COLLECTING PLANTS FOR CREATION RESEARCH SOCIETY HERBARIUM

JONEEN S. COCKMAN*

Received 19 November 1986 Revised 31 May 1987

Abstract

Several suggestions are offered to interested readers who would be willing to collect plants for the Creation Research Society (CRS) Herbarium. Help is solicited in this important project.

Introduction

In the late 1970's while pursuing an undergraduate degree in Range Science, I was fortunate to be a student of a group of botanists at Humboldt State University in Arcata, California. These men also had an amusing side as they began a nation-wide contest to identify the "worst dichotomy." A "dichotomy" is a series of paired choices employed to unlock a plant's identity. For example, "petals present vs. petals absent" is a pair of choices used to arrive at an end or the identity of a particular plant.

Being neophytes of *A California Flora* by Philip A. Munz, my classmates and I thought the description of California poppy, *Eschscholzia californica*, would win by a landslide. It was, "sepals cauducous at anthesis," which means that the sepals fall off when the flower is ready to bloom.

A sepal is similar to a petal. In many flowers it is green in color and a number of them are located just below the petals. In the California poppy the sepals are fused. It is as though the poppy were wearing a sweater of sepals and pulling the sweater off over its head. Since a dichotomy is composed of a pair of choices, the taxonomist must assume that the alternate choice is for the flower to have "normal" sepals. As I learned to speak "Munzese" the former description took on certain meaning. The winner of the dubious award went to "flowers blue," an innocuous description that came in from another university.

Some plant specimens if not properly collected can be as innocuous as "flowers blue." On the other hand, a plant fragment with a few meaningful field notes can become a favorable herbarium specimen once it is identified. The purpose of this paper is to lend some pointers to those field biologists who will be collecting treasures for someone else to identify.

Building a Model Herbarium

A model herbarium is one which includes properly identified voucher specimens to use as reference material and historical documents. Documentation is the key point and the weak link in many herbariums. Often collectors and curators simply will not be bothered with field notes.

Among the documentation for plant specimens is a list of botanical uses a plant may have. Much of the literature researched is based on American Indian uses of certain plants. As the CRS collection grows, some individual plants or taxonomic groups may become more important as their uses as medicines are revealed.

Currently the CRS herbarium collection is focused on grasses, forbs, trees and shrubs. However, lichens, mosses and their associates are not to be excluded. A few creationists have already begun to collect plants. As a result a herbarium now exists and has collections from five different field seasons. The collection has grown to include about 150 different species. Most of the plants are from Arizona, Alabama and Georgia. Presently the specimens are catalogued at The Master's College, Newhall, CA. Ultimately they will be kept at the CRS Grand Canyon Experiment Station when a suitable building has been constructed. As a taxonomist identifying plants from numerous areas of the United States, I like to have contact with experts from each region. If you are a botanist who is able to do verification of plant identities on finished herbarium specimens, your help is needed. Currently someone who can verify plant taxonomy on specimens collected from the Southeast could help us greatly.

The plants being contributed to the experiment stations should be of high quality. The herbarium collection for the Grand Canyon Experiment Station is just beginning and it can be done correctly from the start which will save many future headaches. All plant collectors can help accomplish this goal.

Collecting Complete Specimens

Consider grasses in the genus *Bromus*. Many collectors have a way of picking grasses that resembles a horse grazing. One hand grasps a wad of culms (stems) and pulls. If the roots do not come voluntarily, they are broken. The blades (leaves) are torn from the culm and a million pieces go into the press-none of them resembling a whole plant.

Referring to Hitchcock and Chase's *Manual of the Grasses of the United States*, the taxonomist turns to *Bromus* in the key. Are the plants perennial or annual? How does one know without roots? If it appears somewhat robust the plant may be perennial. If the plant is a perennial did it have creeping rhizomes (underground stems) or not? Again, the specimen has no roots so how can the taxonomist really know? You are left guessing with three dozen brome grasses from which to choose.

