Nostrums

March
Stream imp.

(Nature is particular)
(The rodents: beaver, muskrat, trees.)
You don't prescribe a nostrum. You find out what, if anything, ~~is~~ ~~Nature~~ is wrong w/ its Nature, & then you prescribe a specific treatment. This is the easy part. The ~~ha~~ hard part is that you've got to do it.

March

Too much management is not likely to be a problem, unless you have money to throw around. The human species has incentives to manage lightly. ~~It's work. It costs you in~~ ~~why would you want to work~~ ~~do that~~; I you can play.

And then nature gives you an incentive to go lightly. It takes work to drop a beaver — and you'd like to watch it anyhow.

Stream as wind-chime March

Stream most fluid

when dynamic: sound

by water from river,

as in '78(?) Han sun

do qua valley.

Not to be seen as

a cathedral organ more

like a wind-chime.

But has to be stabilized

for us people.

Grand Canyon Roars Again as Ecologic Clock Is Turned Back

Continued From Page B7

dam to allow it to pass more water safely, the full restorative effects of flooding cannot be exploited, some experts say. Furthermore, the effects of a restorative flood are not permanent. Many of the new beaches and sand bars have been steadily eroding. That was expected, but now nature has thrown a curve: high water caused by heavy snows in the last two winters forced the Government last week to increase somewhat the normal flow from Lake Powell, behind the dam. Rather than building the beaches and bars, this flow is expected to speed their erosion.

All this testifies to the difficulty of restoring natural processes once human activity has drastically altered them. In this case, the experiment has shown that controlled flooding "is only a tool, it's not a panacea," said David L. Wegner, an aquatic ecologist and engineer who directed the Glen Canyon scientific experiment for the Federal Government until recently. He now heads a private consulting company, Ecosystem Management International Inc., in Flagstaff, Ariz.

Still, whatever its ecological outcome, the experiment is widely seen as a breakthrough in another arena, that of politics and policy. In the past, Western dams like the one at Glen Canyon have been operated with only two considerations in mind: producing electrical power and providing water to farms and cities downstream. Protecting nature was nowhere in the picture. Now it is, along with a whole range of human activities that depend on it, like angling, boating, camping and nature study — all the tourist-related activities that economically define what is called the New West.

So while the Grand Canyon experiment is only a beginning, many say its main importance may be that it has shown that widely divergent interests, all of whom took part in the planning, can compromise in trying to give nature freer rein.

With the Grand Canyon flood, "we're taking a whole new step toward restoring river systems and not just destroying them," said Pam Hyde, the southwestern regional director for American Rivers, a national environmental group.

How Swirling Eddies Alter Habitats

Source: Dr. Edmund D. Andrews; David L. Wegner

Illustration by Dimitri Schidlovsky for The New York Times

When the Colorado River floods, it creates calm backwater areas in the Grand Canyon where native fish can spawn and grow. This commonly happens on the downstream side of a tributary, whose waters push boulders out into the river, narrowing it and creating rapids. Where the river widens again, circular eddies form and the water slows. This allows sand to settle and create a bar thrusting out into the stream. When the flood subsides, the bar is exposed and the backwater forms behind it. Damming the river stops this process, and backwater havens dry up.

Federally licensed private hydroelectric dams in the East are increasingly attuning their operations to nature's requirements. But the Grand Canyon experiment is said to be the first involving a big Federal dam in the West. There are scores of these, and Interior Secretary Bruce Babbitt, who pushed the button to start the Grand Canyon flood, said in an interview that the experiment "has enormous implications for river management all over the West" and that the lessons of Glen Canyon will be applied to other rivers.

Before the Colorado was dammed, the big floods that created and refurbished habitat for native fish worked mostly on the downstream side of tributaries, which pushed boulders out into the main stream, narrowing it and creating rapids. Where the river widened again just below the tributary's mouth, circular eddies formed and the flood waters slowed. This allowed sand scoured from the river bottom to settle and create a submerged bar thrusting out into the main stream. After the flood subsided, a calm backwater formed behind the now-exposed sandbar.

During the deluge, native fish that had evolved with flooding "would go right against the side wall of the canyon, where the velocity is lowest, and put their noses right into the wall and ride out the flood," said Dr. Edmund D. Andrews, a geophysicist who is co-leader of a team of experts at the United States Geological Survey office in Boulder, Colo., who have extensively studied the 1996 controlled flood. The non-native fish stuck to mid-stream and were carried away, leaving the backwater spawning habitat to the natives.

The flood also pumped new energy into the ecosystem by stirring up vast deposits of nitrates, phosphates and carbon, in the form of decaying vegetation and other organic matter, that had been trapped in the bottom sediments. These liberated nutrients fed algae and microscopic animals at the bottom of the food chain

The Glen Canyon Dam interrupted this life-giving cycle. Sandbars eroded. Backwaters dried up. Widely distributed invasive species like the catfish and carp ate the scarce, isolated natives and competed with them for food and spawning habitat. Invasive plants like the tamarisk, a native of Egypt, crowded out natives along the shoreline. Nutrients remained locked away, useless.

The objective of the "spike flow" last March was to re-establish the natural process while avoiding serious harm to a blue-ribbon trout fishery just below the dam, to endangered species like the Kanab ambersnail and to 4,000-year-old Native American archeological, cultural and religious sites near the water's edge.

The scientific papers now emerging show that the flood heightened and slightly widened existing sandbars, built scores of new camping beaches, liberated large quantities of nutrients and created 20 percent more backwater area for spawning fish. No endangered species were significantly harmed, it was found. Nor was the trout fishery, although some experts are unsure what would happen to it if floods became routine.

But the sandbars and beaches were found to be eroding not long after the flood, and higher everyday water releases made necessary by the heavy runoff of melting snow rendered the backwaters unusable for spawning. Non-native fish species and large, invading shoreline plants were scarcely affected.

All in all, Mr. Wegner said, "It's a little early to claim success."

As things stand now, experts say, going very far beyond the March 1996 flow level would probably require releasing water through its spillways rather than through special conduits around the dam, as is ordinarily done. Some of the experts say they fear that the force of a historic-size flow could damage or even destroy the dam. Dr. Andrews, for one, suggests that for about $120 million in dam renovations, it would be possible and economically feasible to restore floods of historic velocity. Long-term recreation revenue might help offset costs.

A Government analysis calculated the cost of last spring's flow at $1.8 million in foregone electrical generating capacity. The Government absorbed this cost rather than pass it along to consumers of electricity. Some experts suggest that in the future, consumers should bear part of the cost, since the ecological damage is caused by the need to supply power.

