DARLINGTONIA

THE NEWSLETTER OF THE NORTHCOST CHAPTER
CALIFORNIA NATIVE PLANT SOCIETY

October 1986

*Calendar*


12 Nov. General meeting & program--Mary Hektner on Ecology of the Bald Hills.

23 Nov. Flea market--fleas and help needed.

26 Nov. Board meeting. Material for Darlingtonia due.

3 Dec. General meeting & celebration--at Dave Imper's house.

*Board Meetings*

Board meetings are held at 5:30 pm, in SD-167 at H.S.U., one week before general meetings; hence, there will be one on 29 October and one on 26 November. We will not have meetings in January. This is when we act on proposals and chart the chapter's course. Everyone is welcome. Call Dave Imper (444-2756) for more info or to confirm times and dates.

*General Meetings & Programs*

We normally meet on the first Wednesday of the month, and for now, we are meeting at the Humboldt State University Campus in SD-157. However, in November the meeting will be on the second Wednesday in December we will meet at Dave Imper's house, and there won't be a meeting in January. It is hoped this inconstancy won't cause undue consternation in the membership. By February, we may be ready to move off-campus again. The meeting starts at 7:30 pm; the program at 8:00. Don't forget to either park on Union Street for free or put money in the meters.

12 November--Ecology of the Bald Hills of Humboldt County: plants, wildlife and history, a talk by Mary Hektner, ecologist with Redwood National Park.

3 December, 7:30 pm--In place of our December program, all members are invited to Dave (i.e. Kim) Imper's house for a chocolate dessert/champagne potluck. Bring in the season conversing with friends. Take Old Arcata Road north from Eureka, 1/2 mile past the turn to redwood acres, to Lower Mitchell Road (north of bridge), go right 2 miles to top of hill, turn right on Lentell Road, follow CNPS signs. Call Dave (444-2756) for more info or directions.

*Saturday, 23 November*

-N.E.C./Chapter Benefit Flea Sale-

Help needed! It's time once again to dust out those cupboards and rid yourself of space-hogging, unwanted treasures. The chapter is going to the Redwood Acres Flea Market on November 23rd. The purpose is to make money to keep up our association with the Northcoast Environmental Center and to keep our own kitty comphy. We need your donations of assorted usable, trivia and miscellaneous. Just about anything sells. Help is also needed to run the booth. Give Flea-man-Dave a call at 444-2756 or Kut-Rate-Ken at 822-8360. --Dave Imper.

-Elections-

The time has come to vote-in a new board (well, not too new). The nomination committee must report failure to truely fill some of the positions this year--like President and Vice-President. Dave Imper has reluctantly agreed to lead the meetings and make like a boss, and John Sawyer will arrange the programs. This is only until some energetic souls step forward to help out. Other jobs that are still open are: taking minutes (Secretary), Rare Plants Chair, Escaped Exotics Chair, going to state meetings (President), refreshments coordination. If other's still would like to take on some of the work--even small jobs--they shouldn't feel inhibited. The ballot is on the next to the last page.

A Passacaglia and Fugue in Pseulolekella

by Paul Wilson

I actually do like Bach. But his "Passacaglia and Fugue for Organ" is a bit beyond me. It is a powerful piece of music that conjures up feelings, feelings such as one might get from being locked alone in a small, windowless room, for an indeterminant amount of time, in a straight jacket. This composition comes in two parts. In the first, the Passacaglia, Bach takes a fairly simple theme of eight measures, and he plays it over and over, each time varying the accompaniment. You hold your breath (or pant feverishly--depending on your disposition). When will the end come? Then, when it's almost impossible to stand it any longer, Bach launches into the second part, the Fugue. The first twenty repetitions of organ pounding build up great hope for a reprieve--but, Bach was a master. In the Fugue, he does not adopt a new theme. Instead, he takes the old motif, cuts the notes in half, changes the key, and the millstones turn around and around and around, only now more quickly, until finally, after umpteen variations, he ends in a triumphant (or gasping) coda. Bach's is a study in the plasticity of a single theme.