How much better it would have been if the grass collector had taken the time to secure several complete specimens of the same brome grass including the roots and/or underground stems. A small garden trowel proves to be invaluable when collecting roots. However, I admit to having used antlers, pencils, pocket knives, branches, lug wrenches, finger nails and screw drivers.

As the collector becomes familiar with different flowering families he will learn what makes a good specimen. The best specimen is a complete specimen. However, not all plants need to be collected wholly in order to run them through a key. A collector may get away with "top snatching" in the Geranium family since most Geranium keys focus on flowers and fruits.

*Joneen Cockman, B.S., is the Plant Taxonomist and specialist in ethnobiology for Creation Research Society. She works as an Environmental Scientist for International Technology Corporation and receives mail at P.O. Box 2397, Carlsbad, NM 88221-2397.

But do not try that with the Buttercup family. The best rule is to never be guilty of "top snatching."

Table I was compiled by Dr. James Payne Smith, Jr., Dean of the School of Science at Humboldt State University (Smith and Simpson, 1977). It lists features emphasized in the identification of common flowering plant families.

Preparing the Specimens

If possible it is best to place fresh plant specimens directly into a plant press. However, good plant presses are at least 12" x 18" in size and somewhat cumbersome to carry in the field. A good substitute is two small pieces of cardboard sandwiched around newspaper and tied with a bungi cord. At the least plants should be placed in plastic bags, one specimen per bag. Do not plan to leave the plants in plastic bags for any prolonged period of time. Fungus such as mold or mildew may grow on the plants. Fungal growth can distort the appearance of pubescence, alter flower color and cover up important anatomy. If it is necessary to leave plants in plastic for several hours or more, refrigerate them to retard fungal growth. Field presses and plastic bags are only for temporary holding; specimens should be transferred to a regular plant press as soon as possible.

A plant press is used to dry and flatten the specimens. Better presses are composed of two lattice-work frames allowing for more air circulation, however, plywood can also be used. Between the two frames are layers of newspaper, "blotters" and ventilators. Newspaper holds individual plant specimens. Field notes may be written on the newspaper right along side the specimen. (Using a bright colored ink will help to highlight the notes making them easier to locate later.)

Blotters are thick, and absorbent to aid in drawing moisture away from the plants. Ventilators are similar to corrugated cardboard and aid in air circulation. These materials are combined in a specific order. The plant specimen is centered between newspaper. On either side of this are two blotters, then ventilators (Figure 1).

Sponge pads may also be useful in drawing moisture from plants. However, the primary purpose for sponge pads is to cushion bulky specimens that would otherwise be crushed or broken in the press. Shrub branches, cacti, heavy thistles and fruits may benefit from the addition of sponge pads. Photographs illustrating these items and the plant press are found in Figures 2-4.

The quality of a specimen depends largely on how it is placed into a press. It should be positioned as if it were going on display. Shake off excess soil. Arrange the plant so that it looks good and will fit easily onto an 11½" x 16½" paper. Try to display the anatomy of the plant by turning leaves and flower heads so that some are seen from the front and some from the back. On grasses, pull a few leaf blades away from the culm (stem) so the inner collars and ligules can be seen. Taller specimens may have to be bent into a V, N or W shape. Very small specimens may need to be enclosed in an envelope so they do not get lost in the press. Some characteristic features of plant anatomy are shown in Figures 5 and 6.

Heavy, fleshy specimens such as cacti and large thistles need extra preparation before going into the

Table I. Features Emphasized in the Identification of Common Flowering Plant Families.

