or another. Potentially the beginnings of our

domesticated sunflower had a diverse set of origins involving several of the wild species that became first weedy, then crossed back to wild species and were collected and selected by the different peoples. The nomadic tribes, particularly in the western US, that gathered from wild plants used the seeds for food and medicine also used the seed hulls for a purple dye that stained their baskets, textiles and bodies. Tribes in the eastern US were experienced gardeners and grew sunflowers among their other crops. They had large single-headed sunflowers in their gardens, evidence for selection from the wild and/or weedy species, which have many flower spikes with rather small flowers. Thus in the millennia of inhabitation of North America prior to Columbus, sunflowers were selected for large heads by Native Americans.

Major among the plant treasures of the new world were the edible seeded golden yellow daisies. The transfer of sunflowers from North America to Europe following Columbus's epic journeys is nowhere recorded. However, in 1568, the Belgian herbalist Dodonaeus wrote a description of the American single headed sunflower with an unambiguous wood cut illustration. During this era, sunflowers were recognized by the English, Spanish, French, Italians, Germans, and the Dutch as being useful for their gardens as well. It was grown as an ornamental in Hungary in 1664. Czar Peter I of Russia or Peter the Great as he was known for most of his career, travelled incognito to the Netherlands in 1697 wherein he likely encountered American sunflowers growing in the Dutch botanical garden in Leyden. Thus two centuries before the renowned Russian ecobotanist Vavilov traveled and collected and defined the biological origins of most of our important crop plants, the Russian emperor acted as a biologist and seedsman by carrying samples of fertile sunflower seeds back to mother Russia. Thanks to human ingenuity and strength of character, they became a major oil seed and food plant for the peoples of the cold steppes of the Eurasian continent.

The Holy Orthodox Church of Russia and its Contribution to Human Nutrition

For religious Christians, the most solemn time of year is Lent, the forty days before Easter. This profound springtime observation memorializes the period that Jesus spent fasting on in the wilderness of the Judean desert, divining from God the future of his incarnation on earth. During Lent, orthodox Christian religions worldwide reduce the affluence of the diets of their parishioners, including the elimination of animal products and fatty foods. This encouragement to fast, pray and practice asceticism presages the baptismal ceremonies celebrating the death and resurrection of Christ. While sunflowers had been grown in Russia from the time that they were introduced by Peter the Great, they had not been proscribed by the Holy Russian Orthodox Christian Church and were not included in a list of high fat crops not to be eaten during Lent. The peasants, recognizing the importance of having fat, the highest energy source of all of our foods, in their diets, obeyed the letter of the law while maneuvering around it by incorporating sunflower kernels in their culinary regimes. By this time another virtue of sunflower seeds had become clear to the peasants of Eastern Europe and the Asian steppes. Sunflower oil has a lower setting point than animal fats. Thus it remains liquid at lower temperatures. It

pours during colder weather and provided an oil for illumination as well as for cooking. The seeds themselves having 30-50% fatty acids made a wholesome and nutritious contribution to breads, soups, and stuffing. Since sunflowers were aliens, introduced from beyond the great oceans, the church officials forgot to interdict their use. In this way, Russian peasants began to grow sunflowers much more widely and what was a pretty flower for annual gardens became a major staple for a great country. Sunflower seeds remain to this day a primary snack food in Russia.

The American weed that travelled to Russia via Holland was a mixture of types including the large single headed and multibranched polyheaded types. When it was grown in Russia, the peasants recognized the value of large single flower heads and large seeds. They also selected for thinner shells and an increased amount of oil in the kernels. Thus in the tradition of agriculture worldwide, the native peoples selected for horticulture worldwide, the native peoples selected for horticultural characteristics improving a weed into an agricultural crop. Mennonite immigrants from Russia in the mid 1870's to Canada brought seeds from their kitchen gardens to their new home-land in North America. Several American seed companies first offered the Giant Russian Sunflower in the 1880's. The American sunflower, a North American weed found favor and acclaim in many foreign lands. It returned home with celebration and fanfare. In the process, fortunes have been generated, farms saved and lives improved.