This is the realm of sound and time, and maybe if my musical interest were more than casual, I would be able to muster for Bach's organ music some kind of masochistic appreciation of how much difference he managed to pack into one statement of overwhelming similarity. And maybe there is yet hope for me,
for in an analogous pattern in the biological world I have recently managed to emerge fairly sane from what surely has been just as intense an experience. I am, at present, putting the finishing touches on a professional investigation, and the time has come to write it all down for you. I am writing this essay for very clear and definite reasons. It is not merely to explain what we found, though I hope that will be a good lesson in the savage vagaries of evolution. Nor am I even only doing my usual in a compliant manner of a professional pattern. This time, I am milking out one more level—I want to offer a glimpse of what the emotional and psychological components of research have been in this my first formal pursuit of truth of an admittedly tiny but nonetheless heuristic portion of reality.

It started in a modest way. When I was a freshman, Dan Norris asked if I would like to collaborate with him in studying a moss that he suspected of being undescribed (i.e., new to science). I accepted, and we wrote away for specimens of Pseudoleskeella altissima. This is a European species that we then believed to be the only thing our plant could possibly be confused with. The plan was to find generalized differences between our plant and this comparison species and then to describe it. Nothing elaborate. We fully intended to finish in six months.

Ah, we were naive! In fact (and I am a bit embarrassed to say this), we proceeded along as planned, and after eight months we even managed to get it into manuscript form. But some things set like burrs in the crotch, and we began to suspect that the new species and the comparison species both seemed to have a great amount of malleability in a disheartening number of features—the same ones. Second, the difference between the comparison species and other Pseudoleskeellas seemed less and less clear. In other words, the whole genus was potentially a mess, and we didn't have any business simply comparing our plant to one other European species, and on that basis decry it as distinct and new to science.

We, therefore, decided to look at specimens from the other species. (Projects, you see, have a way of growing.) But neither of us had extra time and nothing more was done. Meanwhile, I went away to Michigan for the summer, and Dan to Finland. I returned. During Fall quarter, we requested tons of specimens, and Dan worked on the material in Finland. For Winter, I signed up for independent study to work on the project.

That was the quarter. And this is the link to Bach. I looked at specimens, hundreds of them, thousands of them. Leaf after leaf, and it seemed that each one was different but that there was a common theme contained in them all. The goal was simple—find the species in the genus, find where the discontinuities in many features actually occur. I drew pictures, I made long and detailed tables contrasting various possible species, and after that were so different! So many characteristics could be found to tell them apart (compare for instance Figures 5E & 5m). If I only looked at a dozen or so specimens at a time, distinctions could be found; things could be sorted; charts could be made. But when those distinctions were checked against other specimens, intermediates would soon appear. Then there were intermediates between the intermediates, and at the level of even a couple hundred specimens, seemingly complete continuity could be established. And too much new material affected the sample. I soon discovered that I was finding, on the same specimen, leaves that would be placed in different species. Could this possibly be one, extremely plastic species? How could anything be so malleable in that many features? How could anything be so damn intractable? I was pretty sure there were times when I figured I just wasn't made for the research game. Mosses can be fun to look at, but who in the world has a reservoir of aesthetic appreciation that can maintain itself through thousands of dried, dead plants, hour after hour, day after day for weeks on end? They are not particularly cute, and even if they were, that many of them would still wear away the nerve endings. There were also questions as to whether I was somehow singularly deficient in vision. I have never had a quick mind; nor am I even of average ability in the minutiae of lizard brain operations. My concepts are dogged diligence, a moderately powerful (though ponderous) ability to apply broad themes to specific cases, and an okay memory for longish files and general concepts. I just wondered if these strengths with these frailties were really going to work out very well in approaching reality from the direction of details (and I still wonder, though now I figure there isn't anything to be done about it). Those months were a time for peering squarely in the mirror only to see an indistinct image.