Family	Underground Parts	Leaves	Flowers	Fruits	Take Note of:
Amaranthaceae				x	Monoecious or dioecious
Araceae	x	x		x	
Araliaceae	x		x	x	
Asclepiadaceae			x	x	Position of fruiting pedicel
Betulaceae				x	
Boraginaceae	x		x	x	
Cactaceae			x		Spines & glochids
Campanulaceae			x		Corolla shape
Caprifoliaceae				x	
Caryophyllaceae			x	x	Style number
Chenopodiaceae					
Commelinaceae			x		Very delicate flowers
Compositae	x	x	x	x	Ray flower color
Cornaceae				x	Branchlet color
Crassulaceae		x	x		Basal rosette
Cruciferae		x	x	x	
Cucurbitaceae				x	Monoecious or dioecious
Cyperaceae	x			x	
Ericaceae			x	x	Fruit surface
Euphorbiaceae			x	x	Watery or milky sap
Fagaceae		x		x	Growth form
Geraniaceae		x	x		
Gramineae	x	x		x	Mature spikelets
Hydrophyllaceae	x		x	x	
Iridaceae	x		x	x	Flowers very delicate
Juglandaceae		x		x	Nature of pith
Juncaceae			x	x	Flat or terete leaves
Labiatae	x		x	x	Flower color & markings
Leguminosae	x	x	x	x	
Liliaceae	x	x		x	Bulb morphology
Loranthaceae			x	x	Host plant
Malvaceae			x	x	Flower color
Nyctaginaceae	x			x	
Oleaceae		x		x	
Orchidaceae			x		Flower color & markings
Plantaginaceae		x	x		
Polemoniaceae	x		x	x	Flower color
Polygonaceae	x			x	
Portulacaceae			x	x	Stipule morphology
Ranunculaceae	x	x	x	x	
Rhamnaceae			x	x	
Rosaceae	x	x	x	x	Flowering & sterile stems
Rubiaceae				x	
Salicaceae		x		x	
Scrophulariaceae			x	x	Flower color & markings
Solanaceae			x	x	
Ulmaceae		x		x	
Umbelliferae	x	x		x	
Violaceae		x	x		Flower color & markings

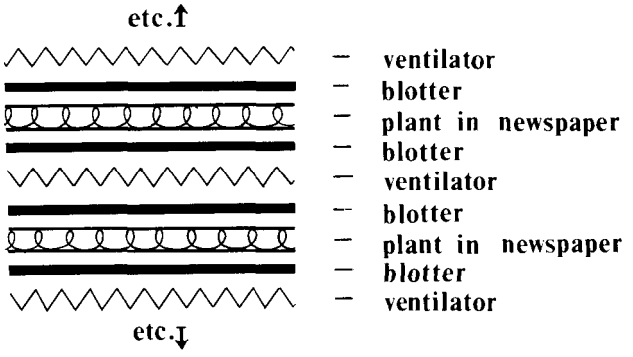

Figure 1. Cross sectional diagram of the specific order of materials surrounding a plant specimen in a plant press.

press. Large thistle heads should be sliced in half vertically with one-half remaining intact with the stem. Cacti pads and fruits also should be sliced in half, parallel to the plane of the pad or fruit. The halves should be scooped out while taking care not to injure the outside structures, i.e. spines and bristles.

Once the specimens are in the press, check them periodically. Place plants on dry blotters if any sign of mildew appears. (Do not separate the specimen from the original newsprint.) The length of time required to dry a specimen depends largely on the succulence of the specimen. Most grasses will dry without having to change the blotter. Heavier plants such as thistles may require a change. It may take weeks to dry heavier plants like cacti. It is preferable to mail specimens when they are completely dry. But if you must mail damp specimens, include a note to the taxonomist so he can transfer them to a dry press and continue to monitor them against mildew formation.

If plants are collected when green and then dried, they should hold together well. But you may find that a dried specimen begins to lose its fruit or seeds. Thistles do this frequently and soon the downy seeds are scattered. Collect these and any other lost anatomy into an envelope. Label and keep it with the main specimen.

Packing Specimens to be Shipped

Dry plants are very fragile, however, they can be shipped without a plant press. If the specimens are still loose between newsprint, layer them as flatly as possible in a snug fitting box. It may be necessary to insert heavy paper such as poster board between the layers. Do not crush the specimens, they should be packed loosely. If there is any room to spare, use foam or other packing to fill the space.

