IES Newsletter

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July - August 1988

AT THE ARBORETUM

The Public Education Program is offering five special one-day workshops this fall. Sign up early to reserve space!

The Acid Rain Study Ponds and Pollution Garden are open to the public through October, during Arboretum hours.

An IES Sunday Ecology Program contributes to the celebration of the Bicentennial of the Ratification of the Constitution in New York State. "Walk back in time..." on October 16th.

The IES Newsletter is published by the Institute of Ecosystem Studies at the Mary Flagler Cary Arboretum. Located in Millbrook, New York, the Institute is a division of The New York Botanical Garden. All newsletter correspondence should be addressed to the Editor.

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Research Experiences for Undergraduates at IES

College students who consider a career in science are not always lucky enough to have the opportunity to do active research as undergraduates. This summer, however, eight undergraduate students spent almost three months at the Institute of Ecosystem Studies, doing independent research in collaboration with Institute ecologists. The program that made it possible for the students to work at IES is called Research Experiences for Undergraduates, and is sponsored by the National Science Foundation.

One of the principal goals of the National Science Foundation (NSF) is to assure an adequate supply of high quality mathematicians, scientists and engineers for the future. An effective way to achieve this goal is to provide opportunities for college students to participate in mathematics, science and engineering research experiences. This year, only six awards were granted in the field of biological science: IES was the recipient of one of them.

The Institute project was called "The study of ecology as an interactive process: Research problems and strategies for the undergraduate." Conceived by Drs. Alan Berkowitz, Steward Pickett and Stuart Findlay, the summer's program involved not only completion of an independent research project by the students, but also interaction with IES scientists and educators as well as guest speakers in weekly seminars.

In the first seminar, scheduled shortly after they arrived at the Institute, students were introduced to the methods of scientific problem solving by Kass Hogan, IES program leader in ecology education. Seminars by IES ecologists in subsequent weeks dealt with topics such as how to design experiments, how to work with other scientists and how to communicate results. Special "Research in Context" seminars introduced the students to "Science and Society" through the eyes of Dr. Allison Power of Cornell University's Science, Technology and Society Program; "A Lawyer's Perspective" from Nicholas A. Robinson of the Environmental Law Program at Pace University; and "Science and Ethics" as seen by IES Director Dr. Gene E. Likens.

At the end of the program, students presented their research results at a seminar. Each wrote a scientific paper on his or her research problem, the methods involved in solving it and the conclusions reached, and the collected papers will be available to the public in early 1989 as an IES Occasional Publication. IES scientists hope to offer the REU program again next summer.

The 1988 REU students and their projects were:

Catherine L. Adler (Middlebury College, Vermont): Small mammal population biology; Jay McAninch, mentor.

Christopher John Blakeman (Antioch College, Ohio): Gap dynamics in old growth forests; Steward Pickett, mentor.

Mark P. Hennig (State University of New York at New Paltz): Stream ecology; Stuart Findlay and David Strayer, mentors.

Melanie Holland (Massachusetts Institute of Technology): Bacterial mortality in lakes; Michael Pace and George McManus, mentors.

Philip Kim (Unity College, Maine): Gap dynamics in old growth forests; Steward Pickett, mentor.

Marit Larson (Wesleyan University, Connecticut): Physiology of plant competition; Alan Berkowitz, mentor.

Ronald S. Montesi, Jr. (Colgate University, New York): Stream ecology; Stuart Findlay and David Strayer, mentors.

Claes Jonas Thelemarck (State University of New York College of Environmental Science and Forestry): Predation on stream invertebrates; Stuart Findlay, mentor.

GLYN CLOYD

Wesleyan student Marit Larson grew bean plants in the IES Greenhouse to study how plants compete for water resources.

Something Strange is in the Air

Gary M. Lovett, Ph.D., *Plant Ecologist, IES*

There are things in the air you may not know about. The air quality monitoring program at IES was set up to measure some of the less well-known constituents of the atmosphere, complementing the long-term monitoring of weather variables, precipitation chemistry and stream chemistry at the Arboretum. The Institute's monitoring program provides a detailed characterization of the environment here, and serves as a background for our ecological research and as a reference to judge if conditions change in the future. Tony Restaino, a research assistant with a M.S. degree in meteorology, operates the environmental monitoring program under the supervision of a committee of staff scientists. We have just finished summarizing our first complete year of measurements of air quality at the Arboretum, from April 1987 to April 1988.

