

Angler's plants

Need more work on types of weeds - maybe with photos.

Has anyone done a book on weed types?
Could use black & white photos of them.

Nasham Book?
Call Butler for advice.

p. 411 - Summarize stream classification per Mothman.

Hard to improve on.

Trout food - good discussion follows.

412 - Mayfly nymphs entirely dependent on algae. p. 417

Don't eat weeds but the algae on them.

Those special, fragile places where trout thrive



The Letort Spring Run in Carlisle, Pa

JOHN RANDOLPH PHOTO

Spring Creeks

IT WAS DUSK by the time we reached the bridge above the quarry. Ground fog settled in the little valley along the run as we walked downstream to the footbridge and halted to search the water. Nervous water in the quiet bridge pool betrayed a trout restlessly in search of food. His dorsal appeared for a second and then disappeared. Downstream another trout patrolled the tail-water of the next pool, and so it went in the little spring creek: The trout, safe in the gloaming, were going on the fin.

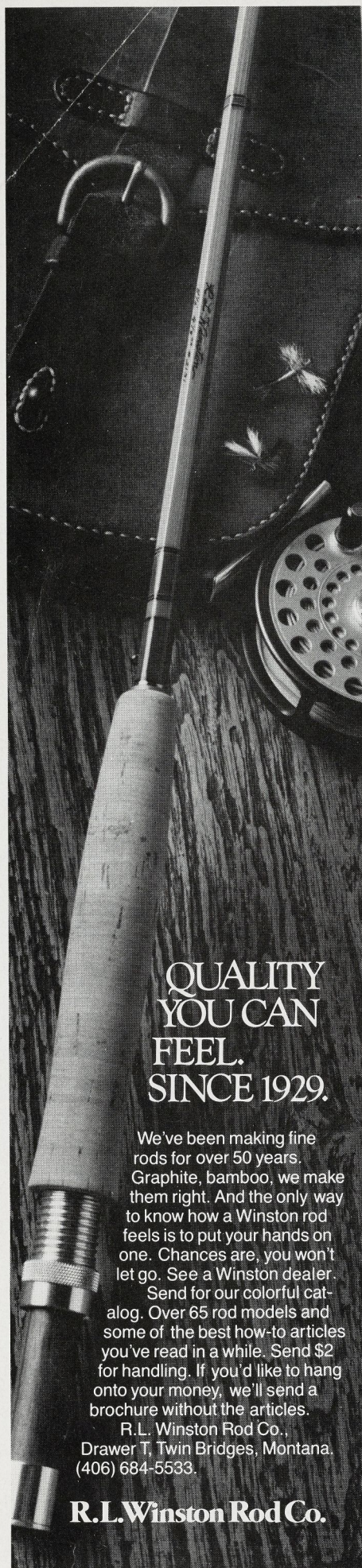
In my excitement to thread the line and leader up the rod guides I missed the sixth guide. The Turtle knot would not tie in the darkness and I settled for an improved clinch. As I stepped onto the quaking ground at streamside and crouched to sneak close for a cast to the cruising trout below the bridge, a frantically knifing bow wave shot from the shallow gravel tailwater and ran upstream to the dark and sheltered nooks and crannies of the bridge. *Tout finis.*

I tried the next downstream fish—adios! I schlepped in among the tulles and high weeds for a shot at the third. I knee-walked to casting distance and backcast high and caught goldenrod. I ripped the fly free and lifted the tippet to the wan sky to check it—gone. I thought of Nick Lyons. I fumbled in my pockets for the right fly box and after four pockets recalled that it was in the duffle at home, still resting from the Montana trip. I settled for a ratty fly-patch Muddler and fumbled in the darkness with flip-focals and tippets and a hook eye that had obviously closed since the fly's last use. Trout wakes slanted here and there in the spring run while I fumbled in the weeds and watched.

There! The tippet finally through the hook eye, the Muddler snugged down and held firmly when I pulled on it. I knee-walked closer to the run, the ground quaking beneath me. Just enough light left to spot the outline of a cressbed. I cast the little fly beside it and let the pattern sink and sweep downcurrent. It stopped and I lifted the rod tip gently. Live weight wriggled down the line in the gloom. The trout, a big one, thrashed and rolled a rod length away. I led the fish into a bed of cress at my knees and lifted gently and rolled it on its side.

The brilliant pink stripe along the brown's flanks glowed in falling light. It occurred to me that it was the most brilliantly-colored wild brown I had ever seen. Its head was large for a 20-inch fish, but its stomach was full and deep. It might go three pounds, I thought as I turned the trout and examined it. A diet of spring-creek scuds and cressbugs had colored the fish with vivid stripes, which extended along its gill covers and down its flanks to just above its ventral fins. The brown had markings that were distinctly different from the butter-yellow, halo-spotted fish I had taken previously on the Letort Spring Run. As I examined it, I considered the brilliance of trout colors in cold, clean scud-filled spring creeks. I recalled dramatically-colored fish taken on such streams as Darlington Ditch, Thompson's, Nelson's and Armstrong's. They are fragile streams that cannot endure much pounding by fishermen. They are often privately-held streams, where the landowner's affection for trout and fly fishing leads him to be protectively paranoid about his water and its fish.

Continued on page 6



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Spring creeks may be the crown jewels of our North American trout streams. Their welfare requires special handling, with limited and controlled access by fishermen and regulations that call for sport fishing only. They are often best protected by single owners who allow a limited number of fishermen on their beats, and then only under tight prescriptions of sporting conduct. Others, such as the Letort Spring Run, fare well under careful fishing-regulation management by the state, but their futures are always subject to danger by land-use changes in the watershed. Legislated protection can sometimes help.

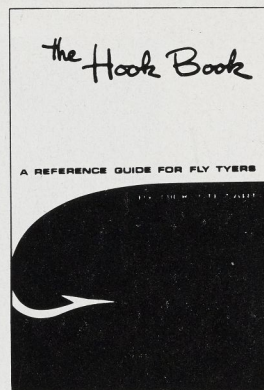
That evening, after I released the trout and returned home, my local newspaper reported heartening news. The Letort Spring Run would be considered for designation as a Pennsylvania Scenic River. If included in the program, the little spring creek, which is surrounded by increasing development, may survive as a premiere trout stream into the twenty-first century. Provisions in the law would not necessarily restrict bad developments or provide a state-mandated legal framework within which fishermen can work to assure the Letort's preservation. Scenic River designation by the state would simply put the welfare of the Letort in the hands of local (Carlisle) citizens. Under its Scenic River program (enacted in 1972) the Pennsylvania legislature can declare a river to be a scenic water worthy of preservation. Local citizens, landowners and state conservation agency representatives create a management plan for the river and its watershed and the fate of what happens to the water, from acceptance of the water as a Scenic River henceforth, is in local hands, guided by state agency study and recommendations.