Not that it was all bad, even during the hardest times. I don't know how to communicate this. There was something at stake. I was standing on the frontier. I knew more about the paradoxes of Pseudoleskeella than anyone has ever known. And there is a certain perverse pleasure to be derived from knowing that all previous understandings are even more flawed than one's own. There were, also, moments of triumph and elation, times when I would make a breakthrough, add a tiny piece to the puzzle, but a piece nonetheless, a characteristic that would make a breakthrough and make it ever so slightly better. The thrill of those breakthroughs I think is something like when you're just learning to swim and you realize that you actually made it to the surface without touching bottom. There was hope—not guaranteed but at risk.

There is also a lonely isolation hidden in research. And I felt it, was grazed by it at least. When I found those fragments of evidence, there was an immediate urge to run and find someone to tell them, "The world is yet young!" And when friends were at hand, I did this, but it is not easy to communicate the grand importance of something like a slight difference in the length of cells over the midrib. My friends are experienced researchers, so with difficulty I was able to transfer a little of the excitement. But some of the edges were taken off, and I often felt a bit silly about the whole enterprise. After all who really should care what the species are in some obscure moss genus? Who? I for one. But beyond the species, there is something that matters to me even more; ironically, it is the emotions, the triumphs and depressions, and the stimulations of a striving mind.
Winter quarter drew to an end, and I realized that there was no possible way I could retain in my memory all the specimens that I had looked at. I had to draw up a summary. That was the turning point. I picked out specimens that I felt showed all the features I wanted to remember, and I photographed their leaves. This lead me to look at the plants in a different way, to pay attention to the transition between leaf forms within a single specimen.

I had known since the days of our new-species-description that in Pseudoleskea there are two types of leaves: call them the leaves of the sun and leaves of the earth. The sun-leaves make up the obvious foliage that grows on the exposed tops of mats. Earth-leaves are much more clandestine—they grow on kinky stolons on the undersides of mats. These two leaves are different in numerous aspects. Sun-leaves are longer, narrowing gradually to a point; their midrib tends to be strong and is often single; their cells are rather short; and in some species they can be quite toothed. Earth-leaves are roundish, abruptly narrowing to their tip which is curved back and a bit tubular; their midrib tends to be weak and is generally forked nearly from the base; their cells can be much longer than in sun-leaves; and they are never much toothed. These two leaf types also differ in other more ethereal ways. They are not, however, discontinuous—all intermediates occur between the two forms as one moves up and down shoots. We call this a multiple-attribute heterophyly spectrum with complete intergradation. Each of the rows in Figures 1-4 shows the spectrum. Note how different the ends are, but that they are connected by inbetween forms.

This heterophyly spectrum is not the only source of different leaf-forms within a specimen. Leaves also change in many ways as they develop. As sun-leaves grow, they become longer with stronger midribs. As earth-leaves grow, they become not longer but broader, with perhaps even weaker midribs. Both forms get longer, more thick walled cells. Here, there is a second multiple-attribute continuum, the

FIGURE 1: Portion of matrix present in one specimen of P. nervosa. Showing leaf and inset of cell pattern.

FIGURE 2: As in Figure 1, but for P. sibirica.
It is illustrated by the columns in Figures 1-4. In other words, on a good specimen, you can see an enormous range of leaf forms that vary along two spectra. These leaf-forms can be arranged into an imaginary matrix the axes of which are the two spectra. A key point to understand (and one that I didn't appreciate at the time) is that leaves from different matrix positions are necessarily different in numerous features, for those features are intrinsically correlated to each other.

