The Plant Press

THE ARIZONA NATIVE PLANT SOCIETY

VOLUME 17 NUMBER 3 SUMMER, 1993

A DEBT TO THE FUTURE: SCIENTIFIC ACHIEVEMENTS OF THE DESERT LABORATORY, TUMAMOC HILL, TUCSON, ARIZONA

by Janice Bowers

(Second of a Two-Part Series)

The Productive Years - 1906 - 1917

The accession of Forrest Shreve proved to be another milestone in the history of the laboratory. Shreve's appointment to the staff became official on May 1, 1908, and in June he arrived in Tucson.

Among his 85 published papers and books were several ecological classics, including *Vegetation of a Desert Mountain Range as Conditioned by Climatic Factors* (1915), *Vegetation of the Sonoran Desert* (1951), and *The Desert Vegetation of North America* (1942). His steady concentration on ecological research, his creativity in attacking and solving new problems and his devotion to the desert helped forge the reputation of the Desert Laboratory. If Shreve shaped the reputation of the Desert Laboratory, it in turn molded him, gave him a focus for his interests and scope for his abilities.

Shreve's studies of *Carnegiea* (Shreve, 1910) and foothill palo verde (*Cercidium microphyllum*) (Shreve, 1911b) were among the earliest analyses of the changes that take place in plant populations with time. Based on heights of individual *Carnegiea* plants, he derived a growth-rate curve and estimated that the oldest individuals were as much as 175 years old. He also discovered that, since about 1860, establishment of both *Carnegiea* and Cercidium microphyllum had declined on Tumamoc Hill. His Analysis of high-elevation floras in the Santa Catalina and Pinaleno mountains eventually led him to postulate what later became a prediction of the theory of island biogeography, that massive mountain ranges serve as source areas of propagules and smaller mountain ranges as targets (Shreve, 1919).

(Continued on Page 5)

INSIDE: NOTES....PG. 2, JOJOBA PRINCESS....PG. 4, NATIVE PLANTS & SPACE....PG. 9, CONSERVATION PAGE....PG. 11

NOTES FROM THE PRESIDENT

On a sunny afternoon in February 1976, a nervous thirty year old graduate student waiting to present his first scientific paper at a professional meeting left the floor of the Second International Conference on Jojoba and Its Uses and retired to the adjoining restaurant. Seated at the near empty bar was a small man in his early seventies who with a mischievous twinkle in his grey-blue eyes invited the younger man to join him for "just the one" as the Irish say. Although I had never lain eyes on him prior to that moment, I somehow knew that this gentleman could be none other than Dr. Howard S. Gentry, retired U.S. Plant Explorer, pioneer in jojoba research, and world authority on the genus *Agave*.

At the time of his death at 89 in Tucson in early April, Dr. Gentry - an ex-officio member of our ANPS Board of Directors - had touched the lives of a great many of Arizona's botanists, horticulturists and desert plant enthusiasts. Howard Gentry was an inspirational figure from an heroic age of arid plant science - exploring from horseback the flora of the Mexican Rio Mayo in the 1930s, working on the wartime Emergency Rubber Project in the 1940s, travelling around Iran in search of gum tragacanths and around the deserts of Arizona and California in search of jojoba in the 1950s. We loved and respected Dr. Howard Scott Gentry greatly, and, we will miss him deeply.

In 1978, at the age of 74 and after many years spent studying, thinking and writing about jojoba, Dr. Gentry (using the pen name "Matchmaker") summed up his vision of the future of his now famous Sonoran native. Addressing the Third International Conference on Jojoba and Its Uses, Matchmaker delivered an innocent seeming-homily that left many in the audience scratching their jojoba-conditioned heads and asking "What's the old fellow getting at?" Like a mountain climber who surveys the world from a great height, Matchmaker had seen far and wide and predicted the future of sleeping Princess Jojoba with deep insight and characteristic impish humor. It is both for the benefit of that insight and for a *recuerdo* of delightful quality of mind that we shall all now miss so that I have asked our editor to reprint Dr. Gentry's 1978 address "Jojoba: The Sleeping Princess." Rest in peace, our sleeping Prince. You will live on in out memories and in our dreams.

- Bill Feldman

Dr. Gentry and his wife spent a portion of their lives at the Desert Botanical Garden. Each, in their own way, had an impact. The following excerpts are reprinted from the Summer 1993 issue of the Sonoran Quarterly.

"Biology Loses A Giant: Dr. Gentry Dies in Tucson

"...Dr. Gentry was a towering figure in the world of biology and considered one of the world's foremost experts on agaves. Much of the strength of the Desert Botanical Garden's agave collection is the direct result of Dr. Gentry's work.