The approach is Canadian. In Canada the conservation, preservation and clean-up of lakes is put in the hands of lake residents through their lake organizations. The Canadian philosophy is simple: the local water is yours to destroy or preserve. We, the central government, will not dragoon you into preserving it. We will provide all the technical help, and all the money, we can to help you preserve what is yours, but "you" must do it. Pennsylvania puts land-use controls in the hands of local governments, thus what Carlisle-area citizens want for the Letort is what they will get through local zoning and the Letort Management Plan. If the Letort is to be preserved as a fine trout habitat, it will be the people who live around it that do the job.

Six rivers in Pennsylvania have been listed under the program since its inception: 93 miles of the Schuylkill, Stony Creek, 32 miles of the Lehigh River, French and Octarora creeks and Lick Run.

JOHN RANDOLPH

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A VISION OF LAKES

by PETER STEINHART



Twilight on a lake in Minnesota's Boundary Waters wilderness.

LOVE OF LAKES is a particularly northern phenomenon. There are lakes near the equator, including vast inland seas like Victoria, Tonle Sap, and Titicaca. But lakes do not come easily in the tropics, for southern landscapes are old beyond the age of lakes. The lakes fill with silt or dry into desert playas. In the north, where glaciers dug out depressions or left moraines to dam valleys, rivers have not had time to fill these holes with silt, and lakes dot the landscape. The Alps have their lakes. Japan has thousands. Sweden has more than one hundred thousand lakes. The English have their Lake Poets, the Irish wax poetic about the Lough of Shadows, and the Scots sing of Loch Lomond. Alaska has more than a million lakes, and the rest of the United States has a hundred thousand.

The lake of our imagination belongs to a young landscape, a place with clear skies, forests of pine, and streams full of rush and tumult. We have a com-

mon vision of lakes, a vision of enfolding woods and bright blue water, of sun and ease and silence. We see it from a swaying hammock or a gently rocking boat. Thoughts move slowly, like ripples curling over glassy water or dust motes rising in a column of sunlight. The wind sighs softly in the branches overhead. A jay scoffs somewhere in the pines. Wavelets lap quietly at the sand.

Beyond, the water reaches into sky and distant wooded shores. But the imagination cannot make the crossing, for the scene lacks edge and precision. Lakes do odd things to light and sound. The moisture wafting off a lake filters light and paints the sunset red. Clouds come back to Earth in reflection, but their shapes are warbled and scattered on the surface of the water. Sounds are muffled here, amplified there, so that a person talking a mile away may sound close at hand, while an outboard motor clearly in sight

hums like a solitary bee. Lakes do to light and sound what sleep does to thought. There is an odd mix of reality and illusion. The setting is not made for action, but for contemplation and dream.

Lakes nurture the imagination. We look into the still waters of a mountain lake, wrote British essayist William Sharp, and are dimly perplexed and troubled. "Some forgotten reminiscence in us is aroused, some memory not our own but yet our heritage is perturbed." Old tales referred to poets and dreamers as "children of pools," who "looked into the hearts of men and into the dim eyes of life, troubled by the mystery and the beauty of the world." Sharp thought that we gaze thirstily upon lakes because they "may reveal what the soul perceives."

What we see in lakes depends much on what we bring to the shore. Tennyson saw King Arthur's sword, Excalibur, rising from the dark waters of England's Bassenthwaite. All over the world, we are as apt to look for monsters glooming about the depths of large lakes as we are to think of them sulking in the vaster seas. Phantoms bob to the surface of Loch Ness and Lake Champlain, and a relict dinosaur is said to slog around the lakes of central Africa.

At its best, a lake may simply be a lens through which we examine ourselves. "A lake is the landscape's most beautiful and expressive feature," Thoreau declared. "It is the Earth's eye, looking into which the beholder measures the depth of his own nature."

A generation of Americans thought of summer as a lake. Our summer camps for children rose on the shores of New England lakes in the 1890s. By the 1920s, the summer ideal was a cabin hard by the shore of Lake George or Winnepesaukee or Mille Lacs. There were rituals of putting up screens, caulking boat hulls, walking out onto the dock to see whether a winter of ice and citified haste had changed the

GERALD BRIMACOMBE

The Rolex Awards for Enterprise were established in 1976 to underwrite the projects of enterprising individuals who are committed to advancing the common good. Grants have been awarded in the fields of Applied Science and Invention; Exploration and Discovery; and the Environment. By helping to translate goodwill into action, The Awards not only serve mankind and nature as a whole, they also foster awareness of the moral as well as the intellectual dimensions of the spirit of enterprise. These are the 1987 laureates.

Expanding the frontiers of modern healthcare.



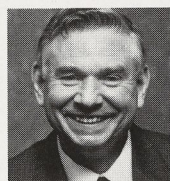
Jacques Luc Autran, founder of Seamen Without Frontiers, a philanthropic association, turned a fishing vessel into a floating hospital to bring healthcare and education to isolated societies, such as the islanders of the Maldives.

Preserving endangered species.



Stephen Kress's innovative techniques successfully repopulated near-extinct colonies of birds on Maine islands and will soon be employed in attempted recolonizations in the south of Japan.

New insights into evolution.



Entomologist Pierre Morvan will organize an expedition to Nepal to study the effects of extreme geographic isolation on the formation of particular species, and will complete a book on the subject.



The Rolex Awards for Enterprise

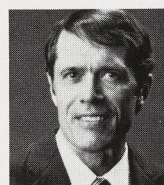
For the Good of the Planet and its People

Religious teaching and environmental education.



Nancy Lee Nash will glean teachings about nature from Buddhist writings and incorporate them into an educational syllabus to be used in Thailand colleges.

Demystifying an ancient culture.



Johan Gjefsen Reinhard will explore the peaks and lakes of the Peruvian Andes to determine the role of those ancient religious sites in the formation of pre-Colombian society.

The Spirit of Enterprise, The 1987 Rolex Awards, a book about the five laureates' projects, as well as 238 other outstanding proposals, is available in bookstores and from the publisher, Van Nostrand Reinhold.

Additional information about the awards is available from The Secretariat, The Rolex Awards for Enterprise, P.O. Box 178, 1211 Geneva 26, Switzerland.



ROLEX

lake, wading into the baptismal chill of June waters. "Summertime, oh summertime," wrote essayist E. B. White, "patterns of life indelible, the fade-proof lake."