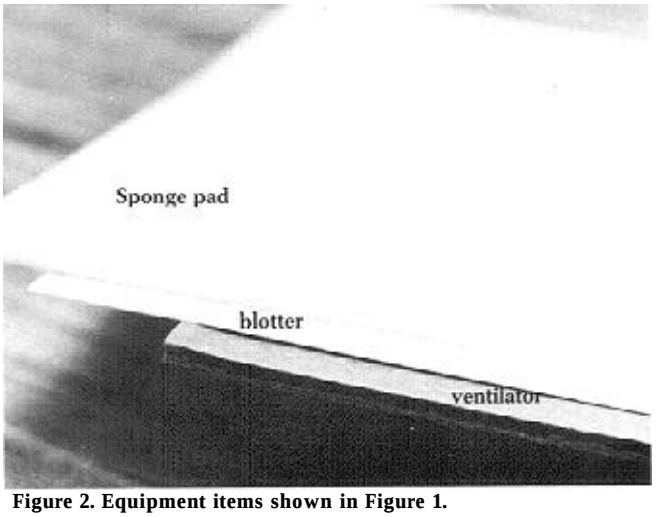

Figure 2. Equipment items shown in Figure 1.

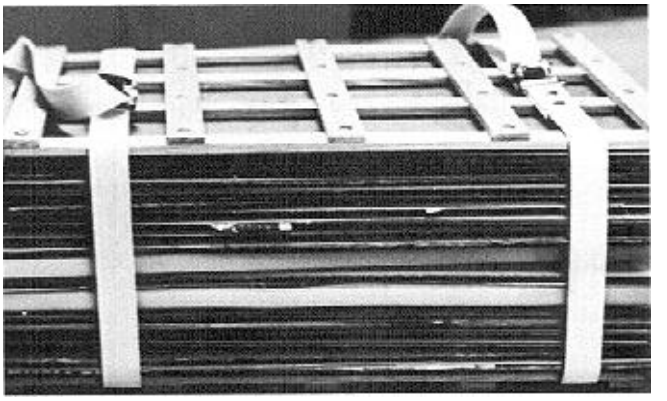

Figure 3. A hardwood, lattice frame press with adjustable straps.

If the plants are already mounted onto herbarium paper, use a box that is only slightly larger than the herbarium mount. Treat a herbarium mount as if it were fine art. Do not let it become smeared with newsprint. Make sure that any glue used in mounting is dry. It is best to insert a piece of clean paper between each mount.

Always ship specimens with a return receipt. It is nearly impossible to place a value on them. They represent time spent in the field, time for taxonomy and literature review. They are valuable and should be tracked as if they were worth a fortune in gold, because if properly prepared, they are priceless.

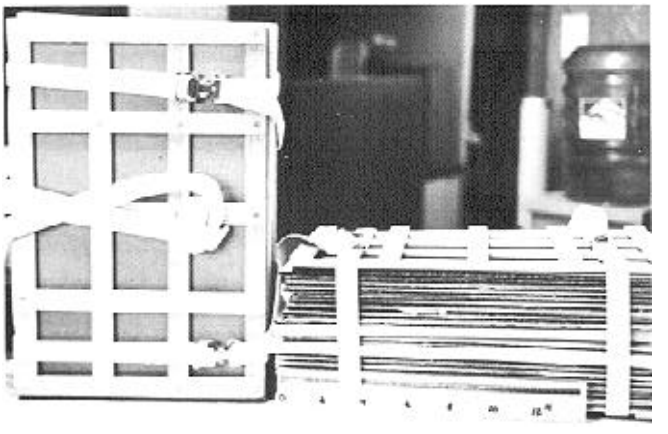

Figure 4. Two views of a suitable plant press.

Field Notes

These are best obtained either while collecting and inserted into the press with each corresponding specimen or recorded directly into a field notebook for permanent record.

When God created, He designed and it is this design that taxonomists like to tear apart, examine, pigeon hole and quantify. This system of identification may not be the best but it is our way of keeping track of the Creator's outline.

Figure 5. *Verbena* sp. Monadelphous stamens form a tube surrounding the style with filaments diverging at the top in members of the family *Malvaceae.*

Always try to collect a complete specimen including flowers as well as ripe fruit and enough root to tell whether it is a taproot, fibrous root or rhizome. But if you cannot obtain a complete specimen, then include a discussion of missing details in your field notes. If the plant is so large that it cannot be collected (a tree or bush) then carefully describe it in your notes. Include height, growth form, trunk size, type of bark, etc.

