Nature Study

Water

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COMING TO TERMS WITH WATER CONSERVATION

Photo by Helen Ross Russell

Most of us learned long ago that seventy percent of the Earth's surface is covered with water. If we examine a world map while pondering that fact alone, we might conjecture that the world's oceans can function as enormous receptacles of pollution and waste emanating from the land. Furthermore, when we consider the energy and motion of the oceans' major currents, offshore upwellings and coastal waves, we might surmise that oceans can serve as effective waste treatment systems to dilute, disperse, and transport "away" our wastes. Believe this, and we're in for an alarming surprise!

Those same currents have been known to dump our wastes onto neighboring shores, producing the dreaded "swimming in a sewer" syndrome portrayed recently by the television program NOVA. Some pollutants never disappear; others, such as the common styrofoam cup, persist for years. Plastic materials generally pose a serious threat to marine life: sea turtles engulf plastic bags; tubenosed seabirds pick colored particles from the surface and fish; seals and crustaceans entangle themselves in "ghost traps" (monofilament from discarded or lost fishing gear) that linger for decades along the ocean floor. Our use of the sea for recreation may change if pleasure boats of the future find themselves detouring around hundred-mile ocean highways of trash.

The amount of plastic debris being dumped into our seas is astounding. Merchant shipping supposedly dumps an estimated 639,000 plastic containers into the oceans every day; the U.S. National Academy of Sciences reports that commercial fishermen and sailors may lose or dump up to 350 million pounds of packaging and fishing gear into the seas every year.

Consider our coastal wetlands. They act as nurseries for fishes, crustaceans, mollusks, and marine worms utilized by an estimated two-thirds of our world's fisheries. Tidal marshes, mangroves, and coral reefs act as nutrient suppliers, buffers to storms and important shelter for birds and fish. Yet they are being destroyed all over the world by pollution and development, including erosion, siltation, dredging, and filling-in. If we are to protect our fisheries and waterbirds, we must maintain the habitats and ecological processes on which these creatures depend.

Protection and management of international seas and inland waters will require international cooperation in reconciling competing interests and mitigating the threat of pollution. The Columbia, Mississippi, and St. Lawrence river basins are just three examples of shared freshwater resources on which the U.S. and Canada must cooperate.

Of greater concern to most people is toxic contamination of our freshwater supplies. The problem is acute. For example, in 1980 the Great Lakes Water Quality Board identified approximately 450 contaminants in the Great Lakes Ecosystem, 30 of which are known to cause chronic human health problems.

Management of our freshwater supplies until now has been based on development – how to extract more water to serve our increasing water needs. This unchecked supply-side philosophy has led to the U.S. doubling its water withdrawal between the years 1950 and 1970. In Massachusetts alone, the increased demand for water by Boston and environs has forced the Metropolitan District Commission to propose nine alternative measures for offsetting what may become a deficit of 120 million gallons per day by the year 2020. One alternative would involve capturing and diverting water from the Connecticut River to feed Boston's Quabbin and Wachusett reservoirs. Yet, the total recoverable water from leakage in the MDC system is at least 56 mgd, and another 30 mgd could be saved if water treatment facilities were added! Clearly the need is for water efficiency and conservation.

On a world scale, the degradation of watersheds has been ranked as one of the highest priority issues by the "World Conservation Strategy," the international Bible for resource conservation. Despite modern technologies and engineering, adequate clean water supplies for the world's diverse needs seems only a dream at our current rate of consumption. We need a concerned and informed citizenry that can demand higher standards for water quality to force industry, agriculture and cities to cut back on waste, and to treat used water for re-use, and pressure schools, businesses, and homes to install water fixtures that meet efficiency standards. We must come to terms with wise use of this basic and precious resource.

KATHLEEN BLANCHARD
President of ANSS

Nature Study

Water

Photo by John Green

Send nominations for the positions of vice president, recording secretary and 5 directors to Dr. John Kirk, R.D. 2, Box 272, Branchville, NJ 07826 by March 1. Elections will be by mail ballot in May.

WATER, SCULPTOR OF THE LANDSCAPE

Ruth Melvin

The oceans containing 98 percent of all water were born, geologists tell us, during the earliest history of the earth. According to W. W. Rubey in a magnificent essay entitled *Geologic History of Sea Water* (1951) there is a strong case for the belief that both the atmosphere and the oceans have been largely derived from the interior of the earth and that oceans have grown in volume throughout geologic time. As the surface temperature of the protoplanet decreased the interior heated because of radioactivity and the gases locked in the non-volatile solids began to be freed. Tremendous volcanic activity brought the volatile materials to the surface where they combined in remarkable ways to provide the planet earth with the air and water necessary to sustain life. This process continues and can be witnessed today in Hawaii and in Iceland where volcanic fumeroles, geysers and hot springs abound.

Roughly three-fourths of the earth's surface is covered with water. The ocean with its 97 percent is salty, which leaves only three percent of the total water fresh. About four-fifths is locked in ice caps and glaciers. Most of the ice is in Antarctica, Greenland and other polar regions such as Iceland, which in spite of its name, is covered with glaciers on only 11 percent of its surface. Water in streams and fresh water lakes amount to only 1½ percent while 98½ percent of the fresh water other than that which is in ice caps is in the ground.

Fortunately there is an excellent system of water circulation that operates continuously all over the world. We call it the hydrological cycle. Water evaporates from the great oceans as well as from the land and as it rises as a vapor it moves great distances with air masses that cross and crisscross the earth. As it rises it cools and condenses, falling as rain or snow to the earth's surface. Here it enters streams and lakes and oceans or percolates through soil and rock to become ground water. The movement of the water within the ground to the water table is slow, usually recognized in terms of feet per year. About two-thirds of the total rain and snowfall evaporates from the land and water surfaces or is transpired by trees, grass, and other plants. The surface water moves rapidly; rivers are replenished over and over as the process continues.

Reading the landscape from coast to coast we recognize the tremendous power all this moving water exerts. Mountains are worn away only to rise again. Sediments are deposited in the seas and subsequently lifted by forces within the earth's crust to form plains or they may be folded in the process to form mountains. In addition to its ability to evaporate and condense, water has other notable properties: it is known as a universal solvent and when it reaches the freezing point it expands. These account for the weathering process which breaks down the rocks and makes it possible for running water to change our landscape. Limestone, composed of the mineral calcium carbonate is slowly dissolved in water. This process makes great underground caverns and sink holes on the surface of the land. In addition the water carries the mineral in solution where it eventually reaches the sea and if the sea is warm and enough time elapses the mineral may be taken into the bodies of sea animals which rain to the bottom as they die to form the fossil rock. The original source of the limestone mineral, however, was locked into igneous rocks which by a complicated process called hydrolysis were broken down to provide the calcium carbonate and the dissolved quartz as well as other minerals which were carried to the sea in solution. It is exciting to recognize their presence in sedimentary rocks.

In the freezing and thawing process as water penetrates rock openings it expands and contracts forcing particles of the rock to fall away with the result that they may be transported by water either in solution, suspension or traction. Broken down rocks containing clay and other minerals provide the material which streams carry

The abrading and transporting work of streams is responsible for a cycle of erosion which forms first, youthful, V-shaped valleys, with cliffs and waterfalls and plunge basins. This phase persists as long as the stream remains active enough to remove all the weathered material sliding off the sides or brought in by its tributaries. Falls and plunge basins occur when a softer layer of rock lies below a hard layer. The cap rock is undercut by the stream and collapses, thus providing more abrasive material to continue the process.

When the gradient of a stream is lowered the velocity of water is reduced and a stream enters a mature state in the cycle. Its energy is just not great enough to scour out the channel and it starts to cut sideways and forms meanders. The valley floor becomes wider and the stream carries only light material in traction. As the topography diminishes the stream enters an old age state where only uplift of the land gives a chance for rejuvenation. The San Juan River oxbows in Utah known as "The Goosenecks" are the picturesque result of uplift and rejuvenation.

"Ice" water or the action of glaciers has been responsible for a noticeable part of the scenic views of our landscape. The rugged terrain of New England with its gray rock ledges, its stony soil, its variously sized lakes and swamps, its huge erratics, its kames, eskers and drumlins are evidences of in suspension. Sand, pebbles (and larger rocks when a stream is rapid and contains a large volume of water) roll and push each other along the bottom abrading the surface and sides of the stream bed. Thus by transporting and abrading, water running over the face of the land is the major force in the production of scenery. Of all the agents of erosion, including ocean waves and currents, wind, ice and underground water streams move more material a greater distance than all the others combined. Water is responsible for our hills and valleys, hills being that part of the surface not yet washed away! Even the scenic features of many deserts are ascribable to water.

RUTH MELVIN *of Ohio, a former president of ANSS, is a geologist and environmental activist.*

a continental glacier (at least one!) which covered the land. The last glacier wasted back only a few thousand yers ago from a large portion of the United States and these land forms are duplicated in New York, Wisconsin, Ohio and other states affected by the continental glaciation process. The last period of glaciation covered the mountains, too, and left cirques, arêtes, hanging valleys with wispy waterfalls and, famous in geology texts, U-shaped valleys. Yosemite is typical but they occur at Mt. Washington in New Hampshire, the Tetons, the Rocky Mountains, and many other parts of the world.

A visit to Iceland emphasizes the relationship of glaciers to volcanic and stream action. This new island, located on the Mid-Atlantic Ridge separating the European tectonic plate from the North American plate, was covered by the last glacier but has only a few ice caps remaining. Nevertheless, great braided streams of water emanate from them, eventually forming rivers emptying into the Atlantic or the Arctic Sea. Tremendous waterfalls, "foss" they call them, are found on these rivers where a resistant layer of basalt tops layers of ash, tillite or other loosely cemented material. When the gradient diminishes the streams meander aimlessly giving some real variety to the landscape. Since bridges in the interior are practically non-existent the traveler gets well acquainted with water as his bus crosses and recrosses the streams produced by the glaciers. Water is copiously present, seen not only in rivers but in hot springs, mud pots, fumeroles and geysers. (They are "geysirs" in Iceland where the term originated!). Heated by the underlying lava, water forces its way to the surface to the advantage of all who live there. The thermal water is piped into the cities to provide heat in the buildings as well as hot water for bathing! A minimum of hydrocarbons, as used in many places, keep this country in pure air and its citizens very healthy.

Volcanic land forms, particularly in the western United States, must be recognized for their contributions to the scenic landscapes. The Columbia Plateau of basalt, the eruptions and deposits in the rift valley of the Rio Grande near Los Alamos, the "Pacific Circle of Fire" mountains, the tremendous outpouring in the past in the Cascades and the Sierras are exciting to view from land or air. The reduced rainfall in that section of the country forces the geologist to acknowledge vulcanism as the fiery sculptor of landscape. We must recognize the landscape today is but a momentary scene in the long stretch of geologic time. As the lands affected by the geologic processes of yesterday evolved into the landscape of today so the rock cycle related closely to the water cycle predicts continued change for tomorrow.

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Heindl, L. A. *The Water We Live By* published by Longmans Canada Limited, Toronto, 1970

Shimer, John A., *This Sculptured Earth, The Landscape of America,* Columbia University Press, 1959. □

Editor's Note: In the previous issue of *Nature Study* several credits were inadvertently omitted:

- The Museum of Fine Arts, Houston, Texas, for illustrations in "Nature's Part in Art," by Dr. Richard Baldauf; "Biotic Provinces of Texas"
- Beth Geils for the cover illustration, "Arts, Photography, and the Environment"
- Ray Pfortner, vice president and a partner at Peter Arnold, Inc., for photographs in "The Art of Nature Photography" by Frank Knight.
- John Lubbe, associate editor of *Nature Study.*

Honorary Life Membership Awarded

Long time ANSS member Lena Feighner (see Meet a Member, *Nature Study* January 1985) was elected an honorary life member of the Society at the fall meeting of the Board of Directors. Lena had celebrated her ninetieth birthday birding and botanizing in the Lake District of England.

CALLING ALL MEMBERS . . .

. . . to think and write about a Journal about winter to be published in November 1987 with a deadline for articles September 10.

If you conduct an especially successful project this month, write it up immediately. Tell us about a topic that caught the imagination of your classes; about a special outdoor activity; an imaginative nature center project; about some aspect of winter that especially delights you. How do you tell those little brown birds apart? Have you done planting for winter feeding? What stories can you read on touring skis and snowshoes? *What is winter like for those of you who live south of the snow belt?* What special things do *you* do between December 21 and March 21?

Send your idea for an article to the editor so that we can prevent duplication and develop a Journal with a wide coverage.

Helen Ross Russell, Editor
44 College Drive
Jersey City, NJ 07305

ACID RAIN IN THE CLASSROOM

Charlotte McCabe

It has become one of the most publicized environmental problems of our day. Acid rain is in the news, from *National Geographic* to *Sports Illustrated.* While the problem has yet to be solved, all of this publicity has certainly heightened public awareness. In 1984, for instance, a Harris poll revealed that 90% of the American people feel that acid rain is a serious problem.

A subject that has received such widespread media coverage deserves classroom time as well. The high school science classroom is a natural home for this topic, but elementary students as well can and should be introduced to the dynamics of acid rain.

Put into the simplest terms, acid precipitation (as it is more accurately named) kills plants and animal life by changing the pH of their environment (pH being a measure of acidity and alkalinity). Different environments and different organisms have different tolerances for these pH changes. The geologic component of the Adirondack environment, for example, is one reason for the acid precipitation damage seen in this mountainous lake area in New York State. Here the rocks and soil lack the natural buffering capacity to neutralize acidic substances.

While there is agreement on the effects of acid precipitation, the debate rages as to its causes. Most, with the obvious exception of the utility companies, agree that pollutants introduced into the atmosphere by the burning of fossil fuels causes acid precipitation. Coal-fired generating plants and automobiles are particularly to blame. Acids are formed when sulfur dioxide and nitrogen oxide gases emitted from these sources react with water in the atmosphere. The acids are literally washed out by rain, snow, sleet and other forms of precipitation. Long range transport of these pollutants can result in acid deposition far from the site of emission.

The far reaching effects of acid precipitation make it an ideal vehicle for the study of many concepts. And don't let the fancy scientific terminology scare you off. While acid precipitation research conducted by the world's scientists may involve complicated laboratory techniques, a basic understanding of the problem can be achieved through simplified classroom studies. Not only can students learn about the chemistry of pH but the biological impact of changes in acidity. Likewise, the study of the hydrologic cycle takes on added meaning when we introduce the element of acid precipitation. Investigations into the causes and effects of acid precipitation cut across many disciplines.

CHARLOTTE McCABE *is at the Pocono Environmental Center.*

Chemistry–Perhaps the first topic to be introduced, no matter the age level of the students, is pH. While high school students may be able to handle discussions on the relationship of pH to the number of hydrogen ions, younger students may only become confused. A simple demonstration using common substances can be set up to illustrate the meaning of pH.

Fill small jars with substances such as vinegar, lemon juice, milk, ammonia, and dissolved baking soda. Measure their pH with a pH meter if you have one (the most precise technique but also the most expensive) or pH paper (much cheaper and available through such sources as the Carolina Biological Supply Company). Also measure and then compare tap water and rain water to your other samples. Have the students make a chart from these measurements which illustrates the pH scale.

Biology–Once it is understood what is meant by acidity, it is important to consider its biological ramifications. This can be done in a number of ways, but need not involve live animals or plants, or even a laboratory. A simple game of tag followed by a discussion is one possible technique.

Use armbands or signs to identify participants as pollutants (sulfur dioxide and nitrogen oxide), rain, fish, and plants. Mark off two areas of the room, one for clouds and the other for a pond. As you begin the game, prevailing winds will push the pollutants to the rain. Once tagged, the pollutant/rain couple will try to tag the fish and plants, resulting in their death.

The game can be expanded in many

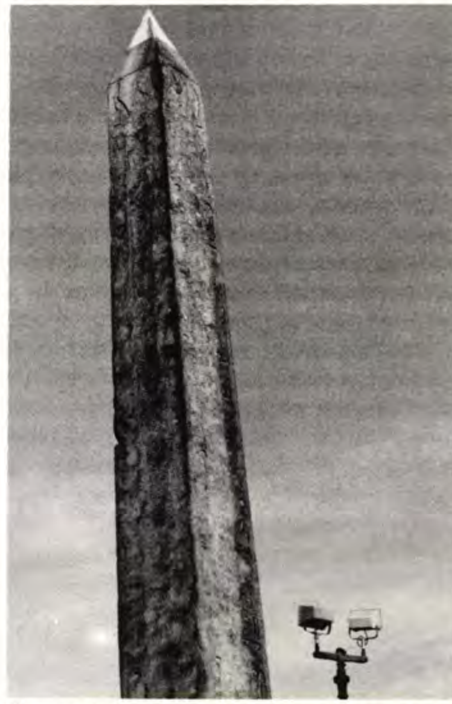

Photo by Ray Pfortner

Cleopatra's Needle, an obelisk from ancient Egypt, was given to NYC a century ago. It was set up in Central Park behind the Metropolitan Museum of Art. The hieroglyphics were then sharp and clear, preserved by Egyptian desert conditions. Today acid rain has dissolved most of the surface of the limestone and the patterns are obliterated.

ways. The food web might be increased by adding other animals and plants (e.g. osprey, raccoons, oak trees), and the effects on individual species examined. Scrubbers and buffers can also be added. Scrubbers can tag pollutants, neutralizing them for 10 seconds. Buffers can tag and neutralize pollutant/rain couples.