Future controlled floods might not be as expensive as the first, however. One important scientific finding was that most of the Grand Canyon flood's ecological effects were felt in the first 48 hours of the weeklong flow. This suggests that a substantially shorter and therefore less costly flood might achieve the same results. Dr. Andrews said the consensus of his group was that several new, short spike flows might be an ecologically healthier way to dispose of this year's heavy runoff of melting snow than a steady, somewhat heightened everyday flow.

In the meantime, officials, scientists and water managers are hoping that the 13-year research project leading up to last spring's controlled flood has answered enough questions so that any future floods in the Grand Canyon or elsewhere would be easier to carry out as well as less costly. Nevertheless, the process of getting all interests to the table and coming up with a plan that all can live with is not expected to be easy. So if a new era has dawned, it may not unfold very rapidly. "It will be a slow process," Secretary Babbitt said.

Workaday World of Livestock Clones a Research Blockbuster

Continued From Page B7

get a grant, researchers have to explain how they will study a biological system and how they will take it apart to understand its molecular basis, Dr. Silver said.

Dr. Randall Prather, an animal scientist at the University of Missouri in Columbia, said he and other scientists had different interests. He and other animal scientists, he added, have different interests from the standard N.I.H grant recipient. "A lot of times, what we're dealing with is practical applications," he said.

And Dr. Wilmut's paper, Dr. Silver noted, was utterly utilitarian. "It was pure technology," he said, a technical manual for how to clone a sheep.

Although the work of Dr. Wilmut, an embryologist at the Roslin Institute in Edinburgh, focuses on cloning, the most forbidden and evocative technique of reproductive biology, its ultimate goal is practical: making sheep that are drug factories. So, for many of the nation's leaders in reproductive biology, Dr. Wilmut's feat was doubly astounding. First, he did it — he cloned a sheep, confounding the biologists who had concluded that cloning adult animals was impossible. And second, he seemed to come out of left field, out of a community centered on large farm animals and issues that these scientists had thought little about.

"I don't know him," said Dr. Silver, who studies mice. People in animal science "don't come to our meetings," he said.

Dr. Wilmut's tour de force was to take DNA from an adult sheep's cell and use it to grow a new being, an identical twin of the original. He took udder cells, from a 6-year-old sheep, that were growing in the laboratory and fused one of them with a sheep egg. He had already removed the egg's nucleus, containing its DNA, so the egg had no genetic material of its own. The new DNA took root in the egg and directed it to develop into an embryo. Dr. Wilmut implanted that embryo into a third sheep, which gave birth to a lamb, Dolly, that was born in July.

Next, Dr. Wilmut expects to add genes to the cultured adult sheep cells to turn them into miniature factories churning out pharmacologically useful proteins. Then he will clone the best of the drug-producing cells, making sheep whose milk will gush with drugs. His work is supported by PPL Therapeutics P.L.C., a small Edinburgh biotechnology company that wants to sell the drugs it extracts from sheep milk.

Granted, the process is not yet very efficient. In a paper that will be published on Thursday in the journal Nature, Dr. Wilmut reported that he had fused 277 udder cells with an equal number of eggs but that only 29 of the eggs had developed into embryos. When he transferred these embryos to the sheep who were the prospective surrogate mothers, only 13 became pregnant. Of those 13, only one carried the pregnancy to term and delivered a live lamb.

That means that even if scientists wanted to clone a human, they would have to wait for improvements in technology to make cloning more efficient and to insure that the babies that resulted would not have terrible, even fatal, defects. Scientists once thought that cloning was biologically impossible — now that they know it can be done, they need to learn how to do it better.

But animal scientists and veterinary scientists have a long history of breaking ground in reproductive medicine, said Dr. Ralph Brinster, a professor of veterinary medicine at the University of Pennsylvania.

"In the old days, veterinary practices were mostly large animals," Dr. Brinster said, adding that animal breeders had been plagued by the reproductive problems of their herds. About a third of the embryos that implant in an animal's uterus spontaneously abort — in humans, the number is closer to half — so breeders were eager to find ways to make animal reproduction more reliable and efficient.

In the 1950's, investigators discovered how to freeze mammalian sperm — in cattle — and how to transfer embryos from one animal to another, also in cattle. The dairy industry was transformed, Dr. First said. Average milk production went from about 7,000 pounds a year to today's average of about 15,000 pounds a year.

At about the same time, biologists also discovered how to transfer mouse embryos from one female to another to establish a pregnancy in the surrogate mouse mother. Yet the researchers working with cows and those working with mice were unaware of each other's work, Dr. Silver said.

Later, these methods were taken up by doctors treating infertile patients. They froze sperm for artificial insemination, and they transferred embryos for in vitro fertilization, in which doctors remove eggs from a woman's ovaries, fertilize them in the laboratory and implant the developing embryo into a woman's uterus.

But animal science has jumped ahead. Last year, for example, Dr. Brinster discovered how to add new genes to sperm cells and how to transplant sperm-producing cells and grow them in another animal, which could then become a virtual sperm factory. Dr. Brinster talked of veterinary applications. A champion racehorse or a prize bull might become essentially immortal, his sperm-producing cells kept alive in another horse or bull or even in a mouse, and harvested when needed.

Dr. Brinster does not work with humans, and he leaves speculations about ethics to others. Dr. Wilmut does the same.

