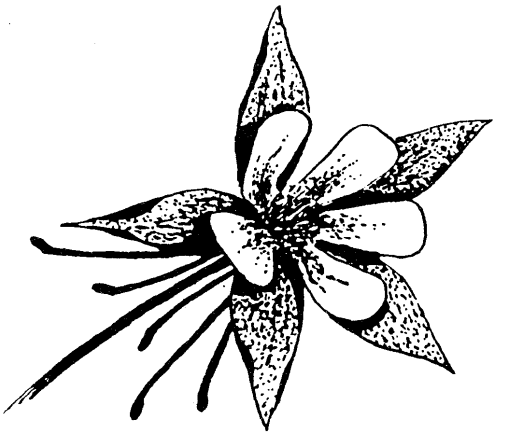
Aquilegia



Newsletter of the Colorado Native Plant Society

"...dedicated to the appreciation and conservation of the Colorado native flora"

Volume 16 Number 6 November/December 1992

A Little Colorado Native Plant Chemistry

Frank R. Stermitz
Colorado State University

Plants are powerful chemical factories which produce an astounding array of compounds called secondary metabolites, whose presence in the plant is rarely understood. Primary metabolites are compounds such as amino acids, fats, sugars, and nucleic acids which are found in all living organisms. Microbes, fungi and higher plants also produce compounds, termed secondary metabolites, which are restricted to certain taxa or groups of taxa. The function in the organism of many secondary metabolites has not been discovered. Some well-known examples of secondary metabolites found in plants are the alkaloids (compounds containing a nitrogen atom) morphine, cocaine, caffeine, and strychnine. The new antitumor drug taxol, terpenes (components of turpentine), and the latex compounds which yield natural rubber are all nonalkaloidal secondary metabolites, as is urushiol, the active ingredient of poison ivy. Literally tens of thousands of other plant compounds, less spectacular to the public, but just as interesting to the plant chemist, are also known and the number discovered increases by the hundreds each year.

Because many of the plant secondary metabolites have a poisonous or deterrent effect on other organisms, one hypothesis suggests that they have evolved as defensive substances or deterrents against herbivores or predators. Some plant chemicals, such as floral scents or pigments have a clear function as attractants to pollinators, but the majority of secondary metabolites are hidden away within the plant and are only detected after the plant has been crushed and the individual chemicals have been separated from cell debris.

Over the past 31 years, my students and I have probed this "secret chemical life" of 179 different species of plants, including 64 native to Colorado. Some of the work has focussed on biological activity of the plant compounds. We have analyzed tropical plants in the hope of discovering new medicines and have determined the causative agents of livestock poisoning from toxic range plants. We have also studied plants used or touted as folk medicines or herbal teas, usually to find out if there is a health risk to human consumption. In the past ten years, one major interest has been to discover why some insects, especially the larvae (caterpillars) of certain moth and butterfly species, restrict their food consumption to a few or even a single species of native plant.

In the course of each of these research projects, we have usually analyzed several species from one genus or several genera within a single family and this has allowed us to compare the chemistry of related plants. This knowledge can be useful for taxonomic purposes; such studies are called chemotaxonomy or biochemical systematics. The assumption is made, somewhat simplistically, that more closely related taxa will contain chemical compounds of more similar molecular structure than will more distantly related taxa.

- continued on page 4

Contents

TIME TO RENEW YOUR MEMBERSHIP!

Once again, it's reminder time—have you paid your CONPS dues? Dues notices were sent out in late November. Please remember that dues cover a calendar year, except that new members who join in the second half of a year are credited for the following year's dues, as well. Your mailing label on this newsletter shows the year THROUGH which you are paid—i.e., PAID THRU 92 means you should remit your dues for 1993!! (However, if you have sent your payment within the past few weeks, please note that the label could be incorrect due to the lead-time required for the newsletter.)

Membership Committee Chair, Myrna Steinkamp, also notes that the post office will not forward bulk mail, so if you move and want to continue to receive Society mailings, it is essential to notify the Society (P.O. Box 200, Ft. Collins, CO 80522-0200).

An important reminder...

Beginning in 1993, the Post Office will require us to use 9-digit ZIP codes. Please help us by providing your complete, 9-digit ZIP code on your renewal form. If you do not know your 4-digit ZIP suffix, please contact your local post office (or ask your mail delivery person).

Errata

The illustration of *Pedicularis groenlandica* which appeared on page 5, Vol. 16, No. 5, of *Aquilegia* was mistakenly attributed to artist Janet Wingate. The illustration should have been attributed to Kris Meiring. It appeared previously in a 1989 EPA publication called *A Handbook of Wetland Plants of the Rocky Mountain Region* by David J. Cooper.

Aquilegia
is printed on 100% recycled paper

Aquilegia

Aquilegia is published six times a year by the Colorado Native Plant Society. This newsletter is available to members of the Society and to others with an interest in native plants. Contact the Society for subscription information.

Articles from *Aquilegia* may be used by other native plant societies or non-profit groups if fully cited to author and attributed to *Aquilegia*.

The Colorado Native Plant Society is a non-profit organization dedicated to the appreciation and conservation of the Colorado native flora. Membership is open to all with an interest in our native plants, and is composed of plant enthusiasts both professional and non-professional.

Please join us in helping to encourage interest in enjoying and protecting Colorado's native plants. The Society sponsors field trips, workshops and other activities through local chapters and statewide. Contact the Society, a chapter representative, or committee chair for more information.

Schedule of Membership Fees

Life	$250
Supporting	$ 50
Organization	$ 30
Family or Dual	$ 15
Individual	$ 12
Student or Senior	$ 8

Membership Renewal/Information

Please direct all membership applications, renewals and address changes to the Membership chairperson, in care of the Society's mailing address. Please direct all other inquiries regarding the Society to the Secretary in care of the Society's mailing address.

Newsletter Contributions

Please direct all contributions to the newsletter to:

Tamara Naumann
940 Quinn Street
Boulder, CO 80303

Deadlines for newsletter materials are February 15, April 15, June 15, August 15, October 15, and December 15.

Short items such as unusual information about a plant, a little known botanical term, etc. are especially welcome. Camera-ready line art or other illustrations are also solicited.

Please include author's name and address, although items will be printed anonymously if requested. Articles submitted on disks (IBM or Mac) are appreciated. Please indicate word processing software and version.