The New York State Department of Environmental Conservation (DEC) has a program designed to monitor the State's compliance with U.S. Environmental Protection Agency (EPA) standards set to protect human health. DEC measurements include sulfur dioxide, ozone, nitrogen dioxide, lead, inhalable particles and other atmospheric substances. The IES program has a different focus--we are concerned primarily with how the atmosphere interacts with plants, animals, lakes, streams, soils and other aspects of natural ecosystems. These interactions include not only the harmful effects of air pollution, but also the natural transport of substances through the atmosphere and deposition on the earth's surface.

Our sampling is done from a tower, about 9.1 meters (30 feet) above the ground. We capture small atmospheric particles by drawing air through a filter using a vacuum pump. After the particles are filtered out, the air passes through another filter that traps nitric acid vapor (a significant pollutant gas) and then through a third filter that traps sulfur dioxide, yet another gaseous pollutant. These filters are changed every week and chemically analyzed. We also measure the concentrations of the pollutant gas, ozone, with an instrument that uses ultraviolet absorption to detect the gas.

From the particulate filter we measure the total load of particles in the atmosphere, plus the concentration of particulate calcium, magnesium, potassium, sulfate, nitrate, ammonium and a few other substances. These are all plant nutrients or pollutants, or in some cases both. We have found levels of these substances that are about normal for a rural area. Calcium, magnesium and potassium are part of the natural dust in the air, and when they deposit on plants and soil they contribute to the nutrition of organisms. The sulfate and nitrate we measure are mostly the result of fossil fuel combustion, and while these particles deposit on the land in dry form they act just like the sulfate and nitrate that cause rain to become acidic. Ammonium probably comes from agricultural activity. The ammonium and nitrate contain nitrogen, which acts as an important plant fertilizer.

Surprisingly we found moderately high concentrations of the pollutant sulfur dioxide in the air. The average annual concentration at the Arboretum was 15 micrograms per cubic meter, with the concentrations being highest in the winter. The primary source of sulfur dioxide in the atmosphere of the northeastern U.S. is coal burning at power plants and industrial facilities. Because it is quickly transformed to sulfate particles in the atmosphere, the sulfur dioxide we see is probably not emanating from the major coal-burning areas of the Midwest, the areas that give us most of our acid rain. We suspect that the sulfur dioxide we find in our filters is instead the output of the coal-burning power plants along the lower Hudson River. The concentrations we measured are not high enough to cause direct damage to people or other animals or plants, but as this sulfur is deposited it can contribute to acidification of soils, lakes and streams in the same way that acid rain can.

Ozone

Ozone is potentially the most dangerous air pollutant that we measure. Ozone is a highly reactive form of oxygen that is formed when nitrogen oxides and hydrocarbons (air pollutants associated with urban areas) react in the presence of sunlight. Ironically, this ozone is the same substance that occurs naturally in the upper atmosphere and protects us from ultraviolet radiation. The "good" upper atmosphere ozone is being depleted by some pollutants (e.g., freons) at the same time other pollutants are creating harmful concentrations of ozone near the earth's surface. Compared to the upper atmosphere, the ozone at ground level is low in concentration, but it can still cause plant damage, reduce photosynthesis and cause breathing difficulties in people with respiratory problems.

According to our measurements and those made elsewhere, this summer has been a particularly bad one for ozone all over the eastern U.S. This phenomenon is probably due to the hot, stagnant air that engulfed us. To protect human health, the EPA has set a standard of 120 ppb (parts per billion, a unit of concentration) as a peak hourly average concentration. In a typical summer that limit may be exceeded on only one or two days, but this year we have exceeded it much more frequently.

As of August 14, we had exceeded the standard on 18 days for a total of 72 hours. On five days the peak hourly average was over 170 ppb, and the maximum observed concentration was 205 ppb for a brief period on July 16.