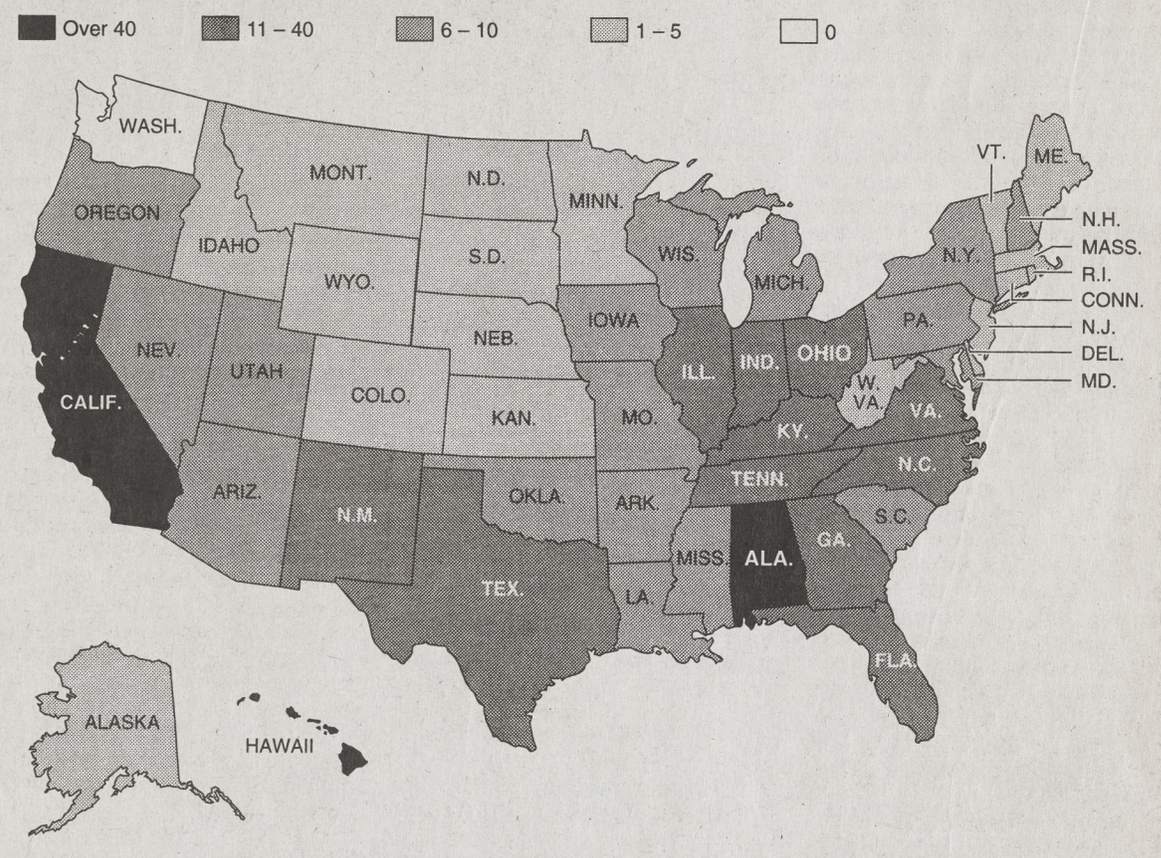
"It's safe to deal with animals, isn't it?" said Dr. Ralph Munson, an ethicist at the University of Missouri in St. Louis. "No one ever accuses us of playing God with animals."

"We believe in our society that financial reasons justify much of our research, particularly if it doesn't involve humans," Dr. Munson said. Perhaps it should be no surprise, he added, that animal researchers, treading close to the most delicate ethical issues of human identity, keep insisting that applying their work to humans is the furthest thing from their minds.

And perhaps, Dr. Munson said, it is no surprise that animal research on reproduction goes ahead in its own little world, unnoticed by most scientists or the public until it comes up with something shocking, like a clone of an adult sheep.

Extinct Species in America: An Update

At least 110 of the United States' 20,500 known species of plants and animals have become extinct since the 17th century, and 416 more are missing and possibly extinct, according to an analysis of state data by the Nature Conservancy, a conservation group. A third of living species were adjudged imperiled to some degree. In general, states with the most extinctions had the most species, or especially fragile organisms, or were hit unusually hard by human disturbance. State totals add up to more than the national total, since some species were more widely distributed. A report is to be made public on Thursday.



STATE	PRESUMED EXTINCT	POSSIBLY EXTINCT
Alabama	24	74
Alaska	0	2
Arizona	2	6
Arkansas	6	4
California	25	21
Colorado	2	3
Connecticut	2	0
Delaware	1	1
Florida	4	15
Georgia	6	20
Hawaii	26	243
Idaho	2	0
Illinois	10	10
Indiana	10	4
Iowa	3	1
Kansas	2	0
Kentucky	16	2

STATE	PRESUMED EXTINCT	POSSIBLY EXTINCT
Louisiana	3	5
Maine	3	0
Maryland	6	2
Massachusetts	3	0
Michigan	4	6
Minnesota	1	1
Mississippi	4	6
Missouri	3	4
Montana	1	1
Nebraska	2	0
Nevada	5	5
New Hampshire	4	3
New Jersey	3	2
New Mexico	1	11
New York	3	5
North Carolina	5	9
North Dakota	1	0

STATE	PRESUMED EXTINCT	POSSIBLY EXTINCT
Ohio	9	3
Oklahoma	3	4
Oregon	2	6
Pennsylvania	2	5
Rhode Island	2	0
South Carolina	4	2
South Dakota	2	0
Tennessee	17	15
Texas	6	14
Utah	1	8
Vermont	1	1
Virginia	8	17
Washington	0	0
West Virginia	2	3
Wisconsin	4	3
Wyoming	2	1

2/25/97

By WILLIAM K. STEVENS

Last March, in a precedent-setting effort to turn back the ecological clock, Federal officials unleashed four roaring jets of white water from a Federal hydroelectric dam on the Colorado River. The objective was to mimic the annual floods that for millenniums, until the dam was built, had set the terms of life at the bottom of the Grand Canyon.

The plants and animals of the river and its Grand Canyon shores evolved with the West's spring and summer floods and were superbly adapted to them. These floods not only poured nutrients into the ecosystem, but they also carved its architecture by redistributing sand from the river bottom, shaping it into sand bars and creating backwaters where fish could breed and grow.

The advent of the Glen Canyon Dam in 1963, 15 miles above the Grand Canyon, short-circuited this process, initiating an ecological decline that pushed several of the canyon's unique species to the brink of extinction.

So when 45,000 cubic feet of water thundered out of the dam's flumes each second for a week, the first experiment of its kind at a big Federal dam in the West, the air was filled with hosannas to a new era.

But has the experiment really panned out?

The formal reports from a corps of scientists are only now coming in, and the picture is decidedly mixed.

The flood did build many new beaches, sand bars and backwaters. Some of the beaches made superb camp sites for the canyon's abundant river rafters. But the deluge was not strong enough to flush non-native species from the system, as had been hoped. Among these intruders are carp and catfish that compete with and prey on endangered natives like the humpback and bony-tailed chubs, the Colorado squawfish and the razorback sucker. Experts say that a natural flood, on average more than twice as powerful as the controlled one, would have swept away the non-natives, while the natives, more suited to watery cataclysm, survived.

Short of partly renovating the

Continued on Page B12

Sourc

lurching to and fro in a genuinely palpable way. Let go, and as the ball takes off, you feel the reaction.

The concept known as force feedback has long been recognized as an important element in realistic interfaces between humans and computers. In his 1991 book "Virtual Reality," Howard Rheingold discussed several applications of the technology, from arcane systems designed to let chemists feel simulated molecular forces to an Atari arcade game called Hard Drivin' that let you "almost feel the asphalt in the road" through feedback from the steering wheel.

Until recently, force-feedback products were far too expensive to think about trying at home. Now, for about $180, the Force FX joystick from CH Products lets you experiment with the technology on your very own desktop. Information is available at (800) 624-5804 or www.chproducts.com.

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With its broad base, six buttons and two four-way "hat" switches, the joystick resembles other fancy models that game addicts love. But in addition to its game port connection, it requires a serial port and AC outlet to control and power the two built-in motors that provide the unit's push-back force.