ANNOUNCEMENTS

CENTER FOR PLANT CONSERVATION SYMPOSIUM
Restoring Diversity: Is Reintroduction an Option for Endangered Plants?
April 20-22, 1993

Reintroduction is used increasingly by government agencies, conservation groups, and the private sector as part of strategies to conserve biological resources. Reintroduction offers the potential to incorporate rare plants into community and ecological restoration and management projects. However, much of this effort is experimental and conducted in the absence of national policy guidelines or understanding of its long-term biological significance. Moreover, reintroduction and restoration may have important consequences for national policy on protection of existing populations and habitat.

The Center for Plant Conservation is sponsoring a three-day symposium in St. Louis to examine these issues. The goals of the symposium are to:

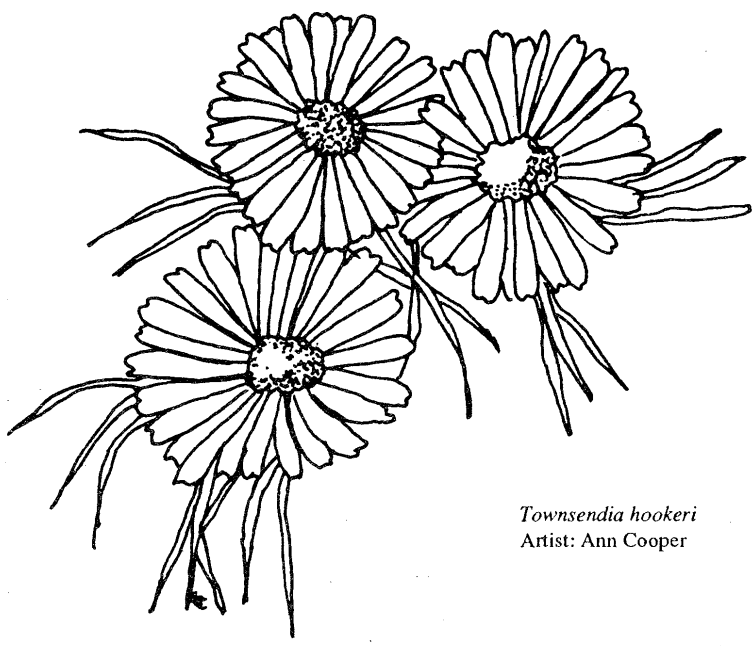
- assess case studies and current experience with rare plant reintroduction;
- review current policies of various federal and state agencies, conservation organizations, and the private sector;
- develop national policy guidelines for rare plant reintroductions.

Symposium topics will include: issues and principles in rare plant reintroductions, strategic and political considerations, ecosystem management practices, biological significance, technical feasibility, case studies, mitigation and rare plant reintroduction, policy analysis and guidelines.

The expected results of the symposium will be a book of contributed papers, including national guidelines that can be used for reintroduction projects by agencies and organizations throughout the country.

Registration forms are available from:

Marie M. Bruegmann
Reintroduction Symposium
Center for Plant Conservation
Missouri Botanical Garden
P.O. Box 299
St. Louis, MO 63166-0299
(314) 577-9450



Townsendia hookeri
Artist: Ann Cooper

NATIVE PLANT SEED EXCHANGE

If you are interested in receiving a list of native plant seeds that are available for exchange, or if you are interested in collecting seeds for exchange, contact:

Craig Alseike
3256 Salem Street
Aurora, Colorado 80011
(303) 366-0587.

VOLUNTEERS NEEDED

The Colorado Aquarium Society is planning to build a major regional aquarium near 104th Avenue and U.S. 36 (Denver-Boulder Turnpike) in Westminster. The facility will be one of the largest freshwater aquariums in the country, featuring simulated mountain streams, slow moving rivers, and other regional freshwater habitats, along with their inhabitants. Project proponents expect the aquarium to attract as many as one million visitors per year. Educational, research, and volunteer programs will be offered to complement programs offered by the Denver Museum of Natural History and the Denver Zoo.

Volunteers are needed to help plan, design, install, and care for a native plant landscape on the aquarium grounds. Creek and wetland restoration and enhancement projects are planned for Big Dry Creek, which is adjacent to the proposed facility. Project planners are also soliciting volunteer help in planning live botanical exhibits representing plants of the Rocky Mountain and other north temperate and arctic aquatic and related environments. Ground-breaking may occur as early as next summer, with completion by 1996.

If you are interested in contributing your enthusiasm and/or expertise to this exciting project, contact Carol Dawson (303) 722-6758.

Plant Chemistry, *continued from front page*

Castilleja rhexifolia
Artist: Janet Wingate

The poppy family (Papaveraceae) was an early interest of ours and one which we have recently again investigated. The genus *Argemone* (prickly poppy) was especially exciting chemically and we eventually analyzed 19 species which occur in the western U.S., Mexico and South America. We also studied rarer western members of the family and recently found interesting compounds in the endangered bear poppy, *Arctomecon humilis*, from southern Utah. Chemical studies require destruction of plant material, but modern methods of analysis often allow us to use only a single plant or two and sometimes even a single leaf. Other poppy genera in our program were *Papaver* (poppy), *Meconella* (meconella), *Romneya* (Mitilija poppy), *Eschscholzia* (California poppy), *Dendromecon* (tree poppy), and *Platystemon* (cream-cups).

Range livestock, particularly cattle, are poisoned when they eat *Astragalus miser* (weedy milkvetch) so we found out what the toxic constitutent was and eventually completed analysis of 13 other *Astragalus* species. The Fabaceae also provided us with *Lupinus* (lupine) and *Thermopsis* (golden banner) as subjects. In the tropics, some legumes reach large tree size and we found new antimicrobial compounds in the decay-resistant Costa Rican tree *Dyphysa robinioides.*

The Scrophulariaceae (figwort or snapdragon family) of the western U.S. provided us with material for studies on *Castilleja* (Indian paintbrush), *Orthocarpus* (owlclover), *Cordylanthus* (bird's beak), *Pedicularis* (lousewort), *Besseya* (kittentails), *Maurandya* and *Penstemon.* The first four are natural root parasites on plants of other species and we have looked at secondary metabolite transfer from the host plant to the parasite. *Castilleja*, *Besseya* and *Penstemon* are also larval food plants for some strikingly patterned butterflies and the chemical reasons for these plant-insect interactions have been interesting to explore.

