



Newsletter

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Director's Note

This issue of the newsletter is about ecology education. Recent stories have highlighted the Institute's role in ecology education for elementary school students, and for the many young scientists who have participated in the IES Research Experiences for Undergraduates program. Here, we look at educational opportunities for older students.

We recently compiled a list of IES graduate students who, during the past two years, have completed or are completing their doctoral theses. There are 60 names on the list. The newsletter cover story, grown from a "reunion" photo of some of my students from over the years, begins a series on the graduate student experience.

Annual enrollment in the IES Continuing Education Program now exceeds 1,600. As the story on page 3 describes, indications are that these adult students are becoming "ecological ambassadors", applying in their professional and private lives the techniques and approaches learned here.

The IES Newsletter is published by the Institute of Ecosystem Studies, located at the Mary Flagler Cary Arboretum in Millbrook, New York.

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The Graduate Experience: Dr. Likens' Students Carry on the Tradition of Leadership in Ecology



MOLLY ANEARN

Some of Dr. Likens' past and present graduate students attended the recent Cary Conference at IES. L. to r., back: Dr. Stuart Fisher, Arizona State Univ.; Dr. Lars Hedin, Cornell Univ.; Dr. Likens; Mr. Gregory Lewis, Cornell Univ.; Dr. David Strayer, IES; front: Dr. Jonathan Cole, IES; Dr. Judy Meyer, Univ. of Georgia, Athens; Dr. Kathleen Weathers, IES.

The Hubbard Brook Ecosystem Study, begun by Dr. Gene E. Likens and colleagues in 1963, is renowned for its science. It was in the early days of this long-term research program that Dr. Likens documented the presence of acid rain in North America. Study of a watershed in the Hubbard Brook Experimental Forest, in the White Mountains of New Hampshire, after a commercial whole-tree harvest produced data relevant to forestry practices such as clear-cutting. Ecologists have been doing research at Hubbard Brook for almost 30 years to learn more about what factors regulate songbird populations. Dr. Likens and collaborators are studying the ecological fate of the breakdown products of chemicals that have replaced chlorofluorocarbons as aerosol propellants and refrigerants. And this is just a sampling; over 50 projects are ongoing at the site.

Hubbard Brook has an educational component as well, as an outdoor laboratory for graduate student research. For students to earn a master's or doctoral degree in ecology, they not only must complete the required course work and pass an oral and written examination, but also must develop a thesis, do the research and then defend the results of that research before

their advisor and their graduate committee. Research in ecology, almost without exception, includes field work; to a hungry graduate student, the Hubbard Brook Experimental Forest is a smorgasbord of field sites and interesting questions.

For Dr. Likens, training graduate students to become strong ecologists is as important as his own research. Since 1965, he has advised 38 students through the typically two- to six-year degree process; 11 have received master's degrees and 27 their doctorates. Most, but not all, have done their graduate research at Hubbard Brook. While all merit a profile here, space permits only a selection.

Jonathan Cole: Aquatic Microbiology

As an Amherst College undergraduate, Mr. Cole was an advisee of Dr. Stuart Fisher, who had been one of Dr. Likens' first graduate students. It was his work with Dr. Fisher that led Mr. Cole to become Dr. Likens' graduate student at Cornell University. His Ph.D. thesis was on bacterial and algal interactions in freshwater bodies; he did his research at Mirror Lake, in the Hubbard Brook Valley. After earning his doctorate in 1982, Dr. Cole took a post-doctoral position at the Woods Hole Oceanographic Institute, where he continued his microbial decomposition studies 14,000 feet under the ocean's surface on board the deep-sea submersible *Alvin*.

In fall 1983, the Institute of Ecosystem Studies opened under the directorship of Dr. Likens, and Dr. Cole was the first ecologist to be hired at the assistant scientist level. He brought with him funding to study the role of molybdenum in the nitrogen cycle of lakes and oceans and to continue his deep-sea decomposition research. Among his current projects are a study of carbon and phosphorus budgets in Mirror Lake, in collaboration with Dr. Nina Caraco and Dr. Likens, and

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Graduate Students, from page 1

Hudson River research, primarily dealing with phytoplankton productivity. Dr. Cole is also doing "whole-lake studies" in Michigan's Upper Peninsula. In a paper published last summer in *Science*, he and Dr. Michael Pace described how predatory fish directly affect biogeochemical cycling, and presented whole-lake studies as a model for biogeochemical cycling in other ecosystems.