The skimpy manuals and clunky DOS-based setup software are all too common in the rough-and-ready gaming world. The Windows 95 calibration screens available from the joystick icon on the control panel are not much better. Tip: When Windows tells you to "move the POV hat to the up position, and then press ENTER," be sure to press the Enter key before

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Not a spectator Manch

Nobody can do everything.

What I want to do is to put into motion: figure

What I ought to do + how

I know it. NOT

a spectator, a participant.

March 5/26/97

Fenced for fish

Cattle to be kept away from Rock Creek in the name of bull trout

PHILIPSBURG (AP) — The U.S. Forest Service is working with area cattle ranchers to protect the bull trout on a two-mile stretch of the Middle Fork of Rock Creek southwest of here.

The banks of the river are sloughing into the creek, causing gravel bars. The gravel bars are changing the meander of the creek, which is causing willows and shrubs to die. Cattle grazing in the area also like to chew on the willows, whose roots hold the banks in place.

"The banks are eroding, causing subsurface flow which is bad for the fish," said Steve Gerdes, a fisheries biologist with the Philipsburg Ranger District of the Beaverhead-Deerlodge National Forest.

"We need to make sure that the water is staying in the channel of the creek, otherwise the fish can't find their way upstream. And the tributaries upstream from there are some of the most important spawning habitat for bull trout in Rock Creek," he said.

In an effort to keep the damage from continuing, more than two miles of the creek will be fenced off to create a 500-acre "riparian pasture," said George Bain, district ranger for the Philipsburg Ranger District.

Fishermen and recreationists will still be able to access the river, but cattle will not.

The $53,000 fencing project will be done this summer with federal and state land management money and $3,160 from the two ranchers with grazing permits on 50,000 acres in the area.

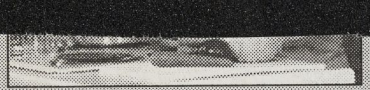
"We will not let cattle there until we jointly agree that conditions are improving," Bain said.

A review of the riparian pasture will be done in 2003. Land managers will then decide if the area is capable of sustaining cattle.

The criteria for improvement will be measured by stream bank stability, willow and shrub health and the degree of root establishment.

Bain said the two ranchers that hold five-year grazing permits in the area are as concerned about the creek's health as he and other fish biologists.

"I think this is a great solution to an obvious problem," said Bain. "It's expensive but I feel it's worth it. It will keep the permittees in business, keep the (grazing) allotment alive, and focus on the problems of the creek to turn it around."



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Trout Line (Ta) Fall 1996 Jan

Cottonwoods

By Noorjahan Parwana

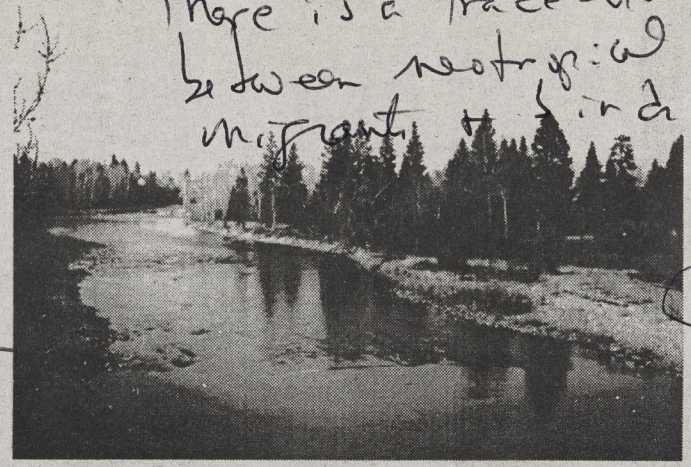
The Problem

For many of us, the beauty of Montana's streams and rivers lies in the sight of the cottonwood forests lighted by the late afternoon sun. Unfortunately, there is growing concern among scientists that Montana is losing its cottonwood communities. Threats come from logging, dams, grazing, residential development along stream corridors, and competition from introduced species. Riparian corridors represent less than 1.5 percent of the total landbase in this state and cottonwood communities make up only a portion of that acreage. Because of the ways land is being managed, and the specific requirements necessary for cottonwood recruitment, chances are that once a cottonwood forest is gone, it won't be coming back.

More Than Just A Pretty Face

Cottonwood communities support a disproportionate amount of wildlife habitat relative to their acreage. More of Montana's birds live in this tangle of water-loving trees than any other habitat. Coniferous forests, the next most productive community in this state, support only one-half to one-third of the breeding bird densities that cottonwood communities support.

Neotropical migratory species, which represent over half of Montana's breeding land birds, are particularly dependent on the deciduous streamside forests. Three-quarters of these long-distance travelers live in the leafy fringes of our rivers and streams. Sit patiently in a cottonwood forest. You'll see vireos and warblers, tanagers and kingfishers, finches and osprey. The structural diversity of these stands also offers nesting sites, forage, and cover to deer, moose, raptors, waterfowl, and small mammals. This community is a very important component of a healthy fishery since it provides thermal cover, streambank stability, and erosion control.



Bitterroot River Photo by Nina Viesulas

Establishment of Cottonwoods is a Tenuous Business

The establishment of a cottonwood forest is extremely tenuous. The delicate seeds require moist, newly deposited mineral soils that are exposed to full sunlight. These conditions are most often the result of spring floods. Dams and reservoirs on so many of our waterways have all but eliminated these pulses of water and disrupted the forces upon which cottonwood germination depends. Within established cottonwood stands, sprouts can often be found growing under the tree canopy. However, most of these do not survive more than 5-1 0 years and, thus, do not enable stand regeneration.

Cottonwood establishment is dependent upon seedling survival under a very limiting set of environmental conditions. The roots of the delicate seedlings require constant moisture. A natural drop in the water table following spring runoff combined with irrigation dewatering of streams during the hot summer months can leave seedlings high and dry. Others are lost to trampling and browsing from deer, elk, moose, horses, cows, and sheep. Catastrophic winter ice jams may wipe clear entire sandbars and islands of the tiny trees that survived that first growing season. In a recent study along the Clark Fork River, less than one percent of all seedlings survived the first year.

The Threats

Unfortunately, a market has developed recently for cottonwood logs. Landowners with stands of cottonwood on their land are being approached to sell their trees. The landowner may not profit much financially but is lured by the opportunity to increase pasture acreage. The decision to sell off the cottonwood stand is often made, not recognizing the finality of cottonwood removal or weighing the consequences in terms of other benefits these communities provide such as wildlife habitat and scenic beauty. And what becomes of the trees that are harvested? They are turned into caskets, pulp, paneling, trailer bedliners, wainscoting, and firewood.