Geology–The level of acid precipitation damage is often controlled by the degree to which soils can neutralize acid. If the soil in an area has a high buffering capacity, acid precipitation which percolates through it will be neutralized before entering the groundwater and then lakes and streams. Unfortunately, many areas receiving acid precipitation do not have this natural buffering capacity.

Using funnels made from bleach bottles, you can set up your own percolation test. Collect several types of soils from your area, filling each funnel with a different sample (a piece of filter paper in the bottom of each funnel will help with the process). Next, make an acidic solution (using vinegar and water) and measure its pH. Pour this solution over the samples and allow it to percolate through the soils to containers placed below each funnel. Measure the pH of the resulting liquids and compare to learn which soils have the best buffering capacity. You might also use vinegar-water solutions of several pH levels percolated through the same type of soil.

Social Studies–Acid precipitation is not only an environmental problem, but a political and economic one as well. The nature of our society is such that not one but all of these elements will determine how the problem will be handled.

Role playing in a debate situation may help students to understand the interaction of these, at times, conflicting parameters. Divide the class into three groups: environmental lobbyists, owners (or stockholders) of utility companies, and members of a congressional subcommittee. The stage is set as follows: Congress is in subcommittee to decide if a bill should be presented to cut sulfur dioxide emissions by 30%. The utility company representatives must decide, and then argue, whether this is acceptable or should be revised. The environmentalists and congressmen also present their appropriate arguments. Depending on the age level of the students, you may want to give them certain facts, such as the current costs for scrubbers or other pollution control systems.

Useful Sources of Information–

The Acid Rain Foundation, Inc.
1630 Blackhawk Hills
St. Paul, MN 55122

(Along with other materials, publishes an extensive Acid Rain Resources Directory)

National Wildlife Federation
1412 16th Street, N.W.
Washington, DC 20036

(Request a copy of their "Acid Rain: A Teacher's Guide"–some of the above techniques were adapted from this publication)

Information Directorate
Environment Canada
Les Terrasses de la Chaudiere
10 Wellington Street
Ottawa, Ontario K1A 0H3
Canada

(Can provide may useful handouts)

National Film Board of Canada
Suite 313
111 East Wacker Drive
Chicago, IL 60601

(Free loan films–"Acid From Heaven" and "Acid Rain: Requiem or Recovery") □

THE DILUTION FACTOR

Verne N. Rockcastle

Suppose that you had one mole of the world's deadliest poison (100 mg) dissolved in 1000 ml of water, then poured a glassful (250 ml) of this deadly solution. In this glassful would be ¼ (250/1000) of a mole (6.02×10^{23} molecules) or 1.5×10^{23} molecules. Only someone who wanted to commit instant suicide would drink this solution. But suppose it was poured out and the glass re-filled with water. Would you be willing to drink it then? Probably not! Yet, consider the dilution of the poison after one re-filling of the glass with water, assuming 0.5 ml was left in the glass at the end of each rinsing, as drops clinging to the sides and bottom.

1st rinse: 0.5/250 of 1.5×10^{23} molecules left, or 3.0×10^{21} molecules

This is a lot of the molecules of poison still left, so even after the first rinse, you probably would not drink from the glass. Let's rinse it again.

2nd rinse: 0.5/250 of 3.0×10^{21} molecules of the poison left, or 6×10^{18} molecules.

Even this number is too high to risk drinking, so let's rinse several more times, each time calculating the number of molecules of poison left in the glass of water.

3rd rinse: 1.2×10^{16} molecules of the poison

As you can see, by the third rinse, even with the world's deadliest poison, the dilution of 1.2×10^{16} molecules in a glass containing 1.5×10^{23} molecules of water means a concentration of only about 1 molecule of poison in 10^7 molecules of water, or 1 part in 10 million. Yet many of our environmental toxic chemicals are accepted in food and drinking water at concentrations several times this high!

By the 4th rinse, that has dropped to 1 part per 20 billion – a dilution that is so low that the poison could not be detected by any currently known method.

Rinsing is effective. It is often much overdone by people who don't understand dilution and how quickly something is attenuated to the point of impossible detection by rinsing. □

ON WATCHING THE BOARD DRY

I washed the board in the room today,
And pondered the wet that
wouldn't stay,
But disappeared into the air
To fill the unseen spaces there.

How gaseous bits that were displaced
Weighed more than those that took
their place;
How heavy bits went out the door,
To leave less mass than was before.

It seems that vapor, entering air,
Does not with other gases *share,*
But does molecular tit-for-tat:
One supplants this, this one that.

No crowding them in constant space;
Instead, their neighbors they *replace,*
As if each were assigned a seat
To keep molecular muster neat.

A water molecule, at mass eighteen,
Does not just sort of squeeze between
Two others, twenty-eight and
thirty-two,
But does the space between eschew.

This insistent, lightweight molecule
Obeys an Avogadroan rule:
It moves more massive ones aside
With a vaporish, molecular pride.

In any room with board just washed,
Some molecules might well
get squashed
If water molecules began to press
With nary a crack to ease the stress.

But they do find cracks, and
squeezing past,
Decrease the total, 'til at last
The pressure in the room once more
Equals that beyond the door.

It's nice the way the air is made,
How molecules make vapored trade,
For if that simply could not be,
They'd put the squeeze on littl' ol' me!

– Verne N. Rockcastle

THE LAST ONE IN IS A ROTTEN EGG!
(or Some Tips on Underwater Photography)

Ray Pfortner

Photo by Ray Pfortner

BRAIN CORAL, 25 FEET, MAHO BAY, ST. JOHN, USVI. When using a strobe, avoid distracting backscatter (the "blizzard effect") from the particles suspended in even the clearest water and add drama by sidelighting your subject. (Ray Pfortner/Peter Arnold, Inc.)

True or False:

Underwater photography should really be left to the experts?

True, you say? For most of us, and certainly even for most professional photographers, the answer would be "true." Underwater photography has always seemed too specialized, too involved, and far too costly.

But the answer today is definitely "false" – good underwater photographs can be readily made by most anyone at all confortable with snorkeling. When underwater photography was first developed by Louis Boutan in 1893, it typically took one hour to complete one photograph and exposures lasted 30 minutes or more. Today a host of affordable – or very rentable – aquatic cameras, many of the simple-minded point and shoot 35mm variety, and new, improved films have completely changed the picture. So have improved snorkeling and scuba equipment plus much easier access to the most photogenic locales.

RAY PFORTNER *is Vice President and a partner at Peter Arnold, Inc., a scientific stock photography agency with a special strength in underwater photography. Ray teaches an underwater photography workshop each summer for the Maho Bay Camping Resort on St. John, U.S. Virgin Islands.*

Most importantly, underwater photography remains for any would-be photographer one of the last less (although no longer un-) crowded frontiers in photography. The first truly amphibious camera was only produced as recently as 1960 in the form of the Calypso (now the Nikonos) developed by Jean de Wouters and none other than Jacques Cousteau. There is perhaps no better way to find a fresh and marketable angle in photography right now than to take your camera and your skill below the surface, especially in fresh water.

All this is not to say that underwater photography is easy. Rather, it is easier than it seems. You must, of course, first be comfortable in the water, at least as a snorkeler. Scuba makes it all easier, but isn't essential. By the way, a snorkel vest that can be inflated at the pull of a cord is a good investment towards full comfort and security.

First time down you will probably get results that surprise you and your audience in terms of the overall quality of the images. But if you want to get more serious photographs, you must also learn to think and to see aquatically. Water is obviously a very different medium from air. It is 800 times denser. 100-foot visibility (the sort of visibility that closes airports) is a diver's dream come true and continues to fill planes bound for the Caribbean. Water molecules and the matter they keep in suspension act even under the clearest conditions simultaneously like a sponge, a mirror, a filter, and a lens. Underwater colors appear radically different, objects appear dramatically larger and closer, and contrast and definition are markedly reduced.

To see how aquatically-minded you already are, try answering the following questions:

1. All of the red light entering water is absorbed in the first ________ feet. Deeper than ________ feet you will see only black and blue.
2. Water magnifies objects by approximately ________ and distances by ________ .
3. Focusing under water must be done very carefully by measuring the actual distance. T F
4. In the water a 35mm lens acts like a ________ lens.
5. A ________ mm lens offers the same view as looking through your mask.
6. A telephoto lens is advisable for fish photography. T F
7. Wide angle lenses are the best for underwater photography. T F
8. Underwater photographs should never be taken at more than 10 feet from the subject. T F
9. Underwater flash photographs should never be taken at more than 5 feet from the subject. T F

Before reading on, grade yourself. The answers are listed at the end of this article.

Underwater focusing is done according to how far away your subject *appears* to be, not how far away it actually is. Measuring distances is very misleading. Wide angle lenses really are among the best lenses to use underwater, because they allow easier focusing and maximum depth of field (i.e., depth of focus from front to back within the frame) plus a wide field of view. Close-up lenses are also excellent, especially as your experience increases, for they minimize the amount of water and suspended particles between the film and your subject, and make for especially dramatic views. Telephoto lenses are not advisable for all the opposite reasons: too narrow a field of view, too difficult to hold steady, and for compressing too much water and suspended particles in between the film and your subject.

While we are talking about hardware, two other points should be mentioned. First, you initially have a big and difficult choice to make: to buy – or rent – a truly submersible camera or the alternative, an underwater housing. It's not an easy decision. Even the best underwater photographers don't agree on which approach is best. The simplest, cheapest and easiest way is to go with the submersible camera. But as your skills and needs increase, housings become a more enticing alternative. My best – and only – advice is to do your homework before deciding. Talk to people and read up on both systems. Maybe even rent one or the other before really making up your mind.

CHRISTMAS TREE WORMS & BRAIN CORAL, 10 FEET, FRANCIS BAY, ST. JOHN, USVI. ***Compose for drama, and remember, closer is almost better underwater just like above water.*** ***Ray Pfortner/Peter Arnold, Inc.)***

Secondly, some sort of flash (aka strobe) is important – at least for any shooting done more than 10 or 12 feet below the surface. Many point-and-shoot cameras include a built-in flash; more elaborate cameras necessitate separate flashes, which often involve considerable expenses. (In major cities, renting just an underwater strobe is a very good alternative for the most important trips.)

No matter what equipment you end up using, remember a few more tips. First, take some time to study good underwater photographs in books and calendars. Then practice what you see being done in those images. Avoid pointing the camera down towards the bottom. The resulting photos only look cluttered, poorly defined, and very amateurish. Do surface dives or use scuba and shoot close to minimize the water column in front of your lens and to fill the frame. Shoot at eye level and even shoot upwards to increase contrast and the definition of your subject. Silhouette shooting can be particularly effective. Including the water's surface and reflections on it makes your photos have more impact. Be sure to shoot verticals, not just horizontals to separate yourself even further from the rest of the "school."

SOFT CORALS, 15 FEET, FRANCIS BAY, ST. JOHN, USVI. Try to avoid photographing down from the surface. Instead shoot at eye level or even upwards towards the surface, and compose for graphic impact. *(Ray Pfortner/Peter Arnold, Inc.)*

For starters select more stationary subjects like coral, slow-moving invertebrates, shipwrecks, or even boats at anchor. Remember, you and your camera are already in motion thanks to buoyancy, currents and wave action. Wearing weight belts with 4 pounds of weight while snorkeling or using scuba tanks helps to reduce your own motion considerably. Be sure to focus on your fellow snorkelers or divers for still more challenging subjects, and to convince your audience that you really did get your feet wet. Fish and sea turtles present the biggest challenge – and rewards. Beginning with some careful observations in advance of any picture making will pay off. You will soon find, for example, that many fish are territorial, so you can pre-focus on a fish's favorite spot and know that your subject will soon swim back into position. Just be sure to do your best to include the eye of the fish in your photo. Motor drives can be invaluable for this reason and for underwater

Photo by Ray Pfortner

SNORKELER, 10 FEET, MAHO BAY, ST. JOHN, USVI. Underwater housings for your regular camera offer an alternative to truly aquatic cameras that is worth considering. When photographing underwater, be sure to get shots of your fellow snorkelers/divers. As subjects, they are both interesting and challenging. *(Ray Pfortner/Peter Arnold, Inc.)*

photography in general. Without the eye, your fish photos will invariably seem dull and lifeless.

And finally some parting shots to round out this brief introduction to a new world of photography. Use flash often – think of it as your own portable sunshine, capable of restoring color and better defining your subject. But use side-lighting to avoid backscatter from suspended debris (like a snow storm or stars in the sky) and to add interest via shadow detail. And try to keep within at least five feet of your subject. Even at only five feet, your flash pulse must travel a round-trip of ten feet, and the water will minimize the impact of your strobe by eating up most of the red. Bracket your shots (i.e., shoot three exposures of each shot wherever possible – one as recommended by your light meter or film/camera instructions plus one at ½-1 stop over and one at ½-1 stop under).

Remember to keep at least as careful track of light conditions under water as you would as a photographer above water. Avoid shooting when the surface is choppy, since less sunlight penetrates the surface then. And plan to shoot under water mostly between 10 a.m. and 2 p.m., when the sun is highest and conditions brightest under water. Thus underwater photography is a perfect complement to your above-water photography, which is best done when the sunlight is most pleasing and the shadows best for creating a 3-D effect (i.e., before 10 a.m. and after 2 or even 3 p.m.). Also, don't forget to try your luck in fresh water. The competition is even less and for many of us the medium is right at hand.

Whatever you do, do take the plunge. Your photographs are bound to make a big splash. The last one in really is a rotten egg . . . and time is a-wasting. More and more photographers are getting into the swim. But beware! Underwater photography is unbelievably exciting and rewarding. Once you get your feet wet, you might just never get completely dried out again!

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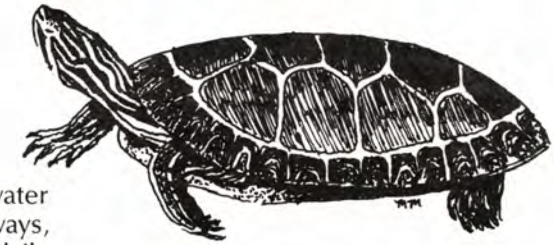
Quiz Answers: (1) 15 feet, 30 feet, 80 feet; (2) ⅓, 25%; (3) False; (4) 50mm; (5) 28mm; (6) False; (7) True; (8) True; (9) True. □

BRINGING WATER, CHILDREN, AND STREAMS TOGETHER

Tanya Oznowich



The engineer Thomas King once summarized the water issue in the following terms: "Of all the substances that are necessary to life as we know it on earth, water is by far the most important, the most familiar, and the most wonderful; yet most people know very little about it."

As an educator, the goals of leading students to a clearer understanding of what water is, its role among living things, and its cycle of motion directly affected by and affecting the presence of humankind, is a challenging one. The following series of indoor/outdoor activities and discussions, followed by an exploratory visit to a freshwater site, may be helpful in meeting these goals.

Before "diving into" any aquatic study, it is useful to first make the students aware of the water in themselves. Seventy percent of our bodies is made up of water. Because water exits in our bodies in a variety of ways, we must consume at least 5 pints daily to maintain this percentage. If we were to remove all of the water from our bodies, what might we look like? Students usually agree that the other 30% of our individual body weights might resemble a pile of dry bones or instant iced tea mix.

TANYA OZNOWICH *is the Program Director at the Weis Ecology Center in Ringwood, New Jersey. Along with teaching lessons on water and other environmental topics, she spends her time writing songs dealing with the environment.*

A relay race is helpful in further defining water's role. Divide the class into two teams and have each team line up single file at the starting line. At the opposite end of the playing area, place two large cans labeled *Needs Water* and *Does Not Need Water.* Scatter index cards of two colors (one for each team) face down directly in front of the cans. The index cards have pictures and/or words on them describing living and non-living natural objects and manmade objects. If the object described on the card needs water in order to exist or in order to be produced, it must be placed in the *Needs Water* can. If it does not, it must go into the other. Have the first child on each team begin the race. The winning team is determined not only by the best time, but the largest correct number of cards. Afterwards, discuss the results. This activity not only points out water's role in all forms of life, but its involvement in both the natural and human production of non-living objects and materials.