In one of Van Gogh's 1887 paintings, standing majestically above a garden full of plants in a Parisian neighborhood are large stalked, single-headed sunflowers. These are reminiscent of Russian Mammoth's, the outstanding variety with striped seeds and huge heads that today are still very popular with many American gardeners.

Gardening with Sunflowers

"When I was a small boy in Tennessee, my grandmother planted a few sunflower seeds in the corner of the garden. She said they were planted for the three B's: beauty, bees and birds. How those plants did grow. They held dominion over all other plants in the garden because of their size and beauty."

Johnny Pendelton

Mac Hoke, County Agent of Wallowa County in Oregon wrote in the 1920's "Sunflowers have not proved difficult to grow; in fact we have found the crop to be one that stands neglect better than any other forage crop. On the other hand, sunflowers respond to good tillage and proper care as well if not better than other commonly grown crops.."

These quotes reflect a common observation concerning annual sunflowers. They are the pride of a novice gardener. They sustain the experienced gardener whose experience with difficult crops makes the ease of growing sunflowers even more appreciated. Frequently they come back from the previous years gardening. Fertilization and cultivation can give stunning plants, reminding us to cherish the marvel of life. The huge flowers of the giant single headed kinds bring delight from the children, aah's and sighs at the market and prizes at the county and state fairs.

The colors and textures of the brightly colored new hybrids and open pollinates light up our minds and stimulate our gardening as only the wonder of nature can achieve.

We garden with sunflowers in many ways and with several strategies. Early in the spring, we plant seeds in flats in the greenhouse. Once they have germinated and developed several leaves, we transplant them, 1-2 seedlings in a 4" pot and grown them until mild weather arrives. Then they are transplanted into the garden to provide the earliest flowers. Generally this is a two weeks to a month before the volunteers and earliest direct seeded ones flower. We find this useful in breeding as well as to secure the earliest sunflowers for the market.

The differing heights of the various sunflowers allow us to use them for isolating other plants in the garden. Segregating corn varieties from one another can be furthered with sunflower hedges. Isolating basil using sunflowers works well in this regard as well. Stacked tiers of different height sunflowers with different floral characteristics make stunning arrays of intense beauty and aroma. Although we plant many batches of sunflowers that we collect from our fields, we always leave areas for volunteers from the prior year's crops. These routinely have unusual flowers that escaped our previous year's seed collecting. The open-pollinated volunteers make thickets and mazes that amuse our children and are free of the patterns that our agriculture and its machines produce. Naturally the birds appreciate our efforts and harvesting seeds means that we have to pay attention to their maturation lest they get there before us. Blackbirds are well known competitors for sunflower seeds in the commercial fields of North Dakota and neighboring states.

When friends of ours who raise grapes had problems with birds feeding on them, we found that planting sunflowers nearby gave the birds abundant food and shelter such that they ignored the grapes completely.

The Nutritional Characteristics of Sunflower Seeds

Sunflowers are grown extensively through out the temperate zone. The same cultivars succeed in all the major continents, from North America to Europe and Asia, from Australia to Africa and to South America.

What is commonly called the sunflower seed is botanically a fruit, technically an achene. It consists of an internal kernel and an outer hull. Before processing, the achenes are dehulled. Agriculturally there has been extensive selection for different types of hulls. The thicker hulls with larger kernels are grown for the confectionary market as shellable achenes and shelled kernels, usually roasted and salted, and eaten out of hand. Some are made into sunflower butter. The hulls make up 40-45% of the weight of the achenes. Only 5 % of the US crop is used for direct consumption. For ones destined to yield oil, selection has been made for thinner hulls and kernels with a higher oil content. Since the hulls contain waxes, pressing or extracting oil directly from the achenes yields an inferior oil that contains hull waxes. Thus most oils for human use are made from dehulled achenes. The hulls are used in animal feeds for roughage, for producing organic compounds, as an energy fuel and after combustion as a high potassium fertilizer.