Americans began to value lakes just as we were making the leap from a country culture to an urban culture, and moving en masse to the cities. Lakes then appealed to us as refuges. Thoreau held that one view of Walden Pond "helps to wash out State Street and the engine's soot."

To be an American is to believe in the primacy of action over thought. To take a vacation is to rest from the imperative of action. In the 1920s, lakes were a chance to regain the rural past's kinship with nature and the human immediacy of the small town. Going to the lake meant the chance to keep what was natural, observant, and contemplative from being knocked out of us by the haste, anonymity, and drive of the city. It was a chance to reassert an older nature over calculation, artifice, and the uncertain faiths of economics and fashion.

Early in this century, we began to build summer places on the shores of the lakes. Even then, isolation protected most of the lakes. Railroads were the chief link to the lakeshore. There were few roads. To get tourists into the Adirondacks, one entrepreneur even hauled a passenger-laden steamboat onto a railcar and portaged it to Blue Mountain Lake. But after World War II, roads snaked into the woods, and suddenly lakes were only a few hours from town. And then a real land rush occurred. The Northway opened dozens of Adirondack lakes. Highway 50 transformed Lake Tahoe from a summer resort to what one writer called "an urban recreation area." Today, there are eighteen-story highrises and marinas accommodating thousands of boats along the shores.

MORE AND MORE, lakes are girdled with housing and veiled in the smell of grilled onions and automobile exhaust. Some lakeshores are fenced with wall-to-wall houses, with twenty-five-foot frontages and no gaps between. Planning maps of the Adirondacks show the lakes ringed in red, signifying clusters of cabins, condominiums, and resorts. Around Wisconsin's Lake Okauchee, development is three tiers deep and latecomers have had to buy easements to guarantee themselves access to the lake. Lakes in northern Wisconsin that in the 1950s saw only fishing camps for a few sum-

mer weeks were by the 1980s ringed with houses and condominiums, with lawns rolling down to the lakeshore and decks out over the water. "We've got probably five thousand lakes that fall in that category," says Dale Morey, Wisconsin boating law administrator.

The prospect is that this trend will continue. Says Courtland Cross of the Lake Sunapee Protective Association, "The lakes haven't gotten any bigger, but there are more and more people wanting to use them." Jack Donatell of the Wisconsin Department of Natural Resources says, "If the economy gets better you'll see more development, more building, more subdivision."

There were clear signs in the 1960s that the lakes were changing. Their waters were losing their primitive clarity as algae bloomed, nurtured by leaking septic tanks, erosion from onshore construction, and the stirring of bottom sediments by powerboats. Cochran Lake in northern Wisconsin had pure water until the 1950s, when seven cottages were built on its shores. By 1968 the waters were a pea soup of algal scum. By 1968 more than one-third of American lakes showed signs of cultural eutrophication. In places, lake dwellers tossed copper sulfate crystals into the lakes to kill algae, rather than treat the sewage. The Environmental Protection Agency established its Clean Lakes Program in 1975, but studies by the North American Lake Management Society suggest that water quality continues to decline.

It isn't just water quality that is at stake. We are beginning to look at lakes differently. Many of our lakeshores have become cityscapes of cottage, marina, and condominium. In the age of air conditioning, the summer cabin has been winterized and what was a ten-week summer season is extended into a year-round occupancy. Leo Bourassa of the Virginia Lakes Association believes that eighty percent of the places on Virginia lakes are now year-round homes.

The number of boats registered in New Hampshire went up from 42,000 to 60,000 between 1984 and 1986. There is so much boat traffic on some lakes that officials are wondering whether they will have to limit the number of boats launched on summer days. And the boats are bigger and more powerful. Says Cross, "Twenty-five years ago, you couldn't buy a motor more than 25 horsepower. Now you can buy them in 1,000 or 1,200 horsepower." More power means more speed, more noise, more shoreline ero-

sion from bigger wakes. And the power and speed of boats turn the purpose of lakes to dominion. They urge us to the action of the city.

And there is a different kind of visitor now, one who comes in haste and noise, lugging a powerboat, staying only for the day or the weekend. A visitor who plunks his boat down on a lake that bristles with houses and sun-decks is likely to see himself as an outsider, a democrat among swells, and to cast his vote in speed and noise. Such a visitor is not likely to feel contemplative. Lakeshore residents watch these visitors roar by and worry about sewage in their drinking water and noise from boat parties moored offshore of their cabins. Cross says of New Hampshire's Lake Winnepesaukee, "It's not Golden Pond, that's for sure." He tells of a family that had a place there for seventy-five years but now goes to the lake only from Monday to Friday, returning to the city on weekends to avoid the shrillness.

THERE HAVE BEEN attempts to save the old repose. Lakeshore property owners have formed lake associations to lobby for zoning laws, growth restrictions, and regulation of powerboats. Some lakes restrict powerboats to certain hours or parts of the lake. Wisconsin's Devils Lake allows only electric motors. Since 1983 Wisconsin has restricted powerboats to "slow-no wake" speeds on lakes smaller than fifty acres. But growth restrictions are the heart of the problem, and they are harder to come by. Despite twenty years of effort, California and Nevada have been unable to put effective limits on growth at Lake Tahoe.

Thoreau didn't imagine that a lake might be lost. "Sky water needs no fence," he wrote. "Nations come and go without defiling it. It is a mirror which no stone can crack, whose quicksilver will never wear off, whose gilding Nature continually repairs... All impurity presented to it sinks, swept and dusted by the sun's happy brush."

Thoreau was wrong. On a large number of American lakes, the contemplative feeling he found at Walden is simply gone. John Banta of the Adirondack Park Agency worries about "the loss of pristine character, the ability to sit in a boat on the lake and feel like you're in the middle of the Adirondacks and away from the rest of the world." Says Robert Roden of the Wisconsin Bureau of Water Regulation and Zoning, "On a lot of these lakes, you haven't had that feeling for years."

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Lake conservation has not risen to these challenges. We have regarded lakes as an afterthought of water quality, not as discrete places. Since property development is a local issue, and large lakes generally lap at the shores of a number of local and county planning jurisdictions, local regulations are seldom uniform or coordinated. Rural lakeshores often have no zoning laws. States have not developed the mechanisms to cope with lakes that they have for rivers and coastlines. There is no national lake-conservation organization. The organizations that have evolved to fight for lakes are parochial in scope, like the League to Save Lake Tahoe, the Lake Champlain Bi-state Committee, the Task Force for the Future of Lake George, or the Lake Sunapee Protective Association.