"Dr. Gentry and his wife, Marie, moved to the Garden in the early 1970's, occupying the Archer House when it was still used as a residence. While at the garden Dr. Gentry wrote *Agaves of Continental North America*, still regarded as the major work on agaves.

"Dr. Gentry retired from the Garden in 1987 and moved to Tucson a year ago. His wife, Marie, was a long-time Garden volunteer."

COMMENTS FROM THE (SUBSTITUTE) EDITOR

o The story continues concerning the Desert Laboratory. This second installment of a two-part series starts out with the arrival of Forrest Shreve and his accomplishments, through the difficult years and the closing of the facility in 1940, to the present renaissance. You'll find it interesting, at times discouraging, but in the end hopeful for the future of the "Desert Laboratory."

o Enjoy "Jojoba: The Sleeping Princess" written by The Matchmaker, aka Dr. Howard S. Gentry. Bill Feldman asked that this be printed in memory of Dr. Gentry who died in April. Bill summed it up in his "Notes" when he said that Dr. Gentry "had touched the lives of a great many of Arizona's botanists, horticulturists and desert plant enthusiasts." In addition, it appears that Bill has lost both a mentor and a friend.

o "Native Plants and Space" is a truly unique look at the relationship that native plants and non-native plants have with their environment. Through the use of colorful words and phrases, a poetic mental picture is created.

o Continuing the native plant theme, a response is included concerning the question "What is a native plant?" Aren't you glad we asked that one - this debate may go on for years.

o The Conservation Page describes the continuing destruction of the Ironwood tree in Mexico to satisfy the demand in the U.S. for charcoal and wood carvings. Also discussed in the resolution of a lawsuit concerning endangered species, specifically several plant species.

And finally, you may notice that there is no Chapter and Committee News. Well part of the reason is that it is summer and there isn't a lot going on. But even if there is something happening, no one bothered to tell me! I'm a strong believer in treating adults like adults so I have not bothered to track down anyone to see what's going on. Most of you are pretty good about getting stuff submitted, so this isn't targeted at you, but there are a few people who could be doing a better job submitting info for The Plant Press.

PLANT PRESS NEWSLETTER CONTRIBUTIONS

Contributions of articles, artwork, and letters to the editor are gladly received and may be handwritten, typed, or on disk, ASCII preferred. Disk and diskettes will be returned if requested.

Please send to:
The Plant Press
c/o Dean Brennan
906 W. Cheyenne Drive
Chandler, Az. 85224
(602) 786-9554

NEXT DEADLINE: AUGUST 31, 1993.

Please direct all inquiries regarding the Arizona Native Plant Society to the Secretary at the official address:

P.O. Box 41206 Sun Station
Tucson, Az. 85717

JOJOBA: THE SLEEPING PRINCESS

Jojoba is like the sleeping princess who waited 100 years until the kiss of a certain prince could awaken her. Actually, it took resounding smackers from two princely entrepreneurs from well beyond the Kingdom of Jojoba to bring her to light. One is still known as Chief Jojoba; the other we call the Entrepreneur. At this date one wonders if Jojoba really is responsive yet. Already she has suitors by the hundreds cajoling her, extolling her, probing her, and panting and peddling her, but some of us are asking what will her dowry be? I am innocent, she may say, you are the chooser, and only to him who can choose wisely from my multitudinous gifts will fortune come. Only then can the symbiotic marriage of Man and Jojoba be fully consummated and the magic oil fully anoint the broad bald head of Industry.

Now, the great gift of Jojoba is her variability. Her stature is tall or short, spreading, dense or loose. Her leaves are green or gray, thick or small. Some flowers will fall at the light kiss of frost or from other cause; some hang on for weeks or months. Some open for pollen when no pollen is flying. Her fruits are small, round or long; some are large but never large enough; some are one-seeded, two-seeded, or three seeded; some grow singly, twinned or clustered; some dehisce easily or not at all. Her seeds vary from pea-sized (2,000 per pound) to peanut size (400 per pound). The oil content varies from 37 percent to 54 percent. Some seeds grow into plants without hesitation, but others start and die from frost or other unknown causes. Jojoba refuses to grow on thousands of square miles in its native habitat on land that appears more suitable than the hot rocky slopes where it abounds.