Some of the most productive grazing lands are usually within the riparian zone. Extensive grazing by livestock and big game animals may damage or remove young trees and shrubby thickets that many wildlife species depend on.

There are other factors contributing to the loss of our cottonwood communities that the individual landowner has little direct control over, such as residential development and flood management. However, a landowner can make decisions about the impacts of grazing and logging on his/her individual forests. Cottonwood communities are valuable not just for their scenic splendor, but also for their role in biodiversity and the health of Montana's fisheries and clear waters.

If you would like more information about cottonwoods, contact:

The Montana Riparian and Wetland Association
School of Forestry
University of Montana
Missoula, MT 59812

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Chapter notes

George Grant Chapter — Butte

On July 27 several members of the George Grant Chapter spent a beautiful sunny day planting willows and dogwoods on Norman Bohmsen's property on upper Rock Creek. We were joined by members of the West Slope Chapter, DFWP biologists Eric Reiland and Wayne Hadley, assorted kids, dogs, and a commercial angler from Alaska (who happened to be passing through the area). A big thank you to Norman, who has already completed an extensive riparian fencing project and is doing a terrific job improving habitat on his property.

On August 3 several chapter members joined forces with the Big Hole River Foundation to host the sixth annual Kid's Day at Herb Hall's ranch on the Big Hole near Glen. Members taught kids—many from underprivileged backgrounds—about fly tying and entomology, and took more advanced kids on a boat trip down the river. As usual, the event was a huge success, with big smiles all the way around.

WestSlope Chapter — Missoula

On Saturday, August 3rd the George Grant Chapter, Butte and the West Slope Chapter, Missoula got out some volunteers for a streamside revegetation project on the Bohrnsen Ranch in upper Rock Creek. This project was funded by the Montana Dept. Fish, Wildlife and Parks, and organized by Eric Reiland, Fisheries Biologist. It was delayed and rescheduled due to some problems with the East Fork Dam. Luckily, due to the wet year and the fact that they are releasing water from the darn, we feel that the ground was still moist enough so that our planting efforts will be successful. The George Grant Chapter got out 6 to 8 volunteers, with five from Missoula including two Hellgate High School students. One TU member from Kentucky saw a sign in a Missoula fly shop and took a day off from fishing to join us. We were supervised by two people from F, W & P, with Rich Clough from Deerlodge in addition to Eric. We could have used more help, but we all pitched in and put in a long hard day and got the job done. Basically we carried heavy digging tools and flats of willows, dogwoods, etc. way upstream and worked our way down. We often had to wade back and forth across the raging, swollen torrent, fearful every moment that the darn might fail and we would all be washed to our deaths. Afterwards Eric fired up his barbecue and provided a very welcome dinner for all the participants. Older guys like me sat around feeling kind of

WestSlope Chapter - Missoula, continued

defended this settlement publicly saying that he did not want to send a negative message to mining companies, one of the traditional mainstays of Montana's economy. In addition, 3/4ths of this money was spent on the "Governors Project", the improvement of the Warm Springs Ponds. While the idea behind these ponds is very good, the question remains wether it was proper for the state to have paid so much for this project which really should have been funded by ARCO under superfund law. Today we have a situation where employees from the Dept. of

Willow planting on Rock Creek, July '96. Mike Morris Green, Marty from Tennessee & Ginger.

Environmental Quality feel they have to defend this project because a lot of State funds and engineering went into it, instead of giving us, the public, a fair and impartial review of wether the ponds are working as well as they should.

The other 1/4 of this penalty money, $250,000, was given to MT. Dept. F, W & P, specifically earmarked for projects that would benefit the fisheries in the upper Clark Fork and repair damage from the fish kill. F, W & P decided to spend a little on very urgent project ' but to invest the bulk of this money in an interest-bearing trust fund to be saved until the final superfund cleanup decision on the upper Clark Fork was made. Last spring Sandi Stash and other representatives from

As The Worm Turns: Whirling Disease Update

Whirling Disease

FISHERIES DATA. Anglers and other trout lovers were shocked this summer to hear that whirling disease had been detected in tributaries of the Missouri and Big Blackfoot Rivers. Whirling disease, caused by the parasite *Myxobolus cerebralis*, is responsible for the dramatic decline of the rainbow trout populations on the Madison River.

Small numbers of young rainbow trout from Prickly Pear Creek, a tributary of the Missouri River, were found to be positive for *Myxobolus*. The downstream rate of spread of whirling disease infection on the Madison River had been estimated to be about 15 miles per year, but its sudden appearance in the Missouri suggested that other factors may accelerate its movement. Attention has focussed on pelicans which travel long distances and could carry the spores up and down the river system in their digestive tracts after eating infected trout. Fisheries workers believe the infection is very early and no impacts have yet been observed on the Missouri River.

Have Dave "Silt"?

Letters to the Editor

Editor:

Only a nit-picking member of the jargon-ridden geological sciences could write the following, but I've been intending to say this to fishermen for some time and you turn out to be the lucky one.

Fisherfolk almost always refer to fine sediment as "silt"–as you do repeatedly in the article on Phantom Canyon–when in fact most of it actually is "mud".

Silt is composed of particles of silicate minerals (mostly quartz and feldspar) in the size range .0039mm to .0625mm.

The fine sediment we usually find in the waters we fish is a mixture of clay minerals, clay-sized particles (<.0039mm), and silt. This is mud. Commonly, some very fine-grained sand (.0625-.125mm) might be present, in which case geologists would call the sediment "very fine sandy mud".

It's not that deposits of relatively pure silt don't occur, but it would not be easy for a layman to distinguish them from the more common mud. Late in the article you seem to imply that mud is black. although most of us have seen layers of "black sand" containing magnetite, etc., sediments and sedimentary rocks that are black usually owe their color to organic matter, whether they are silt, mud, sand, limestone, or whatever.

Considering the disaster your article described, I should be ashamed to have brought up this minor matter. If you need any geological expertise during your editorship, I offer to help. Thanks again for a good *Streamside*.

Regards,
John Trammell
Geologist

Unlimited Forum

by Fred Rassumssen

Where is the Fire in CTU's Members?

I was a member of Boulder Fly Casters when that chapter was in the forefront of fighting for resource issues in the state. Currently I am an officer in Collegiate Peaks Anglers in the Arkansas Valley where our members, about 160 in number, put in a total of 815 volunteer hours in 1996. In both instances these chapters were or are a model for resource conservation in their communities.

At the time of the Two Forks struggle, within CTU, there was a considerable surge of interest in protecting the resource on a small piece of the South Platte because it was called a world class fishery and it was in the back yard of the Front Range. Since that time, except for our superb legislative committee, the board and officers of CTU, and the outstanding work of Jo Evans in the legislature, it seems to me that most TU members along the Fort Collins to Colorado corridor are content just to fish, work a little with kids, and raise money. They ignore the major and persistent water projects that threaten many Colorado rivers. Is fighting any of these water grabs on your personal work list? Your chapter agenda?