It is now easier to have the class make up a group definition of "water." With the class sitting in a circle, pass around a clear jar of water. As each student receives the jar have them state aloud a phrase describing water and one of its characteristics, uses, or forms. How many times can the jar be passed around the circle without any repetitions?

Most students are aware of the term "recycling" but rarely relate it to water or include themselves as a "vehicle" in the hydrologic cycle. One active way of introducing this concept to younger students is by using creative dramatics. Divide the class into groups of four and have each group form a square. Use a stuffed sock or a water balloon to represent a water molecule, one molecule per group. Person #1 in each group represents the ocean and by placing the molecule between their feet must imitate its action. As the water molecule "evaporates" into the sky, they toss it to person #2. This second person is a cloud and must imitate such before the molecule rains over the land and is tossed to person #3. Person #3 is the land and, after acting this out, indicates that the molecule found a stream by passing the molecule to person #4. As a stream, person #4 must act out their part and finally return the molecule to the ocean, person #1. This game can become quite challenging as the speed of passing and acting is increased. Ask the class what would happen if the molecule evaporated directly from the land (#3) via such forms as puddles, dew, springs, etc.? Where would these things fit into the cycle? Finally, have the class make a list of how many places humans fit into the cycle.

Photo by Charlotte McCabe

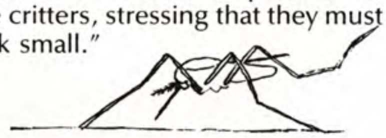
Photo by Charlotte McCabe

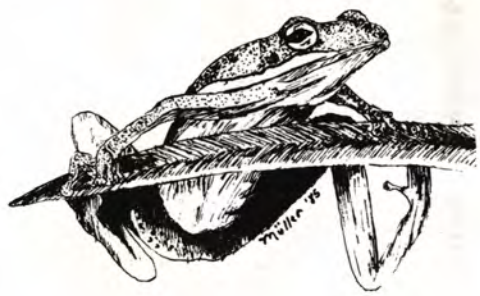
Water creatures can be found under and atop rocks, settled in the gravel or mud on the stream's bottom, nestled in decaying leaves, or atop the water's surface.

One way of locating them is to remove a rock from the stream and examine its surface for movement. Another method is to remove a net full of stream bottom material and empty it on shore or in a large dish pan. As the creatures are exposed to the warmer air temperature they become active (during the winter months this material can be examined indoors). Gently place the "captives" into the water-filled collecting pans, being careful to return each rock or net-full of bottom material to the water as it may hold overlooked creatures.

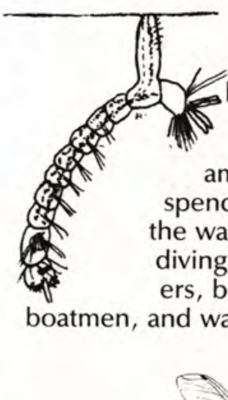
The students are now ready to examine one small part of this cycle by visiting and exploring a natural, freshwater site. Streams are a preferred site as they are usually locally accessible, abounding with life, and able to be studied year round. Old clothes and a second pair of shoes or boots will be necessary when working at the water's edge. Some suggested equipment to be transported to the site are stream dip nets (with a small mesh so that tiny creatures cannot escape), kitchen strainers, dish pans, hand lenses and/or portable microscopes, plastic cereal bowls, and laminated identification keys or books. Remember to return all inhabitants, unharmed, to their habitat after examining them.

Upon arriving at the site students are usually anxious to explore and collect. Before dividing up the equipment and sectioning off the stream, hold a brief discussion to explain what to look for and where. Since the most common of the smallest creatures that can be seen with the naked eye are insects, show the class pictures of these critters, stressing that they must "think small."





Insects to be found in their underdeveloped stages include caddisfly and mosquito larvae, and dragonfly, mayfly, and stonefly naiads. These insects spend only a portion of their lives in the stream environment. Some examples of insects who spend their entire lives in the water are whirligig and diving beetles, water striders, backswimmers, water boatmen, and water pennies.



Larger animals that may be found include salamanders, crayfish, snails, leeches, fish, and an occasional frog. Search for them under rocks, in open water, and places where rooted plants grow.

Slower streams and deeper pools allow rooted plants to grow, attracting such herbivorous insects as mayfly naiads and caddisfly larvae. The leaves from plants and the quiet surface of the water serve as floating hatcheries for snail and insect eggs. These are, in turn, preyed upon by the scissor-like jaws of beetles, dragonfly naiads, and fish. In such habitats, oxygen is provided by photosynthesis. Cardon dioxide is also plentiful due to decaying leaves and debris.

Special adaptations to different environments can also be explored when looking at stream inhabitants. Creatures in faster waters, for example, must constantly battle the current in order to exist. Herbivorous insects such as mayfly and stonefly naiads have flattened bodies and a pair of strong claws on each leg which help them cling to rocky surfaces while scraping algae. Predacious insects, such as some types of caddisfly larvae, may build a protective shelter around themselves. Other insects such as the water strider "walk" atop the water surface.

Water quality can be explored as well by examining what species are found. While a high percentage of dragonfly naiads and crayfish may indicate slightly polluted waters, the presence of stonefly naiads and water boatmen indicates cleaner waters.

Back in the classroom, the students can discuss such topics as camouflage, reproduction, and life cycles. The class can then proceed to examine other aspects of the stream, such as stream temperature, rate of flow, chemical properties, and physical and geological relationships with the land. Reflecting on the water cycle, have the students discuss the effect on stream creatures of the dumping of poisonous chemicals. What else would be affected by such an incident?

By performing this series of activities and discussions, the class will not only become more aware of the role of water but its recycling among living things including humans. This can be expanded by exploring other aquatic sites or by pursuing such current issues as acid rain, toxic waste, oil spills, and water pollution. □

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HELP CLEAN UP OUR WATER

We have a problem.

A big problem.

But, unlike the weather, there is something that you can do to help. And it's as easy as the flick of the wrist.

The problem is the water quality of our lakes and streams. It's deteriorating, and fast. The result is an overloaded waste water treatment plant. And that will cost you money.

Here's what you can do to help: simply look at the labels or look over this list, and buy products that have little or no phosphorus. Together we can make an impact.

Michigan residents were able to reduce phosphorus levels by 24%. And we can do even better if each person that reads this brochure acts. And why not? It's as easy as the flick of a wrist.

Use Low Phosphorus Products:

Amount of phosphorus given as percent by weight in product. **Liquid** laundry and **liquid** dishwashing products have little or no phosphorus.

LAUNDRY DETERGENTS

None or Trace:

All (liq. & pow.)	Purex (liq. & pow.)
Amway SA-8	Rinso
Arm & Hammer	Scotch Buy (liq. & pow.)
Breeze	Sears Heavy Duty
Controlled Suds	Shaklee Basic L
Diaper Sweet	Thrift King
Dynamo	Trend
Era	White Magic (liq.)
Era Plus	Wisk
Generic (some)	Woolite (liq. & pow.)
IGA Heavy Duty	Yes
Ivory Snow	

6.0 to 6.1%

Bold	Su-perb
Fab	Tide
Gain	White Magic (pow.)
Oxydol	

7.7 to 16.4%

Ajax	Dreft
Punch	Dash
Generic Heavy Duty	Generic (plastic bottle)
Cold Power	Fresh Start
Super Suds	Amway SA8 +
Cheer	

GENERAL CLEANING AGENTS

None or Trace

Always Soft	Mr. Clean
Amway LOC	Pine Power
Ajax Liquid	Pinesol
Bon Ami	Purex
Borateem	Scotch Buy (liq.)
Cameo	Shaklee Basic H
Clorox Prewash	Shur Fine Bleach
Clorox 2	Silex
Comet (liq.)	Snowy Bleach
Drano	Soft Scrubb
Fantastic	Spray and Wash
Formula 409	20 Mule Team Borax
Fluff	Windex
Grease Relief	Zud
Janitor in a Drum	
LaFrance	

0.5 to 3.8%

Lysol	White Magic Scouring Powder
Ajax (pow.)	
Lysol Deodorizing	Comet (pow.)
Top Job	Spic and Span

5.6 to 17.6%

Lime Away	Axion
Amway Smashing White	Rain Drops
	Biz

DISHWASHING DETERGENTS

None or Trace

Ajax	Ivory
Cinch	Joy
Cyrstal White	Lux
Dawn	Palmolive
Dermassage	Rainbow
Dove	Shur Fine (liq.)
Generic (liq.)	Sun Light
	Thrift King

8.7%

Amway	Sears
Electrosol	Shur Fine (pow.)
Finefare	Shaklee Basic D
Generic (pow.)	

10.9 to 12.9%

Finish	Cascade
Calgonite	White Magic
All	

Amount of phosphorus in product taken from label on products sold in area January, 1983. Some products recommend smaller amounts per load and so put less phosphorus in the sewer than percentage shows. □

–Contributed by Dr. Richard Baldauf
Houston Museum of Natural Science

WATER FACTS

Initially compiled by Dr. Luna B. Leopold,
Research Hydrologist, U.S. Geological Survey.
(Some items have been updated and others added by
Dr. Richard J. Baldauf, Houston Museum of Natural Science.)

The earth's oceans, ice fields, lakes, and rivers contain more than 324 million cubic miles of water. Beneath the earth, in soil and rock, lies some 2 million cubic miles in the form of ground water. Another 3,100 cubic miles of water, mostly in the form of vapor, is contained in the earth's atmosphere.

☆ ☆ ☆ ☆ ☆

If the earth's total supply of water were poured upon the 50 United States, the land surface would be submerged to a depth of 90 miles.

☆ ☆ ☆ ☆ ☆

About 95,000 cubic miles of water goes into the air annually. The greatest part, about 80,000 cubic miles, rises from the oceans. But 15,000 cubic miles of water is drawn from the land, evaporated off lakes, streams, and moist soil, and a significant amount is transpired from the leaf surfaces of living plants. The total process is called "evapotranspiration."

☆ ☆ ☆ ☆ ☆

Of the water that goes into the atmosphere, most (71,000 cubic miles) falls back directly into the oceans. Another 9,000 cubic miles falls onto land but runs into rivers and streams, and is returned to the oceans within days, or, at most, in a few weeks, being used many times by many successive users as it goes. The remaining 15,000 cubic miles of water soaks into the land, where some is available to life processes of plants and animals, some flows slowly underground through porous earth materials to supply water wells, and some is trapped in "water mines," to remain indefinitely.

☆ ☆ ☆ ☆ ☆

The perpetual global water cycle requires that at any moment an average of 3,100 cubic miles of water be distributed throughout the atmosphere as vapor, water vapor, or droplets. If all of it abruptly fell as rain, and the earth were perfectly smooth, the earth would be covered with barely an inch of water. The turnover is quite rapid; once every 12 days, on the average, all the water in the air does fall and is replaced.

☆ ☆ ☆ ☆ ☆

Most of the earth's original supply of water probaby is still in use; little has been added or lost in the millions of years since the first clouds formed and the first rains fell. The same water has been pumped time and again from the oceans into the atmosphere, dropped upon the land and transferred back to the sea. In this hydrological cycle, at any instant, only about 5 gallons of every 100,000 gallons of the total water supply is in motion; most of the water is stored in the oceans, frozen in glaciers, held in lakes, or detained underground.

☆ ☆ ☆ ☆ ☆

In the United States, a drop of water spends an average of only 12 days passing through the air; it may remain in a glacier for 40 years, in a lake for 100 years, or in the ground for hundreds of thousands of years. Eventually, however, every drop becomes involved again in the water cycle, even that trapped deep in the "water mine" which may need to wait for an earth movement to free it from its trap.

☆ ☆ ☆ ☆ ☆

Water fit to drink (fresh water) exists in the ground nearly everywhere on earth. The Sahara itself, a synonym for total aridity, is underlain by water – an estimated 150,000 cubic miles spreading over 2.5 million square miles of land area. Indeed, most of the world's entire stock of fresh water (2 million cubic miles, or more than 97% of the total available supply) is inside the earth. Half of this huge supply is believed to be within a half-mile of the surface and is therefore reasonably accessible, especially if it is under sufficient natural pressure to require little or no pumping and if wells are properly spaced and managed to insure the best possible yield.

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The water at Warm Springs, Georgia, where many polio patients are treated, originally rained on Pine Mountain, two miles south of the village. The rain seeped into a rock terrain, known locally as the Hollis formation, which carried it northward at a depth of a few hundred feet. Its average temperature at the start is about 62°F. However, the Hollis formation is deflected by impermeable rock. The water is heated during this movement and also increased in pressure before it is turned back to the surface where it emerges at a temperature of 88°F.

☆ ☆ ☆ ☆ ☆

The salt cedar tree, common in the Southwest, poses a large water-waste question. Extending its roots down to the water table, this tree in effect "breathes" ground water into the air through its leaves, transferring 20 trillion gallons to the atmosphere each year over 900,000 square miles of the Western United States.

☆ ☆ ☆ ☆ ☆

Water of the ancient seas not only provided the habitat in which first life developed, but undoubtedly was involved in the great design by which life was created. Thus, many living organisms are mostly water and no life can exist without water; human existence without water is limited to about 10 days.

☆ ☆ ☆ ☆ ☆

The human nervous system is geared to maintain a delicate water balance and a 2% variation causes discomfort, while greater excess or deficiency can cause death or serious disorder. The thirst sensor is in the throat and without it one can dehydrate with no craving for water.

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Water in the human body serves many uses: it cools, carries food to cells, moistens and cleanses the eyes and eliminates waste products from the kidneys. Of the 50 quarts of water in the body, about 2½ must be replaced each day to account for that used in food production, cooling (perspiration), and waste disposal.

☆ ☆ ☆ ☆ ☆

Some animals are adapted to environments where fresh water is not available. Whales have kidneys which allow them to drink and dispose of sea water; the sea gull has a special apparatus in its skull for distilling water to obtain a fresh water supply.

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Water sources determined the cradles of civilization and shaped the pattern of history, just as water problems destroyed civilization. "Egypt is the gift of the Nile" as Herodotus said, and our 365-day calendar is based on its flood cycle. Salinization of irrigated land drove early populations from the Indus Plain as well as from what is now southwestern United States; the Egyptians built massive dams almost 5,000 years ago, at about the same time the Mesopotamians were constructing very impressive irrigation canals. Even sophisticated developments of underground water were evident during this early era.

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All rivers flood according to patterns that can be described in statistical terms, but the exact time and severity of a particular flood cannot be predicted accurately. Much flood damage results from building on flood plains which are well identified.

☆ ☆ ☆ ☆ ☆

The concept that steam might be used for power was first conceived by a Greek scientist, Hero, in the first century A.D.

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The first ice sheets of the Great Ice Age began to move about 1.5 million years ago, according to some evidence. The ice age was marked by at least four major advances and retreats. The most recent ice age reached its climax about 50,000 years ago. It covered much of northern Europe, all of Canada, and most of the northern half of the United States with packs often a mile or more thick. This ice did not leave the United States until about 10,000 years ago.

☆ ☆ ☆ ☆ ☆

New England's famous sandbar peninsula, Cape Cod, a relatively young offspring of the last ice age, has lost a two-mile-wide strip of land because of erosion by ocean waves. At the present rate of erosion, the outer Cape will be gone entirely in 4,000 to 5,000 years.

☆ ☆ ☆ ☆ ☆

Unless they are hemmed in by humans, all streams will flow in curves: natural channels are seldom straight for a distance of more than 10 channel widths. Thus, a stream 100 feet wide will have straight stretches no longer than about 1,000 feet.

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Glaciers are in reality frozen rivers slowly flowing under great pressure, with complex circulation patterns carrying tons of silt and rock debris to terminal "moraines" or to the sea.

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Microscopic quantities of water can produce gigantic effects. Single drops of rain exert many pounds-per-inch of pressure on surfaces they contact, and single drops of water freezing in narrow crevices can split the strongest rocks (and water pipes in winter weather!). Such micro-effects, including solution by dissolved carbon dioxide, are responsible for major changes in our weathering landscapes.

☆ ☆ ☆ ☆ ☆

Because waterfalls expend great energy suddenly at the point of impact, rather than gradually over the entire river course, they tend to destroy themselves by severe base erosion, undermining and collapse. Niagara is an example: 20,000 years from now it will have ceased to exist.

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About 75% of the nation's population lives in cities and suburbs, and use averages to about 150 gallons of water per city dweller per day.