Hackelia (stickseed) species of the Boraginaceae (borage family) are utilized by warningly-patterned moth larvae and the larvae were found to store toxic alkaloids obtained from the *Hackelia.* Other studies in the Boraginaceae, on *Cynoglossum* (hound's tongue), *Mertensia* (chiming bells), *Symphytum* (comfrey) and *Borago* (borage), also stemmed from their content of similar poisonous alkaloids. The presence of alkaloids in *Cryptantha* (cryptantha) have led us to analyze eight species and the results may have a bearing on controversies about the *Oreocarya/Cryptantha* divisions. These alkaloids are also present in some Asteraceae (sunflower family) and we have determined the alkaloid content of several *Senecio* (groundsel) species as well as *Liatris punctata* (gayfeather). Both of these genera serve as root hosts for *Castilleja.*

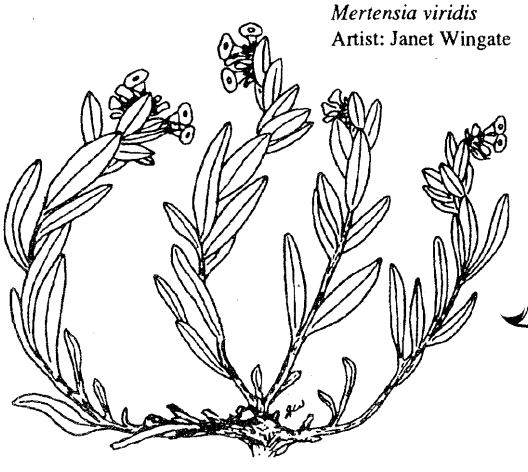
Besseya alpina
Artist: Janet Wingate

Conifers, such as spruce and pine, are well known to contain terpene compounds and these have been studied chemically for one hundred years or more. We recently found alkaloids in conifers, and are now trying to find out why the trees make these compounds which are usually biologically-active. So far all spruce species (*Picea*) and most pines (*Pinus*) we have analyzed contain such materials.

Western species from several other families, which have yielded their chemical secrets to my research students, are *Mahonia repens* (Oregon grape) and *Berberis fendleri* (Fendler barberry) in the Berberidaceae family, *Caltha leptosepala* (marsh marigold), *Delphinium nelsonii* (Nelson larkspur) and *Trollius laxus* (globeflower) in the Ranunculaceae family, *Cymopterus watsonii* (rock parsley) in the Apiaceae family, and *Frasera speciosa* (monument plant) in the Gentianaceae family.

Although the chemistry could have been done independently of any botanical interest, we have made almost all our collections ourselves and have learned the value of field study, particularly in those parts of the program which have dealt with parasitic plant species, plant/insect interactions and systematics. It has been a great learning experience for a chemist without biological training. Had a botanist been along in our early work, I probably never would have collected poison ivy root (mistaking it for something else) or brought back a plant from the Argentine hinterlands which wasn't even in the proper family for my study. We quickly learned to have all our collections authenticated by a botanical authority and to always deposit voucher specimens, with exact collection locations, in a herbarium. In this way we document the exact plant population which has been studied chemically. The National Science Foundation has funded most of our research, with money which came from those of you who pay taxes, so we are appreciative of your support.

Mertensia viridis
Artist: Janet Wingate



ANT-PLANT SYMBIOSIS IN THE ASPEN SUNFLOWER

Walt Fertig - President
Wyoming Native Plant Society

This article first appeared in the Wyoming Native Plant Society newsletter, Volume 11, Number 4, October 1992.

Western North America is home to a dozen species of sunflowers in the Composite genus *Helianthella*. Each species is characterized by subtle differences in leaf and floral morphology. The aspen sunflower, *Helianthella quinquenervis*, can be further distinguished by its unique means of defense against herbivory. Instead of relying on chemical or structural defenses, the plant utilizes aggressive ant guards for protection against insect pests. In return, the sunflower provides the ants with food in the form of nectar.

Similar ant-plant symbiotic relationships have evolved independently in hundreds of species of plants. In the majority of known cases, the plant utilizes ant defenders in place of more conventional chemical deterrents. Ant protection is often more economical than chemicals and is not as easily circumvented by insect pests. In order for the system to work, however, the plant cosymbiont must be able to attract a steady population of ant guards. Without its partners, an ant plant is left defenseless and will suffer from reduced reproductive fitness, defoliation and possibly even death.

Most *Helianthella* species utilize sesqueterpene lactones to defend against insect herbivores. The production of these toxins is a drain on the metabolism of the plant and reduces the amount of energy available for leaf, flower and seed production. Toxins are most successful in deterring generalist-style insect herbivores but may fail to discourage specialized feeders. A single mutation may alter the physiology of an insect pest, making it immune to existing chemical defenses. Lastly, chemical defenses are more often a reaction mechanism than a preventive one. Toxins are released only after physical damage has already been inflicted.

The use of ant defenders allows the aspen sunflower to invest a greater proportion of its energy towards increased seed production. Unlike chemical systems, ants provide a good generalized defense against both specialized and unspecialized herbivores and can act before damage has been incurred. Most importantly, insect herbivores must evolve behavioral modifications to overcome an ant defense. This is much more difficult and takes a greater number of generations to accomplish than acquiring chemical immunity.

To attract ants, the aspen sunflower secretes carbohydrate and amino acid rich nectar from nectaries located on the involucral bracts enclosing each developing flower head. It regulates ant activity and the cost of nectar production by secreting nectar gradually and only in small quantities. As a result, ants are constantly travelling about the flower head in search of nectar. Foraging ants react aggressively to all insects they encounter, including other ants and potential herbivores. It is this aggressiveness that the sunflower relies on to drive off its many insect pests.

Picture-wing flies and agromyzid flies are the major insect herbivores of *Helianthella quinquenervis*. In both species, adults mate on the plants and females lay their eggs on the immature flower heads. Fly larvae complete their life cycle in the developing ovules and seeds. Large numbers of larvae can greatly reduce the seed yield of a plant. Aggressive ants interfere with flies trying to lay eggs on the flower heads. Ants rarely kill flies outright, but can drive off egg-laden flies simply through their pugnacious behavior.