Field notes are important not only to the taxonomist but they are also indispensible to the ecologist. Reggie Fletcher, Botanist for the United States Forest Service Southwest Region, has verified the identification of many of the plants collected for CRS. He claims that one of the most important elements on an herbarium speciment sheet is a list of associated species. If a botanist has an idea of what a plant was associated with, he will have an idea of where to look for it in other localities.

Figure 6. *Sphaeraclea* sp. Monadelphous stamens from a tube surrounding the style with filaments diverging at the top in members of the family *Malvaceae.*

Field notes should include as much of the following as possible:

—List of associated species.
—Community type (riparian, dry meadow, woodland, etc.)
—Soil type (or your best description)
—Elevation, percent slope, aspect
—Geomorphic setting
—Location (Section, Township, Range; name of Land Grant, vicinity; county; highway marker, etc.)
—Description of missing anatomy
—Site notes (overgrazed, old field, fenced, spring, etc.)
—Commonness of the species (abundant, common, few, rare)
—Flower color (flower color may change after the plant is dried, descriptions are written for live plants)

When field collecting, taking notes may get to be a redundant chore. One set of notes may suffice for several plants. Specific details can be noted on the newspaper or drying paper covering the particular plant in the press. Dr. George Howe, who has already contributed many specimens to the CRS herbarium, suggests carrying along a small tape recorder which may be used to store field observations. These notes can be transcribed at a later date and attached to the particular specimen when it is more convenient. Either way, notes should be collected into a field notebook for permanent record and frequent review. Your personal collection number should be recorded and a list maintained of the next available number (see section on organizing data for use of the Personal Collection Number). Recorded data will be invaluable to the taxonomist who inherits the plant specimens.

Learning Basic Plant Anatomy

Anatomical criteria are needed to support identification. If you cannot collect the complete plant, attach a descriptive note. It does not have to be as glamorous as Munz's "sepals cauducous at anthesis" but it could be as follows. "This plant wears pixie caps which when pulled off expose the petals." Or, "This plant had a long root that broke before I could find the bottom of it."

Although a field biologist need not be a taxonomist, it is still helpful to have a basic understanding of plant anatomy to take to the field. Knowledge of anatomical criteria is needed to understand the botanical literature. There are a number of small-sized references that can be handy in the field such as *The Peterson Field Guide Series* and the *Finder* series. Pocket sized references can be purchased for trees, flowers and berries. These references contain glossaries and many pictures as well as illustrations of plant anatomy. Most college book stores will offer a local version of plant field guides.

Being Aware of Other Disciplines

At the March, 1986 meeting of the Society of Ethnobiology, one of the biggest complaints voiced concerned plant anatomy. It was reported by the keynote speaker, Dr. Vorsila Bohrer, a leader in ethnobiology in the Southwest, that scientists from other disciplines are frequently not learning skills from botany that could help them understand the botanical literature. Unfortunately many universities are not

willing to let their people cross over into other departments to learn such related skills.

The problem with being a purist in your own particular discipline is that much valuable information on plants is never recorded. One summer I had the delightful duty of monitoring permanent range transects in a Northern California wilderness area. Transects are long lines along which vegetation is recorded and analyzed. Some of the transects had been established for as long as 20 years. Most of the transects had been inventoried fairly well for the important range grasses, but the forbs (a range management term for wild flowers) had not been treated carefully since the purpose of these transects was to determine forage production rather than to develop a complete vegetation inventory. The last 10 feet of one transect crossed a bog which contained populations of "rare" or "threatened" plants. These had never been recorded on the transect readings or any other file. Meanwhile, the managers of that forest had contracted a botanist to look for one of these species which had been growing in one of their own transects without them knowing about it. The contracted search was unsuccessful in locating the plant. Had these plants been mentioned on previous transect readings, even as a note, it could have saved the U.S. Forest Service some expense.