David Strayer: Freshwater Shellfish

Dr. Strayer came to IES as a post-doctoral associate in fall 1983, also with a degree from Cornell. With Dr. Likens as his graduate advisor, he had done thesis research on the benthic animals — the bottom-dwellers — of Mirror Lake. In 1985, he joined the Institute's scientific staff. An aquatic ecologist, Dr. Strayer is particularly interested in the ecology of freshwater animals and is doing pioneering research on the invasion of the Hudson River ecosystem by the zebra mussel.

Another of Dr. Strayer's interests is North America's freshwater clams. Of the approximately 300 species, says the ecologist, only 25% are considered "secure"; human impacts — water pollution and habitat destruction — have given these shellfish the dubious distinction of being the most threatened of any group of organisms in North America. Dr. Strayer feels that to reverse the situation we must understand the ecology of these animals, and since 1990 he has been developing ways to monitor mussel populations and learn why the animals live where they do. His main field site is the Neversink River, near Port Jervis, N.Y., where, in collaboration with the Lower Hudson Chapter of the Nature Conservancy, he studies the dwarf wedge mussel. These animals are on the federal endangered species list with only about two dozen populations remaining in the world, all of them in eastern North America; the Neversink River has the second largest population. After observing mussels at 270 quadrats in the river, Dr. Strayer is finding that the stability of the river bottom is more important to the animals' survival than are more commonly considered parameters such as water depth, sediment size and stream velocity.

Kathleen Weathers: Atmospheric Deposition to Forests

As a master's degree student at Yale University early in the 1980s, Dr. Weathers worked with Dr. F. Herbert Bormann, one of the co-founders of the Hubbard Brook Ecosystem Study, and was hired to collect

cloud water for a pilot project initiated by Drs. Likens and Bormann. The project developed into a nationwide study, and Ms. Weathers ran it until fall 1986 when she began a Ph.D. program at Rutgers University. Dr. Likens was her advisor, and her research, which was an offshoot of the cloud water project, dealt with how landscape features affect patterns of atmospheric deposition. While working toward her degree, she was appointed manager of the laboratory facilities at the Institute, and still devotes part of her time to those responsibilities.

After completing her doctorate in 1993, Dr. Weathers broadened the scope of her research. She collaborates with Dr. Gary Lovett on studies of nitrate concentrations in stream water in the Catskill Mountains and with Dr. Steward Pickett and graduate student Mary Cadenasso on atmospheric deposition to forest edges. She is also the principal investigator for a new study of how forests are fertilized by nutrients from oceans and other sources, being done on the island of Chiloé off the coast of Chile. Dr. Weathers says that the impact of nutrients via cloudwater there are potentially large, with high levels of nitrogen, and she hopes to learn if this is a direct result of oceanic upwelling.

Lars Hedin: Forests as Biogeochemical Systems

Dr. Hedin is another ecologist who does research in Chile. A graduate student of Dr. Likens in the late 1980s, Dr. Hedin did research at Hubbard Brook on the effects of air pollution on forest and aquatic ecosystems. At the same time he began a collaborative study, on Chiloé, with Dr. Juan Armesto (an IES adjunct scientist) at the Universidad de Chile in Santiago, with a view toward establishing a parallel project to the Hubbard Brook Ecosystem Study. He received his doctorate from Yale in 1989, and now is an Associate Professor in the Section of Ecology and Systematics at Cornell University. His studies of how forests work as biogeochemical systems take him to Patagonia — because southern Chile is one of the least polluted regions on Earth, Dr. Hedin hopes to learn how undisturbed forests function so that he can better understand human effects on those ecosystems.

The December 1996 edition of *Scientific American* features an article on "Atmospheric Dust and Acid Rain". In it, co-authors Hedin and Likens present evidence that acid rain continues to have harmful consequences, in spite of regulations imposed by the Clean Air Act.

They propose that one reason for this may be a reduction in atmospheric dust particles, which carry minerals capable of neutralizing acid rain, and suggest that further reduction of acidic pollutants may be the most effective solution.