Princess Jojoba has sent out no pesty dragon for the suitor to slay. The challenge is to put together the pieces of the prodigious puzzle she displays: to find the combination of leaf and branch, of constitution for frost, fungus resistance, and persistent fruiting, and the best fruit richest in oil, and easy to harvest. It is all a cross-plant puzzle that must spell *pre-adapted* for each suitor's home. The way of a maid with a man only seeming fickle be, as those of us who have lived long enough to meet ERA now realize. If you are playing Jojoba for fun, then almost any pretty form will do. But if you follow the game of life, then you look for a good breeder, and the challenge is a problem of choices -- CHOICE, that vaunted capacity and prerogative of heady Man. Just choose your bride out of a million when there are none, not one, who you really know. A maid is but a trap, said the philosopher Schopenhauer. Matchmaker can hear the old pessimist chuckling in his grave as the vibes of Jojoba stir him. Nevertheless, the bewitching Jojoba is pursued by the undaunted, babbling, persistent Man, who knows that in the end he will get the best of it. Jojoba baits us with choice in abundance, but what will the harvest be?

> What is a poor man to do?
> Matchmaker said: Watchout! She's a proposition.
> Dr. Chemist said: She has magic oil.
> Chief Jojoba said: Let's jog with Jojoba
> Entrepreneur said: There will be funds from the national coffer for powwows.

Poorman planted Jojoba seeds, which he got for a high price from the pushy peddler of popular thrust. Plant seeds, water pots, set out transplants. Water, weed and prune. Poorman ached with the cold and sweated in the knuckle-hot sun. But frost killed the seedlings. Floods ripped through the plantations. Fungus blotted out others. Count the living, throw out the dead. Replant, weed, watch and wait for seed. When the seed finally came it was small and scarce and its glamour cosmetic price was gone. There was row after row of straggly plants in a wide Jojoba field; poor breeders, poor yielders.

(Continued on Page 5)

Poorman said: It's a seven year walk and no beer.
Matchmaker said: You made a poor choice.
Entrepreneur said: We will have another powwow.
Dr. Chemist said: Whither are we leading the Poorman.
Chief Jojoba said: Go see Dr. Research, the optimistic foreseer.

Poorman sent his son and stayed in his orchard with Jojoba, rubbing his hot knuckles in the desert sun. After five years his son came home with Jojoba genes in his head and Jojoba chromosomes in each hand. Later there was a row after orderly row of cloned Jojoba bushes; all good breeders, all strong bearers. The big, abundant seed was harvested and crushed. Magic oil filled the vats. Entrepreneur called another meeting.

Old Matchmaker said: This is symbiotic celebration.

Princess jojoba became Queen Jojoba. She was there everywhere. She lined the paths to the meeting house, soothing the travel-weary Jojobaphiles arriving from distant countries. She was the conversation piece at every table. There were Jojoba sauces, Jojoba cakes, Jojoba cocktails that lined the intestines of all the feasting guests. Dr. Chemist said: Be merry, have no fear of fat or alcohol. No misfortune can come when you are aligned with this magic oil. Mr. Industry was prominently there. His broad bald pate still gleaming, but with hair on his chest. Jojoba business coursed through his brain and his machinery and products ran like a purr of commercial contentment. Chief Jojoba gave a speech and welcomed the helpful whale lovers. But they were on the beach anointing the beached whales with magic oil. They sent the whales out to sea singing; a paean for the symbiotic marriage.

Poorman heard none of this. He sat in his orchard shade rubbing jojoba oil on his knuckles. He said: It's been seven times seven year walk. Bring me another beer! He had beer and it was brought.

-Matchmaker

This is a talk delivered by Howard Scott Gentry, Third International Conference on Jojoba, September 14, 1978, Riverside, California, and published in Jojoba Happenings, Vol. 25, 1978, Office of Arid Lands Studies, University of Arizona.

(Continued from Page 1)

While working in the Santa Catalina Mountains, he determined that desert plants are limited in their upward movement by cold, and that forest plants are limited in their downward movement by soil aridity. He emphasized that physical environment factors, not competition between plants, control the vertical limits of species distribution. In *Vegetation of a Desert Mountain Range* (1915), he stated clearly that plant species are distributed according to individual requirements and tolerances such that no two have identical distributions. Thus plant communities are not rigidly repeated entities but fluid, gradually changing assemblages. Several years later, Henry A. Gleason, a midwestern plant ecologist, codified and named this principle as the "individualistic concept of the plant association" (Gleason, 1917, 1926). By the 1950's, the individualistic concept was supported by a substantial body of evidence (McIntosh, 1975), and by the 1970's it was widely accepted.