Where is all this ozone coming from? Since ozone is formed by the reaction of air pollutants and sunlight, the highest production rates occur when the sunlight is strongest, around noon. Here at the Arboretum we typically see our peak concentrations between 5-9 p.m., indicating that the ozone is drifting here from a source somewhere upwind. Our highest concentrations are associated with southerly winds, meaning that the ozone must be coming from the large megalopolis to our south.

Some of the current research projects at IES focus on the role of natural atmospheric material as well as atmospheric pollutants in forest nutrient cycling, and on the effects of ozone and acid rain on plants. For instance, IES Chemical Ecologist Dr. Clive Jones is investigating how ozone affects the interactions between plants and plant pests, and a team of researchers working with me is studying the effects of ozone and acid rain on nutrient losses from trees. The IES Public Education Program has set up acid rain study ponds and a "pollution garden" to demonstrate to Arboretum visitors some air pollution research methods and effects. For these projects and others, the collection of data on our air quality is crucial for determining proper experimental treatments and for interpreting the results.

Perennial Garden Highlights: August - Sept. - October

Mid-to Late August	*Kirengeshoma palmata* *Hosta plantaginea* var. *grandiflora* *Phlox paniculata* 'Fujiyama'
Early to Mid-Sept.	Ornamental grass garden *Ceratostigma plumbaginoides* (Plumbago) *Chelone glabra* (Turtlehead) *Astilbe chinensis* var. *pumila* (False Spirea)
Mid-to Late Sept.	*Chrysanthemum nipponicum* (Nippon Daisy) *Sedum telephium* 'Autumn Joy' (Live-Forever) *Ligularia dentata* *Epimedium* sp. (Barronwort)
Early to Mid-October	*Belamcanda chinensis* (Blackberry Lily) *Aconitum arendsii* (Monkshood) *Asarum* sp. (Wild Ginger)

...and many more!

For weekly listings, see the "Dutchess Living" section of the Taconic Newspapers.

25 Years at Hubbard Brook

Clear stream waters often reflect the image of the surrounding forests. In 1963 a group of scientists wondered if maybe stream waters could reflect the *physical* condition of the forest as well, in the same way that the physical condition of a person can be measured by chemical analysis of that person's blood and urine.

To test this theory, Dr. Gene E. Likens (then a professor at Dartmouth College and now director of the Institute of Ecosystem Studies); Dr. F. Herbert Bormann (then also a professor at Dartmouth College and now at Yale University's School of Forestry and Environmental Studies); Dr. Robert Pierce (U.S. Forestry Service); and Dr. Noye Johnson (Dartmouth College) began an experiment at Hubbard Brook, a tributary of the Pemigewasset River in New Hampshire's White Mountians. In July 1988, the 25th anniversary of the Hubbard Brook Ecosystem Study (HBES) celebrated the success of that experiment.

A quarter century of research by close to 200 scientists and graduate students on the 3300 hectare (8250 acre) Hubbard Brook Valley makes this area the most intensively examined piece of property on the earth. The HBES was the first time that entire ecosystems (forests, streams, lake) and their interactions had been studied: the living trees, decaying wood, fallen leaves, roots and soils, non-woody plants, precipitation, stream flow, fish, birds, mammals, salamanders, bacteria, etc. Research continues year-round as scientists observe disturbance -- both natural and man-made -- and recovery over extended periods.

One of the HBES research programs came to the public's attention in the early 1970's when Drs. Likens, Bormann and Johnson identified the problem of acid rain. Their long-term observations had documented this cause and effect relationship, and the importance of their findings helped bring the name Hubbard Brook to the world's attention.

The 25th anniversary celebration took place at the USDA Forest Service Headquarters at the Hubbard Brook Experimental Forest in West Thornton, New Hampshire, during the annual HBES cooperator's and alumni meeting held from July 6-8. In addition to special events in honor of the anniversary, fifty-one scientists and students presented short talks on current research projects dealing with the Hubbard Brook Ecosystem Study.

Those interested in information on research at Hubbard Brook are invited to contact HBES Executive Secretary Phyllis Likens, c/o IES.