Experiments with sunflowers in which ants have been removed illustrate the success of the ant protection system. Sunflowers with ant guards lost an average of only ten percent of their seeds to insect predation, while unprotected plants exhibited seed mortality rates as high as ninety percent. In the absence of ants the system usually backfires, as the nectaries attract more insect herbivores.

Despite its overall success, the ant defense system of *Helianthella quinquenervis* is not foolproof. Any gravid female that eludes the ant guards will be able to produce many offspring because ants do not seek out and destroy fly eggs, larvae or pupae. Other insect pests, such as the *Hemeosoma* moth, can avoid ant guards altogether by laying their eggs at night, when ants are less active. Larger vertebrate herbivores, such as elk, are unaffected by pugnacious ant behavior, although the unpalatability of the ants themselves may discourage grazing. Overzealous protection can also be a disadvantage if ants discourage insect pollinators.

Due to their reliance on ants, aspen sunflowers are restricted to areas where ants are abundant. Uneven distribution of ant colonies is probably the single most important factor in determining the survivability of seedlings. Transect studies following a gradient in ant density show that seed mortality rises with increasing distance from ant colonies.

The aspen sunflower has diverged from its close relatives by evolving a non-chemical defense system in conjunction with aggressive ants. The immediate benefit to the plant is improved energy conservation. Less metabolic energy is required for defense and more can be invested in reproduction. Drawbacks include lessened fitness in the absence of ants and a reduced ability to pioneer new habits. For good or bad, the evolutionary path taken by the aspen sunflower has become intertwined with that followed by its ant cosymbionts.

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Inouye, D. and O. Taylor. 1979. A temperate region plant-ant seed predator system: consequences of extrafloral nectar secretion by *Helianthella quinquenervis*. Ecology 60:1-7.

Janzen, D. 1966. Coevolution of mutualism between ants and acacias in Central America. Evolution 20(3):249-275.

Workshops - Spring 1993

The Colorado Native Plant Society workshop series was established in 1985 to provide members with winter-time activities when field trips are impossible. CONPS members have attended more than 79 workshops over the years. Workshops bring native plant lovers together with a well-informed instructor who may have photographs, herbarium specimens, live plants, or other materials for hands-on study. The opportunity to receive one-on-one instruction and informative lectures has made the workshop series one of the most popular Native Plant Society programs. Attendees need no special skills or background; a love of plants and a desire to learn are the only prerequisites. The goal is to demystify plant identification and to enhance in all of us our enjoyment and understanding of Colorado's native flora.

Please **mail** your registration to Bill Jennings, P.O. Box 952, Louisville, CO 80027. Indicate the workshops for which you would like to register, and include your name, address, and telephone number. Phone registrations will also be accepted (666-8348). Register promptly, as workshops tend to fill up quickly. The fee for each full-day workshop is $10 for CONPS members and $22 for non-members ($10 for the workshop and $12 to join the Society). Payment is made on the day of the workshop. About two weeks prior to the workshop, registrants will receive information by mail about location, time, lunch, and suggested references or materials to bring to the workshop.

It takes considerable time and effort for the instructors to plan and develop workshops and field trips. Please let us know how you like the activities offered by CONPS. We need your suggestions for future workshops and trips. We also appreciate feedback on whether you find them informative and exciting or dull and uninteresting. We'd like your opinion on how well we are serving you, our membership.

MONTANE and SUBALPINE GRASSES

Location: Foothills Nature Center, Boulder

Third Session: Saturday January 23, 1993
Fourth Session: Saturday, February 13, 1993
Leader: Dr. David Buckner

Dr. Buckner will take us through the fascinating and confusing world of the grasses of the mountains. After covering the terminology necessary to study the grasses, he will distribute numerous specimens for us to dissect and identify. This will be an unique and rewarding workshop, continuing our series on identification of this important group. Every Colorado botanist should have a working knowledge of the grasses.

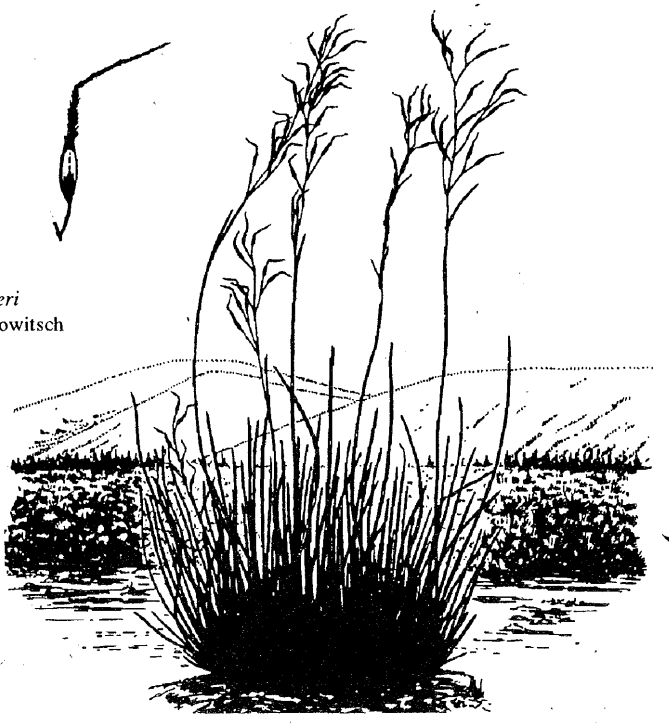
Note: Both the 3rd and 4th sessions are filled, but names are still being taken for the waiting list.

CENTURY PLANTS (AGAVES) of the SOUTHWEST

Leader: Wendy Hodgson
Location: University of Colorado, Boulder
First session: Saturday, February 6, 1993
Second session: Sunday, February 7, 1993
Lecture: Friday, February 5, 1993 - 7:30 p.m.

Although Colorado has no native species of genus *Agave*, any person who has travelled to the deserts of the Southwest cannot help but notice these striking succulent plants, with the tall stalk of tubular flowers and the huge rosette of spine-tipped leaves. Native Americans used these plants in a variety of ways, and Aztec uses of agaves are mentioned in the Denver Museum of Natural History's current Aztec exhibit. The species *Agave utahensis* is winter hardy in Colorado and has bloomed in the Denver Botanic Garden's Rock & Alpine Garden. Some smaller species are suitable as house plants. The Colorado Native Plant Society is pleased to present this workshop to be led by Wendy Hodgson, curator of the herbarium at the Desert Botanical Gardenin Phoenix. Ms. Hodgson will focus on identification of the fewer than two dozen species native north of the Mexican border and on the problems of species limits in a complex genus.