When the Carnegie Institution hired Shreve, they also acquired his wife, Edith Bellamy Shreve. Due to regulations against nepotism, Edith could not be on the Desert Laboratory payroll, but she worked just as hard as any of the salaried staff, and desert studies are richer for her contributions (Bowers, 1986). Trained as a chemist and physicist, she took up research in plant physiology in 1911 under the guidance of Livingston and MacDougal.

(Continued on Page 6)

(Continued from Page 5)

By 1918, she had published six papers, including a study of transpiration in *Cercidium microphyllum* (E. Shreve, 1914) that is still cited in ecophysiological literature. In studying autonomic movements in joints of cholla cactus (*Opuntia versicolor*), she discovered that the plants lost water during the night and took it up during the day, the opposite of the expected pattern (E. Shreve, 1915).

Like Forrest Shreve, Burton Livingston took an experimental approach to plant ecology, and although he thought of himself primarily as a physiologist, his work in Tucson was oriented toward native plants in the natural environment. When he came to the Desert Laboratory as a visiting investigator in 1904, little was known about movement of water from the soil through the plant and into the atmosphere. It was not known how plants removed water from the soil nor how stems conducted water from roots to leaves nor to what extent stomata regulated transpiration nor even for certain that they did. Livingston determined that the rate of evaporation from an artificial surface and the simultaneous rate of transpiration from a leaf were not the same. He inferred that plants do indeed regulate their transpiration rates, and he defined relative transpiration as the ratio of transpiration to evaporation (Livingston, 1906). Within two years, he had determined that relative transpiration "followed quite closely" the pattern of stomatal openings and that stomates "have much if not all to do with the regulation of transpiration."(1)

One of Livingston's more durable contributions was the atmometer, a device that measured the evaporative power of the air. Atmometer data collected from fifty stations in the United States provided the basis for one of his major works, written with Forrest Shreve, *The Distribution of Vegetation in the United States as Related to Climatic Conditions* (Livingston and Shreve, 1921). This 590-page book was one of the early attempts to correlate climatic factors with vegetation types, a long-standing interest of Livingston. In 1908 and 1911 he used evaporation data to explain distribution of vegetation types; in 1913 he defined broad climatic areas based on temperature, precipitation and evaporation; in 1916 he derived an index of moisture-temperature efficiency for plant growth.

After Livingston left the Desert Laboratory in 1909, MacDougal replaced him with Herman A. Spoehr, a young chemist and plant physiologist who had recently earned his Ph.D at the University of Chicago. Spoehr's arrival in Tucson in 1910 eventually proved to be a turning point for the laboratory because his interests lay not in the relationship of plants to environment but in their internal processes. Where Livingston had been a physiological ecologist, Spoehr was a straightforward physiologist, and Livingston's departure left a gap that Spoehr did not fill.

Something of a philosopher, a stickler for detail and a conscientious researcher, Spoehr eventually became best known for his work on the chemistry of carbohydrates. He studied the breakdown of malic acid, a photosynthetic derivative abundant in cactus tissues (Spoehr, 1913). In fact, he was the first to show how malic acid breaks down into simpler derivatives upon exposure to light (Richards, 1915; Evans, 1932). It was to be many years, however, before plant physiologists were able to fit these details into the overall picture of crassulacean acid metabolism, in which cacti and other succulents take up carbon dioxide at night, producing malate, which is broken down the following day into various acids and carbon dioxide.

The Carmel Brain Drain-- 1918-1927

The decade between 1918 and 1928 saw a temporary loss of direction and vigor. By 1918, MacDougal's early interest in desert ecology had waned in favor of physiology and genetics. The Coastal Laboratory in Carmel, California, proved more amenable to his purposes than the desert station, and by 1920 he was residing in Carmel year-round. Spoehr and his family also moved to Carmel that same year. Moreover, once Shreve's work in the Santa Catalina Mountains was completed, he had no particular reason to stay in Tucson during the summer, and between 1918 and 1926, he and Edith spent their summers in Carmel.

At MacDougal's request, the Department of Botanical Research was reorganized as the Laboratory for Plant Physiology in 1923, emphasizing his greater interest in physiology as opposed to ecology. In 1926 Shreve was put in charge at Tucson and Spoehr in Carmel, both remaining under MacDougal's supervision.

The Shreve Years--1928-1940

In 1928 the Desert and Coastal laboratories underwent administrative reorganization again, and the Laboratory for Plant Physiology became the Division of Plant Biology. Spoehr was promoted to chairman of the new division, and MacDougal stepped down. Shreve remained in charge of the Desert Laboratory with full responsibility for its direction and tone.