In the San Luis Valley plans are in place to suck water out of the Valley, pump it over Poncha Pass and into the Arkansas River to the detriment of San Luis water interests, indigenous agriculture and the stability of flows in the Arkansas River.

In South Park, Aurora has plans to sink wells into the aquifer at Como, ship the water to Spinney Mtn. Reservoir, then use it to grow more suburbs. Go figure.

In the Gunnison drainage, Front Range cities have not given up on the Union Park project which has designs on Taylor River water. If put in to place it would seriously diminish its flows, store the water in a new reservoir in Union Park then pipe it into South Park and hence to the already over crowded corridor along the east side of the mountains.

Farther north on the Eagle river, plans are in place to dam the river just above Red Cliff, put another dam above the reservoir that forms from the first one, then dam the tributaries above that.

Colorado Springs has on its books plans to build a big dam on the Arkansas River near Buena Vista that would flood out hundreds of homes, destroy wildlife habitat, and seriously alter the ecosystem in the upper Arkansas Valley.

On the Gunnison again, there are still active plans for the AB-Lateral, a project to divert water from the main stem, run it through turbines to generate unneeded power, and dump it in the Uncompadre where it will cause riparian problems. In the process the prospects for maintaining the Gold Medal fishery in the Gunnison below Blue Mesa goes down the tubes.

From my point of view here on the Arkansas, the struggle to maintain whatever integrity remains in our

Continued on page 28

they had arisen. And those states whose destiny it was to fight one another had been forged from fiefdoms and principalities that had warred upon one another, from walled cities that had laid siege to one another, and from fortified hill towns that had laid siege to one another for the valleys in between. The colossal efforts of Charlemagne, Louis XIV, and Napoleon—though they gave us, respectively, the restoration of learning, the apex of the comfortable arts, and the crucial new reality of the career open to the talents—all depended on military might. Kaiser Wilhelm II's similar dreams seem more explicitly violent only in having left behind little that was constructive; and Hitler's demented venture, though it united an unprecedentedly large proportion of Europe, left nothing in its wake—nothing except destruction, and this: the idea of European unity stopped being an intoxicating vision and started being a mundane necessity.

The centrifugal effect of the Nazi regime in Germany scattered the best brains of Europe all over the planet. Exiled to faraway New Zealand, the philosopher Karl Popper developed his argument that there could be no such thing as universal fixes—that the most that society could or should hope to do was to correct specific abuses. This perception surely applies to a united Europe: speculation about what utopian goals it might achieve counts for little beside a firm grasp of what it sets out to avoid—any recurrence of the internecine conflict that was already ancient when Athens fought Sparta and that reached its hideous apotheosis in the Second World War. In the middle of the twentieth century, it had become plain for all to see that Europe's glories—justly renowned even when they had to be rebuilt stone by stone—were merely its structure. Beneath them was the infrastructure—a network of burial mounds linked by battlefields—and it stank of blood. Hegel said that history was the story of liberty becoming conscious of itself. European history has culminated—at last, and in our time—with Europe becoming frightened of itself.

As happens so frequently in human affairs, fear has accomplished what neither reason nor culture ever could. Cultural unity was no illusion—had it been one, Hitler would not have been so eager to dispel it—but cultural unity had not been enough. When the musicians played for Mengele in Auschwitz, it did not mean that art and civilization added up to nothing, but it did mean that they did not add up to everything. Beside the broken bodies of the tortured innocent, the life of the mind was felt to be irrelevant—as, indeed, in any forced comparison it is.

To make sure that no such forced comparison happens again is the task in hand. It is not an easy one. In place of the conquerors' fevered dream of a Europe united by the sword, the peaceful commercial republics of the New Europe make do with such cultural manifestations as the Eurovision Song Contest—a kitschy classic that every year draws a huge television audience, whose more sophisticated members amuse each other with jokes about how dumb it is. The jokes keep changing. For years, Norway's songs reliably lost ("*Norvége* . . . nul points"); then they started winning. More recently, much derisive hilarity has attended the earnest efforts of Turkey. Between laughs, though, the less sophisticated but more thoughtful viewers should take heart: there was a time when the Turks stood at the gates of Vienna and bristled with the armed intention of getting into Europe by less tuneful means.

What the snobs are really afraid of is a United States of Europe that mirrors what they imagine the United States of America to be: an agglomerate dissolved into homogeneity, a consumer society consumed by mediocrity, or, at best, a mindless mimicry of Euro-savvy in which a dauntingly exact copy of Michelangelo's David presides over Forest Lawn's departed Angelenos and an actual-size Parthenon wows visitors to Nashville. But they are wrong about America, which is more than that; and they are wrong about the New Europe, which, as the millennium looms, bids fair to attain a last, unprecedented, and very welcome greatness, through a just peace. Talk about your new! —CLIVE JAMES

EUROPE: AN INTRODUCTION

After so much glorious carnage, a miraculously mundane peace.

SUPPOSE the world were an animal curled up into a ball, like a threatened armadillo, and you wanted to blow its brains out: the best way to do so would be to put the barrel of your gun against Europe and pull the trigger. The United States might be nettled by this dubious favoritism; in the century now waning, it has been called upon to save Europe from itself twice—three times if you count Stalin's opportunistic incursion. But even the United States would have to admit, if pressed, that it is itself a largely European creation, a giant offshoot of the most productive piece of geography in the planet's history. Behind that admission would be a tacit acknowledgment that, although America may have the power, the energy, and most of the money, Europe has the pedigree. As David Copperfield (the Broadway illusionist, not the Dickens character) is reported to have said to Claudia Schiffer while they were touring the Louvre and reading the dates on the paintings, "Talk about your *old!*"

As a word, Europe goes back a long way: Assyrian inscriptions speak of the difference between *asu* (where the sun rises; i.e., Asia) and *ereb* (where it sets). As a place, Europe is old even by the standards of dynastic China and Pharaonic Egypt. As an idea, though, Europe is comparatively new: the word European didn't turn up in the language of diplomacy until the nineteenth century, and to *think* of Europe as one place had always taken some kind of supervening vision. Whatever unity existed within it came not through a unifying idea but through the exercise of power, and did not last.