Table II. A Table of Plant Uses for Certain Specimens in CRS Herbarium. The Herbarium Number is Given for Each Example.

85 - 45
Family — *Lamiaceae (Labiatae)*
Plant — *Prunella vulgaris* L.
Name — "Selfheal, Heal-all"
Sept./Oct. 1985
Place — Marietta, Ga.
Uses — Various teas were made for bruises, burns, diabetic sores, cuts and acne; it was cooked as greens; it flavored other medicines. (Hamel & Chiltoskey, p. 54)

85 - 50
Family — Fabaceae
Plant — *Cassia fasciculata* Michaux.
Name — "Partridge pea"
Sept./Oct. 1985
Place — Marietta, Ga.
Uses — A root medicine was used to keep Indian ball players from tiring; mixed with wild senna, a tea was made to treat fainting. (Hamel & Chiltoskey, p. 54)

85 - 58
Family — Asteraceae
Plant — *Solidago odora* Aiton
Name — "Sweet goldenrod"
Sept./Oct. 1985
Place — Horse Pens 40, Ala.
Uses — Various teas were used for fever, colds; diaphoretic; tonic; stimulant; nerves; measles; female obstructions; tea used for bloody discharge from bowels; summer complaint; neuralgia; sore mouth; tuberculosis. (Hamel & Chiltoskey, p. 36)

85-62
Family — Asteraceae
Plant — *Anaphalis margaritacea*
Name — "Pearly everlasting"
Sept./Oct. 1985
Place — Marietta, Ga.
Uses — Used for catarrh, colds, throat infection, bronchial cough, headache, sun blindness, chewing tobacco. (Hamel & Chiltoskey, p. 48)

Organizing the Data

Fifty percent of a taxonomist's time is spent in actual microscope work. The other half goes to managing the data and preparing the plants for the herbarium. Ethnobiology research is additional. In order to access the abundance of information that comes in from the field it will become increasingly necessary to computerize the CRS herbarium.

Even in the age of computer technology there is nothing like the original source for gleaning information. As a collector you are the original source and should be keeping track of your own specimens. To do this you will need a numbering system.

The CRS Herbarium will provide a number of its own. However, the collector should also have his own number which will go onto the herbarium sheet label along with the collector's name. This number is completely separate from the number assigned by the herbarium.

The personal collection number is one that you assign to a plant. If it is the first plant you have ever collected in your career as a field botanist, it is assigned the number "1." The second specimen is assigned the number "2" and so on. According to Smith, new numbers are assigned anytime you move to a new specimen, new location or new day. He has described a few examples. (Smith, 1979, p. 6).

1. If I collect 10 different kinds of plants at a certain site, I will have 10 collection numbers.
2. If I collected each of the 10 plants in duplicate or triplicate, I would still have only 10 collection numbers, each in duplicate or triplicate. This is the only situation in which a collection number is used more than once.

Figure 7. Mount of *Polygonum* showing envelope used to corral small seeds.

Figure 8. ***Cassia fasciculata*** **with ethnobotany notes; Cherokee ball players used a root medicine to keep them from tiring.**

3. If I move to a second site and collect five more plants, I will have five more collection numbers. This is true whether or not any or all of the five plants duplicate species collected at the first site. New numbers are assigned because this is a different collection site.
4. If I should return to any of these sites at a later date, all of the plant collections made at that time would get new numbers.

Photographs of finished herbarium sheets are illustrated in Figures 7-10

Figure 9. *Prunella vulgaris.* A good example of a specimen collected with the root.

Conclusion

Bohrer (1986) reminded field biologists that they are at best interpreting rather than identifying. She said that we draw on clues to give our best guess of what "it" is. Therefore, she said that we must document our way to a conclusion. Dr. Bohrer reminded her colleagues that redundancy of work can provide an insight that cannot be acquired in any other way. Her final reminder to the ethnobiologists was "treat each step as important and worthy." We as creationists should be even more concerned. God created in completeness and wisdom. His design is exquisite. Collect intelligently so that your work can become an integral part of the CRS herbarium.