Recognizing that the quality and quantity of research at the Desert Laboratory had diminished in recent years, Shreve told one colleague in 1930 that "things have been going on rather slowly here...and I am anxious to enlarge our staff and to get a little more motion on the investigations that seem to be most vital to our understanding of the desert."(2)

(Continued from Page 6)

Like MacDougal before him, he publicized the Desert Laboratory in various journals (Shreve, 1929a, 1931), and he succeeded in luring scientists from as far away as Germany and Great Britain. Among them were Heinrich Walter of the University of Heidelberg, who studied osmotic values in the sap of characteristic desert plants, and Eric Ashby of the Imperial College of Science in London, who examined the stomatal anatomy of *Larrea*.

Earlier researchers at the laboratory had placed so much emphasis on cacti that non-succulent perennials had been neglected, Shreve felt. In 1927 he began a comprehensive investigation of *Larrea* and he, his assistants and several visiting scientists studied various aspects of its physiology and ecology until about 1935.

From his study of the stomatal anatomy of this plant, Ashby concluded that its most effective adaptations to drought were the high osmotic potential of the roots and the high osmotic value of the leaves (Ashby, 1932). Ernest Runyon, a visiting investigator from the University of Chicago, argued that "the extreme xeric character of this plant would not be expected from the structure of the mature leaves" (Runyon, 1934: p. 132). Instead, behavioral characteristics enabled plants to survive drought: shedding of twigs, death of older branches, loss of leaves at the onset of drought and resumption of growth with the return of moist conditions, resinous coating to check transpiration and mechanically prevent wilting. Runyon also worked on germination and establishment of *Larrea* in nature and in the laboratory. He learned that the seeds display delayed germination, that the leaves and stems might be allelopathic and that germination in nature is enhanced in disturbed areas (*Carnegie Yearbook* Vol. 28. 1928/1929; Vol. 29. 1929/1930).

Another habitue of the Desert Laboratory during the Shreve years was Howard Scott Gentry, an independent young botanist who supported himself by collecting in remote areas and selling his specimens to herbaria. Interested in Gentry's collections from the Mayo River valley in southern Sonora, Shreve offered him desk space at the Desert Laboratory in 1937 and encouraged him to write up the results of his studies. This Gentry did in *Rio Mayo Plants* (1942), a book still useful to biologists working in the area.

As the depression deepened, the number of visiting investigators who could afford to spend summers at the Desert Laboratory dropped steadily. In 1929, according to the *Carnegie Yearbook*, fourteen scientists had worked at the lab for periods of three to twelve months and forty-two others had visited for one to ten days. In 1932 the number of visiting scientists fell to six, and for several years after that, none came. The lab was no longer the busy place Shreve had envisioned, but a scientific backwater.

Though staff salaries were prohibitively expensive, travel was still cheap, and in April 1932 Shreve botanized in northern Sonora with Leroy Abrams, a plant taxonomist at Stanford University. Shreve hoped to secure data on the habitats occupied by *Larrea*, *Fouquieria*, *Cercidium* and *Encelia*. Abrams wanted to make an extensive plant collection. From this inconspicuous beginning came Shreve's five-year-long Sonoran Desert project and eventually, his classic *Vegetation of the Sonoran Desert* (1951).

Travel in Mexico during the 1930s was not easy. Even major roads were unimproved, and after heavy rains, some roads could hardly be navigated even with chains on the tires. Often Shreve made no more than forty or fifty miles in a day, partly because of the poor roads and partly because of frequent stops to collect plants and inspect the vegetation. Over much of Baja California, as Shreve noted, "there are extremely few places in which even the simplest supplies or repair parts can be secured."(3)

Between 1932 and 1937, Shreve traveled 10,000 miles throughout the Sonoran Desert. These trips gave rise to a series of descriptive papers on vegetation (1934b, 1934c, 1936a, 1936b, 1937a, 1937b, 1937c, 1938) and to *Vegetation of the Sonoran Desert* (1951), published the year after his death. Hailed as a classic soon after publication, this book described the Sonoran Desert and its seven subdivisions; the characteristic plant communities and life forms of each subdivision; presented distributions maps and brief narratives of twenty-six dominant species; and discussed ephemeral species with an emphasis on their distributional affinities and germination requirements. Shreve intended *Vegetation of the Sonoran Desert* to be the first in a series of books about the North American deserts, but he never reached his goal of treating all the deserts in detail.