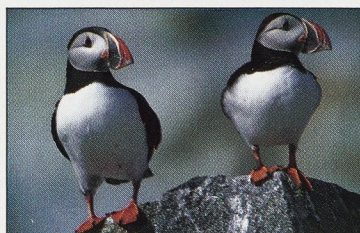
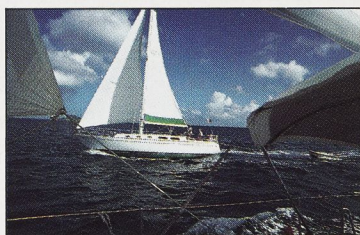
It is surprising, when you consider how much lakes are a part of the northern setting, that so little is even written about them. The Lake Poets of England, Coleridge, Southey, and Wordsworth, wrote much about walks up the mountains and creeks, away from the lakes below. They wrote little of the lakes. Travelers to Italy's Lakes Como and Maggiore waxed poetic about the Alps but left the lakes yawning in the background. The explanation may be that we go to lakes not as destinations, but as settings in which our true destinations are hidden.

The names of lakes may hide an insight into them. We seldom name them for soldiers or statesmen or scientists. Nor do we often keep the original Indian names that give the landscape a kind of timelessness and authenticity. Our smaller lakes have names that are obvious, plain, or sentimental. There must be thousands of Long Lakes, Round Lakes, Duck Lakes, Deer Lakes, and Pine Lakes. The Fulton Chain Lakes in New York are simply numbered. A large number of lakes named in the last hundred years were given the name of a resort owner or of a fisherman's wife or daughter.

It may be that lakes are trivial by comparison to mountains and seacoasts and rivers. They lack the dramatic sweep, the insistent event, the challenge to one's hand and heart. Lakes don't turn us into adventurers the way rivers and seacoasts and mountains do. At their best, they make us contemplative and unlock the gates of reverie and feeling. We have never declared that reverie and feeling are very valuable in the United States. And, in the end, that is probably the greatest threat to our lakes.

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by ROGER L. DI SILVESTRO

SAGA OF AC-9, THE LAST FREE CONDOR

ON EASTER SUNDAY a lone condor drifted out of the California skies above Bitter Creek National Wildlife Refuge and came to rest beside the carcasses of a domestic goat and a fetal dairy calf. Within minutes hidden cannons exploded, sending a mesh net cascading over the bird.

Biologists from the U.S. Fish and Wildlife Service and the National Audubon Society moved in quickly to untangle it. The captured condor, a seven-year-old male called AC-9, was quickly spirited away to the San Diego Zoo for two weeks of quarantine. Later he would be taken to the San Diego Wild Animal Park to join a baker's dozen of his cohorts, all protected in cages from a world no longer hospitable to their kind. But this particular bird had a significance the others could not share. For he had been the last of the wild condors, and his capture brought to an end the *natural* history of a species as old as the ice ages.

Oddly enough, AC-9, the last wild condor that biologists put their hands to, was also the first they had touched in the era of modern condor research. That was seven years ago, at the very start of an intensive effort to save the giant vultures.

AC-9 hatched on May 14, 1980, in a cave at the base of a cliff in the Angeles National Forest. His parents, biologists say, squabbled more than did most condor pairs, behavior which can result in broken eggs. Regardless, they hatched one of only two condors that would be successfully reared that year.

AC-9 was forty-five days old when biologists from the Condor Research Center in Ventura, California, picked him out of his nest on June 28th and took his measurements. Weight, 3,230 grams; wingspan, 33.7 centimeters; and so on. All part of an effort to establish baseline data on growing condors.

Radio tags were not used on California condors until 1982. The Angeles Forest hatchling was named IC-9—for "immature condor"—when he was tagged on December 11, 1984. Radio tagging permitted close monitoring of

the bird, so biologists were well aware of his activities in the fall of 1985 when it became clear that IC-9 was now ready to be called AC—adult condor—9. He met his first mate.

She was AC-8. An older and more experienced bird, she had been widowed in the winter of 1984–85. She chose AC-9 over two older males. This was the first time that biologists witnessed a widowed condor replacing a lost mate. It was also the first time that biologists knew the age of a male at first breeding. The following March, AC-8 and AC-9 laid their first egg, which broke because of DDT-induced eggshell thinning. A second egg laid in April was subsequently taken to the San Diego Zoo, where it hatched successfully.

During his adult life, AC-9 ranged over most of the known condor range, from Blue Ridge in the Sierras to San

Luis Obispo County. Doubtless he took advantage of the calf carcasses that started to appear with increased abundance in April 1985. These were put out by the Condor Research Center in an effort to keep the big birds from feeding on contaminated carrion. Researchers thought this necessary because condor numbers had been falling precipitately—from fifteen to nine in three months, from five nesting pairs in 1984 to only one in 1985—and the four known condor deaths from 1983 to 1986 were all feeding related. Three were caused by lead poisoning from the ingestion of bullets in animals that had been shot, and one by a poisoned bait set out for predators.

During the time that AC-9 and AC-8 were getting to know one another better, a decision was made in Washington, D.C., that would reverberate powerfully throughout the con-

BEFORE IT'S TOO LATE

TROPICAL RAINFORESTS teem with life, and that abundance is vibrantly illustrated in a new National Audubon Society poster calling attention to the plight of this beleaguered habitat. Thirty tropical species are illustrated in brilliant color against a background that depicts a mature South American rainforest. From amidst the leaves peer such creatures as the red howler monkey, ocelot, ocellated antbird, cerulean warbler, scarlet-eyed treefrog, silky anteater, and resplendent quetzal, all identified in a graphic key.