Gregory Lewis: Linkages Between Land and Water

Mr. Lewis is among the current group of Dr. Likens' students at Cornell. He did his doctoral research in the Allegheny National Forest in northwestern Pennsylvania. There, in the early 1990s, an outbreak of elm spanworm, a native species, resulted in forest defoliation, with severe damage to beech trees and moderate damage to sugar maples and yellow birch. Mr. Lewis studied the effects of this defoliation on stream water chemistry in two watersheds. He found that nitrate in stream water increased during the defoliation and remained high for two years after the caterpillar population crashed in 1994. These findings are consistent with those from other studies of response to deforestation — the experimental clear-cut at Hubbard Brook, for example — in which leaching of nitrate into streams also was reported. Mr. Lewis is in the final stages of finishing his thesis and has accepted a postdoctoral position at the Savanna River Ecology Laboratory in Aiken, South Carolina, where he will study the fate of radioisotopes in the cooling reservoir of a nuclear reactor.

Dr. Likens' philosophy is that graduate training is a very special period in the development of a scientist. "(The students) need to learn skills and approaches that will serve them well when they are out on their own," he believes, "and I try to help them develop independent skills to the maximum extent possible." And because so many have done their field work at Hubbard Brook, where Dr. Likens continues to do research, he has had the opportunity to work more closely with them than might otherwise have been possible. "I am very proud of the achievements of my students," Dr. Likens says of the many doctoral and masters's degree candidates with whom he has worked. "I've been extremely fortunate to have bright, creative students that at the same time are nice people."

Dr. Likens is currently supervising four Ph.D. candidates in addition to Mr. Lewis, all students at Cornell. Judging from the successes of their predecessors, their training will prepare them to continue the tradition of scientific leadership.

IES Continuing Education Program Makes an Impact on the Landscape

by William Montgomery, Program Leader - Continuing Education

"I will now try (because I know how) to use ecologically-sound, non-chemical controls," wrote a student after completing the *Insect Pests and Diseases of Plants* course taught at the Institute of Ecosystem Studies by Ms. Caroline De Wilde, Director of Horticulture at The New York Botanical Garden. After *Spring Wildflower Identification*, instructed by IES native plant gardener Judy Sullivan, a participant said, "By learning more about the world of wildflowers, I feel more inspired to live an ecologically-friendly lifestyle." And following a *Wetlands: Ecology, Creation and Restoration* workshop led by IES aquatic ecologist Dr. Stuart E.G. Findlay and others, a soil scientist wrote, "After listening to the presentations, I can clearly see the superficiality of my consulting company's approach to wetland protection."

Ecological leadership and educational excellence are the primary goals of the Institute's Continuing Education Program, which offers ecologically-focused certificate programs in Landscape Design, Gardening, and Natural Science Illustration, as well as a number of individual courses, workshops, and excursions. Strengthening the ecological perspective of existing programs and developing new ecological programs are priorities. During the academic year ending in June, for example, 21 new programs were introduced — more than

triple the number implemented six years ago. Members of the Institute's scientific, gardening, and education staffs lead many of the programs.

Students in the IES Continuing Education Program come from across the northeastern United States. They include young people just starting out, and professionals who are exploring new opportunities. Some are owners and employees of local landscaping and gardening companies who want to learn more about the latest and best methods in their field. Many are homeowners who love their gardens and want to make them even better. They are couples and families who look forward to the opportunity to learn and have fun at the same time. Indications are that the majority of these participants are leaving with a better understanding of ecology and its applications and that they are using that understanding in their professional and leisure pursuits.

Feedback from these participants is important in evaluating the success of each program and in fine-tuning future offerings. Responses to a new question on the evaluation form are demonstrating the impact of programs on participants' "tendency to apply ecologically-sound principles". On the average over the past year, the tendency rating (on a 10-point scale) "after" completing a program is 16% higher than the rating "before". Rating

changes have been particularly gratifying for certain programs: 108% for *Ecological Alternatives to Lawns* and 58% for *Ecological Landscape Design: Successful Design with Native Plants* (for which IES Head of Education Dr. Alan R. Berkowitz and I are among the instructors). As documentation of the commitment to teach ecological principles, even in core programs such as *Landscape Graphics* that are not clearly ecological in focus, tendency to use ecologically-sound principles ratings "after" were considerably higher than the ratings "before" — 67% higher in the case of the graphics course.

Demonstration of ecological principles for educational purposes on the Institute's grounds is another priority. A student team — led by Dr. Bill Gundermann, Mr. Eric Ewing, and Mr. Len Stevens — has designed a plan for a model residential ecological landscape at the Gifford Tenant House, just east of the Gifford House Visitor and Education Center. The plan is now in the early stages of implementation, and IES visitors may notice that a new red oak and seven eastern white pine trees have been planted. In the near future, students and visitors alike will be able to use the Gifford Tenant House landscape model to observe and experience ecological design, implementation and management principles applied attractively at a residential site.