Ms. Hodgson will give a special lecture on century plants Friday evening, February 5, at 7:30 p.m., in conjunction with the American Rock Garden Society and the Cactus and Succulent Society. Her presentation is free, and will be given at the Denver Botanic Gardens' Mitchell Hall (across from the main facility on York Street).



Ptilagrostis porteri
Artist: Sue Galatowitsch

WEEDS of COLORADO

Leader: Dr. Richard Old
Location: Univ. of Colorado, Boulder
First session: Saturday, February 27, 1993
Second session: Sunday, February 28, 1993
Lecture: Friday, February 26, 1993 - 7:30 p.m.

Aggressive plants that crowd out the natural vegetation are a serious botanical problem, not to mention economic and aesthetic disasters as well. The weed situation is particularly bad where urbanization and agricultural practices have significantly disturbed the natural vegetation, such as in the Front Range Urban Corridor. Following a thorough indoctrination of "What is a Weed?," workshop participants will be introduced to the species currently on the Colorado Noxious Weed List. Biological and identificational characteristics of these and a few others will be discussed. Dr. Richard Old is a weed specialist affiliated with Washington State University in Pullman, Washington, who consults on weed problems all over the West.

In addition to the workshops, Dr. Old will present a special lecture Friday night, February 26, at 7:30 p.m., on current methodologies for computerized identification of plants, a technology that seems destined to replace the dichotomous keys currently in use in virtually all botanical manuals. The lecture will be presented in the Morrison Center at the Denver Botanic Gardens.

ADOPT-A-RARE-PLANT PROGRAM

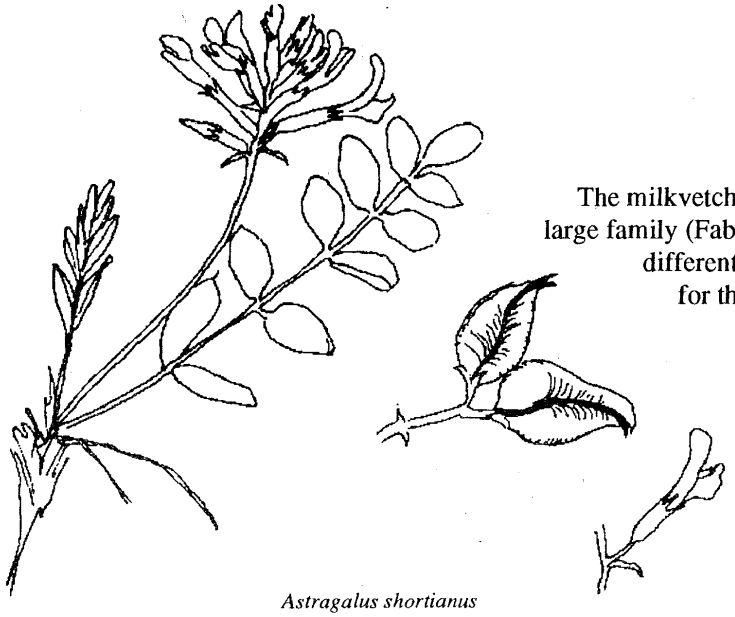
Leaders: Chris Pague, Bill Jennings, and Betsy Neely
Location: Lookout Mountain Nature Center near Golden
Saturday, April 17, 1993

The Nature Conservancy, Colorado Nature Heritage Program, and the Colorado Native Plant Society are developing a volunteer-based "Adopt-a-Rare-Plant" program to assist in maintaining and updating the Heritage Program's rare plant database, and to provide data for The Nature Conservancy's project selection process. At this training session, participants will see photographs and specimens of some of Colorado's rarest plants. Techniques such as herbarium use, appropriate collection of specimens, photography, mapping, habitat description, and field data collection will be highlighted. After lunch, we will visit a site in Wheatridge where *Spiranthes diluvialis* (a federally protected orchid species) has been found. Even if you do not plan to "adopt" a plant, you will find this workshop interesting and informative. Searching for rare plants is the world's most frustrating occupation. The proverbial search for a needle in a haystack is sometimes simple by comparison. Find out what you need in your information arsenal before venturing into the wilderness.

ASTRAGALI of the COLORADO FRONT RANGE

Leader: Loraine Yeatts
Location: To Be Determined
First Session: Saturday, March 20, 1993
Second Session: Sunday, March 21, 1993

The milkvetches (genus *Astragalus*) comprise a very large group of plants in a large family (Fabaceae). With such a large number of species, many of which are differentiated on technical characteristics, identification can be daunting for the wildflower lover. Many of these species are showy and attract attention at roadsides in the spring and summer. Loraine Yeatts has agreed to tackle the Front Range species and will present her observations in this workshop. You will learn the important parts of the pea family flower and how to key the Front Range species.



Astragalus shortianus
Artist: Ann Cooper

FIELD NOTES

William A. Weber and Ronald C. Wittman
University of Colorado Herbarium

Aster alpinus L. var. ***vierhapperi*** Onno: This was first collected in Colorado by Frank Tweedy 5797, "Berthoud Pass, 11,-12,000 ft." July 1903, and was published as the new species *Aster culminis* A. Nelson. A few additional specimens have turned up: Mineral Co.: La Garita Wild Area, Rat Creek/Spring Creek Divide, 11-132 Aug. 1968, *Willard 686* (3 stems without basal rosettes); Clear Creek Co.: 4 miles below Gray's Peak, 18 Aug. 1871, *Dr. George Smith* (one stem mixed with two others belonging to *Erigeron elatior*).

Over the years we have spent a good deal of time hunting for this species, without success. Our difficulty in locating it, we decided, was that we did not understand the precise habitat. However, on 13 July 1992, Loraine Yeatts and Panayoti Kelaidis rediscovered it, probably only a few miles as the crow flies, from Berthoud Pass and very possibly at the very spot where Tweedy got it: Gilpin Co.: Kingston Peak, 4.8 mi. W of Apex, 11,360 ft. alt. It occurs on a gravelly tundra saddle. In my visit to the locality with Dr. Esbern Warncke of Copenhagen, we found that the species did not occur on the bare gravel along with the other common tundra plants of these sites, but that whenever we found a residual patch of turf the plants were there. It seems to me, then, that this is a specific characteristic of the microsite of the species in Colorado, and that once one becomes aware of this, *Aster alpinus* should be found to be relatively frequent, at least in the Front Range.