The lab's demise, after thirty-seven productive years, was the result of several factors. One was lack of confidence in Shreve's administrative abilities. He had been in charge of the Desert Laboratory for only two years when John C. Merriam, president of the Carnegie Institution, decided that Shreve lacked "either the initiative or the continuing faith in his convictions, and the unswerving purpose, required for bringing a really great program to success."(4)

Another factor was the depression, which made serious inroads on the Carnegie Institution's invested funds resulting in closure not only of the Desert Laboratory but also of the Marine Biological Laboratory at Dry Tortugas. The Desert Laboratory was closed because the research goals of the institution had shifted from field-oriented investigations to technologically advanced programs.

(Continued from Page 7)

Frederick Coville's original inspiration lives on in two locales; the Carnegie Laboratory, Stanford University, was formerly Spoehr's lab. From this base, J. R. Ehleringer, H. A. Mooney, O. Bjorkman and others have investigated the physiological ecology of plants in the Mojave and Sonoran Deserts. The other locale is on Tumamoc Hill, where the former Desert Laboratory is undergoing a renaissance under the joint sponsorship of the Department of Ecology and Evolutionary Biology and the Department of Geosciences of the University of Arizona, in cooperation with the Water Resources Division of the U.S. Geological Survey.

Literature Cited

Ashby, E. 1932. Transpiratory organs of *Larrea tridentata* and their ecological significance. *Ecology* 13:182-188.
Bowers, J. E. 1986. A career of her own: Edith Shreve at the Desert Laboratory. *Desert Plants* 8:23-29.
Carnegie Yearbook, vols. 1-44. 1902-1945. Carnegie Institution of Washington, Washington D.C.
Evans, H. 1932. The physiology of succulents plants. *Biological Reviews* 7:181-211.
Gentry, H. S. 1942. *Rio Mayo Plants*. Carnegie Institution of Washington Publication no. 527.
Gleason, H. A. 1917. The structure and development of the plant association. *Bulletin of the Torrey Botanical Club* 44:463-481.
Gleason, H. A. 1926. The individualistic concept of the plant association. *Bulletin of the Torrey Botanical Club* 53:7-26.
Livingston, B. E. 1906. *The Relation of Desert Plants to Soil Moisture and to Evaporation*. Carnegie Institution of Washington Publication no. 50.
Livingston, B. E. and F. Shreve. 1921. *Distribution of Vegetation in the United States as Related to Climatic Conditions.* Carnegie Institution of Washington Publication no. 284.
McIntosh, R. P. 1975. H. A. Gleason-- "individualistic ecologist," 1882-1975: his contributions to ecological theory. *Bulletin of the Torrey Botanical Club* 102:253-273.
Richards, H. M. 1915. *Acidity and Gas Interchange in Cacti*. Carnegie Institution of Washington Publication no. 209.
Runyon, E. H. 1934. The organization of the creosote bush with respect to drought. *Ecology* 15:128-138.
Shreve, E. B. 1914. *The Daily March of Transpiration in a Desert Perennial*. Carnegie Institution of Washington Publication no. 194.
Shreve, E. B. 1915. An investigation of the causes of autonomic movements in succulent plants. *Plant World* 18:297-312, 331-343.
Shreve, F. 1910. The rate of establishment of the giant cactus. *Plant World* 13:235-240.
Shreve, F. 1911b. Establishment behavior of the palo verde. *Plant World* 14:289-296.
Shreve, F. 1915. *Vegetation of a Desert Mountain Range as Conditioned by Climatic Factors*. Carnegie Institution of Washington Publication no. 217.
Shreve, F. 1919. A comparison of the vegetational features of two desert mountain ranges. *Plant World* 22:291-307.
Shreve, F. 1929a. The Desert Laboratory of the Carnegie Institution of Washington. *Progressive Arizona and the Great Southwest* 8:11-12, 31-32.
Shreve, F. 1931. The Desert Laboratory of the Carnegie Institution of Washington. *Collecting Net* 6:145-147.
Shreve, F. 1934b. Vegetation of the northwestern coast of Mexico. *Bulletin of the Torrey Botanical Club* 61:373-380.
Shreve, F. 1934c. The problems of the desert. *Scientific Monthly* 38:199-209.
Shreve, F. 1936a. The transition from desert to chaparral in Baja California. *Madrono* 3:257-264.
Shreve, F. 1936b. Plant life of the Sonoran Desert. *Scientific Monthly* 42:195-213.
Shreve, F. 1937a. Lowland vegetation of Sinaloa. *Bulletin of the Torrey Botanical Club* 64:605-613.
Shreve, F. 1937b. Plants of the sand. *Carnegie Institution of Washington News Service Bulletin* 4:91-96.
Shreve, F. 1937c. The vegetation of the Cape region of Baja California. *Madrono* 4:105-112.
Shreve, F. 1938. The sandy areas of the North American desert. *Association of Pacific Coast Geographers Yearbook* 4:11-14.
Shreve, F. 1942. The desert vegetation of North America. *Botanical Review* 8:195-246.
Shreve, F. 1951. *Vegetation of the Sonoran Desert.* Carnegie Institution of Washington Publication no. 591.
Spoehr, H. A. 1913. Photochemische Vorgange bei Entsauren der Succulenten. *Biochemische Zeitschrift* 57:95-111.