The Institute's mission is to create, disseminate and apply knowledge about ecological systems. The Institute's tradition is to accomplish this with a high degree of excellence. The IES Continuing Education Program strives to meet these criteria, and evidence suggests that we are succeeding.

Editor's note: Mr. William Montgomery came to IES in January 1992, starting his own second career with a master's degree from the Conway School of Landscape Design. With a long-standing interest in ecology and landscape architecture, he focused the IES Continuing Education Program to the Institute's mission. Now, after six years, Mr. Montgomery is moving on. The program that he has guided, however, will continue to imbue landscape designers, gardeners, teachers and others with his high standards of ecological and educational excellence.



Luanne Panarotti, left, program assistant for the IES Continuing Education Program, and Kathy Austell, one of the editors of the program's newsletter, "earthworks".

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Calendar

CONTINUING EDUCATION

The **Winter/Spring 1998** catalogue will be available in mid-December. For program information or a copy of the catalogue, call the Continuing Education Program office at 914/677-9643. Upcoming holiday-season "Natural Crafts" programs include:

Dec. 6: **Fresh Green Holiday Wreath**
Dec. 6: **Raffia Angel**
Dec. 13: **Fresh Holiday Arrangement**

SUNDAY ECOLOGY PROGRAMS

Free public programs are held on the first or second Sunday of the month. Call 914/677-5359 to confirm the day's topic or, in case of poor weather, to learn the status of the day's program.

Meet at 2 p.m. at the Carriage House, behind the Gifford House on Route 44A for:

Dec. 7: **An Origami "Ecosystem in Winter"**, led by Jill Cadwallader

IES SEMINARS

Free **scientific seminars** are held each Friday at 11:00 a.m. at the IES Auditorium:

Nov. 28: Thanksgiving Day, no seminar
Dec. 5: **Bacterial Growth Efficiency**. Dr. Fábio Roland, IES Postdoctoral Associate (Juiz De Fora Federal University, Brazil)

The seminar series will resume on Friday, January 16.

Remember the Annual Holiday Sale at the IES Ecology Shop ... gifts, games, books, holiday and tropical plants ... and refreshments
Friday, December 5: 10 a.m. - 3 p.m.
Saturday, December 6: 10 a.m. - 3 p.m.
Sunday, December 7: 11 a.m. - 3 p.m.

GREENHOUSE

The IES greenhouse, a year-round tropical plant paradise and a site for controlled environmental research, is open until 3:30 p.m. daily except public holidays. Admission is by free permit (see "HOURS").

VOLUNTEER OPPORTUNITIES

For information on volunteering at IES, call Su Marcy at 677-5359. One current need is for Education Program volunteers, for data entry, telephone answering and visitor reception.



Judy Kilmer, right, has been a Perennial Garden volunteer since summer 1994. Here she works in the greenhouse with Display Gardener II Elizabeth Ashton.

HOURS

Winter hours: October 1 - April 30
Closed on public holidays
and during deer hunting season.
Roadways are closed when snow covered.

Public attractions are open Mon. - Sat., 9 a.m.-4 p.m. & Sun. 1-4 p.m., with a free permit*. The IES Ecology Shop is open Mon.- Fri., 11 a.m.-4 p.m., Sat. 9 a.m.-4 p.m. & Sun. 1-4 p.m. (The shop is closed weekdays from 1-1:30 p.m.)

* Free permits are required for visitors and are available at the IES Ecology Shop or the Education Program office daily until 3 p.m.

IES ECOLOGY SHOP

New in the Shop ... great puzzles! ... key chains ... picture frames ... **for children ...** puzzle books ... beanbag animals ... ecology games ... **and in the Plant Room ...** lovely hanging plants

•• Gift Certificates are available ••

Note: The IES Ecology Shop and the Plant Room will be closed for renovation from Monday, Jan. 5, through Friday, Jan. 16. They will reopen for business on Saturday, Jan. 17.

MEMBERSHIP

Join the Institute of Ecosystem Studies. Benefits include subscription to the newsletter, member's rate for courses and excursions, a 10% discount on IES Ecology Shop purchases, and participation in a reciprocal admissions program.

Individual membership: \$30; family membership: \$40. Call Ms. Janice Claiborne at 677-5343.

The Institute's Aldo Leopold Society
In addition to receiving the benefits listed above, members of The Aldo Leopold Society are invited guests at spring and fall IES science updates. Call Ms. Jan Mittan at 677-5343.

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