☆ ☆ ☆ ☆ ☆

Because the enormous power of the pounding surf is spent on the most prominent projections along the coast, the seas tend to erode and straighten rugged shorelines. An 18-foot storm wave has power enough to move a 10-ton stone.

☆ ☆ ☆ ☆ ☆

Water serves other than physical needs of people. To millions of devout Indians the Great Ganga (formerly the Ganges) is sacred, so sacred in fact that they consider it to be beyond any adverse effect (pollution) of the millions who populate its banks.

☆ ☆ ☆ ☆ ☆

Feast or famine are close neighbors in many monsoon climates, such as India. People in the Ganga Plain depend primarily on effective utilization of water provided by the brief rainy season. However, beneath the Ganga Plain is more than enough ground water to sustain a continuous effective agriculture.

☆ ☆ ☆ ☆ ☆

Water-lifting devices (pumps of a sort) have been used for at least 5,000 years. The Egyptian shaduf and Archimedes screw are well-known examples.

☆ ☆ ☆ ☆ ☆

Water was first used for telling time in 250 B.C. and a water clock called a clepsydra, involving a relatively elaborate gear train, was described by a Roman engineer in 95 B.C.

☆ ☆ ☆ ☆ ☆

About 450 billion gallons of water are currently used each day in the United States. Industry and agriculture use 96% of the total consumed.

☆ ☆ ☆ ☆ ☆

In every stream much of the flow represents waste water returned from cities and industries. In periods of lowest flow, such as late summer, waste water may constitute almost the entire flow at some points.

☆ ☆ ☆ ☆ ☆

Converting salt water to fresh water is not new; sailors were able to do this 2,000 years ago. However, it is still a relatively costly process. There is hope of desalting at costs as low as 22 cents per 1,000 gallons in the near future. □

THE STREAM

It might just be the song it sings
Rushing by the life it brings
What makes it come on back for more–
Flowing where it's been before.

A drop of water from the sky
Could once have been a tearful eye
And maybe water that you drink
Will someday help a child to think.

Ageless cycle, up and down
In and out of, life that's found
Not created, it just gets old–
Bottled, channeled, sewered and
Pumped and sold–

It might just be the sights it sees
From underground to open seas
Freezing, boiling, choppy, still
Controlled by force with needs to fill.

To trees and birds and tiny plants
To bugs and bears, and snakes and ants
Without this water we'd all be
A dried-up, powdered memory.

Ageless cycle, up and down
In and out of, life that's found
Not created, it just gets soiled
Acified, polluted and
Soaped and oiled–

It just takes one mistake or two
Before it's all a part of you–
It might just be
It might just be

It might just be the song it sings
Rushing by the life it brings
What makes it come on back for more–
Flowing where it's been before–

And on to what is yet in store.

Lyrics and music by:
Tanya M. Oznowich
1986

HEAT MIXES

Verne N. Rockcastle

In this experiment four of you will work as a team. One person will be Chief Scientist. That person will decide who does what. Another day there will be a different Chief Scientist. Today's Chief Scientist is the person whose birthdate is nearest today. Write the names of your team in these spaces, and put a *star* in front of the Chief Scientist's name. Put an *arrow* (➧) in front of your name.

____

____

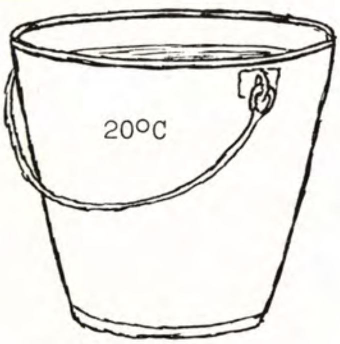
____

____

For Part I of this experiment you will need: 3 insulated cups, 1 quart container, 1 thermometer (Celsius)

If your thermometer is not flat, place it where it won't roll off the table. Thermometers are expensive. You should be careful with them.

Today you will find out what happens when you mix equal masses of water at different temperatures. But first, imagine a *cup* of water at 60 degrees Celsius (60°C) and a *pail* of water at 20 degrees Celsius (20°C):



VERNE N. ROCKCASTLE *is a Professor Emeritus at Cornell University.*

	(Circle one)
Which do you think is hotter, cup or pail?	cup pail
Which do you think has more heat in it?	cup pail
Which would take longer to change 10 degrees if you left it alone, without doing anything to it?	cup pail
If you put the same amount of red-hot iron in the cup and in the pail, whose temperature do you think would change more?	cup pail

Now you can go on with the experiment . . .

In the room are two pails filled with water. One has *cold* water and one has *hot* water. Fill one cup ¾ full with cold water. Make a pencil mark where the water level comes. (Where should you set the cup before making the mark? Why? Would you make the mark on the inside or the outside of the cup?) Pour the water into a second cup. Make a mark on it like the first one. Then pour the water into the third cup and make a mark as before. Now all three cups have marks that show nearly equal measures. (Why do you think marks might not show *exactly equal* measures?) Cold water is still in one of the cups.

Fill a second cup to the mark with hot water. Then take the temperature of the water in each cup and record it:

cold ______________________ °C

hot ______________________ °C

What do you think will be the temperature if you mix the two cups of water in the quart container? Write your *prediction* ______________ °C

Now pour the two cups of water into the quart container, stir the mixture and record its temperature:

______________ °C

How close was your observation to your prediction? ______________ °C

If there was a difference between your prediction and your observation, what do you think might have caused it?

____

____

____

Pour the mixture into the sink (or waste pail). Do *not* pour it back into either of the pails of cold or hot water!

Now fill *one* cup to its mark with *cold* water. Fill *two* cups to their marks with *hot* water. Record their temperatures:

cold ______________________ °C

hot ______________________ °C

hot ______________________ °C

What do you predict will be the temperature when all *three* cups of water are mixed in one container? Write your prediction: ______________ °C

Pour the cups of water into the quart container, stir them briefly, then record the temperature of the mixture:

______________________ °C

How did your observation compare with your prediction?

____

____

____

Which of the water samples (cold or hot) changed more? ______________

Why do you think this happened?

____

____

____

Pour the mixture into the sink (or waste pail). Do *not* pour it back into either of the pails of cold or hot water!

Finally, fill *one* cup to its mark with *hot* water. Fill *two* cups to their marks with *cold* water. Record their temperatures:

hot ______________________ °C

cold ______________________ °C

cold ______________________ °C

Write your prediction of the temperature when these three cups of water are mixed in the quart container:

______________________ °C

Now pour the three cups of water into the quart container, stir them, and record the temperature that you observe:

______________________ °C

How does this observation compare with your prediction?

____

____

Which of the water samples (cold or hot) changed more? ____________

Why do you think this happened?

____

____

Part II

For this part of the experiment you will need: 1 balance, 2 large insulated cups, 1 bundle of nails, 1 thermometer.

You are going to study what happens to the temperature when water and *other* stuff are mixed. But first, think about this . . .

Suppose you had equal amounts of water and iron, both at the same temperature. Suppose you added the same amount of heat to each of them. Do you think one would warm more than the other? (circle one) yes no

If you circled "yes," which would warm more? (circle one) water iron

Now suppose that the water and the iron were at the same temperature. Suppose you took the same amount of heat away from each of them. Do you think one would cool more than the other? (circle one) yes no

If you circled "yes," which one would cool more?
(circle one) water iron

Now go on with the experiment . . .

Place a large cup on each pan of the balance. Put the bundle of nails on one. Add *cold* water to the other cup until it balances the cup of nails. When the two cups are balanced, there is the same *mass* in each cup – a mass of nails in one, and an equal mass of water in the other.

Set the cup of cold water on the desk. Lift the nails out of their cup and lay them on the desk beside the first cup. Put the balance where it is not in the way. Then fill the second cup about ¾ full of *hot* water. Lower the bundle of nails into the hot water and leave it there for about a minute – until the nails come to the temperature of the hot water.

Take the temperature of the cold water and record it: ____________ °C
Then take the temperature of the water around the nails and record it. (Will this be the temperature of the nails? Why do you think so? Can you think of a better way?)

Nails ____________ °C
What do you predict will be the temperature of the mixture when the hot nails are added to the cold water?

____________ °C

Now lift the nails from the hot water and put them quickly into the cold water. When the temperature of the mixture stops changing, record it:

____________ °C

How close was your prediction?

____________ °C

Dry the bundle of nails with a paper towel, then repeat the experiment, but this time balance the cup of nails with a cup of *hot* water instead of cold water. Fill the second cup ¾ full with *cold* water. Record the temperature of hot water in the first cup:

____________ °C
Lower the bundle of nails into the cup of cold water, wait a minute (why?), and then take the temperature of the water around the nails and record it:

____________ °C
What do you predict will be the temperature of the mixture when the cold nails are added to the hot water?

____________ °C

Now lift the nails from the cold water and put them quickly into the hot water. When the temperature of the mixture stops changing, record it:

____________ °C

How close was your pediction?

____________ °C

Discuss your observations with the rest of your team, and try to write an explanation of what happened:

____

____

____

____

Suppose that you had an equal mass of water and iron, both at the same temperature. Suppose that you lighted similar candles and could put a candle under each of the masses, letting the candles burn for an equal time. Do you think that one of the masses would warm more than the other?
(circle one) yes no

If your answer to the question was "yes," which one do you think would warm more? (circle one) water iron

Suppose that you had cold feet when you went to bed, and you wanted something that would stay warm at your feet. Would you prefer to have a hot-water bottle filled with hot water, or filled with an equal mass of nails that were just as hot as the water? (circle one) water nails

Why do you think that the climate of a mid-ocean island stays nearly constant (does not get very hot or very cold)? ____________

____

____

____________ □

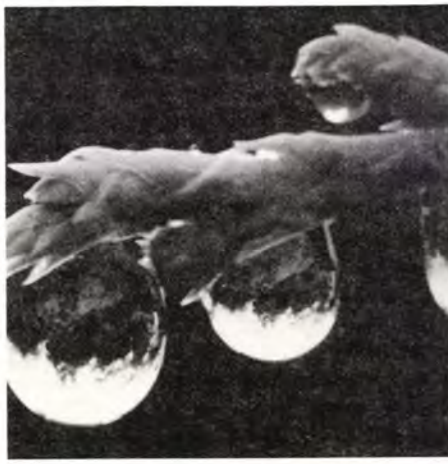


Photo by Verne Rockcastle

RAINDROP

A raindrop splashed upon the sill,
Another on the pane.
A child looked, frowning, at the drop
That cancelled out his game.

But I, I looked beyond the drop
And saw a world in motion:
The drop, minute, was part indeed
Of river, lake, and ocean.

I saw the sun that drew it up
From the surface of the sea;
I felt the wrath of mighty storms
Brewed from its energy.

I saw the many living things
That drop helps to sustain;
I saw the vapor it once was
Before it fell as rain.

All this, and more, before me flashed
When on my sill a raindrop splashed.

– Verne Rockcastle

Photo:Verne Rockcastle

WETLANDS

Nancy A. Zapotocki

A wetland is an area in which water is a controlling factor, influencing the environment in such a way as to dictate the types of plants and animals that exist. These areas occur between upland or terrestrial environments and aquatic environments. In a wetland, the water table is at or near the surface of the land; the land may also be covered with shallow water.

The water which influences the wetland environment may be fresh, salty (marine), or a combination of both (estuarine). Depending on the salinity of the water, different plants and animals are present. The amount of water also dictates the type of plants and animals, as does the geographic location.

Photo by Helen Ross Russell

There are several types of wetlands, including such familiar areas as marshes, swamps, and bogs. **Marshes** are dominated by soft-stemmed herbaceous plants, such as cattails in fresh water marshes and salt marsh cordgrass in salt marshes. These plants grow with their stems partly in and partly out of the water. **Swamps** are dominated by woody plants – namely trees and shrubs. Red Maple, Ash, Willow, and Spicebush are among the common vegetation in Northeast swamps. In both marshes and swamps, the soils are highly organic and form a very black "mucky" soil. **Bogs** are found in areas formerly glaciated. The peat soil is formed by the accumulation and decomposition of plant material, creating a floating mat of vegetation over the water. These areas are characterized by evergreen trees and shrubs, and are often blanketed with a carpet of sphagnum moss. They are most often found in acidic areas that are poorly drained. Bogs are very old, taking thousands of years to form. They are, therefore, good sources of information concerning the ecological history of the region.

Wetlands provide food and habitat for a diversity and abundance of animal life. They are important as breeding, spawning, feeding, cover, and nursery areas for fish. They are also important as nesting, migrating, and wintering areas for birds. Many wetlands serve as buffers which can protect shorelines from erosion by waves and storm surges. Wetlands act as natural water storage areas during floods and storms by retaining high waters and gradually releasing them, thus reducing damaging effects. Wetlands are also important for recharging groundwater. These special areas also purify water by filtering, removing, assimilating, and recylcing pollutants.

These valuable areas, however, are facing development pressures and other damaging effects. To many, wetlands are considered wastelands – to be filled and so made into "useable" dryland which can support development.

Fortunately, the need for protection of these environments has been recognized. There is federal legislation which has focused national attention on the importance of wetland areas to society and set policies on their use and protection. In particular, wetlands are protected by Section 404 of the Clean Water Act, the Swampbusters Provision of the 1985 Food Security Act, and President Carter's Executive Order on the Protection of Wetlands issued on May 24, 1977. In addition, state and local authorities are recognizing the importance of wetlands and developing policies concerning their use or non-use.

Section 404 of the Clean Water Act prohibits the discharge of dredged and/or fill material into waters of the United States without a permit from the U.S. Department of the Army Corps of Engineers. Biologists, ecologists, and other scientists as well as engineers are hired in the Regulatory Program to decide whether or not to authorize a project proposal in waters of the United States, and if so, the conditions under which it will occur. This decision is determined through a general balancing process. All factors which may be relevant to the proposal must be considered. Among these factors are conservation, aesthetics, general environmental concerns, fish and wildlife values, and water quality, to name but a few. Hopefully, after this process, a knowledgeable decision is made, taking the environmental and other relevant matters into consideration.

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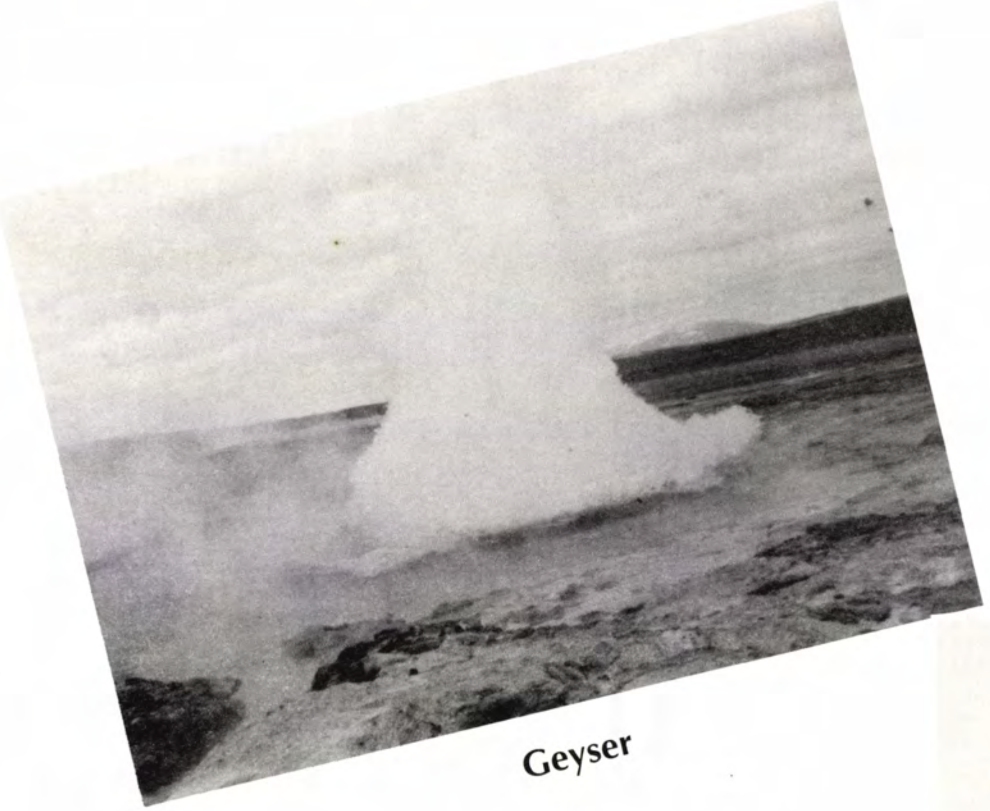
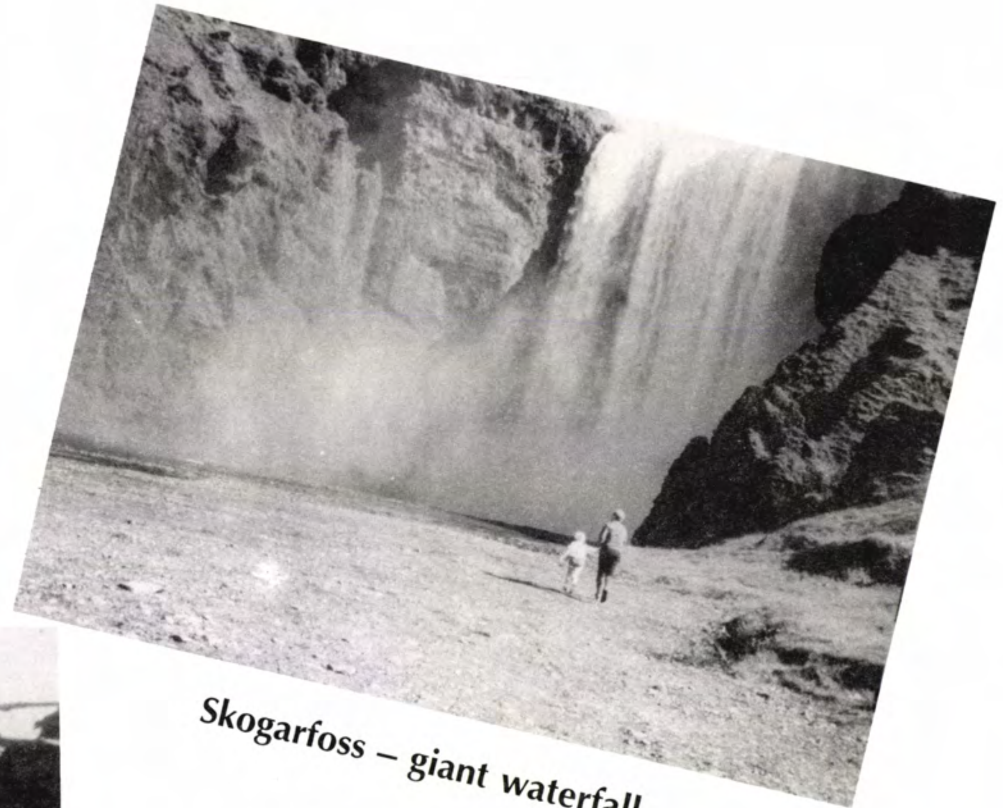
NANCY ZAPOTOCKI *is a biologist with the Army Corps of Engineers in Baltimore, Maryland.*