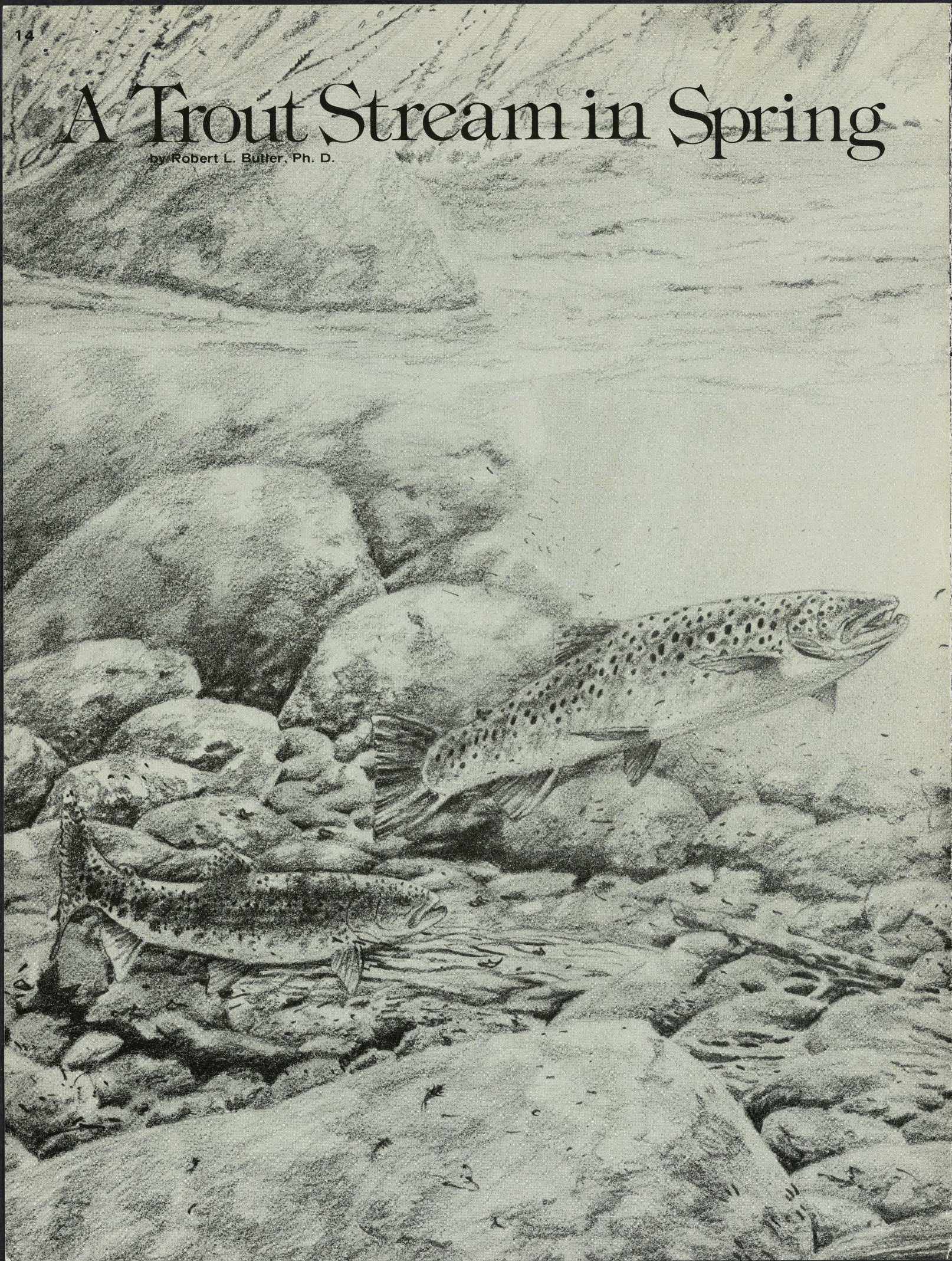
Wildlife artist John Dawson designed the poster to heighten appreciation of the diversity and beauty of a vanishing ecosystem. Five thousand posters were distributed during Audubon Month to school classrooms participating in the Audubon Adventures program. Some 170,000 students nationwide now receive the bimonthly publication *Audubon Adventures*, and their teachers use a special guide developed by Audubon's environmental education staff. Subjects covered this past school year included animal communication and hummingbirds.

Audubon Month, celebrated each April, calls attention to specific environmental problems. Some 70,000 acres of tropical rainforests, which are among the most biologically rich ecosystems on Earth, are being destroyed daily by logging, agriculture, and other development. With them are lost many species with as yet untapped economic and medical potential.

Copies of the tropical rainforest poster can be ordered for \$10 from Poster, Audubon Education Office, Route 4, Sharon, Connecticut 06069.

A Trout Stream in Spring

by Robert L. Butler, Ph. D.



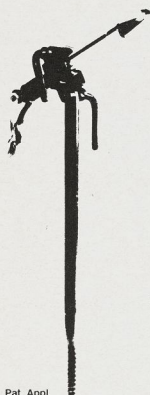
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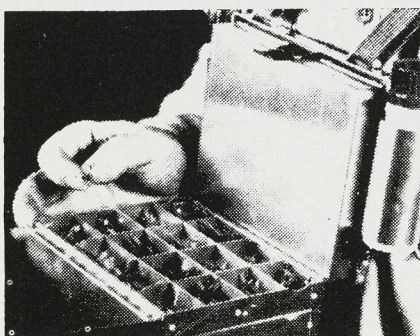
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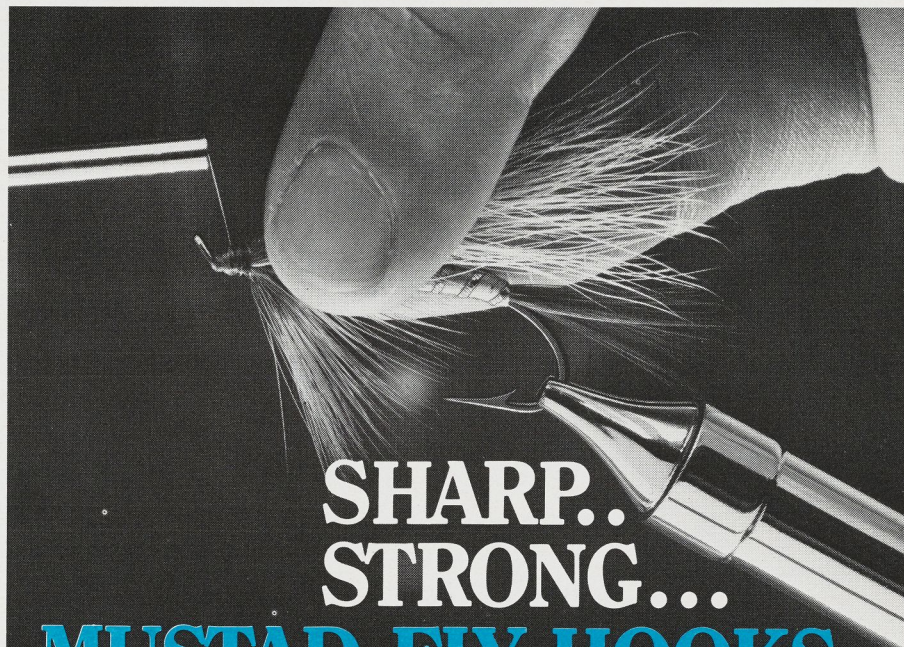
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The streamscape of spring is perhaps the best known of all to the angler. During the past winter he has dreamed many hours at his bench tying old faithfuls and creating new fly patterns that he anticipated would work for him. Now on the stream the song of the whitethroat, the sound of the riffles and the familiar odors are renewing. The streambank is vibrant with new growth of skunk cabbage in the East and its counterpart, the corn lily, of the West. This is the time of bliss for the angler. The stream and what he does on it are an essential part of his life. It and these moments must be protected. He may take time out to lie on his favorite spot that faces the rising declination of the sun, have a pipe of tobacco and reflect on his good fortune, or simply unwrap the sandwich he made for the trip and enjoy his sanctuary.