While I was photographing individual specimens, I started to understand the matrix. Meanwhile, I had been reading a hot new article, "Ontogeny and Phylogeny in Tortula" by Brent Mishler (1986, Systematic Botany 11:189-208). In this paper, Mishler argued that different species of the moss genus Tortula differ in their degree of development at maturity. With my pictures and Mishler's paper fresh in my mind, I finally, after all my strivings, I had a stroke of insight.

It is simple, nothing beyond the powers of a mediocre intelligence: 1) while a great range of leaf forms can be found on an ample mat, usually on one plant one leaf form is dominant; 2) the dominant-leaf-forms of different specimens occupies different positions in the matrix; 3) the dominant leaves of different plants differ greatly--they must, and the necessary reason for the difference is they differ in matrix position; 4) these were the distinctions that we had been seeing all along, but we had been trying to use them without understanding that we were contrasting non-comparable leaves. In other words, on different Pseudoleskea specimens, the dominant leaf-form holds different positions in the matrix. Sometimes the dominant leaves are on the extreme sun-leaf end and sometimes they are more toward the earth-leaf end. Sometimes they are less developed and sometimes they are more developed. All depending on the plant you happen to have in hand and where along these two spectra any plant happens to lie determines greatly how it will look.

I prayed that I was right. I knew that if I was, we would have the rat by the tail, and even if we couldn't find good species boundaries, we would at least have an explanation of how it is that these plants can be so plastic in so many features. I felt (contingently) revived. But I was still wary--if I have learned nothing else from this project at least I have been taught that Pseudoleskea have a tenacious backlash that is not to be underestimated or forgotten. They have brought me to my knees so many times! I was, and am yet, wary. I also was, characteristically, slow. It took a long time for me to realize the full implications of my breakthrough (perhaps I still haven't).

But I wrote Dan and started digging around in the literature. Mishler's was not the only paper that ever explored species differences in the context of development. I found a rather extensive collection of writings that dance in and around an elaborate system of ideas. The study-organisms of these papers were mostly animals but there was a scattering of plants. Many of the recent papers were centered around a conceptual framework, the idea of evolutionary changes in the timings of development and maturation such that different species differ in their degree of development. Here was theory. Something to grab onto, even if it wasn't precisely the right thing.

With painful slowness, things started to solidify. I was not able to spend much time with the specimens during Spring quarter, but I did do a lot of thinking and a lot of talking. The talking was invaluable. I begged the indulgence of my friends, and each time I explained my ideas I got a little better at thinking the right thoughts.

Until early August, I still wondered if the whole thing was really worth publishing. Then Dan came home for a short visit, and declared we would finish or bust. That was

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**FIGURE 3:** As in Figure 1, but for *P. tectorum.*

**FIGURE 4:** As in Figure 1, but for *P. serpentinense.*
perhaps a bit too exclamatory, but we did
dart working frantically toward an end. When
ideas get into manuscripts they can look real
different. The first manuscript of two years
ago told us we needed to know more. This one
boosted our enthusiasm. We were on fire.
Everything (almost) was fitting together. The
importance of the project swelled in our
minds, it took on a new emphasis. It is no
longer merely a reclassification of species,
it is now a study in plasticity and evolution.

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In the game of research, an idea is like a
raindrop falling on a lake. It creates a
series of ripples. They may expand to encom-
pass a giant area, but as they do so they di-
minish in size and become absorbed among all
the other ripples from all the other rain-
drops.

Our one raindrop was linking together
numerous features of difference. We showed
that leaf shape is intimately tied to midrib
length, cell shape, cell wall thickness, and
tothing, as well as size and the overall
demeanor. These features are not independent,
they are aspects of the same two things—de-
gree of development and position along the
heterophyly spectrum. Because they are not
independent, we treated them collectively as
two conceptual characters corresponding to the
two spectra. We then tried to interpret these
characters just like any other characters. We
asked, "Do they mark species boundaries (as
determined by a correlation with other inde-
pendent characters) or are they just noise
that gets in the way of true gaps?" The answer
is a messy one; the answer is both (assuming
one chooses to recognize species—see below).
Species do differ in their matrix position
tendencies. There is also great malleability
within species in matrix positions. Thus, the
species overlap, and a continuity of form is
observable (see Figure 6). The point is, there
are knots of intrinsically linked traits that
need not have any great genetic basis, such as
earmarks long histories of evolutionary diver-
gence. We understood, in a rough way, the
linkage and we were thereby able to concep-
tually reduce the plasticity.