WATER AT WORK IN ICELAND

Photos by Ruth Melvin



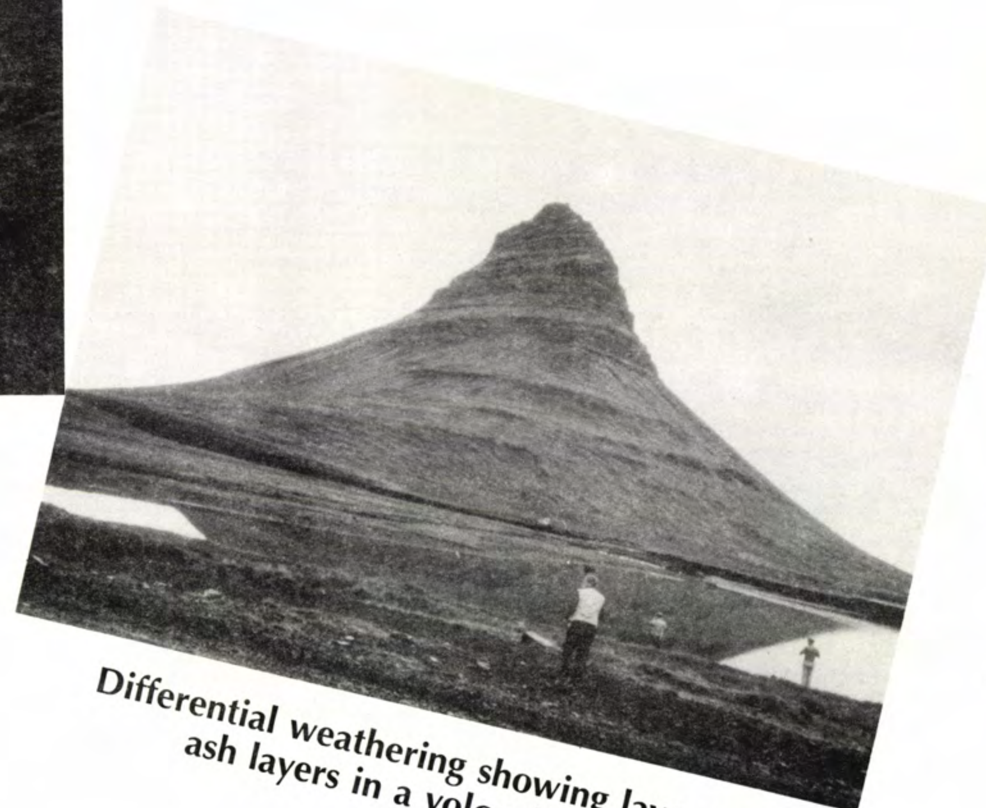
Geyser



Skogarfoss – giant waterfall

A glacial tongue

Salmon fishing along a meandering stream



Differential weathering showing lava and ash layers in a volcanic cone

TIPS ON PHOTOGRAPHING WATER IN ITS MANY FORMS

John Green

Photo by John Green

Position the flow of water so it travels towards and below the center of the viewfinder.

JOHN GREEN *of Amherst, MA, is an Interpretive Naturalist who specializes in leading tours and giving lectures illustrated with his photographs.*

Water, in its many forms, is one of my favorite photographic subjects.

Watery subjects should be approached as one would approach any other, using *focus, composition* and *exposure* as guiding elements. The fourth element, *visual impact,* is not always present, but technically acceptable results are obtainable keeping the first three elements in mind.

EQUIPMENT AND FILM

A basic set-up may be the following: a camera with a normal and a small telephoto lens, sturdy tripod, cable release, gray card or an incident light meter. This is pretty much the set-up I use. You may have other ideas, just be sure to keep it simple!

I generally use Kodachrome 25 film, but here again it is a matter of personal choice. Different films, Kodachrome, Ektachrome, Fujichrome, will render the same colors in a different manner.

TECHNIQUE

For most photographic situations I set up the tripod and camera as soon as I spot the desired picture. I then select the appropriate lens and "measure the scene" (focusing on the front and back of the scene to determine the "range of depth").

Next, I select an F-stop, using the depth-of-field scale on the lens that will accommodate the "range of depth" determined above. The proper exposure is derived by selecting the appropriate shutter speed.

STREAMS

Photographing streams with a normal lens (55 mm range) permits a sufficient angle of view to take in a lot of action. Using the depth-of-field scale on the lens guarantees a nicely focused picture. A short telephoto lens (135 mm range) permits one to crop the scene and highlight a smaller area.

Following basic rules of composition, position the main subject, perhaps water flowing around a rock, off to one side so the motion of the water travels towards and below the center of the viewfinder. A low camera angle aimed across the stream affords another interesting perspective.

Photographing under soft lighting conditions (early or late in the day), along a wooded stream lessens the disparity in light levels between sunlit (highlights) and shadowed areas. Here, exposing for highlights will still yield some detail in the shadows and permit an increase in exposure of a ½ or full stop, to yield more details, without overexposing the highlights.

Photo by John Green

The sun creates ever changing lighting conditions on the ice formations and small streams of flowing water.

(NOTE: increasing exposure by changing the aperture, alters the depth-of-field, so exposure adjustments are made using shutter speeds. Also, it is important to remember, overexposure and underexposure are not necessarily negative terms, depending on the degree of each.)

PONDS/LAKES

Different conditions prevail when photographing bodies of water. The attraction to ponds and lakes is enhanced by the existence of trees, hills or mountains on the far shore.

On a windless day the reflections are impressive. In the Autumn, a slight breeze creates a French Impressionist affect and a constant wind is the agent of action-packed waves. If the sky is blue, the water surface is blue, and a gray sky means gray water. One can predict the photographic results by keeping an eye on the environmental conditions. As mentioned earlier, use of the depth-of-field scale will aid in obtaining well focused pictures.

Avoid dividing a scene in half by keeping the horizon away from the center of the viewfinder. If the main center of interest is above the horizon (e.g., a puffy white cloud) tilt the camera up to show the cloud, which moves the horizon below the center-line. A moose feeding in the water at a distance calls for tilting the camera down, which now shifts the horizon above the center-line.

WATERFALLS

The most dramatic mood of water is the waterfall!

My rule of thumb for acceptable waterfall photographs is: an abundant volume of water (as in early spring) calls for a fast shutter speed (1/125 of a second or faster), to stop the action and minimize harsh overexposed areas. If the volume of water is small (as in late summer), and the substrate is visible behind the water and the water course bounces around, a very slow shutter speed (1/8 of a second or slower) results in the exaggerated gauzy affect. Avoid areas in direct sunlight, otherwise the highlights may be grossly overexposed when using very slow shutter speeds.

Waterfall photography during the winter months is challenging. Isolating small partially frozen areas can yield amazing results, as the sun moves across the sky creating ever changing lighting conditions on the ice formations and small streams of flowing water. CAUTION: Dress warmly and be aware of slippery conditions.

CLOUDS

Large, puffy white clouds are beautiful and easy to photograph. One must be aware, however, that camera meters react to very bright subjects (snow, sand and white clouds) by underexposing them. To compensate, put the white back in the subject by increasing the exposure a stop or so. Remember, if there is an entire landscape in your viewfinder, anything darker than the puffy white clouds will be underexposed. Exposing for the darker areas will wash out the puffy white clouds. The option is yours.

Photo by John Green

Exposing for puffy white clouds will usually underexpose the area below the horizon.

FOG

This is the exotic side of water photography. It is an excellent condition for silhouettes and very dramatic results are possible, if a few easy rules are followed. The less complicated the subject the greater the impact. On a windless day locate yourself so the subject is positioned against the lightest area of fog. If the sun is visible (as a white disc) the scene is enhanced. Expose off the brightest area that will appear in your picture (this will underexpose the subject, creating a silhouette) and click away.

SNOW

Working with snow is fun! The key is accurate exposures. Remember, if you can see texture in the snow, the texture should show up in the photographs. Working on bright-cloudy days and using a gray card with your camera meter or a hand meter that reads incident light will help pinpoint exposures.

There are many photographic possibilities, such as snow falling in front of conifers, plumes of snow falling

Photo by John Green

Snow presents many photographic possibilities.

from trees, snowy landscapes and animal tracks (best taken on sunny days).

VISUAL IMPACT

Colors, tones, lighting conditions and camera position all contribute to visual impact. Becoming familiar with the interaction of colors with varying lighting conditions is important.

For example, photographing a clump of red maple leaves in the autumn on a drizzly, foggy day may sound like something that a sensible person ought not to do, but it can yield startling results.

Just think, the rain has washed the leaves free of airborne particles (dust, etc.) and the sun (diffused by the clouds) is not washing out the color. What you have is pure red or red-orange. But what you also have is an extremely low-light level. If you are using a slow speed film there is a good possibility your camera meter won't respond. There are formulas for calculating low-light level exposures, but rather than tackle the subject here I suggest you refer to John Shaw's book *The Nature Photographer's Complete Guide to Professional Field Techniques,* and read his paragraph on *Reciprocity Failure* and how to overcome it. Or, send me a self-addressed envelope and I'll send you my technique for handling the situation.

In Freeman Patterson's book *Photography For The Joy Of It,* he says "If an image has a limited range of colours it must have an extended range of tones." Visualize a lake at the base of a mountain range, on a cloudy day. The color variety may be nil, but the gradation of tones in the mountain peaks may yield awesome photographic possibilities.

Some subjects are vertical, some are horizontal and others fall in between. Holding the camera in the position best suited for the subject often increases visual impact.

Studying the work of others through nature magazines and photography books, by such notables as John Shaw and Freeman Patterson, will enrich your understanding and your approach to photographing watery subjects. But nmothing is more invaluable than practice, practice, practice!

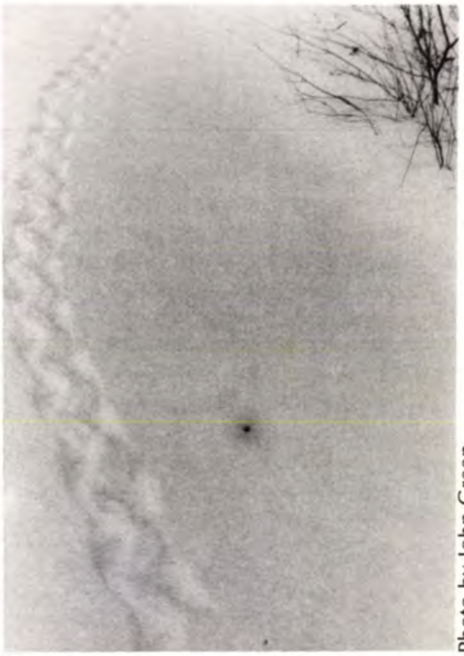


Photo by John Green

Animal tracks in the snow are best photographed on sunny days.

CONSERVATION

Water is extremely important to the existence of all living things. It is evident, however, that humans take it for granted. We poison water with all types of pollutants, but still expect to use it for consumption and recreation.

Perhaps through our photographs of water, in its many interesting forms, we can remind ourselves and others how beautiful and important it is. We cannot live without it! □

Photo by John Green

If the sun is visible (as a white disc) the silhouetted scene is enhanced.

Photo by John Green

"If an image has a limited range of colours, it must have an extended range of tones."

A GREAT LAKES SUPERIOR EXPERIENCE

by Nancy Franz

Sunset on Lake Superior

The sun rises over Lake Superior as 30 youngsters and adults set out from their tents to enjoy a breakfast cooked over the campfire. Preparing for a day of nature study and outdoor recreation in the northwoods of Wisconsin, this group is exploring the natural world through the Superior Experience – an environmental education and leadership camp.

The Superior Experience was created in 1982 when a group of youth workers met in Duluth, Minnesota, to set the foundation for a camp that would focus on Lake Superior. Their vision was based on the Sea Camp model, originally conducted by Minnesota Sea Grant.

The first environmental education camp was conducted in Superior, Wisconsin, at a University Field Station on a 3-mile long sand bar in Lake Superior. The four-day event was designed by youth workers who saw a need to teach youth 13 years of age and older and adults natural science subject matter and leadership skills. The program's advisors planned to utilize the Lake Superior ecosystem as the means for developing these skills.

Participants came from seven Minnesota and Wisconsin counties in 1983 for the first Superior Experience. The camp was conducted the first year by University Extension Agents from Minnesota and Wisconsin. The expenditures for the program were funded by youth foundations, local businesses and private industry. Program supplies were provided by government agencies and the University system.

Campers and the first Superior Experience took part in educational activities given by University faculty, Extension agents, Forest Service Resource People, local environmental center staff, and Sea Grant employees. The youngsters and adults sampled activities in forestry, the lake ecosystem, the lake shore astronomy, and the field environment. In addition, time was dedicated to forming a personal or small-group plan for sharing the information upon their return home.

Outdoor camping skills were also included in the four-day camp. Participants lived in tents, cooked their meals over an open campfire, and discovered outdoor recreational activities. First Aid, boating, group games, and natural science careers were discussed.

A pre-test and two post-tests were conducted with the campers to determine the amount of knowledge gained as a result of the event. Questions were solicited from the instructors prior to the participants' arrival. Written and oral program surveys were also used to evaluate the event. Almost all of the educational sessions, as well as recreational and social activities, were rated highly. However, food and food preparation were not popular since delegates were new to cooking meals over an open fire. Learning was evident as were new friendships. The highlight was a two-hour trip in the University Research vessel on Lake Superior.

Individual experiences in public speaking were scheduled into the camp program to build leadership skills. Each camper gave a five-minute presentation on a natural science topic or activity. The oratories ranged from information on mosquitoes and weather to building a bluebird trail. Youth were sometimes shy about speaking in front of a large group but gained courage and eventually expressed ·emselves well.

Public relations efforts were made to provide recognition to donors for their support and give information about the event and its participants. Public service announcements and news releases were sent to radio stations, television stations, and newspapers in Minnesota and Wisconsin before and after the event. A fish boil was also held during the Superior Experience as a recognition program for donors and participants. These efforts resulted in greater visibility and popularity for this environmental education camp.