Footnotes

1. B. E. Livingston to D. T. MacDougal, 15 July 1908, AHS.
2. F. Shreve to J. W. Shive, 14 June 1930, SC.
3. F. Shreve to P. C. Standley, 22 Sept. 1931, SC.
4. J. C. Merriam, memorandum of conversation with Dr. Shreve, 5 Aug. 1930, CIW.

NATIVE PLANTS AND SPACE

Wade C. Sherbrooke, Southwestern Research Station, American Museum of Natural History, Portal Arizona.

Every plant's roots penetrate soil and suck up the nutritive broth of the earth's mantle, where the remains of past geologic events mix with microscopic components of the experiment of life. Each rootlet weathers an environment as significant to the entire plant as are light, temperature, humidity, herbivores and pollinators to the vegetative and reproductive portions. Above ground and below ground, all these factors are unique components of a particular place that molds an individual plant.

Plants do not move far in a lifetime. They seem locked into a piece of geography, and indeed are parts of the landscape. The bonds holding them to earth are only briefly broken during flights of reproductive creativity, through pollination or seed dispersal. Otherwise their lives have been sculpted by the climatological, geomorphological, and biological realities of a particular place on planet earth.

Do native plants have different relations to their environments than non-natives? Do native plants offer us something that cannot be attained through non-native plants?

Native plants and non-native plants have different ecological relations and histories in terms of place on Earth. Native plants can serve us well if we are trying to establish an understanding of place for ourselves. Non-native plants are linked to accelerating cultural changes that began before the origins of agriculture. Non-native plants are products of disassociations of species from places to which they evolved.

Today, native species are where they evolved. Because of this they help to define the highly detailed landscapes of the natural world. By learning about the intricacies of the lives of native plants in a geographical area we build stores of knowledge about that piece of the globe. Familiarity is established, along with the feelings that result from it. Native plants are neighbors for those of us mentally and emotionally connected to our living environs. We meet them on morning walks, follow them through the seasons, watch their children grow, and record their deaths and decay. Native plants offer uncluttered connections to a sense of place in the biosphere.

Non-natives can connect us to diverse places and the unending, at least for each individual human brain, array of evolutionary possibilities that exist amongst plants. They stretch our minds to other places and a different set of events. But these transplants offer little to our understanding of the continuity and integrity of our biotic neighborhoods.

As our minds assimilate portions of the native and non-native vegetative world our viewpoints are molded by the nature of the dichotomy of these perspectives. By focusing on native plants we march a path towards greater identity with place. Willful contemplation of native plants can be a commitment to expand ones mind in the direction of familiarity with place and the intricacies of evolutionary process within the confines of a particular ecological system. Unconsciously surrounding oneself with non-natives blurs any biological interpretation of place and clouds one's view of an ecosystem evolved in situ. If mankind continues to value a sense of place, then mankind should value the significance of native plants.

WHAT IS A "NATIVE" PLANT?

This question, asked by Barbara Tellman in the Fall, 1992 issue of *The Plant Press*, was reprinted in a recent "Flora of North America Newsletter" and we have a response from Vermont. Suggested definitions will be included in the newsletter as space permits.

To refresh your memory here is a portion of the original question that was reprinted in "Flora of North America Newsletter" 6(4)28

"What is a Native Plant? Does that seem like a dumb question? We all know without doubt that [to Arizona] a saguaro is a native plant while a salt-cedar is not. Native plants are like love or sleep. If you are the type that has to define them, you obviously don't know what they are...."

This is a response received from Cathy A. Paris, Vice-President, SAG-Flora, Department of Botany, University of Vermont. The SAGF appears to be struggling with a similar question.

Proposed SAGF (Scientific Advisory Group of Flora) Guidelines for Recommending Plants of Endangered and Threatened or Threatened Status

1.4 A native species is one that can be shown to have been present in our region for at least 100 years, and for which there is no evidence that it had an exotic origin, or was introduced.