This idea is not hard to understand. You
would not, say, want to postulate great evolu-
tionary distance between two madrone trees

FIGURE 6: Conceptual matrix placement
of the sunry species each with their
respective ranges of variation. The
center points mark the position of an
average specimen; the radii show how
far some specimens deviate from that
average. Note the overlap of species.

FIGURE 5: Dominant leaves and cells of those leaves from various specimens in sunry
species. A-D) P. nervosa; E-H) P. sibirica; I-M) P. tectorum; N-R) P. serpentinense.
Notice within each species how the extreme range of different leaves is transformed,
and that this same transformation, with all its associated characters, is repeated (to
some degree) in each species.
after proving that they differed in height, weight, trunk diameter, number of leaves, number of branches, etc. Of course they would differ in these features! They are all aspects of one thing, the tree. But see it this way: that you were contrasting a sapling and a fully grown tree. Yet, the situation can get more confusing. First, traits needn't be so obviously linked—who would think that midrib length and marginal toothing would be connected? Second, you can get cases that lack anything as clear-cut as size to tie the traits together—like our heterophyll spectrum. And third, when the multifaceted differences do correspond to real gaps in diversity, you are lead to believe the gap is greater than it actually is. Certainly, for instance, Figure 1B and Figure 3I are so different as to suggest different genera. In actuality, we're having a hard time defending a species distinction. And all because of a linkage of characters.

Think about it. Think about the ripples. Correlations in independent features are the stuff that characterological universals are based on. They are the things that you use to measure natural affinities, to speculate on adaptation and even to characterize the process of evolution. Obviously, it is necessary to try to know when characters are actually independent and when they are linked to each other. The idea of intrinsically correlating characters is not new, but I do suspect that it is underemphasized. We have found one case where it has a dramatic effect on the interpretation of diversity. Who can tell how much biological understanding we lost differentiating these different features play off against one another? *Pseudoleskeella* is a lesson in the nature of form—in its complexity and origin. It was my triumph to understand this.

Victory notwithstanding, *Pseudoleskeella* is still far from a paradigm of tidiness. Many things remain worrisome, the same ones that a couple months ago I felt hog-tied by. Now they are only irksome. The spectra are hard to define precisely and to separate—we haven't done, and I doubt we could do, an exact statistical description. Second, even though we now have noticed that leaf length, leaf bluntness and the freedom of movement in the matrix, the species boundaries remain uncertain. There is a good reason for this—the characteristics of the two spectra use up a lot of features, the plants are simple, hence there are precious few places to look for differences. There is also the nagging question whether much or all of the species differences and certainly the dominant leaf form character could not be environmentally induced and have no genetic basis whatsoever. What about the new species, *P. serpen
tine*? It grows only on serpentine rocks ("serpentine"), and these formations are famous for inducing peculiarities. The other species also have their own specific habitats. Are the differences in the plants directly caused by the habitat or are the plants that are distin-
guous in form somehow linked to the habitat? Such is the two edged dagger of habitat differences. And even if they are distinct, what is the use of recognizing such tenuous and cloudy species? My family is genetically different from your family. Still there is no reason to draw a species boundary between the two. These are the imperfections in our story. I admit they are blotches, but I think not deadly ones.