In memoriam: John S. Eaton

RAY WINCHCOMBE

When John Eaton joined the Institute of Ecosystem Studies staff in 1983 he brought to the new facility 18 years of experience as a forest ecologist with the Hubbard Brook Ecosystem Study as well as a wealth of knowledge about all aspects of laboratory operation. In his position as IES laboratory manager he put all those skills to use, and also found time during his scientific career to write over 30 scientific publications and one book. John Eaton died in June, and at a memorial service during July's Hubbard Brook meeting Dr. Gene E. Likens spoke of his colleague and friend:

So many of us learned so much from John Eaton. Self-taught, his mastery of carpentry and woodworking, electronics, computers, and chemical procedures helped and inspired most of us. I often wondered how I could train graduate students adequately without exposing them to John. He taught them and me to first *try the simple, straightforward way. He made major contributions to and was a stabilizing force for the Hubbard Brook Ecosystem Study and the Institute of Ecosystem Studies. Dedicated, steady -- and most of all unfailingly loyal -- John made significant contributions to science, and to the lives of those of us around him. He always had time to stop whatever he was doing and to give a helping hand. He was patient, he was knowledgeable, he was interested and he was truly helpful.*
We will miss his wise counsel, his uncompromising integrity, his encompassing friendship, his sitting like a pretzel in his chair, and his hearty laugh echoing through the halls.

The John S. Eaton Fellowship Fund has been established at the Institute to commemorate Mr. Eaton. Dr. Likens indicated that income from the fund will be used to bring young scientists to Institute laboratories to learn the techniques and values that distinguished John Eaton's career. Donations to the fund may be sent to the Institute.

Education Program Grows

The Institute's Continuing Education Program has so far graduated 21 students with certificates in landscape design or gardening. Each fall, winter and spring term now has an increasing number of students enrolled in courses--13 courses are being offered this fall--to earn certificates and/or to improve abilities in home landscaping and plant care. Special workshops and ecological excursions round out the Education Program's offerings. Information on the fall schedule is in the Calendar on page 4 of this Newsletter.

To help serve the growing number of students and workshop and excursion participants, Jacqui Gantnier is assisting the Education Program staff as Program Leader for Continuing Education. Ms. Gantnier has a certificate in Landscape Development and Maintenance from Ulster County Community College and certificates in Commercial Flower Arranging and Horticultural Therapy from The New York Botanical Garden. She has worked as a head gardener and designer and implemented a horticultural therapy program for Ulster County Mental Health Services. Her part-time position at IES allows her to continue her free-lance work as a floral designer. (Incidentally, that independent business experience has already helped her coordinate a fall IES workshop called "Planting the Seeds for Your New Business.")

Ms. Gantnier will be at the IES Education Program office two days a week. Current and prospective students are invited to call (914) 677-5358 if they have questions about their courses of study.

GLYN CLOYD

Local Weather

Data collected at the IES Weather Station provide background information for ecological research at the Institute and serve as a standard against which long-term trends in weather and air quality may be compared.

May and June, 1988

Highest temperature: 34.9° C (95°F) on June 15

Lowest temperature: 1.5° C (35° F) on May 4

Number of days high temperature at least 32° C (90° F): 7

Daily average temperature: 16.7° C (62° F) (Normal*: 16.1° C (61° F))

Precipitation: 13.18 cm (5.19 in.) (Normal: 17.96 cm (7.07 in.)

Average rainfall pH**: 3.90

Strongest wind gust: 55km/hr (34 m.p.h.) from the Northwest on June 5

Prevailing wind: North-Northwest (341°)

Average wind speed: 8 km/hr (5 m.p.h.)

*"Normal" values are taken from data collected for a 30 year period at the Millbrook School.

** Degrees of acidity or alkalinity are indicated using a logarithmic pH scale. On the scale of 0-14, vinegar - an acid - has a pH of approximately 3, and "neutral" is 7.0. The pH of "normal" rain is 5.6 or higher.