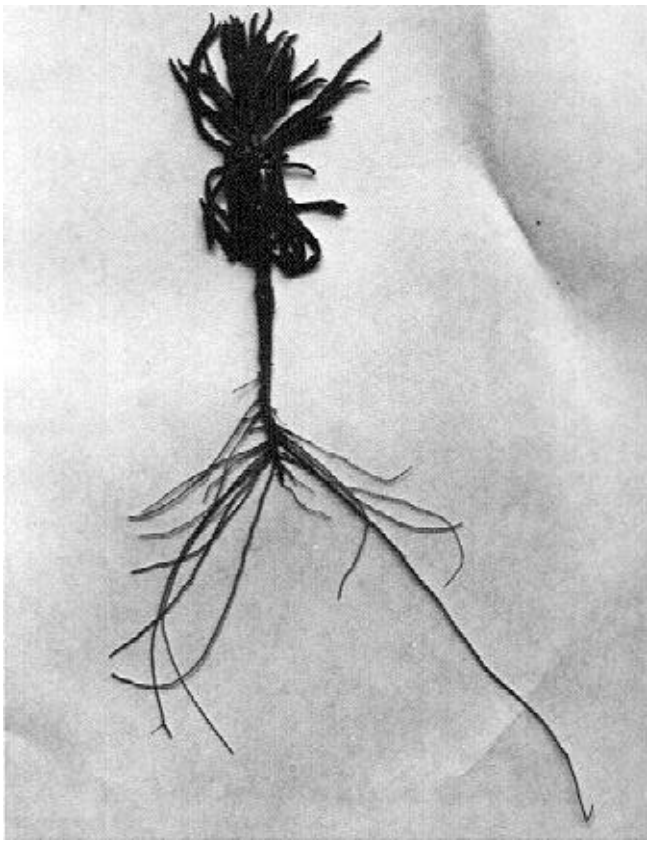

Figure 10. ***Dithyrea wislizenii.*** **A better example of collecting the root.**

Acknowledgements

I wish to thank the CRS Research Committee for authorizing and funding the CRS Herbarium Project. I gratefully acknowledge the donors who by their gifts to the CRS Laboratory Project fund are making this research possible.

References

Bohrer, Vorsila. 1986 Keynote Speech. Ninth Annual Ethnobiology Conference. March 22. University of New Mexico. Albuquerque, NM.

Craighead, John J., Frank C. Craighead, Jr. and Ray J. Davis. 1963. A field guide to Rocky Mountain wildflowers. The Peterson Field Guide Series, Vol. 14 (Roger T. Peterson, editor) Houghton Mifflin Company. Boston.

Fletcher, Reggie. 1986. Personal interview.

Hamilton, Paul B. and Mary U. Chiltosky. 1982 Cherokee plants, their uses—a 400 year history. Hickory Printing. Asheville, NC.

Hitchcock, A. S. and A. Chase. 1951. Manual of the grasses of the United States. U.S. Government Printing Office. Washington, D.C.

Howe, George F. 1986. Correspondence.

Keator, Glenn and V. R. Winemiller. 1980. Sierra flower finder. Nature Study Guild. Berkeley, CA.

_____. 1980. Master tree finder. Nature Study Guild. Berkeley, CA.

_____. 1980. Winter tree finder. Nature Study Guild. Berkeley, CA.

_____1980. Pacific coast berry finder. Nature Study Guild. Berkeley, CA.

_____1980. Pacific coast tree finder. Nature Study Guild. Berkeley, CA.

_____ 1980. Redwood region flower finder. Nature Study Guild. Berkeley, CA.

_____. 1980. Desert tree finder. Nature Study Guild. Berkeley, CA.

_____1980. Rocky Mountain tree finder. Nature Study Guild. Berkeley, CA.

Munz, Philip A. 1968. A California flora and supplement. University of California Press. Berkeley, CA.

Niehaus, Theodore F. and Charles L. Ripper. 1976. A field guide to Pacific states wildflowers. The Peterson Field guide Series, Vol. 22. (Roger T. Peterson, editor) Houghton Mifflin Company. Boston.