When I think about this research business, I see two components. There is the intellectual, the collective, the information about the organisms, in our case looking at similarities and differences. There is also the theoretical, the thing you do when you are thinking up ways to interpret the observations, when you are trying to discover what your data mean or (as is more often the case) could mean. Optimally, the two should be kept always on the alert, playing off against each other. The mind should be urged to create an abundance of ideas while a truth of facts is amassed and is actively dismissing those ideas that are flawed; thus the best ideas will be selected as rapidly as is possible, and they can then suggest other avenues of thought and of observation. In studying *Pseudoleskeella*, I have operated at the sub-sub-optimal. I didn't think enough in the first year of the project, for the last five months I have done little but theory, and now I am racing to finish the practical. Things should be in smaller chunks. Next time I will hope (against chance) for more sense.

You are wondering, what this has to do with Bach? Well, I figure—filippantly—that "The Passacaglia and Fugue" is Bach exploring similarity and difference at the limit of even in his ability—how could he have found another variation or been able to stand it if he had? In *Pseudoleskeella*, this is precisely what I was up to (and I almost couldn't stand it). Look at the rows in Figures 1-4. They are different rows in different species at the various stages of development, and the leaves within them are different as well. Now have I illustrated everything—there are innumerable intermediate rows and columns. Difference is abundant, and I spent an enormous time studying it and still I remained confused. It wasn't until I saw the similarity too that I was ready to understand. There is but one theme greater than difference in *Pseudoleskeella*, and that is similarity. Look. Each of the rows bears a certain likeness to all the other rows. Each of the columns is like all the other columns. A commute between the different leaf, specimen after specimen, thousands of them, at the limit of my endurance, it has been an extravaganza of difference within similarity. And the thing that has made this journey worthwhile, more than anything else, has been the powerful stirring of emotions—frustration and triumph, hope and fear, shame and pride, and a striving to bring the cosmic out of the miniscule. Are these not the same feelings that Bach might have had?

But the point of this article is not just to give Bach free rein; it's not just not just a thinly disguised pleaing of my own feathers either—there are many things that a part of me would have dearly loved to forget or at least leave out, other things could have used heroic additives. But I have forced myself to stick with purpose, however self-incriminating it might be. My purpose is to lead you through the pains and joys of the art and show you the early development of a biologist, and I hope I have done it as honestly as is at all possible. After all, this is the only chance I will ever have.

* I have been greatly supported by several people. Perhaps the study and the experiences
are as much their's as mine. I thank Karen Lu, Carin Thomas, Ken Berg, Doreen Stabinsky and Michael Mesler, and I acknowledge the contribution as well as the tutelage and companionship of Dan Norris.

This plant grows in the H.S.U. greenhouse; it is native to the Old World tropics. --Paul Wilson.

Persons wanting to subscribe to Darlingtonia without joining the Chapter may do so by sending $3.50 to: J. P. Smith, Membership Chair; Northcoast Chapter of CNPS; P. O. Box 1067; Arcata, CA 95521.

Clovers of Northwestern California
by Doreen Stabinsky

The following key was borne of a frustration at first couplets that ask: "Plant annual versus plants perennial?" I've essentially taken the three extant keys to western clovers (Trifolium) and synthesized them, making a single concise key to the forty species and varieties listed as occurring in Northwestern California. All the brilliant couplets contained in the old keys I have stolen, all the obnoxious ambiguities I've left behind. Do not be deceived into assuming mine is an independent effort—there is little original matter herein save creative rearrangements of others' genius. Hopefully though, my reconstruction will benefit clover lovers and keep to a minimum the membership of the NCCHA (Northwestern California Clover Haters Association).

Those attempting to use the key should clearly understand the basic organization of clovers. The flowers are much like other members of the pea family (Leguminosae = Fabaceae). The petals are arranged into a corolla that consists of a banner, two wings and a keel, all of which are surrounded at their base by a calyx that is made up of lobes, or teeth, and a tube:

![Diagram of a clover flower parts]

The flowers are aggregated into heads, which in many species are subtended by a whorl of leafy, fused bracts—the involucre:

![Diagram of a clover head]