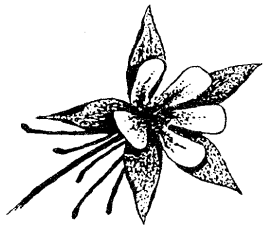
I have seen *Aster alpinus* in the Front Range of the Canadian Rocky Mountains northeast of Banff, and know it from numerous observations in the Altai Mountains of Siberia. Onno's variety *vierhapperi* was based on his discovery of short blunt epidermal hairs of 2-3 cells but in two vertical series (biseriate hairs). In searching for these hairs, which, incidentally I found on both American and at least some Asiatic specimens, I discovered a previously undetected difference between the normal elongate-celled multicellular hairs abundant on the leaves and stems. In all of the American specimens these long hairs have the lowermost cells finely striate, and in most of the Eurasian specimens had these basal cells densely papillose. It seems to me likely that this difference may by significant, and it will be interesting to see if the American race extends into Asia and whether it is geographically distinct from the papillose Asiatic race.

Aster alpinus is a dry tundra plant. It is rarely more than 20 cm tall; each stem bears a single terminal head; it resembles an *Erigeron*, but the ray-flowers are broader than in most *Erigerons*. The involucral bracts differ from *E. peregrinus* by being acute rather than attenuate and not covered by purple-black hairs. The stem leaves are narrowly lanceolate, as are the clumps of basal leaves. The whole plant is gray-pubescent. After flowering, the ray-flowers characteristically become reflexed, as in some *Erigerons*.

Phippsia algida: This tiny alpine grass was first discovered in Colorado at Summit Lake, but the work of Vera Komarkova shows that it occurs in the Indian Peaks region and is locally abundant on a number of high peaks in the Ten Mile and Mosquito Ranges. It is considered to be a perennial in all the literature. Its habitat is wet gravels fed by snow melt at or above 12,000 feet. We had an urgent request from a Norwegian botanist for live plants for population biology studies, and in September we went to collect these on Pacific Peak, where Vera found at least an acre of plants. At this locality and several others in the Ten Mile/Mosquito ranges we searched for *Phippsia* but found nary a plant. We were not prepared for this, assuming the species is perennial. The explanation for its absence appeared to be drought conditions that had lowered the water table severely in these limestone/dolomite habitats (habitats more prone to this subsurface drying than granitic ones).

We expected that the Summit Lake locality would have *Phippsia*, but we did not want to take any plants because the population is very small and the area is protected. The next available place where we knew *Phippsia* to be abundant was in the Green Lakes Valley in the Indian Peaks region. In fact, we did find substantial tufts of the grass between the 4th and 5th Green Lakes. Here *Phippsia* grew in dense polsters up to several inches in diameter, in the wet gravel below a snowbed. The interesting fact about it is that each plant arises separately, with no connection to the others in the clump, from a cluster of short, slender rootlets, and all of the leaves are green and certainly produced this year. There is no evidence whatsoever that *Phippsia* is perennial!

If *Phippsia algida* is an annual (making, with *Koenigia islandica*, two alpine annuals in the Colorado flora), how does it overwinter and survive dry seasons? Does it overwinter as masses of seed-bearing inflorescences lying under the surface of the gravel, so that it can produce dense polsters of individual plants, each arising from seed? The same question may be asked for *Koenigia*, which grows in the same places. Desert annuals, and annuals on the high Sierra Nevada, are able to lie dormant in the seed bank for many years, but this phenomenon is not explored for our two species. This is another problem that an amateur botanist might tackle successfully.



Workshop Report

Asclepiadaceae: the Milkweed Family led by Carolyn Crawford

Report by Janet L. Wingate

The CONPS workshop on the Asclepiadaceae was held in Boulder at the Foothills Nature Center October 24th and 25th. Both sessions were filled to capacity.

Carolyn began the workshop with a discussion of the unique floral structure and highly specialized pollination mechanism found in the milkweed family. She had prepared a model of an *Asclepias* flower to illustrate the gynostegium (upper portions of the flower) and used the model to explain how a pollinium (a small structure containing pollen) clips onto a pollinator's leg. She described how the "translator apparatus", which is attached to the pollinium, dries and forms a "knee-bend", and how, finally, pollination is completed when the pollinium is inserted knee first into an anther slit and drawn up into the stigmatic chamber by the insect's leg. We examined several pictures of pollinators caught in the act. Then we dissected flowers of three species of *Asclepias* to bolster our understanding.

Later, Carolyn presented a slide show of the Asclepiadaceae species that occur in Colorado. Species of *Asclepias* were presented in morphological progression according to Robert Woodson's monograph. Carolyn explained major differences and similarities used to group species into various subgenera and series within the genus.

A handout containing drawings of the flowers of native Colorado species along with Woodson's classification helped us understand this interesting group. Lab material included dried specimens and flowers preserved in alcohol. All Colorado species were available for study (representing 9,000 miles of travel!). All of the common species were available for dissection, including material from adjacent states. Additional handouts included a random access key and a distribution listing of all species Colorado species.

I was impressed with the amount of work and planning that Carolyn put into the workshop. She did an outstanding job, making this workshop an excellent example of the quality of instruction offered through the CONPS workshop program. Thanks Carolyn, for sharing your expertise with us.

Note: handouts from the workshop are available from Carolyn Crawford 666-8348.

This little note appeared in the Wall Street Journal (11 Nov 1992):

"(The) Ogallala Down Co. of Nebraska uses the seed parachutes of milkweed in comforters and pillows."

A Visit to the Oklahoma Native Plant Society

William A. Weber
University of Colorado Herbarium

I was invited by Dr. Paul Nighswonger to speak at the dinner of the annual meeting of the Oklahoma society meeting at Northwestern Oklahoma State University at Alva. Unfortunately, they met on the same day as the CONPS Annual Meeting, but it was a command performance because I had the chance to lecture for the first time in the presence of my undergraduate major professor Dr. George Goodman, whom I studied under in 1937-1939! That was 56 years ago, count 'em! I found George to be in excellent shape, and for the first time we were able to have a long, serious discussion as adults on botanical matters.