The sun that has warmed the angler in his moment of relaxation from fly fishing has alerted the trout through forced increase in metabolism with increase in water temperature. Although many trout have survived the low metabolic demand of winter and its inimical anchor ice, the increase in temperature makes a sudden demand on metabolism that removes some of the weaker fish from the social order. Within a short time of death the slime secreting mechanism fails; the fine suspended sediments of the stream soon cover the fish and obscure it from the angler's view. The dead trout appears as a camouflaged part of the bottom. And — the angler has often wondered why he seldom sees a dead fish in the stream.

Each 10°C rise in temperature has doubled the

poikilothermic metabolism of trout. They are not under the self control of body temperatures as we (homoiotherms) are. For the fish this means, get on with the feeding or perish. The incidental feeding during the winter (except during the breakup of anchor ice at which time aquatic insects are dislodged in great numbers and sent downstream for the frenzied feeding of trout) now is replaced with the metabolic imperative of eat to live and reproduce. But first, sites from which foraging can be done with low energy output must be found.

The finding and establishment of foraging sites and heirarchical position is of high priority. Realignment of the social order will be made at the sites selected. Some of the old timers that occupied the area for several years past will be missing; some will have been creeled by the angler or taken by nature. The alpha, "top dog," brown trout of last year has been testing his foraging sites of last year. If he is in good condition, he will maintain his competitive advantage for the top position in each of the sites he occupied. His body language in the form of frotnal displays, caudal displays, wig-wag and nipping on occasion as well as lateral display under threat of a lateral blow or nip from an opponent (see illustrations in "Trout Watching," Summer 1980 issue of *Trout*) is his way of winning new foraging sites or maintaining the old ones of last year. Although vision between adversaries is important, the initial communications is in terms of size and strength transmitted through the lateral line, that unique sensory organ of fish and a few amphibians. It is sensitive to water displacements made by vigorous swimming movements between contestants. Water displacements felt along the lateral line function inversely as the cube of the distance between the two fish. For example, if one fish were to receive a stimulus signal of water displacement on a scale of say starting from 2, then one-half the former distance the signal would have increased to 8 and successional halving the distance each time would produce a series of stimuli on the order of intensity of 64, 512, 4096 etc.. Added to the distance aspect of the signal is the stimulus that relates to the size of the opponent. This part of the signal is a function of the cube of the mass, that is, a fish twice the mass of another has an eight-fold advantage. Slight differences in size, therefore, can make large differences in communicating superiority. When two fish are very nearly the same size the strength of the nip, especially when scales or skin are removed, is most convincing in establishing dominance. All fish but the lowest of the heirarchy will have to assert dominance over others at each of the foraging sites at the beginning of the season. But this effort is not continued at the same intensity throughout the spring, summer and fall. Once the heirarchy is established for the year it is only rarely changed in a non-fished populations. However, resorting of the social order is required with loss or addition of individuals.

Agonistic behavior comes at high metabolic cost, so once the social heirarchy is established a slight flick of the caudal fin or depression of the dorsal fin is a sufficient signal of dominance. Just the presence of the dominant is enough. There is no contest. Metabolic conservation is well understood by wild fish in agonistic behavior, and use of a foraging site must also be a low cost activity. Some preliminary measurements done with a hot wire anemometer (an electronic tool to measure pencil-point velocities in the stream) by Greg Pierce, a graduate student working at Spruce Creek, has demonstrated very sharp increases in velocity at either side and above many of the foraging sites. Therefore, these sites have hydraulic features that permit a low ratio of caloric expenditure for swimming to caloric intake of food.

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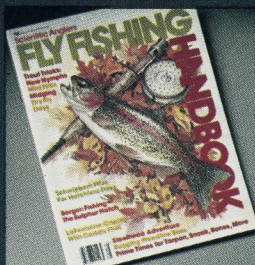
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The dominant trout is free to take over any of his foraging sites any time he pleases, but he occupies only one at a time. Some sites are used with much greater frequency and for longer periods than others. He does not keep all fish from all positions at all times, therefore, these are not "territory" in the former sense of the word. Bob Bachman, my last doctoral student has in 3,000 hours of observation contributed much to the previous paragraphs and has broken this old idea of territoriality as well as many other ideas of the past (see "Trout Watching"). All other trout in the hierarchy learn through agonistic encounters with the dominant and with each other where they belong in the order of use at each of the foraging sites. Bob has found dominants that occupy one side of the stream, seldom if ever are found on the other side. And this is in a stream not more than 25 feet wide at the study site. A different hierarchy with different fish were to be found there.

It is assumed that young of the year trout and most of the trout in their second year of growth occupy the small pockets of the riffle area. They are seldom seen in the areas with other older fish and are taken in greatest numbers with electrofishing gear in the riffle areas. Here they are visually isolated from other fish, have adequate cover, an abundance of food and are free from the threat of larger fish. During the summer some of the trout in their second year of growth will move into the stream sections occupied by older trout. They find foraging sites to the rear of the larger fish or smaller sites with hydraulic features suited to them but not to larger fish. They offer no competition to the larger fish and generally stay clear of their advances or threats. Their frequency of foraging and rejection of items is much higher than in the older fish. They are naive, but they are learning the features of food and flotsam. Some live to be much older trout having suffered the experience of a novice's cast, a poor imitation or the release from an expert's cast and well-tied fly. Within four or five years of life trout have gained thousands of hours of experience which include an excellent memory of noxious experiences. Fish with such a baccalaureate are a challenge to the best of anglers.

Although suspended sediment aids appreciably in visually isolating fish from each other at their foraging sites, the cognizant angler of the spring season takes advantage of the higher sediment loads characteristic of that time of the year. Thawing of the ground accompanied with the melt of snowpacks and spring rains generally produce the highest sediment load of the year. The angler positions himself when possible between the target fish and the sun to take advantage of the flare of light caused by sunlight flashing off the facets of sediment particles. It is glare through which the fish cannot see. It is not unlike that which the angler experiences when he is driving into the sun or meeting cars at night with his windshield speckled with fine dust or droplets of water. This phenomenon is also the bane of underwater filming. I recall having wasted 5,000 feet of film on the spawning behavior of cutthroat and rainbow trout. We had a tropical rainstorm on a heavy snowpack at Sagehen Creek, California, during the spring of 1973. I had driven 2,600 miles and had devoted much effort in preparation. At first I knew I shouldn't waste the film, but after a few days fearful that my efforts would be a total loss I convinced myself that the water was clear enough to make the record. The footage is meaningful only to me. It would not pass the critical eyes of the public.