Botanists conventionally distinguish native species (Presumed to have been in a region prior to European settlement) from aliens (recent arrivals, usually from some distance away, often introduced or transported by people)....

Such a definition is essentially a historical summary. It is unsatisfactory for conservation biology because it doesn't recognize that the natural range limits of plants are constantly changing, and that any region of study is continually acquiring species, by natural processes, that are 'native' just beyond its borders.

(Well, maybe somebody else has the answer!)

NEWSLETTER FORMAT

As you have probably noticed, at least I hope someone has noticed, that the last few newsletters have been formatted differently and yes this one is different than the last. Although I enjoy doing the layout, I'm the first to admit that my creative skills are somewhat limited. In addition, when using Word Perfect, or in this case Microsoft Word, there are certain limitations on creativity.

Assuming I can work through some of the limitations that result from the computer software, I would like to have some feedback regarding a format that is the most appealing. Your preferences for such things as type style and size, one column versus two column, page borders, etc. is the kind of feedback I would like to have.

More importantly, if anyone reading this has any suggestions regarding newsletter design, I would be thrilled to get your suggestions. Any assistance will be greatly appreciated.

-Dean Brennan

CONSERVATION PAGE

At the ANPS annual meeting, Mr. Humberto Suzan, Arizona State University, presented his research on the benefits and threats to Ironwood (*olnega tesota*) in Mexico. Although not at risk of extinction, large numbers of Mexico's ironwood trees are being felled by woodcutters to supply the United States with charcoal and "Indian" woodcarvings.

Ironwood trees are vitally important in the Sonoran Desert ecosystem, where they provide microclimates for a variety of other plants such as night-blooming cereus and young saguaro cacti. Since Ironwood grows so slowly, destroying these trees damages the productivity of the desert for centuries.

Mr. Suzan said that extensive ares of desert are being stripped of both ironwood and mesquite trees for "mesquite" charcoal, most of which is exported to the U.S. (ANPS members may want to consider this when debating whether to use charcoal, and if so, what kind.)

In comparison, the effect of the tourist trade in "Seri Indian" woodcarvings has been more limited in both area and in the age class of the trees taken. Wood carvers prefer mature tees; originally the Seris chose dead trees but the proliferation of non-Indian woodcarvers now requires the cutting of old, live trees. Most carvings today are not made by the Seris.

SWEEPING SETTLEMENT OF FEDERAL LAWSUIT WILL HELP HUNDREDS OF PLANTS

In one of the most comprehensive settlements ever of a lawsuit under the Endangered Species Act (ESA), the Bush Administration agreed to expedite federal protection for hundreds of animals and plant species now facing a threat of extinction, and to take steps to protect more than 900 additional species. In total, more than 1,300 species are affected by this agreement, including Arizona's eighteen category 1 plant species.

The lawsuit, The Fund for Animals v. Lujan, was brought on May 28,1992, by The fund for Animals and a number of environmentalists from around the country including ANPS member Julia Fonseca. Her participation in the lawsuit stemmed from her interest in the Arizona willow (*Salix arizonica*), a plant known only to the high, wet meadows of the White Mountains.

Under the settlement, the government must, by September 1996, propose the "listing" of at least 400 domestic species--the process that secures federal legal protection for species under the ESA. Final listing actions must be taken within one year following a proposal. Since the ESA was enacted in 1973, approximately 750 domestic species--an average of about 40 per year--have been listed.

According to Jasper Carlton, one of the plaintiffs in the case, "This settlement will result, in the next few years, in a major increase in the number of species that are protected under the Endangered Species Act. It represents a desperately needed and long overdue commitment by the government to take more seriously its obligation to protect our nation's dwindling biodiversity."

Arizona plant species subject to the 1996 listing deadline *Allium gooddingii*, *Dalea tentaculoides*, *Salix arizonica*, and *Penstemon discolor*. The settlement will also assist animals such as the Florida black bear and Jemez Mountain salamander.

In addition to the 400 species subject to the September 1996 deadline, over 900 more must be officially assigned listing priority numbers within the next year. Such prioritization is the first step in the government's process for listing species. The majority of the species affected by this part of the settlement area plants.

Arizona Native Plant Society Board of Directors

Newsletter Typesetting and Design -

Dean Brennan 786-9554
906 W. Cheyenne Dr., Chandler 85224

The Arizona Native Plant Society
P.O. Box 41206
Tucson, AZ 85717
Address Correction Requested

Non-Profit Org.
U.S. Postage
PAID
Tucson, Ariz.
Permit #1505

If you move, please send us a change of address.

Printed on Recycled Paper