The Alva area is delightfully rural, and the trip south from Medicine Lodge, Kansas, was through rolling hills densely clothed with the red late-summer stems of little bluestem. Two field trips were taken, the first of which I was able to participate in, to the sand dunes of the Cimarron River south of Alva. Here were most of the same species of plants that we find on the narrow triangle of land in the southeastern corner of Colorado, also lying along the Cimarron. I was not able to make the second field trip, to the Great Salt Plain Wildlife Preserve east of Alva, however, because I had to return home to Boulder with the sun at my back. This problem was corrected, recently, when I had successful cataract surgery on my right eye.

The Oklahoma folks were extremely hospitable, the dinner was catered beautifully, the photo contest was spectacular, and although there was no formal program except for business meeting and field trips, the Oklahoma group is an up-and-coming one that we should get to know better!

Celestial Symbols - Part II

Mark Gershman

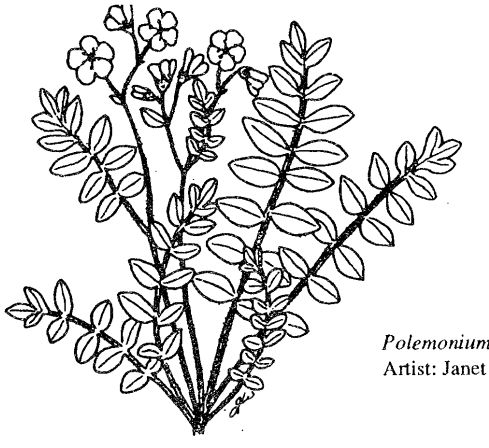
Dr. William Weber, the man I should have asked in the first place, responded to my article (Vol.16, no.4), on meanings of symbols used in some botanical work. Dr. Weber provided me with a copy of chapter XVIII of William T. Stearn's introduction to a 1957 reprint of *Species Plantarum*. It seems that Linnaeus was the originator for most of these symbols' botanical meaning. In fact, it appears that Linnaeus was somewhat notorious for giving words or symbols specialized meanings based upon his needs. According to Stearn, Linnaeus often restricted the application of Latin terms or gave them altogether new meanings. Linnaeus learned about the alchemical and pharmaceutical symbols when he was a student. Later, he appropriated them for not only his botanical works but for describing aspects of medicine, mineralogy and zoology as well.

Linnaeus also used Greek letters for marginal notations. α, β, γ, δ, and ε and others were used to denote varieties of species. The alchemical symbol for water was used also. The symbol for water ∇ was used as part of the specific epithet. It might have been used to abbreviate the binomial for water speedwell, *Veronica anagallis-aquatica*.

Although Stearn lists the co-opted symbols and Linnaeus' meanings for them, he sheds little light on the reasons behind Linnaeus' choices. While using the symbol of Mars for male, and Venus for female seem straightforward, the use of some of the other symbols is puzzling. One might argue that the sun is a fitting symbol for an annual plant, because the lifecycle of an annual must be completed within a single journey of the earth around the sun. The relative arrangement of Jupiter and Mars makes hierarchical sense, Jupiter as the ruler of the Roman gods could be seen as perennial, whereas Mars, his son, less long-lived. Tin is one of the most resistant metals to corrosion and is therefore a good symbol for a perennial. Iron of course is much more subject to rusting.

I remain curious about the use of Mercury's symbol for hermaphrodite, and the Saturn for denoting a woody plant. Unless new information comes to light or the opportunity arises to interview Carl von Linné, the reasoning behind the choices may never be known. The chart below gives some information taken from Stearn's work. Given below are the meanings for the astrological and alchemical symbols in use prior to Linnaeus' appropriation. Refer to the illustration in Volume 16, number 4, of *Aquilegia* for the symbols themselves.

Mars, iron	=	male
Venus, copper	=	female
Mercury, mercury	=	hermaphrodite
Saturn, lead	=	woody (tree or shrub)
Jupiter, tin	=	perennial
Mars, iron	=	biennial
Sun, gold	=	annual



Polemonium delicatum
Artist: Janet Wingate

Chapter News

Boulder Chapter

February 9: Genetic Variation in Two Rocky Mountain Rare Plants
Dr. Yan Linhart, from the University of Colorado, will discuss genetic variation in Larimer aletes (*Aletes humilis*) and Parry's lily (*Lilium parryi*). Conservation of our rare native plants may depend, in part, upon our ability to understand the role of genetics in survival and distribution of rare plants.

March 9: Ecology of *Spiranthes diluvialis*
Anna Arft, a graduate student in the EPO Biology Department at the University of Colorado, will discuss her research on the ecology and conservation of the Ute ladies'-tresses orchid, one of Colorado's rarest wetland orchids.

Monthly meetings are held from September through April on the 2nd Tuesday of the month at 7:15 p.m. in the Boulder Public Library meeting room, 11th and Arapahoe, unless otherwise noted. For information call Betsy Neely at 443-8094 or Elaine Hill at 494-7873.

Fort Collins Chapter

February 2: Cache La Poudre River
Mary Alice and Howard Evans will reflect on their experiences while researching and writing their book, *The Cache La Poudre River: The Natural History of a Rocky Mountain River*.

March 3: Native Plants in the City of Fort Collins
Karen Manci, with the City of Fort Collins, will discuss the present and future use of native plants within the city. The views and perspectives of the CoNPS members will be relevant and important.

Monthly meetings will be held through May at 7:00 p.m. in the large conference room at the headquarters for the Rocky Mountain Station/Arapaho-Roosevelt National Forest 240 West Prospect. The conference room is adjacent to the front patio. Note: the day of the month varies, so mark your calendar! For information, contact Mike Scott at 226-9475.