In 1984 and 1985 the Superior Experience drew more youth and adults. Subject matter at the field station location changed a bit as a result of surveys and the development of new teaching techniques. A session was added on lake shipping since the camp was at

Wisconsin youth watch a boat travel through the Superior port of entry.

NANCY FRANZ *is 4-H and Youth Agent in Douglas County, Wisconsin.*

Superior Experience participants learn about snorkeling from a University faculty member.

Youth participants try outdoor cooking.

an international port of entry. Time for fishing was increased, and a natural science fair was included in the agenda. The fair gave participants a chance to try their skills and creativity in planning, setting up, and carrying out carnival games with an environmental education flair. A food-chain bean-bag toss and a plant identification ring were two examples.

A new teaching technique incorporated into Superior Experience leadership sessions was the Skill-a-thon. With this method groups of three to five people traveled to stations to solve a problem or situation.

An example of a situation is, "You have two 50 lb. packs, 3 life jackets, 2 paddles and a canoe. How would you transport all of the items ½ mile in one trip?" Group members devise their answer by working together and answering the questions of the leader or helper.

In 1986 the Superior Experience moved to a church camp in Lakeside, Wisconsin, as a result of a lack of funding for the field station. The event changed slightly by substituting a canoe trip for the research vessel. A session on environmental issues and problem solving was also added.

Although there have been changes along the way, the four initial years of this camp have been productive. Environmental Education teaching techniques have been refined. Several participants are pursuing natural science careers and approximately 75 percent of the campers have reported utilizing aspects of their environmental education experience in their daily lives.

Learning about the largest fresh water lake in the world is a valuable environmental education opportunity for youth and adults. The Superior Experience camp in Wisconsin focuses on this opportunity. To receive a copy of an informational paper on the Superior Experience through the University of Wisconsin Department of Youth Development, contact: Nancy Franz, Douglas County Extension Office, 203 Courthouse, Superior, Wisconsin 54880, or call 715/394-0363. □

Superior Experience campers live in a tent village for 4 days.

TEACHING ABOUT WATER

Esther P. Railton

Water is unique in its many forms, gas, liquid and solid. It is the most critical resource to life. The curriculum of water includes sources, cycles, properties, uses, quality, and conservation.

The water cycle can be studied by children as young as first grade. One class made a model cycle in their herbarium after seeing an old filmstrip that followed the "Adventures of Junior Raindrop."

Ice is not just ice. Which thaws more slowly, cubes just frozen or those which have been in the refrigerator for a while? Glacial ice has been under pressure; the released bubbles in an iceberg crackle like Rice Krispies. Ice is used for refrigerating (in ice chests), even sculpture. It can also break trees and power lines, cause traffic hazards and provide a skating rink.

Children with learning disabilities especially need to study water in all of its states. Here sensory experience is important: feel cold, warm, swiftly flowing, trickling, ice, snow, frost, steam – great vocabulary building!

Most things children use go into solution with water: foods, paints, cleanup. They can be detectives to locate family uses of water. Which could be reduced? Baths?

Water, historically, has been put to many uses. One primary class made a water clock. Some attest to the continued pleasure and healthful qualities of bathing in hot springs. Others jump from saunas into cold lakes or snow. We ski and slide on water. The list seems to be endless and fascinating to all ages.

Water can do things. Frozen or running, it gouges canyons, erodes hillsides, breaks up highways. Students can find evidence where the water shaped their community. They can make earth mounds and pour water on them to see what happens. What size particle moves farthest? What difference does it make if roadways and paths are placed in various ways on the slope? If the slope is covered or exposed?

ESTHER P. RAILTON, *Ed.D. is Professor of Education at California State University, Hayward.*

Photo by Helen Ross Russell

"Ice is not just ice"

Students in resident outdoor schools often have a first class opportunity to develop the concept "watershed" and trace their own water from its source through aqueducts, reservoirs, filtering plants and delivery systems. Negative examples are unfortunate, but one science class was studying water without being aware that the fenced area adjacent to the school contained a water reservoir for the city. A visit to the hydro-company or a visit from one of its representatives was in order.

Too much and not enough water can be disastrous. Recent droughts have brought crop failure to Africa, Bolivia and the American south-east. Ballads have been written about the great western desert. (Students can collect and learn these.) Floods make the papers more and more frequently. All of this can lead to a weather unit or geography research. Students can find out about floods or droughts in the history of their community.

As people use more and more water, supply is an ever increasing concern. Urban growth is often limited by the supply of quality water. Cities are located by water. Students can calculate from the water bill how much water their families use per person per day. Students who camp can compare use where water has to be carried or held in a tank. Folklore of many countries contains some touching stories of the need for water. Industry, including agriculture, places great demands on water. Fertilizers, pesticides, herbicides are all mixed with water.

People put water to many uses. Children can list these uses in their own community, e.g., transportation and recreation, refrigeration and space heating.

Hydropower is the cheapest source of energy – used wherever possible.

Children can find out if waterfalls or thermal fields are part of their energy system and how water is used, even in nuclear plants. They can construct a little power plant with a pelton wheel cut from a milk carton.

However, people are not the only form of life in need of water. Students can study water communities; estuaries, pond life, riparian habitats, marine life, limnology. Each involves a complicated and fascinating ecosystem. One Michigan class walked out on an ice covered lake (the same activity could be done from boats or, in a limited way, from docks). They let down measured lengths of string, marked by knots and weighted by thermometers. Thus they compared the temperatures of various parts of the lake at various depths.

To understand watershed management, one class made a model river about four inches wide from the tap at the side of their school across about twenty feet of ground. Each participant bought some land on the bank and proceeded to develop it, but not until his/her proposal had been critiqued at the landowner's association hearing and all the upstream and downstream impacts had been considered. Then the original plans were altered, for indeed they learned "No man is an island."

Diseases are spread by water, some through microorganisms living in contaminated water and some by insects breeding near water. These diseases invade through drinking or swimming. A health unit could address this issue. A more recent concern is the mineral content of water, especially heavy metals. Science supply houses have intriguing kits for measuring water quality. The ignominious Kesterson Reservoir in California is a publicized example of what happens when water is contaminated.

The concern for water quality takes on a further dimension as water vapor combines with toxins in the air to produe acid rain. Students may compare wind direction, possible pollutant sources and affected areas. This problem is based on the previously-built concepts of water's changing forms, cycles, weather and significance in the growth of all living things.

Other study topics include the effects of acid fog on art objects. Again these need to be preceded by experiencing and reading poetry about the enjoyment of clean fog on the coast or on a misty morning. Carl Sandburg's "Fog" probably has the most relevance for city dwellers.

Although one tends to think of all water as surface water, national headlines have directed our attention to the fact that aquifers are being heavily drained, often through state boundaries, as in the adjoining corners of Colorado, Oklahoma and Texas. Furthermore, underground reservoirs are becoming contaminated by toxic wastes. Students can overlay water resources maps, available from their state water agency, with political boundary maps. Then, in political science, they can research the federal, state and regional jurisdictions over water supply and quality. Chemistry students can test home wells for more than coliform and hardness, the usual state health department tests, to determine whether there are other pollutants, such as arsenic and lead from agricultural spraying.

These are just some of the investigations students can make to learn about water. Finally, there is the ever present and increasingly urgent importance of water conservation. The need for water conservation is publicized in cycles as the climatical crises come and go, but the world and its atmosphere contain a finite, though vast, amount of water. Students can study maps to see that water sources and population centers are not always in the same locales. They can find souces of waste, e.g., faucets left on, and do something about them. Water conservation must become a way of life.

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WATER GLOSSARY

Charlotte McCabe

Acid rain: precipitation with a pH of less than 5.6; more accurately labeled acid precipitation or deposition as it includes snow, sleet, dew and fog.
Aquifer: an underground layer of sand, gravel, or rock through which water can pass and into which wells can be sunk.
Artesian water: underground water trapped under pressure in a porous layer between non-porous rock layers.
Bog: a wetland without inlets or outlets, containing a floating or spongy mat of vegetation, with acid water.
Coliform bacterium: an aerobic bacillus normally found in the colon, a count of which is often used as an indicator of fecal contamination of water supplies.
Condensation: the changing of water vapor to liquid.
Distilled: water that has been purified through a process of evaporation and condensation with a neutral pH of 7.
Estuary: an inlet or arm of the sea, especially the wide mouth of a river where the tide meets the current and saltwater meets fresh water.
Evaporation: the changing of liquid water into water vapor (opposite of condensation).
Groundwater: water found below the surface of the earth.
Hydrologic cycle: the process involving the circulation and distribution of fresh water on the earth.
Hydrosphere: the surface water that covers the earth.
Lake: an inland body of usually fresh water, larger than a pond and too deep in parts for rooted plants to live.
Limnology: the study of the physical, chemical, and biological components of fresh water.
Marsh: a wetland with herbaceous vegetation not much more than head high, often interspersed with small open water areas.
Percolation: the passing of liquid through a porous material such as limestone or soil.
pH: a symbol for the degree of acidity or alkalinity of a solution; the pH scale ranges from 0 to 14, 7 being neutral, anything greater than 7 alkaline, and anything less than 7 acidic; the pH scale is logarithmic (i.e. a decrease of one unit means a 10-fold increase in acidity)
Pond: a small enclosed body of shallow water where growth of rooted plants is permitted across the entire bottom.
Potable: water that is fit to drink (but not necessarily pure).
Precipitation: forms of water vapor that are heavy enough to fall to the earth's surface; includes rain, snow, sleet, and hail.
Pure: water that is free from any contaminants.
River: a natural stream of water larger than a creek and emptying into an ocean, lake, or another river.
Runoff: water that flows on the surface or through the ground into streams, rivers, lakes, and oceans; results when the ground is saturated or made impervious through such obstructions as asphalt.
Swamp: shallow wetland with primarily woody vegetation (shrubs or trees).
Transpiration: the evaporation of water from the leaves of plants.
Water vapor: molecules of water found in the air.
Water table: the level below which the ground is saturated with water.
Watershed: an area from which water drains and contributes flow to a given stream or river.
Wetland: land areas that are saturated or covered by water at least part of the year; includes marshes, swamps, and bogs – some of the most productive natural areas on earth. □

MEET A MEMBER – PAUL SPECTOR

I am very flattered that you have asked me to "tell my story" for the upcoming 'Meet a Member' section of the *Journal.* As I look back, ANSS has touched my career many times over the years and I truly enjoy the opportunity to be a part of such a fine organization and to serve on the Board of Directors.

Like so many members of ANSS, my first awareness of the group goes back to my years at Cornell. While my focus of study was on the periphery of the nature interpretation program, the influence of Verne Rockcastle and Richard Fischer, and the long tradition of the Cornell Nature Study Movement, played a large role as my career in the field continued.

Upon graduation, I was employed as the director of a nature center in eastern Pennsylvania. Here, I had the opportunity to sharpen my focus of interest in the study of nature and techniques of conveying this to others. After one and one-half years, I realized that I wanted to return to graduate school to pursue a degree in environmental education. Enrollment at Slippery Rock University brought my next contact with ANSS in the person of Craig Chase, my advisor and a past-president of ANSS. Craig's guidance and influence helped me to grow as an educator and solidify my desire to combine my teaching and environmental interests.

From Pennsylvania, it was on to Ohio and my current position at The Holden Arboretum. The Arboretum is a 2900 acre museum concerned with the collection and display of woody plants for scientific and educational purposes. A combination of horticultural collections and spectacular natural areas offer a tremendous resource to the people of northeast Ohio. As the Director of Education, my responsibilities are varied. They include the administration of the department, planning and implementation of programming for adults and children, writing and production of publications and educational materials, and development and coordination of services for students and teachers.

During my first year in Ohio, I had the pleasure of meeting another person very familiar to ANSS members – Ruth Melvin. As a past president and enthusiastic supporter of ANSS, Ruth was instrumental in encouraging me to take a more active role with the organization. Perhaps her motive was to maintain some midwestern input, but whatever the reason, I thank her.

It seems as though everywhere I have stopped throughout my career, ANSS has played a part. In my mind, ANSS can be summed up in one word– people. It is an organization made up of individuals who have been, are, and probably always will be dedicated to the ideals expressed by Liberty Hyde Bailey and committed to sharing them with others. It is a privilege for me to work with such an enthusiastic group, and I know that my association with ANSS will be long and one in which I will have received much more than I can ever return. □

FIVE RECENT BOOKS BY ANSS MEMBERS

POND AND BROOK–A Guide to Nature Study in Freshwater Environments, by Michael J. Caduto. Phalarope Books, Prentice-Hall, Inc. Englewood Cliffs, NJ 07632, 1985

If only I could have had this book sixty years ago! This great addition to naturalists' libraries was not written for nine-year-olds, but I bet they'll be netted by Joan Thomson's excellent line drawings of aquatic animals and by the photographs of habitats, mostly by the author with some by Cecil B. Hoisington and others; and it will not be long before youngsters are sampling the clear text which combines an enormous amount of information with personal come-on-in for getting wet feet.

We nature leaders know that if a group gets out of cars or a bus near a pond or stream, we shall not have the group's attention until they have looked at the water, such a natural attractant. The experienced leader will help the group explore not only this miraculous liquid medium but also the marvelous organisms which make homes in it. ***POND AND BROOK*** makes available exciting facts for the neozoon leader and also many intriguing details which long-time aquatic ecologists can add to their vast store of knowledge.

This exemplary book is no ordinary field guide. It includes lucid descriptions of activities for old and young; an Appendix A: Plant and Animal Adaptations for Aquatic Life (6 pages); Appendix B: List of Common and Latin Names of Organisms Appearing in this book (15 pages); Glossary (16 pages!); and Index of 9 pages. This book was creatively crafted to help all of us learn and teach about lentic and lotic communities. Please do use it, often.

– John W. Brainerd
Environmentalist, Author
and Emeritus Professor

THE FIELD MANUAL FOR WATER QUALITY MONITORING, An Environmental Education Program for Schools by Mark K. Mitchell (M.S.) and William B. Stapp (Ph.D.): 150 pages, 6 x 9 inches, 70 photographs and charts, paperbound. Copies are available through William B. Stapp, 2050 Delaware, Ann Arbor, Michigan, 48103. $6.80 postpaid. Orders for 10 or more are available at a 20% discount.

This excellent book is much more than a field manual. It is a guide for carrying out the best kind of environmental education program – one which gives students the skills and the information they need to make a rational assessment of an environmental situation in their own community. The manual provides, in one place, virtually all of the information needed for carrying out basic field tests on water quality, and for calculating and interpreting the results. It gives suggestions for when and where to carry out the tests, and discusses the man-made factors that affect water-quality.

The manual starts with an introduction that discusses rivers and how to determine their watersheds, gives an overview of the need for water quality monitoring, describes the National Sanitation Foundation's Water Quality Index, and carefully goes into how to take samples in a river or stream.

The second chapter, on the meaning and procedures of the nine chemical tests that are used in the Water Quality Index, makes up the majority of the manual. The tests are for: dissolved oxygen, fecal coliform, pH, biochemical oxygen demand, temperature, total phosphorus, nitrates, turbidity, and total solids. Test equipment needed and where to purchase it or how to make it is listed after the explanation of each test. There is no over-simplification in this manual, the descriptions of both the tests and their meanings are very complete. However, the explanations are beautifully clear and well organized. They will make it easy for a teacher to lecture on or explain each aspect of water quality and the whys and wherefores of each test. Charts for converting the raw data obtained by the students to water quality values, and one for how to calculate the overall water quality of a specific area are provided.

The manual does not deal solely with chemical tests, however. There is a chapter on benthic macroinvertebrates which includes pictures of key organisms to help with identification and a full description of their roles in an ecosystem. An important discussion of how the physical parameters that influence them are in turn influenced by man-made factors is included in this chapter.

Appendices to the book make suggestions for how to use it effectively. A detailed, day by day, sample river monitoring program for a class of high school students is provided. To be able to follow the suggested time schedule, a class would have to be familiar with laboratory technique, or very heavily supervised, but adaptations of the schedule are suggested. Examples of the kinds of actions that classes have taken, once they did their tests and determined their results are also given in this appendix. Another appendix provides the monitoring results obtained by students from high schools located along three different stretches of the Huron River in Michigan.

Cooperative research by different schools is only one of the many creative uses to which this manual may be put. Classes may build up data at one place over a period of years to determine whether or not deterioration in water quality is taking place. The effects of specific man-made factors such as dams and impoundments, urban discharges and agricultural runoff may be tested. The advisability of specific water uses in a particular place may be determined by a class.