Fall Calendar

COURSES

Fall Education Program courses in landscape design, gardening and botany will begin in mid-September. Catalogues have been mailed to Arboretum Members and previous course participants, and are available at the Gifford House Visitor and Education Center on Route 44A. If you would like to add your name to our mailing list, call the IES Education Program office at the number below.

WORKSHOPS

Oct. 8 or Oct. 11 (choose either date): The Gardener's World of Bulbs
Nov. 5: Homeowners Guide to TreeCare
Nov. 5: Planting the Seeds for Your New Business
Nov. 12: Landscape Preservation: Ecological and Social Issues
Nov. 19: Landscape Site Plans: Interpretation and Review

For registration information, visit the Gifford House or call the number below.

ECOLOGICAL EXCURSIONS

Join us for one or more of the following:

Sept. 10: Estuarine Ecology: Canoe Exploration of Constitution Island Marsh
Sept. 24: Ecology and Earth History: Our Local Highlands
Oct. 1: Catskill Mountain Ecosystems
Oct. 6: Caprilands Herb Farm

Advance registration is required. Call the number below for information.

SUNDAY ECOLOGY PROGRAMS

Free public programs are offered on the first and third Sunday of each month. All programs are from one to two hours long, and begin at 2:00 p.m. at the Gifford House on Route 44A unless otherwise noted.

Tentative schedule (please call (914) 677-5358 to confirm the day's topic):

Sept. 4: Labor Day Weekend - no program
Sept. 18: Getting to Know Plants for Use in Naturalistic Landscaping (Mark McDonnell) - Walk
Oct. 2: See What the Air Brings! ... Exploring IES Research Displays (Laury Zicari) - Outdoor Demonstration
Oct. 16: Walk Back in Time: Ecology of a New York Forest in 1788 (Charles Canham) - Walk
Nov. 6: An Oceanographic Look at the Chilean Coast and the Bering Sea (George McManus) - Talk
Nov. 20: The Life in A Drop of Water: A Microscopic Food Web (Jonathan Cole) - Talk

For ecology walks, wear long pants and sturdy, waterproof footwear with socks; long-sleeved shirts or jackets are also recommended. Talks are held indoors at the Gifford House. In case of inclement weather, call (914) 677-5358 after 1 p.m. to learn the status of the day's program.

ECOLOGICAL RESEARCH DISPLAYS

Demonstrations behind the Gifford House Visitor and Education Center introduce visitors to the methods and results of ecological research. The Acid Rain Study Ponds display is open from early May through October. Here, a series of tanks that serve as model ponds (complete with aquatic animals and plants) are exposed to simulated acid rain, and the results recorded twice a week. The Pollution Garden, comparing some visible effects of atmospheric ozone on ozone-sensitive and ozone-tolerant flowering and crop plants, is adjacent to the study ponds.

ARBORETUM HOURS

May 1 - September 30: Monday through Saturday, 9 a.m. to 6 p.m.; Sunday 1 p.m. to 6 p.m. The Gift and Plant Shops are open Tuesday through Saturday 11 a.m. to 5 p.m. and Sunday 1 - 5 p.m. (The Greenhouse and Plant Science Building continue to be closed to visitors at 4 p.m. during the summer hours.)
October 1 - April 30: Monday through Saturday, 9 a.m. to 4 p.m.; Sunday 1 - 4 p.m. The Gift and Plant Shops are open Tuesday through Saturday 11 a.m. to 4 p.m. and Sunday 1 - 4 p.m. Closed on public holidays. (Also closed during the deer hunting season and when roads are snow-covered.)

All visitors must obtain a free permit at the Gifford House for access to the Arboretum. Permits are available up to one hour before closing time.

MEMBERSHIP

Become a member of the Mary Flagler Cary Arboretum. Benefits include a special member's rate for IES courses and excursions, a 10% discount on purchases from the Gift Shop, six issues of the IES Newsletter each year, free subscription to *Garden* (the beautifully illustrated magazine for the enterprising and inquisitive gardener), and parking privileges and free admission to the Enid A. Haupt Conservatory at The New York Botanical Garden in the Bronx. For information on memberships, contact Janice Claiborne at (914) 677-5343.

For more information, call (914) 677-5358 weekdays from 8:30 - 4:30

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