Metro-Denver Chapter

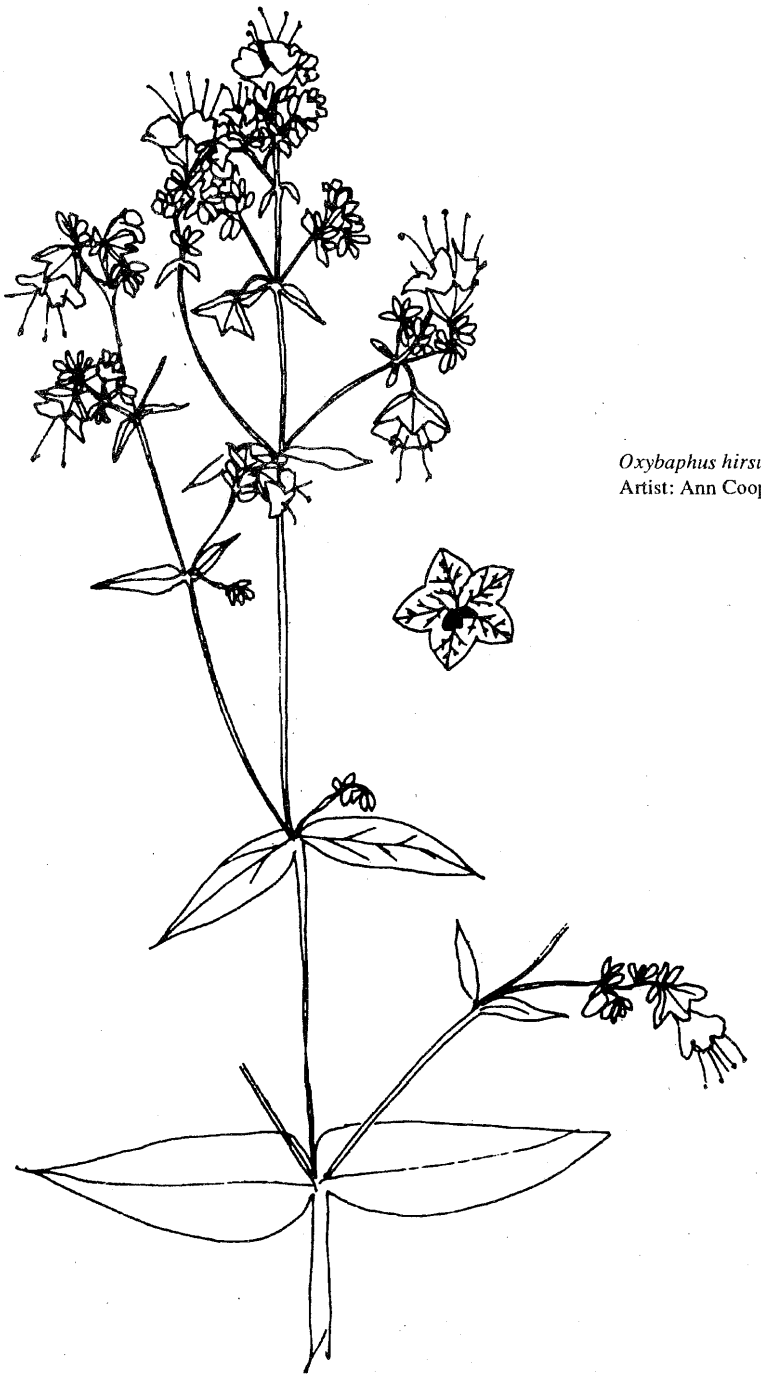
January 27: Alpine Tundra Plants of Horseshoe Cirque

Barbara Siems will present a program on the alpine tundra plants of the Horseshoe Cirque basin in the Mosquito Range. Whether you attended the field trip to Horseshoe Cirque or not, you will enjoy this program! The meeting will be held in the Morrison Center at the Denver Botanical Gardens (DBG).

March 1: Mycorrhizal Relationships

Dr. Brent Reeves, of Colorado State University, will present a program on mycorrhizal (plant-fungal) relationships. This presentation is co-sponsored by the Colorado Mycological Society. The meeting will be held in Mitchell Hall at DBG on **Monday**, March 1st, at **7:00 p.m.** Note the change in day and time!

Monthly meetings are held from September through May on the 4th Wednesday of the month at 7:30 p.m. at the **Denver Botanic Gardens,** 909 York Street, unless otherwise noted. For information, call Ron Abbott at 333-6151.



Oxybaphus hirsutus
Artist: Ann Cooper

Backyard Biology - *Oxybaphus*

William A. Weber
University of Colorado Herbarium

Oxybaphus decumbens: In the valley of the Arkansas River near Pueblo and Canon City there is a peculiar little *Oxybaphus* that was reported as *O. decumbens* (Nuttall) Sweet, and described as a new species, *O. bodinii*. This was said to differ from all other species in our area by having single axillary involucres rather than terminal panicles. It has not been found again in Colorado. However, Ron Wittmann planted seed of buffalo grass in his yard at Louisville, from a company in Kansas, and found that the same *Oxybaphus* came up with the grass. He has been studying this plant for several years, and discovered several interesting facts about it. He found that the plant produces a low hemispherical growth the first year, that axillary involucres appear during the first year, and that in the second year the inflorescence is initially axillary, later terminal and perfect. He also finds that the involucres of the first year have abortive perianths (therefore, no stamens either), so that the fruit may arise from cleistogamy (self-pollonation occuring because flowers remain closed) or parthenocarpy (production of fruit without fertilization). Subsequent seasons produce normal flowers with perianths. If the plant is apomictic (reproduces without the separation and mixing of chromosomes), even during the first season, this has significance for the taxonomy of this very difficult genus of Nyctaginaceae. For the time being, these are only preliminary observations. Ron is collecting seeds of all kinds of *Oxybaphus* and growing them to see how widespread this habit is. Most species of *Oxybaphus* are common and weedy, but we know very little about their biology.

Calendar Overview

Chapter Meetings

Boulder Chapter

Feb 9 Genetic Variation in Rare Plants

Mar 9 Ecology of *Spiranthes diluvialis*

Metro-Denver Chapter

Jan 27 Alpine Tundra Plants of Horseshoe Cirque

Mar 1 Mycorrhizal Relationships

Fort Collins Chapter

Feb 2 Natural History of the Cache La Poudre River

Mar 3 Native Plants in the City of Fort Collins

1992-93 Winter & Spring Workshops

Feb 6-7 **Century Plants (Agaves) of the Southwest**
with Wendy Hodgson

Feb 13 **Montane & Subalpine Grasses**
with David Buckner

Feb 27-28 **Weeds of Colorado**
with Richard Old

Mar 20-21 ***Astragalus* of the Front Range**
with Loraine Yeatts

Apr 17 **Adopt-a-Rare-Plant Training**
with Chris Pague, Bill Jennings, and Betsy Neely

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