The authors have worked with upper elementary, secondary and university students and teachers in producing this book. Advanced high school and beginning college students will be able to read and use the text directly. Students in lower grades or on a lower level will need explanation and interpretation and a great deal of help in carrying out the tests. As with any good teaching program, use of this manual on any level will take planning and effort on the part of both teacher and students. It is a book that no one seriously interested in environmental education can afford to miss.

– Mary D. Houts
Education Specialist
Hershey Museum

THE NATURE SPECIALIST: A Complete Guide to Program and Activities, by Lenore Hendler Miller. American Camping Association, Martinsville, Indiana, 1986, 170 pp.

THE NATURE SPECIALIST was written as a guide and resource for staff members responsible for nature programs at camps. However, don't stop reading if your interest is not nature in a camp setting! This book contains a wealth of information on outdoor activities and techniques which would be useful to teachers, nature center directors and parents.

The book is divided into five sections, the first of which deals with setting up a nature program at camp, preparing a nature shack and ordering supplies. The section on Life in Camp gives directions on gardening, caring for animals, raising moths and butterflies and hatching fertilized eggs. A convenient animal care chart is provided that concisely notes each type of animal's housing, food and handling needs.

The Activities portion of the book contains more than seventy informative and exciting activities from Making Hay Infusion to Making Corn Husk Dolls; from dissecting owl pellets to drying flowers. This section provides a very useful Activities Guide chart which classifies each activity according to several criteria which will enable a naturalist to select the activity most appropriate for a particular group. The chart indicates whether the activity is indoor, outdoor/quiet, outdoor/active; the appropriate age level; amount of preparation required; and whether there is a related craft activity. Sample program schedules are also provided for various age groups ranging from three year olds to mature adults.

The fourth section of the book presents a mixed bag of participatory activities, competitions, contests, rainy day activities, evening and special programs.

The Appendix alone is worth the price of the book. It is filled with simple guides for identifying plants and animals, even galls and skulls. A well-illustrated section on making equipment and cages, and large selections of puzzles, games and other activities complete this section.

THE NATURE SPECIALIST provides a wealth of information and reference material which will enhance a beginning nature program or add new dimension to an existing program.

– Sandra Flynn Burns
Central Connecticut
State University

WINTER HERE AND NOW by Joy Finlay. 1982. Illus. by Joan Heys Hawkins. Aspen House Productions Ltd., Box 8644, Station L, Edmonton, Alberta T6C 4J4, Canada. 138 pp., paperback. (Available through ANSS Treasurer John Gustafson for a limited time, at $6.00)

This handy guide to winter activities in the north country is a welcome addition to the resources available to teachers and teaching naturalists. It fills a void which has long been neglected. ANSS has dealt with winter nature study with an occasional article (most memorable was Chuck Roth's "Time-lapse Geology" teaching tip on snow, published in the form of a TIPS about twenty years ago). The properties of snow and ice, and winter weather, have been dealt with in a variety of formats, and textbooks usually cover the topic to some degree. But Finlay's book is an *activity* guide. It fits in very well with the nature study philosophy of learning through direct contact with the natural world in hands-on (or, in this case, feet-on or bottom-on) experience.

Developed over a number of years in teacher-learner situations, the information and suggested activities have been thoroughly tested. Joy Finlay (the only Canadian member of the ANSS Board of Directors at this time) resides in Alberta, Canada, where there is plenty of winter! This guide is useful wherever snow accumulates, but particularly in the northern U.S. and Canada.

The book is divided into five sections: (I) *Study Now Our Winter* (SNOW) suggests how to develop a winter studies program. (II) *Stories in the Snow* opens up the topics of "reading the snowy landscape" for clues to animal activities, how animals and plants cope with winter, and how snow itself is used for beneficial purposes by living things. (III) *Snow and More Snow* goes into considerable detail on the properties of snow, and gives simple directions on how to make handy instruments to study it, and discusses Indian culture with relation to language about snow and coping with winter. (IV) *Winter Waiting* goes into more detailed study of winter plants and animals – their identification and ecology. (V) *Out and About* deals with human response to winter – keeping warm, using snowshoes, building snow huts, and winter reading. Each section is profusely illustrated with sketches. The text throughout is hand-printed – a pleasing style (if occasionally not as legible as one might wish).

The format throughout this book is developed around the asking of questions – hundreds of them. It is an effective mode. The questions are always relevant, easily understood, and lead to investigative activity to find answers. Factual information and directions for activities are given in brief, clear sentences understandable to junior-high students, perhaps to upper elementary children also. Americans will find the use of the metric system, and a few Canadian differences in spelling, only a minor challenge – and good practice.

Of particular usefulness is the categorization of the suggested activities: science, mathematics, social studies, and language and sensory arts. True to the best traditions in outdoor education, "Winter Here and Now" approaches the subject matter and the learner from an integrated, holistic point of view. It is useful by teachers at every level, and by teachers and students in the upper grades. It's a real antidote to "cabin-fever" in the classroom – put on your toques and snowshoes and go outside!

J.A.G.

THE NATURE OBSERVER'S HANDBOOK: Learning to Appreciate Our Natural World by John W. Brainerd, The Globe Pequot Press, 1986. Chester, CT 05412, $9.95, 253 pp.

Don't put this book on your book shelf. It will be much more useful in the map box of your car. Former ANSS President John Brainerd feels that nature is best observed on our hands and knees or sitting on a stump, but acknowledging that we are such a mobile society, he has written a guide to *nature touring* – "sensing nature while traveling, be it around the yard, around the block, or around the world."

But before sending us out on our nature quest, he insures that we are adequately prepared. Much useful advice is shared on picking a companion, field guide, binoculars, food, clothing and mode of transportation, to name just a few. While the current generation of nature guides urges our visits to places like Sandy Hook Gateway Recreation Area or Montezuma National Wildlife Refuge, John Brainerd makes the travelling easier and less site specific in short chapters with titles like The Sky, Rocks, Natural Vegetation, Streams, Seashores and Wildlife. Acknowledging that the world is full of people, he devotes as many chapters to seeking the natural at the likes of Farms, Quarries and Mines, Bridges and Causeways, Yards and Gardens, Towns and Cities.

For me, the book's main appeal is that it is so full of John Brainerd. We get John Brainerd, the widely-travelled retired biology professor guiding us on a tour of America's types of wetlands. We have John Brainerd, the conservationist, reminding us to wash our camp dishes in a bucket rather than in the stream, and emptying the dirty water on land where air and soil microbes can do their purifying work on it. And we get John Brainerd, the 12 year old, planting his first garden under his father's guidance. There is enough of the child John here to make me want more. Please, John, make your next book a biography of your childhood and growing up years! It would give us insight as to why a part of John Brainerd never grew up. The most special quality of this book is the youthful, uninhibited view we get of the natural world. We see the world with the freshness and excitement of an eternally 12 year old. We are encouraged to "play" in a sandbox to literally get a feel for landforms. We should get muddy playing hydraulic engineer with a garden hoe directing the flow of rain water as it runs down our driveway.

Lest I've given the impression that this book isn't to be taken too seriously, let me finish by referring to its 45-page bibliography that I've already begun using both professionally and recreationally. This book deserves a place in the glove compartment of every professional nature interpreter and serious amateur. □

– Frank Knight
Dept. of Environmental
Conservation, State of NY

A REVIEWER'S NOTE ABOUT TWO INDOOR NATURE BOOKS

John W. Brainerd

In the American Nature Study Society we have a long and excellent tradition emphasizing the study of nature *outdoors*, following dicta by Louis Agassiz at Harvard and Liberty Hyde Bailey at Cornell. In succeeding decades sciences moved increasingly into laboratories where experiments could be more rigorously controlled than outdoors and where new techniques increased ability to analyze component parts of organisms and natural materials and follow processes in more detail. Our Society has tried to maintain a balance by promoting *outdoor* studies. We can be proud of the boost our members have thus given to the science of ecology.

Also we have tried to compensate for the trend wherein sciences have tended to leave behind arts and education for laypersons while scientists emphasize laboratories as sites for sciencing. This balancing role also we must of course continue.

But have we somewhat neglected *indoor* nature studies which are *not* in science laboratories? All other indoor environments are of course blessed with nature. Dr. Helen Ross Russell, while a dean at Fitchburg State College, had a teacher come to her and say in effect, "My classroom is being painted this term and I'm in another classroom, so I'll not be able to teach science." The pet gadgets would not be available! By contrast, I know a teacher who used to take students on a half-hour nature creep down a basement corridor interpreting microclimates, dust, natural sources of artificial materials, and occasionally a silverfish or cockroach, along with the creepy specimens of *Homo sapiens*.

So I welcome the two books reviewed herewith. Both are outstanding examples of nature study *indoors* though not in laboratories; and both relate the indoor studies to the influencing world just outside. "Go thou and do likewise."

THE ECOLOGY OF A SUMMER HOUSE. Dethier, Vincent G. Illus. by Abigail Rorer. The University of Massachusetts Press, Amherst, Massachusetts, 1984.

Dethier, professor of zoology at UMass, has taken many "sailor's holidays" at his family's bungalow on the Down East coast of Maine, relaxing against the chimney on the roof, lying in a hammock, or sitting in the old porch rocker gazing at Blue Hill Bay – relaxing, that is, until some little animal catches his expert eyes or ears. Then he must watch closely, think inquiringly about the animal's behavior, rouse himself to some coping or experimentation, depending on the little beast's impact on family or house. And then he writes, charmingly.

The rustic bungalow has many ecological niches which suite a goodly assortment of amphibia, birds, mammals, spiders, and insects. For each, this sensitive scientist wonders, "Just what is so special about the niche this species frequents?" While sharing his findings with us, he often refers to the environmental relationships of the bungalow itself as it resides in the little meadow above the rocky shore, with small lawn and flower garden surrounded on three sides by the spruce-fir forest. Thus the little niches of the summer cottage fit into a larger scheme.

But Dethier involves us with a still larger perspective as he ponders the values which he puts on life and death of the twenty-seven species of animals which at one season or another co-inhabit the bungalow. In his writing, his graciously light touching of surface tension suggests the deep waters beneath.

I, as one who has spent some fifty summers in a summer cottage on a similar spruce-fir headland, heartily recommend ***THE ECOLOGY OF A SUMMER HOUSE*** to all who would like to learn of life in these environs and, more importantly,, learn how a great naturalist looks at his world wherever he or she may be.

THE LIVING AMERICAN HOUSE – The 350-year Story of a Home – an Ecological History. Ordish, George. Illus. by Clarke Hutton. William Morrow & Company, Inc., New York 1981.

George Ordish must have had fun writing this book. This British economic entomologist has worked in Europe and Latin America for the

United Nations and British Foreign Office. Somehow he has also found time to research the human and animal history of a New England house in Duxbury, Massachusetts, next door to Plymouth, from the digging of its wilderness cellar hole in 1632 until the installation of its solar panels on the roof in 1979. Nice job!

As I read about the Barton family and a few other human tenants of the house, I felt that Ordish must have been quietly looking over their shoulders for those many years. He deals briefly but very first-handly with them as they felled the forest, kept crickets in cages to hear them sing, and dealt with rats and mosquitoes along with a host of other little animals. You may want to study the two-page family tree of the Bartons accompanied by a timeline noting the dates of a few catastrophes and many improvements to the house described in the text, then read on to find out what these changes meant to the 156 kinds of animals which made a home with the Bartons at one time or another or made significant visits. The appendix lists these creatures along with their English and scientific names and the meanings of those names. The bibliography has 66 titles, followed by an index extending from Admiral Butterflies and Agriculture, Principal of, to Yellow Jackets and Zygote.

Along with the chatty descriptions are many passages reviewing considerable basic biology, as the term Zygote suggests. It is truly an "Ecological History," a fascinating tale. □

OTHER BOOKS

A RUMOUR OF OTTERS Savage, Deborah, Houghton Mifflin Co., 2 Park Street, Boston, MA 02108. 1986. $12.95.

Some things are so precious they cry out to be shared. So it was for the old Maori sheepherder on New Zealand's South Island. But only 14-year-old Alexa believed his story of the remote tarn and its otters. In teen-age rebellion she ran away to look for what her famiy and ranchers only laughed at. Near the end of her adventures, she has come to understand herself and has found a special person with whom to share the beauty of what she has discovered.

I strongly recommend this novel for any teenager ready to learn about New Zealand's landscapes, weather, plants, and animals, even though they have strange-sounding Maori names. The author is knowledgeable about human nature too. The girl and her older brother who sets out in a blizzard to find her have many introspective thoughts which older readers will recognize and some teenagers will meet for the first time, no doubt to their benefit.

This tale has been so beautifully word-crafted that I myself must have this moment of sharing, hoping you know some young or not-so-young people to whom to give it.

– John W. Brainerd

WETLANDS – An Audubon Society Nature Guide. William A. Niering. Alfred A. Knopf, Inc., New York, 1985. $14.95.

Dr. Niering has long been recognized for his teaching, botanical research, and labors for conservation of natural resources. His experience shows throughout this book which now enables people to take a broad, informed view of wetlands and to approach them with the delight of analysis. No longer need wetlands be viewed as pest holes but rather be seen as ecologically necessary and beautiful components of our "water planet" (to use Jacques Cousteau's admirable term). We owe him a standing (and often sloshing) vote of thanks.

The pages telling how to use this book, its descriptions of habitats, color plates with marginal notes and drawings, descriptions of species, glossary, bibliography, and index, all combine to make for efficient use both at home and afield. I recommend it highly for all of us who try to help others gain knowledge and wisdom about our natural world and our delicate position in it. Use this book with others but also take it with you on those too-rare and precious times when you go alone to wetlands to be reinspired by them.

– John W. Brainerd

A COASTAL ECOLOGY COLORING BOOK. Vickie Shufer. EcoImages, Virginia Beach, Virginia, 1986, 22 pp. $2.50.

This "coloring book" takes readers on a journey through natural coastal communities. The book begins at the ocean and continues across the dunes into the forest and finally emerges in the marsh land. By the use of detailed line drawings, the book depicts the interrelationships of the plants and animals of each community. At the bottom of each page is a brief narrative related to the illustration.

This is a book which would be appropriate for an upper elementary or junior high school age youngster who enjoys coloring natural history scenes while learning about plants and animals and their relationships with each other. A younger child would find the finely detailed and often tiny drawings difficult and frustrating to color. The interpretive text on each page is not written for an elementary age child – the print is small and the vocabulary and sentence structure too mature.

Although the book is intended to "serve as a nature guide for those wishing to become more familiar with the natural world," the narrative frequently lists many animals shown in the illustration but provides no means to actually identify which animal is which. Even adults experience difficulty with this feature of the narrative – adults given the forest fringe community illustration were unable to distinguish between the cardinal and the waxwings.

This is not a book suitable for the usual coloring book age group. □

– Sandra Flynn Burns
Central Connecticut State
University, New Britain, CT

Fiesta

comes with warblers,
waves of warblers
moving up the continents.

Yellows, Bay-breasteds
Black-throated Greens and Blues.
Myrtles and Magnolias
flourishing wing-tail skirts of white
and yellow.

Redstarts flashing flamenco fans of
orange and red.

Chestnut-sideds with headdresses
of the sun.

Then, Blackburnians
flown from orange flames of
Aztec fires.

The Prothonotary emblazoned with
Inca gold.

Maxwell Corydon Wheat, Jr.*

*From *Thermalling,* a collection of 24 bird poems by Mr. Wheat.

THOREAU: Student and Defender of Nature

Charles O. Mortensen

I am not a scholar of the life and complete writings of Henry David Thoreau, but like Thoreau, I am a student of the natural world, and how as a society we perceive it, and the manner of our utilization. For many of those who have become ardent admirers of this genius from Concord, it was Walden which drew them into a lasting admiration and profound respect. For me, it was The Journal (he usually referred to his journals in the singular), this remarkable compilation of thoughts beginning October 22, 1837, on the suggestion of Emerson and ending on or about November 3, 1861, and containing over 2 million words.

As a young naturalist searching a Nature Center library for a particular reference, I first saw The Journal in the Riverside Edition volumes edited by Blake (1881,93). Among the volumes were four in which portions of his writings were arranged seasonally. It has been over 20 years since that fortunate moment when Thoreau's words first entered my thoughts, and perhaps they were similar to those written on March 18, 1858:

> "Each new year is a surprise to us. We find that we had virtually forgotten the note of each bird, and when we hear it again, it is remembered like a dream, reminding us of a previous state of existence. How happens it that the associations it awakens are always pleasing, never saddening, reminiscences of our sanest hours? The voice of nature is always encouraging." (Blake, p. 170).

What I had found was a companion, a vicarious friend from whom I could draw inspiration, knowledge, and wisdom. In his words, "Friends are those twain who feel their interests to be one. Each knows that the other might as well have said what he said." (Blake, p. 187).