The curious angler cannot judge the quantity of suspended sediment coming down a stream when his view station is above the stream. This position of view is one that can be used only on the lower Mississippi River.

To get a better idea of how much suspended material is coming down a stream that is "gin clear" I have suggested I the past that one put on a face mask and lie down in the stream facing the incoming light. You will then better understand why a dead fish is soon covered with the sediment, and also what advantage the angler has in placing himself between the target fish and the sun. Sagehen Creek is in the top five streams of California for having the smallest sediment load, yet the flare from the numerous particles can be very great. Perhaps now is the time to add a little and help in the understanding of erosion, transport and deposition.

Of all sedimentary particles in our streams sand is the most unstable. It is eroded from its site at water velocities near one foot per second. In contrast to the erodability of sand is that of clay and cobbles, the extremes of particle size in the Wentworth scale. These are eroded at velocities near 10 feet per second. The resistance of clay to erosion is related to its plate-like structure and its associated electric charges. Everyone has experienced the slick or oily feel of wet clay as the expression of the two relationships. Of particular interest also to anglers is the transportability of clay once it is in transport. It will not settle out until velocities of less than 0.001 feet per second are reached. These velocities are met in the side pools, the inside of stream bends and other quiet areas. Once there the material is very difficult to dislodge. Fortunately such deposits can support and are invaded by the water plants, elodea, watercress or veronica. The clay-silt deposits are stabilized by these rooted aquatics through the entrapment of other sediment, and the appreciable reduction of water velocity at the sediment bed-water interface. Bob Hunt of Lawrence Creek, Wisconsin, fame has demonstrated also that elodea and veronica are very capable of stabilizing the moving water sand dunes of streams in the many outwash plain streams of Minnesota, Michigan and Wisconsin of which Lawrence Creek is representative.

The sediment loads of the spring runoff are of particular significance to the spring spawners: the cutthroat and rainbow trout. Their shallow and poorly constructed redds are subject to sedimentation during the spring thaw. They are especially subject to sedimentation in the small tributary and intermittent streams which are very often exposed to logging during the dry summer of the western United States. These two species of trout appear to have made no special adaptation for thorough cleaning and digging of the redd. It may well be related to their evolution in an environment that up until recent time had no heavy silt or clay loads comparable to those waters in which the brown trout and the brook trout evolved.

So — while resting on that south facing slope this spring, give some thought to sediment and its effects on all our streams. All anglers, especially the Western anglers, should be alert for poor land management of watersheds that support the indigenous trout. Soil belongs to the land and is becoming more precious with time. It has little value in the stream.

Postscript:

Bob Butler and Vernon Hawthorne have 23,000 feet of film from which they will make two more films in addition to the two they have done at Sagehen Creek, California. These two films will be entitled: "A Trout Stream in Spring and Summer" and another film on "The Stability of a Stream." The latter film will be of interest to those who wish to understand the hydraulic features of a stream and its natural healing features when properly cared for.

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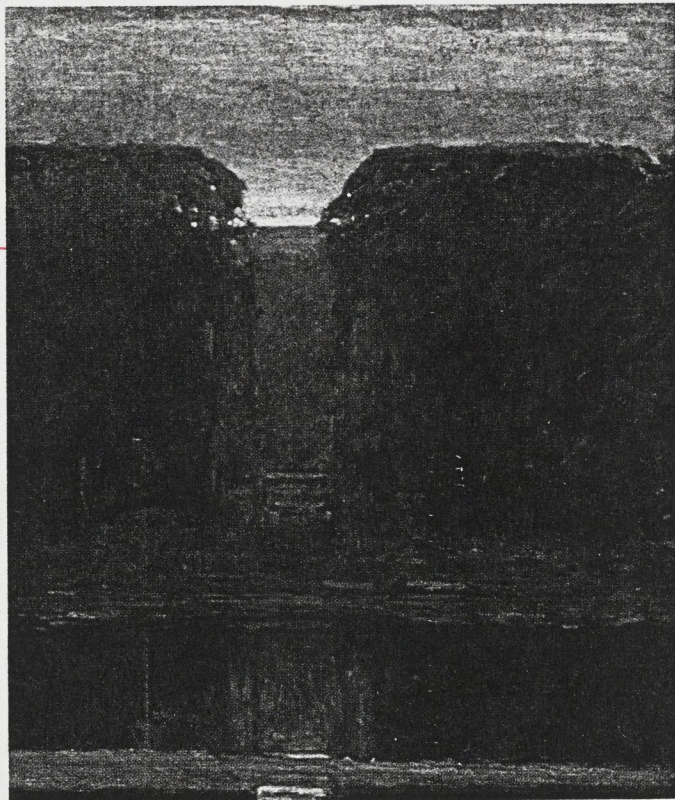
Stenothermal waters and the remorseless flow of time

By David Quammen

I've been reading Heraclitus this week, so naturally my brain is full of river water.

Heraclitus, you'll recall, was the Greek philosopher of the sixth century B.C. who gets credit for having said: "You cannot step twice into the same river." Heraclitus was a loner, according to the sketchy accounts of him, and rather a crank. He lived in the town of Ephesus, near the coast of Asia Minor opposite mainland Greece, not far from a great river that in those days was called the Meander. He never founded a philosophic school, as Plato and Pythagoras did. He didn't want followers. He simply wrote his one book and deposited the scroll in a certain sacred building, the temple of Artemis, where the general public couldn't get hold of it. The book itself was eventually lost, and all that survives of it today are about a hundred fragments, which have come down secondhand in the works of other ancient writers. So his ideas are known only by hearsay. He seems to have said a lot of interesting things, some of them cryptic, some of them downright ornery, but his river comment is the one for which Heraclitus is widely remembered. The full translation is: "You cannot step twice into the same river, for other waters are continually flowing on." To most people it comes across as a nice resonant metaphor, a bit of philosophic poetry. To me it is that and more.

Once, for a stretch of years, I lived in a very small town on the bank of a famous Montana river. It was famous mainly for its trout, for its clear water and its abundance of chemical nutrients, and for the seasonal blizzards of emerging insects that made it one of the most rewarding pieces of habitat in North America, arguably in the world, if you happened to be a trout or fly-fisherman. I happened to be a fly-fisherman.