The Pax Romana prevailed for more than two centuries: it left us the Latin language and all its rich derivatives, and it left us the law—and slavery, and militarism. Erasmus the wandering scholar was at home everywhere he went in Europe, but his wanderings were forced on him, and his humanism would have died young if he had been caught napping where the knives were out. The university system pioneered the notion of intellectual unity, but intellectual was all that it was. Dante spent the best years of his life in exile: a member of a political faction, he was exiled from his beloved Florence not by another faction but by another faction of the *same* faction. The Church united Europe in the one faith—Christendom is a peaceful-sounding word—but finally the faith itself split. Nothing could stop the rise of the nation-states, or stop them from fighting once

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Beavers

Cyber-Hawk

By Paul Kerlinger

CD-ROM Nothing beats seeing a live bald eagle sitting atop a 100-foot white pine on a cold February morning. With that scene in mind, I was bothered recently to hear an eleventh grader bemoaning, "We saw bald eagles on a video at school, so why should we go on a field trip to the Delaware River to see them?" With the advent of such CD-ROMs as *Raptors,* I worry that fewer people will brave the real outdoors to see real nature, so I initially viewed *Raptors* with suspicion.

To my surprise, *Raptors* in cyberspace has much to offer. It is a decent introduction to what may be the most popular group of birds, comprising hawks, eagles, falcons, and vultures. So far, there is nothing comparable out there, but that will no doubt change quickly. Like a book, *Raptors* is organized into chapters—on anatomy, evolution and origins, vocalizations, migration, conservation, and how people can get involved—a mix of narration, text, animation, and still photographs.

Despite its value as a learning tool, I was disturbed that *Raptors* was scientifically outdated or incorrect in places. For example, the chapter on migration ignored recent developments in the field. The simplistic explanation for how hawks soar on thermals leaves the reader with the impression that all updrafts are thermally induced. In fact, many updrafts are mechanically generated by wind deflected by hills, mountains, and ridges. The viewer is also misled by spectacularly incorrect facts: Golden eagles usually fly at speeds of less than forty to fifty miles per hour, not the one hundred miles per hour reported. Likewise, hawks mostly migrate at altitudes below 5,000 feet—rarely, if ever, at 13,000 feet.

Another shortcoming is the list of organizations given in the chapter "Getting Involved." Many of the listings are of regional interest or out of date. Why did the authors not suggest joining local Audubon chapters where viewers can meet knowledgeable people and get involved locally? And why did they not focus on the fun involved in watching migrating hawks, an activity now involving hundreds of thousands of birders?

Perhaps the most important thing that CD-ROMs like *Raptors* can do is introduce people to nature in a friendly and comfortable way. *Raptors* does not do this as well as it could have; still, I was excited by some of what I saw and by the prospect of things to come in the CD-ROM world. (Discerning Nature, 1-888-347-2376, available for Macintosh and Windows)

Ornithologist Paul Kerlinger introduces our raptor section, which begins on page 40.

Bookshelf

Sex and the Origins of Death

By William R. Clark (Oxford University Press, Inc., 1996, $19.95, illus.)

Cell death developed after Earth's first billion years or so with the evolution of sexual reproduction and multicellular organisms—but has been investigated by science only since the 1970s. Immunologist Clark looks at cell death, or apoptosis (from the Greek "falling away," as with leaves from a tree), and explores "programmed cell death"—how and why particular cells commit suicide, ultimately causing our bodies to age and die.

Mining the Sky

By John S. Lewis (Helix Books, Addison-Wesley Publishing Company, 1996, $25)

Planetary scientist Lewis explores some possible scenarios for colonizing the universe, from mining nearby asteroids to stretching a "sky hook" of "piano-like wire" between Mars and its satellites.

The Thermal Warriors

By Bernd Heinrich (Harvard University Press, 1996, $27, illus.)

The shivering of a tobacco hornworm moth or the basking of an orange sulfur butterfly are just two examples that biologist Heinrich uses to illustrate insects' myriad strategies for heating their bodies. While some insects thermoregulate for the advantages of flight and locomotion, others maintain a particular body temperature for growth, for egg incubation, or to avoid the effects of temperature extremes.

Water

By Alice Outwater (Basic Books, 1996, $24, illus.)

By eradicating 300,000 square miles of U. S. wetlands created by beavers' damming activities, the fur trade brought the animals to near extinction and "caused the first major shift in the country's water cycle." Environmental engineer Outwater begins her natural history of water with this pivotal development, traces how ecological changes have affected our waterways, and chronicles efforts to "engineer our way back to clean water."

The books mentioned in "Natural Selections" are available by mail order from the American Museum of Natural History's Museum Shop. For information, please call (212) 769-5150.

with the full disclosure that maximal understanding requires. For this paradoxical reason, a great work of fiction like *Ulysses* will teach us more about human psychology than any true work about a real person. Secondly, scientists view reckless idiosyncrasy—the stuff of juicy lives—as inimical (or at least irrelevant) to scientific achievement and therefore expunge such material, whereas artists view such quirks of personality as intrinsic to creative greatness. A scientist who cuts his ear off is just a troubled soul.

But the second component of Gary's dilemma is personal, and based upon his blindness. He writes at this unconventional age in a large part to tell his remarkable story of achievement in the face of an obstacle that might seem to preclude such accomplishment. What he relates is both fascinating and deeply moving. But two facets of his honor and integrity permit him to go only to the edge of great autobiographical writing, not beyond. First, he encounters Medawar's general dilemma and properly chooses not to reveal his innermost thoughts and turmoils about love, sex, friendships, growing up, the frustrations and joys of science, and so on. His book is therefore a description of a surface—a wonderfully rich and varied exterior to be sure, but still a surface. The literature of natural history abounds with rapturous descriptions of tropical diversity, when first encountered by scientists from higher latitudes (Darwin's words from the *Voyage of the Beagle* are classic in this respect). But consider Gary's different perspective—that of a blind naturalist—on the same phenomenon:

My senses feasted on the rain forest at La Selva. Howler monkeys, dozens of birds, and crickets roared, sang, chirped, trilled and croaked in a continuous symphony that knew no finale.

Second, Gary has always insisted, from the core of his being, that blindness is but one of his attributes—a nuisance (sometimes severe to be sure) but not a disbarment—and in no sense his mark or definition. He is Gary the student of shells, the Dutchman, the scholar, the man who happens to be blind—not Gary the blind biologist. And I have loved and respected him for this stern insistence. Of course, Gary stresses this theme throughout the book, as in his eloquent conclusion:

The integration of disadvantaged groups into society will have been achieved only when a person's accomplishments are judged for what they are, independently of that individual's characteristics. I am not ashamed of my blindness, but neither do I wish all my contributions to be identified with it. Blindness is but one of my attributes. . . . If I am to be a role model, to use a bit of current jargon, I want it to be for integration.

Yet this admirable stance precludes the kind of intense focus on blindness that would make this book distinctive—and that presumably serves as a rationale for writing an autobiography at such an unconventional age. This is a true paradox, and I see no way out—greatness of soul here compromises the possibility of greatness in writing.