I was riveted to his entries dealing with natural history for two reasons: first, his descriptions of nature made the same deep and lasting impressions on my memory as nature itself, e.g. first light on the desert, or an early

Photo by Helen Ross Russell

Ralph Waldo Emerson, Thoreau's mentor and friend, wrote, ". . . wherever there is knowledge, wherever there is virtue, wherever there is beauty, he will find a home."

November snow softly changing an ominous dark green coniferous forest to one of dazzling whiteness; and second, and most important, were his feelings toward the natural world and how civilization showed such little respect and concomitant care for it. "If some are prosecuted for abusing children, others deserve to be prosecuted for maltreating the face of nature committed to their care." September 28, 1857 (Teale, p. 261).

Earlier, I had been a practicing forester who had studied forestry in college and had been proud of helping to meet a governmental agency goal of directing the sale of millions of board feet from standing trees. But I was also an admirer of trees for their intrinsic value, their beauty, and their central role in the forest ecosystem. However, it was upon reading his entry for December 30, 1851 written upon the death of a white pine that I knew I had more to learn about trees and how society should view them.

> "It is fifteen minutes yet to its fall. Still branches wave in the wind, as if it were destined to stand for a century, and the wind soughs through its needles as of yore; it is still a forest tree, the most majestic tree that waves over Musketaquid. The silvery sheen of the sunlight is reflected from its needles; it still affords an inaccessible crotch for the squirrel's nest; not a lichen has forsaken its mast-like stem . . . And now it fans the hillside with its fall, and it lies down to its bed in the valley, from which it is never to rise, . . . folding its green mantle about it like warrior, as if, tired of standing. . . . Before I had reached it, the axemen had already half-divested it of its branches. Its gracefully spreading top was a perfect wreck on the hillside as if it had been made of glass, and the tender cones of one year's growth upon its summit appealed in vain and too late to the mercy of the chopper. . . . It is lumber. He has laid waste the air. When the fish hawk in the spring revisits the banks of the Musketaquid, he will circle in vain to find his accustomed perch, and the hen-hawk will mourn for the pines lofty enough to protect her brood. A plant which it has taken two centuries to perfect, rising by slow stages into the heavens, has this afternoon ceased to exist. . . . Why does not the village bell sound a knell?" (Shepard, pp. 69-70)

And let me mention another favorite entry about trees and their role in the ecosystem:

> October 16, 1857
>
> A great part of the pine-needles have just fallen. . . . How beautifully they die, making cheerful their annual contribution to the soil! They fall to rise again; as if they knew that it was not one annual deposit alone that made this rich mold in which pine trees grow. They live in the soil whose fertility and bulk they increase, and in the forests that spring from it. (Porter, p. 118)

This is one of several Journal passages that I hold up to students as masterful articulation of the earth as a system, what we today would call biogeochemical cycling. For example, as leaves fall to the ground decomposers break down organic nitrogen molecules into ammonia gas and water-soluble salts containing ammonium ions (electrically charged group of elements) which are then converted by other groups of soil bacteria into either water-soluble nitrite ions, atmospheric nitrogen, or nitrous oxide. Some plants can absorb ammonium ions from salts dissolved in soil water and utilize them to build protein molecules. Still another group of bacteria converts these previously mentioned nitrite ions into nitrate ions which are equally useful in the production of nitrogen containing protein molecules. It is imperative that soil

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chemists, microbiologists, and others study this complex process for many reasons, not the least of which is that in our ignorance of all the complexities we may short circuit the microbial system with herbicides, pesticides and fertilizers. The growing interest in returning to natural fertilization (animal waste, nitrogen fixing crops, such as alfalfa) crop rotations and other organic methods is testimony to the importance of organic material as an important factor for soil water retention, aeration, ion exchange, mineral dissolvement (through formation of carbonic acid) and most important, food for microorganisms, which carry out the complex activities alluded to previously.

But back to Thoreau's observation. His phrase, "How beautifully they die" celebrates the life-for-life process that is the essence of this system of which we are a part, and "They fall to rise again" is a fitting capsulation of the cycles of nature.

As one like Thoreau, who enjoys winter as well as summer, let me read a descriptive journal entry:

> January 21, 1853
>
> I wish to hear the silence of the night, for the silence is something positive and to be heard. I cannot walk with my ears covered. I must stand still and listen with open ears, far from the noises of the village, that the night may make its impression on me. . . . Sometimes the silence is merely negative, an arid and barren waste in which I shudder, where no ambrosia grows. I must hear the whispering of a myriad voices. Silence alone is worthy to be heard. Silence is of various depths and fertility, like soil. Now it is a mere Sahara . . . now a fertile bottom, or prairie, of the West. As I leave the village, drawing nearer to the woods, I listen from time to time to hear the hounds of Silence baying the Moon, – to know if they are on the track of any game. If there's no Diana in the night, what is it worth? . . . The silence rings; it is musical and thrills me. A night in which the silence was audible. I heard the unspeakable. (Porter, p. 148)

Here in typical Thoreauvian fashion metaphor is illustrative. The metaphorical expression is not that he laments a night without predator seeking prey, but that in our "civilized ways" we do not hear it at all. Conceptually, it is a defense for the value of a solitude, an attribute of wilderness.

His call for wildness, which I consider his most lasting legacy in relation to the natural world, came in a lecture titled "Walking," first given at the Concord Lyceum in 1851. His opening words were "I wish to speak a word for Nature, for absolute freedom and wildness, as contrasted with a freedom and culture merely civil – to regard man as an inhabitant, or a part and parcel of Nature, rather than a member of society." (Harding, 1975, pp. 659-60). What followed was a lengthy discourse on the value of walking or sauntering, rich in metaphor and analogy as when he comments that we go eastward to realize history and westward into the future following a spirit of enterprise and adventure. However, time and again he returns to the value of wilderness, his central theme: ". . . and what I have been preparing to say is, that in wildness is the preservation of the world. . . . From the forest and wilderness come the tonics and barks which brace mankind" (p. 672). "Life consists with wildness. The most alive is the wildest. Not yet subdued to man, its presence refreshes him." (p. 673). "The wildwood covers the virgin mould, and the same soil is good for men and for trees." (pp. 674-75). "In short, all good things are wild and free." (p. 678).

If one looks carefully at the history of the wilderness movement culminating in today's National Wilderness Preservation System totaling more than 90 million acres, the legacy is apparent. Virtually all the early leaders of the movement, including John Muir, Benton Mackaye, Aldo Leopold, Sigurd Olson, Olaus Murie, and Howard Zahnhiser, drank from his well. Leopold's statement "Ability to see the cultural value of wilderness boils down, in the last analysis, to a question of intellectual humility." (Leopold, 1949, p. 200) is Thoreauvian to the core, for it recognizes a multiplicity of values, material and nonmaterial, which are important to today's society and at the same time concedes that we know little of its complex interrelationships. His additional statement that "Wilderness is a resource which can shrink but not grow" and ". . . the creation of a new wilderness in the full sense of the word is impossible" (p. 200) is closely related to Thoreau's much quoted Journal entry of March 23, 1856:

> "I take infinite pains to know all the phenomena of spring for instance, thinking that I have here the entire poem, and then to my chagrin, I hear that it is but an imperfect copy that I possess and have read, that my ancestors have torn out many of the first leaves and grandest passages . . ." (Teale, p. 276)

I believe, it can be safely said, that Thoreau led the revolution of American thought that has come to value wilderness as a reservoir of genetic diversity, a place of spiritual and emotional value, a place for challenging physical activity, a refuge for solitude and finally a place of dynamic beauty as in Marshall's (1930) references to Emerson's essay on *Nature* "the beauty that shimmers in the yellow afternoons of October who could ever clutch it" (p. 33).

In closing, I would like to bring to you several comments made by Walter Harding (1975) a leading scholar on Thoreau and his writings. He writes that although his essay on "The Succession of Forest Trees," read to the Middlesex Agricultural Society in Concord (1860), is a distinctive contribution to science, it is as a student of our relation to nature that is his most valuable contribution. I wholeheartedly agree, for he writes not only about the physical world of nature outside us, but also of the nature of man within us as in this journal entry of May 10, 1854 – "In Boston yesterday an ornithologist said significanty, 'If you held the bird in your hand –'; but I would rather hold it in my affections." (Teale, p. 262).

If the earth were held with more affection, environmental problems of today would be diminished, and that is exactly why Harding states, "Henry Thoreau is the voice of conscience for our day, for his day, for all days. He asks not to listen to him, but to the voice within ourselves." (Harding, 1975, XXVI). Upon Thoreau's death, Emerson, esteemed essayist and philosopher and Thoreau's mentor and friend wrote, ". . . wherever there is knowledge, wherever there is virtue, wherever there is beauty, he will find a home." (E. W. Emerson, 1917, p. 152). It is my good fortune to be counted as one of those who, like you, has opened the door.

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GETTING YOUR FEET WET IN THE EVERGLADES

John Lubbe

In the Everglades National Park, visitors are often captivated by the rich array and abundance of plants and animals. After all, the glades are a birdwatcher's paradise with over 300 species known in the park. And it is a botanist's Garden of Eden as well. Alongside one of its principal nature trails more than 200 types of plants flourish, including 30 found nowhere else in the world.

For all this richness and diversity, and amid the downright excitement of sighting rare and endangered species, it is easy to forget for a moment that one of the most endangered aspects of this great park is water. Life for many of the Everglades' plants and animals hangs in the balance because of competing human demands for the supply of fresh water to be diverted for agricultural, industrial, and residential purposes.

Water governs life in the Everglades. The park's 1.4 million acres embrace a large section of Florida Bay, a vast waterway stretching southward to the florida Keys. The marshy area north of the bay is actually a freshwater river, six inches deep and 50 miles wide, flowing southward at a rate so slow that it does not appear to flow at all.

Incredibly, for all the water, visitors to the park can see a great deal without ever getting wet feet. Boardwalks lead into some of the marshy areas, short bicycle and tram tours can be arranged, and according to one of the park's rangers, the best birdwatching in the entire park may be accomplished from the breezeway of the Flamingo Visitor's Center at the southern end of the park.

Photo by John Lubbe

Photo by John Lubbe

The campground at Flamingo lies alongside Florida Bay.

The boardwalks, the tram ride, and the free binoculars along the breezeway at the Visitor's Center are all wonderful ways to see the park, but somehow they miss the opportunity to immerse oneself in the park.

For the visitor who is looking for a meaningful personal experience, it is best to take directly to the water, and one of the best means is by canoe.

Canoe trips in the Everglades can be planned for itineraries ranging from a few hours of easy exploration along well-marked canoe trails near the Flamingo Visitor's Center to a genuine backcountry experience lasting more than a week. The following are some suggestions to suit a range of time commitments and interests:

Hell's Bay

An excellent opportunity to navigate through a twisting canoe path of shallow, brackish water and dense hammocks of red mangrove. Progress can be slow, and at times a 17-foot canoe seems just a little too long to make some of the turns, but persistence will see you through. The trailhead begins near the Flamingo Visitor's Center on the main park road. A Backcountry Use Permit, available for free at the Visitor's Center, is necessary. A trip to the Lard Can Campsite or Pearl Bay (approximately 8-10 miles round trip) makes a good day excursion. Overnight trips to Hell's Bay, which require a free permit, can be planned utilizing

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Photo by John Lubbe

At times, the canoe trail to Hell's Bay is a snug fit for a 17-foot canoe.

officially designated campsites. Many of these are located on chickees, wooden platforms mounted in the water on stilts.

Because of the meandering canoe path and occasional low water conditions, a ranger refers to Hell's Bay as "hell to get to and hell to come from." Sequentially numbered markers guide the way through a waterway that at times seems like a maze.

Cape Sable

Cape Sable is a windswept beach on the southwestern tip of the park which has been partly laid bare by the effects of severe storms that come ashore here. The sunset is spectacular. Best approach is from the Flamingo Visitor's Center, and detailed maps of the waterway are available there. Roundtrip is over 20 miles, varying with your choice of route. Either day excursions or overnight canoe camping trips are possible. Campsites are located on the beach. Be sure to get a backcountry permit if camping is contemplated, and check the weather forecast and small craft advisory at the Visitor's Center or marina. Part of the trip is an exposed section of Florida Bay, and wind and choppy water occasionally pose a problem for canoes.

Photo by John Lubbe

More than 300 species of birds are known in the Everglades.

Wilderness Waterway

Harboring almost every type of marine organism found in the Caribbean, the Wilderness Waterway is a well-marked inland water route running 99 miles from Everglades City in the park's northwest corner to Flamingo in the south. Canoes share the route with motorized craft. Travel time for canoes is typically 7 or 8 days. Sequentially numbered markers guide the way, and campsites are available for overnight stops, although they are sometimes not directly located on the waterway. A Backcountry Use Permit is required. Leave a float plan with a friend. Arrangements must be made for pick-up and canoe transport.

GETTING TO THE PARK

Flamingo, the point of embarkation for several interesting canoe routes, lies at the southern end of the park, about 50 miles from Homestead, Florida. Once you get to Homestead, look for Route 9336 which leads to the main park road. Plan to travel during the day so that you can stop along the way to see the exhibits at the Entrance Station near Homestead and to explore the sights along the way to Flamingo. A small entrance fee is charged for vehicles that enter the park at this point. Wildlife frequents the roadway, and the speed limits are strictly enforced.

WHERE TO STAY

The Flamingo Lodge in Flamingo has over 100 air-conditioned rooms, but most overnight visitors stay at the park's two organized campgrounds located in Flamingo and at Long Pine Key, a few miles from the Park Entrance near Homestead. The campgrounds accommodate camping vehicles, but no electrical, water, or sewage hook-ups are provided. With mosquito repellent, tent camping is fun, especially at the Flamingo site which has cold water showers and flush toilets. Modest campground fees are charged during the winter.

Backcountry canoe camping is a good experience if you are willing to rough it. As no fresh water is available in the backcountry, it must be transported. Also, there is no firewood. Use of a small backpacking stove is recommended. Food should be stored in raccoon-proof containers. Backcountry Use Permits, available for free at the Visitor's Center, are required.

CANOE RENTALS

For trips in the southern end of the park originating at Flamingo, canoe rentals are available at the marina near the Flamingo Visitor's Center.

PLANNING YOUR TRIP

Write to the Superintendent, Everglades National Park, P.O. Box 279, Homestead, Florida 33030 for a free brochure about the park and simple maps of canoe trails. The Everglades Natural History Association, a nonprofit group at the same address, has a sales catalog of books about the Everglades. □

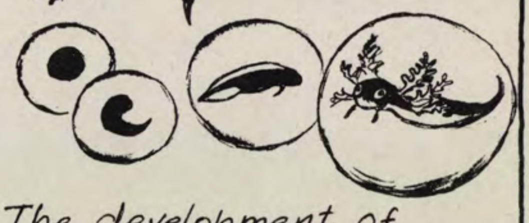
Naturalist's Notebook

Egg-laying Time in the Freshwater Pond

The eggs of most amphibians, fish, and many other aquatic animals, are enclosed in a protective coating of jelly.

The common newt (left) lays her eggs singly on aquatic vegetation.

The spotted salamander (right), lays her eggs in clusters, two inches or more in diameter, attached to sticks or underwater weeds.



The pond snail (right) lays its eggs in pea-sized clusters.

The spring peeper, one of the earliest frogs to appear at the pond each spring, lays its tiny, round eggs singly, as the common newt does.

The development of aquatic eggs (spotted salamander pictured above) may be easily observed in an aquarium.

The wood frog, green frog, and many other frogs, lay their eggs in big, jelly-enclosed masses.

The common toad, on the other hand, deposits its eggs in long double strings.

The male sunfish (below) clears a shallow saucerlike depression on the pond bottom. The female lays her eggs in the nest and he fertilizes and guards them.

The male stickleback (right) builds a nest of vegetation glued together with fluid from his kidneys.

All the eggs in the pond need clean, oxygenated water for proper development. Acid rain, insecticides, and other pollutants often kill the eggs or hinder their proper development.

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COVER STORY

Sublimation is a term used to describe the process of a gas becoming a solid without an intervening liquid state as well as the opposite process of a compound in a solid state converting to a gas without first liquifying.

When gaseous water sublimates it often creates great beauty in the form of snow and frost. These crystalline forms are distinctly different from the frozen liquid form of water that we call ice.

When weather is below freezing ice and snow sublimate – almost magically disappearing into the air without any tell-tale pools of water or dripping icicles. Wet clothes on a line freeze immediately in cold weather but they dry as the ice sublimates.

What happens to the frost on the window pane? Does it melt? Melt and evaporate? Melt and freeze? Sublimate? What temperature stories can be read?

HRR