*The spring creek: a thing of constancy*

One species of insect in particular—one "hatch," to use the slightly misleading term that fishermen apply to these impressive entomological events, when a few billion members of some mayfly or stonefly or caddisfly species all emerge simultaneously into adulthood and take flight over a river—one insect hatch in particular gave this river an unmatched renown. The species was *Pteronarcys californica*, a monstrous but benign stonefly that grew more than two inches long, and carried a pinkish-orange underbelly for which it had gotten the common name "salmonfly." These insects, during their three years of development as aquatic larvae, could only survive in a river that was cold, pure, fast-flowing, rich in dissolved oxygen, and covered across its bed with boulders the size of bowling balls, among which the larvae would live and graze. The famous river offered all those conditions extravagantly,

and so *P. californica* flourished there, like nowhere else. Trout flourished in turn.

When the clouds of *P. californica* took flight, and mated in air, and then began dropping back onto the water, the fish fed upon them voraciously, recklessly. Wary old brown trout the size of a person's thigh, granddaddy animals that would never otherwise condescend to feed by daylight upon floating insects, came off the bottom for this banquet. Each gulp of *P. californica* was a major nutritional windfall. The trout filled their bellies and their mouths and still continued gorging. Consequently the so-called salmonfly so-called hatch on this river, occurring annually during two weeks in June, triggered by small changes in water temperature, became a wild and garish national festival in the fly-fishing year. Stockbrokers in New York, corporate lawyers in San Francisco, federal judges and star-quality surgeons and foundation presidents—the

sort of folk who own antique bamboo fly rods and field jackets of Irish tweed—planned their vacations around this event. They packed their gear and then waited for the telephone signal from a guide in a shop on Main Street of the little town where I lived.

The signal would say: *It's started. Or, in more detail: Yeah, the hatch is on. Passed through town yesterday. Bugs everywhere. By now the head end of it must be halfway to Varney Bridge. Get here as soon as you can.* They got there. Cabdrivers and schoolteachers came, too. People who couldn't afford to hire a guide and be chauffeured comfortably in a Mackenzie boat, or who didn't want to, arrived with dinghies and johnboats lashed to the roofs of old yellow buses. And if the weather held, and you got yourself to the right stretch of the river at the right time, it could indeed be very damn good fishing. ➤

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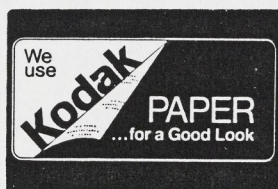
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But that wasn't why I lived in the town. Truth be known, when *P. californica* filled the sky and a flotilla of boats filled the river, I usually headed in the opposite direction. I didn't care for the crowds. It was almost as bad as the Fourth-of-July rodeo, when the town suddenly became clogged with college kids from a nearby city, and Main Street was ankle-deep in beer cans on the morning of the fifth, and I would find people I didn't know sleeping it off in my front yard, under the scraggly elm. The salmonfly hatch was like that; only with stockbrokers and flying hooks. Besides, there were other places and other ways to catch fish. I would take my rod and my waders and disappear to a small spring creek that ran through a stock ranch on the bottomland east of the river.

It was private property. There was no room for guided boats on this little creek, and there was no room for tweed. Instead of tweed there were sheep—usually about 30 head, bleating in halfhearted annoyance but shuffling out of my way as I hiked from the barn out to the water. There was an old swayback horse named Buck, a buckskin; also a younger one, a hot white-stockinged mare that had once been a queen of the barrel-racing circuit and hadn't forgotten her previous station in life. There was a graveyard of rusty car bodies, a string of them, DeSotos and Fords from the Truman years, dumped into the spring creek along one bend to hold the bank in place and save the sheep pasture from turning into an island. Locally this sort of thing is referred to as the "Detroit riprap" mode of soil conservation; after a while, the derelict cars come to seem a harmonious part of the scenery. There was also an old two-story ranch house of stucco, with yellow trim. Inside lived two people, a man and a woman, married then.

Now we have come to the reason I did live in that town. Actually there wasn't one reason but three: the spring creek, the man, and the woman. At the time, for a stretch of years, those were three of the closest friends I'd ever had.

This spring creek was not one of the most eminent Montana spring creeks, not Nelson Spring Creek and not Armstrong, not the sort of place where you could plunk down \$25 per rod per day for the privilege of casting your fly over large savvy trout along an exclusive and well-manicured section of water. On this creek you fished free or not at all. I fished free, because I knew the two people inside the house and, through them, the wonderful, surly old rancher who owned the place.

They lived there themselves, those two, in large part because of the creek. The male half of the partnership was at that time a raving and insatiable fly-fisherman, like me, for whom the luxury of having this particular spring creek just a three-minute stroll from his back door

was worth any number of professional and personal sacrifices. He had found a place he loved dearly, and he wanted to stay. During previous incarnations he had been a wire-service reporter in Africa, a bar owner in Chicago, a magazine editor in New York, a reform-school guard in Idaho, and a timber-faller in the winter woods of Montana. He had decided to quit the last before he cut off a leg with his chainsaw, or worse; he was later kind enough to offer me his saw and his expert coaching and then to dissuade me deftly from making use of either, during the period when I was so desperate and foolhardy as to consider trying to earn a living that way. All we both wanted, really, was to write novels and fly-fish for trout. We fished the spring creek, together and individually, more than a hundred days each year. We memorized that water. The female half of the partnership, on the other hand, was a vegetarian by principle who lived chiefly on grapefruit and considered that anyone who tormented innocent fish—either for food or, worse, for the sport of catching them and then gently releasing them, as we did—showed the most inexcusable symptoms of arrested development and demented adolescent cruelty, but she tolerated us. All she wanted was to write novels and read Jane Austen and ride the hot mare. None of us had any money.

None of us was being published. Nothing happened in that town between October and May. The man and I played chess. We endangered our lives hilariously cutting and hauling firewood. We skied into the backcountry carrying tents and cast-iron skillet and bottles of wine, then argued drunkenly about whether it was proper to litter the woods with eggshells, if the magpies and crows did it, too. We watched Willie Stargell win a World Series. Sometimes on cold, clear days we put on wool gloves with no fingertips and went out to fish. Meanwhile the woman sequestered herself in a rickety backyard shed, with a small wood stove and a cot and a manual typewriter, surrounded by black widow spiders that she chose to view as pets. Or the three of us stood in their kitchen, until the late hours on winter nights, while the woman peeled and ate uncountable grapefruits and the man and I drank whiskey, and we screamed at each other about literature.

The spring creek ran cool in summer. It ran warm in winter. This is what spring creeks do; this is their special felicity. It steamed and it rippled with fluid life when the main river was frozen over solid. Anchor ice never formed on the rocks of its riffles, killing insect larvae where they lived, and frazil ice never made the water slushy—as occurred on the main river. During spring runoff, this creek didn't flood; therefore the bottom wasn't scoured and disrupted, and the eggs of the rain-