Oilseeds

Sunflowers are the fourth largest oilseed crop on earth, followed by soybeans, cottonseed and rapeseed. While sunflowers are native to North America, their cultivation was primarily for horticulture until the late 1970's when millions of acres came under cultivation for the production of seed, oil and protein cake. Most of the production of sunflowers in the USA comes from North and South Dakota and Minnesota. In 1995, the average yield per acre was over 1300 pounds of achenes. By weight, hulls constitute 20-25% of the oilseed achenes.

Dehulled achenes are extracted with hexane or pressed directly to yield oil. Before these processes they are usually dried and then made into flakes. The oils from sunflower kernels are low in saturated fatty acids and high in polyunsaturated fatty acids. Nutritional research has shown that human blood cholesterol levels and the incidence of heart attacks can be reduced by lowering the intake of total dietary fat and replacing saturated fatty acids with unsaturated ones. Thus sunflower oil which is mostly a mixture of oleic and linoleic polyunsaturated fatty acids is a beneficial addition to our diets. By growing the sunflower plants in cooler northern climates of warmer southern climates, the ratio of oleic to linoleic acid can be varied. Colder climates increase the ratio of linoleic acid to oleic in the oil. Genetic selection for sunflower lines with different ratios of these two fatty acids has also been accomplished. In addition, in *Helianthus debilis* var *cucumerifolius*, kernels contain 40.1% oleic acid and 84.2% linoleic acid. Thus these species provide another way to change the composition of sunflower seed oil. Since linoleic acid is an essential dietary component for good health, the use of sunflower oil for margarine, shortening, salad oil and cooking oil continues to increase.

Protein Yield and Amino Acid Content

Confectionary sunflower kernels are dried and ground into sunflower seed butter. This nutbutter is a high protein, high oil food. The kernels are also used in a variety of food preparations including breads, cookies, candies, cereals, stuffings, and as a topping on salads. After the oil has been removed, a high protein cake or meal remains. While the original oilseed kernels contained 20-25% protein, the meal contains 60-65% protein. A critical aspect of this meal is the balance of amino acids, namely the quality of the protein in respect to the quantity provided. It is a good source of the essential amino acids isoleucine and tryptophan. The limiting amino acid in sunflower meal protein is lysine, similar in this way to corn. Although corn is also deficient in the sulphur amino acids methionine and cysteine, sunflower protein is not. Since soybeans, the source of the major seed meal in world commerce, contain enough lysine but are low in the methionine and cysteine, sunflower protein adds a valuable contribution to the balance of amino acids provided by corn and soybeans.

Vitamin E, other Vitamins and Minerals

Sunflower kernels contain important amounts of iron, calcium, phosphorus, sodium and potassium. The amounts vary with the genetic constitution of the seeds, the soils, fertilization, irrigation and other aspects of the growth conditions. Similarly for the vitamin content whereby the kernels contain the water soluble B vitamins, thiamin, riboflavin and niacin.

In the sunflower seed oil are found two anti-oxidant vitamins. Small amounts of beta-carotene, the precursor to Vitamin A and significant amounts of Vitamin E, the tocopherols, are found in the kernels. Of all the commonly available vegetable oils, sunflower oil has the highest amounts of alpha-tocopherol, the most active form of Vitamin E.

Conclusion

I urge you to grow and cultivate sunflowers in your garden. Although sunflowers grow in most soils and under a wide variety of conditions, the native habitats of wild species continue to be destroyed. While hybrids and commercial varieties are still under development, innovation in the combination of wild and modern kinds is relatively unexplored. The vigor, beauty and diversity of sunflowers make them prime allies in improving our soils, gardens and lives.

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