Niehaus, Theodore F., Charles L. Ripper and Virginia Savage. 1984. A field guide to southwest and Texas wildflowers. The Peterson Field Guide Series, Vol. 17. (Roger T. Peterson, editor) Houghton Mifflin Company. Boston.

Smith, Jr., James Payne. 1986. Correspondence.

_____1979. Collection and preparation of vascular plant specimens, Department of Biology. Humboldt State University, Arcata, CA.

_____ and Kathryn E. Simpson. 1977. Vascular plant families Mad River Press. Eureka, CA. pp. 283-4.

Additional Helpful References:

Brayshaw, T. C. 1973. Plant collecting for the amateur. Museum Methods, Manual 1. The Friends of Provincial Museum. Victoria, B.C. 15 pp.

Harrington, H. D. and L. W. Durrell. 1957. How to identify plants. Chapter 13. Swallow Press. Chicago, IL.

ARTICLE REVIEWS

Star formation, luminous stars and dark matter by Richard B. Larson. 1987. *American Scientist* 75: 376-85.

Reviewed by Don B. DeYoung*

Introduction

This article addresses some basic questions in astrophysics. New theories and observing instruments are keeping this field of study very active. In particular, the 1983 Infrared Astronomical Satellite (IRAS) produced much data concerning star formation and the nature of interstellar matter.

The author's position is that nearly all of the dust and gas in space are the remnants of former stars. Evidence is searched for rapid star recycling, with a consequent interest in stellar masses and lifetimes.

Points of Interest

Larson's paper brings out much useful information related to stellar evolution. Some of the points are:

—Stars of one solar mass have a lifetime of 15 billion years if their energy source is nuclear. Because this is the assumed age of the universe, star recycling is thought to be limited to more massive, shorter-lived stars.

—50 percent of stellar clouds are found to have infrared sources embedded in them, usually taken as protostars. The nearest such clouds are in Taurus, 500 light years away.

—The long age view requires that new stars form at the rate of about six solar masses per year in the Milky Way (p. 379).

—IRAS detected regions of extremely intense infrared emission in galaxies. If the radiation is really from protostars, stellar formation is rapid enough to deplete all galaxy dust in less than 10 million years (p. 379). This is implausibly rapid in stellar evolution theory.

—Our neighbor galaxy Andromeda is moving toward us despite the general expansion of the universe. Gravitational attraction by unseen "dark matter" is suggested as the cause (p. 384).

Star Formation

Do stars form spontaneously? This question does not have a definite answer, either from stellar evolution or from creation viewpoints. Concerning the latter, the denial of any present day star formation has often been made a point of orthodoxy. However, we simply do not know! Stars are inherently "simpler" than living systems. If a cloud of hydrogen gas is squeezed to within Jean's gravitational limit, it may well heat up and turn on as a star. Remember that the sun is a gaseous sphere as well as a stable star. If star formation does indeed occur today, it certainly remains a rare event, only in regions of pressure waves. There remains a total inability to explain the host of visible, isolated stars. A timescale problem also remains, since computer models give a million-year startup time for new stars (p. 382). However, just as rapid star decay has been observed—(DeYoung and Whitcomb, p. 86), so formation could also sometimes be rapid. Having raised this controversial point, let me be very clear: All assumptions regarding present day star formation remain speculative. All infrared protostar data remains open to other interpretation—(Steidl, p. 102). No "turning on" of a star has ever been observed.

Consider Larson's data on star formation. *First,* he describes "stellar nurseries" as clouds with densities of at least 10^4 hydrogen molecules/cm^3 and temperatures near 10K. However, (Mulfinger, p. 11) has clearly shown that such clouds cannot form stars. *Second,* Larson reports that instead of collapse, many such clouds often show an extremely rapid outflow of material. Natural explanations of this mass dissipation are lacking. The motion seems to resemble star decay

*Don B. DeYoung, Ph.D., Science Department, Grace College. Winona Lake, IN 46580