Yet Gary's attitude seems to me so deeply, so profoundly right. I have, on several occasions in our parallel careers, been called upon to write letters of recommendation for Gary—in circumstances where (much to my discomfort) I felt compelled to make some statement about his blindness. And all I could ever think to say was: yes, Gary does not have the use of his eyes; and yes, this puts him at a disadvantage for certain things. But all of us lack something—and most of us suffer from an absence incomparably more serious than his. Most of us, after all, do not have brains—and he does.

Stephen Jay Gould is a columnist for Natural History.

Restoring Spring Creek

March

→ Streams can't be contained like lines.

I ~~want to think that~~

are doing this for selfish reasons, but I want to think that restoration of the Creek/wetland is also good for the greater ecology + economy. ~~Flows~~ ~~the~~ Counterbalances floods (high water in E. Bod.; low ... Keeps water table up for crops. Sends good water to downstream users. Some one has calculated that Catskills save NYC expense of a $4 billion ~~water~~ treatment facility. I don't even get water rights.

The ~~benefits~~ water runs downstream to the Missouri, New Orleans, through farms + hedge, live track, + duck marsh

Science Times

Y B7

TUESDAY, MAY 20, 1997

The New York Times

How Much Is Nature Worth? For You, $33 Trillion

By WILLIAM K. STEVENS

How much is nature worth?

Some say the question is unanswerable, that it is impossible to calculate a dollar value for the natural world. Others say the question should not even be asked, that nature, like human life, is priceless and should not be devalued as if it were a mere commodity.

But economists and ecologists are searching for the answer anyway. Nature performs valuable, practical, measurable functions, they say; without them the human economy could not exist, and in many cases people could not duplicate them as cheaply — or at all. And they say it is time that the value of these functions is considered when economic decisions are made.

One notable example of nature's economic value that they cite is the purification of New York City's water supply by microorganisms as the water percolates through the soil of the Catskills. The city plans to spend $660 million to preserve that watershed in good health; the alternative, a water treatment plant, would have cost $4 billion to build.

Nature performs a long list of other economic services as well. Flood control, soil formation, pollination, food and timber production, provision of the raw material for new medicines, recreational opportunities and the maintenance of a favorable climate are among them.

But like a well that is taken for granted until it runs dry, these ecosystem services, as ecologists call them, have long been overlooked until they either no longer work or are gone — as, for instance, when the widespread destruction of Midwestern wetlands meant they could no longer perform their natural function of sponging up water from disastrous floods like those of recent years.

Purifying drinking water costs billions; watersheds can do it for nothing.

And to the extent ecosystem services are noticed at all, people have tended to regard them as free.

Now, as human activity gradually uses up or destroys this natural capital and eats away at the natural systems that provide many of the services, many experts are insisting that the worth of ecosystem services must be calculated and heeded.

The results of the latest and in some ways the most ambitious effort to place a dollar value on natural capital and services were announced last week.

Thirteen ecologists, economists and geographers, in a report in the journal Nature, estimated the present global value of 17 ecosystem services at $16 trillion to $54 trillion a year, with a likely figure of at least $33 trillion. Most of this, they said, lies outside formal markets and is therefore not reflected in market prices, the customary gauge of economic value. Their estimate,

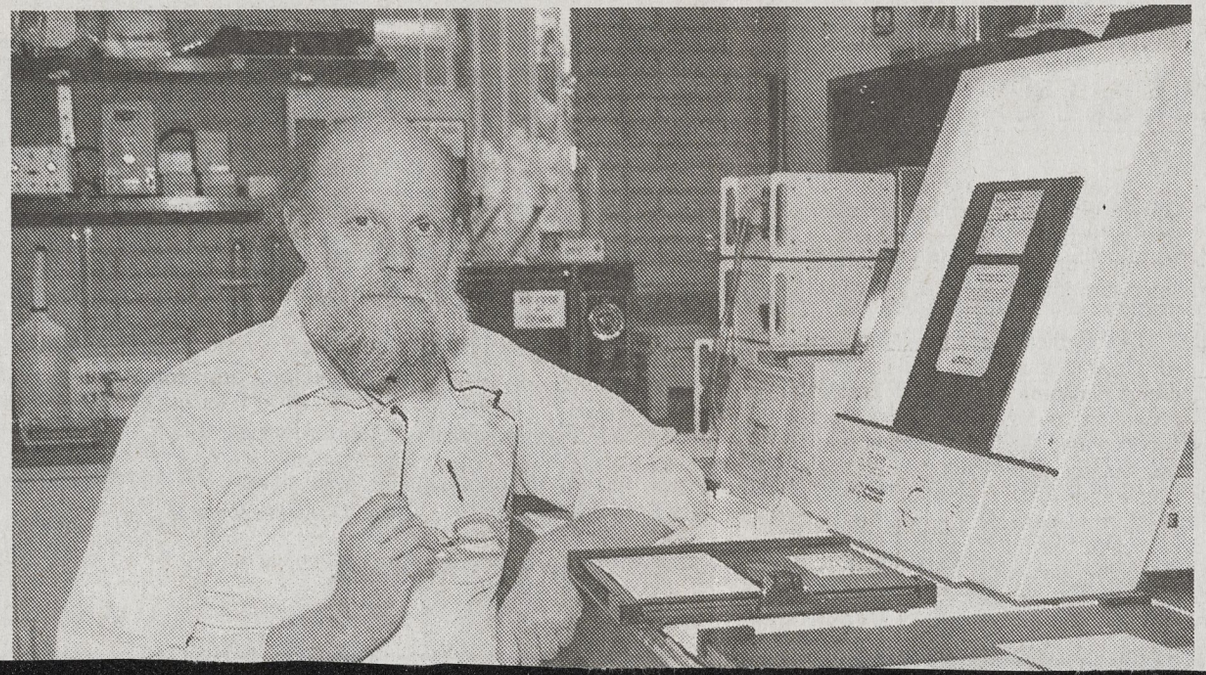
Continued on Page B9

SCIENTIST AT WORK
Caleb E. Finch

Explorer of Aging Process Is Lighting Candles in the Dark

New paths opened on dementia, longevity and role of hormones.

By JANE E. BRODY



LOS ANGELES, May 19 — From the beginning, says Caleb E. Finch, a gerontologist at the University of Southern California here, he had "an instinct for professionally dangerous pursuits." As an undergraduate at Yale University in the early 1960's, he realized that aging was an area of biology about which almost nothing was known and in which few scientists were interested. So Dr. Finch jumped in and began asking questions that today are at the forefront of aging research worldwide.

Central to his concerns are the mechanisms of Alzheimer's disease,

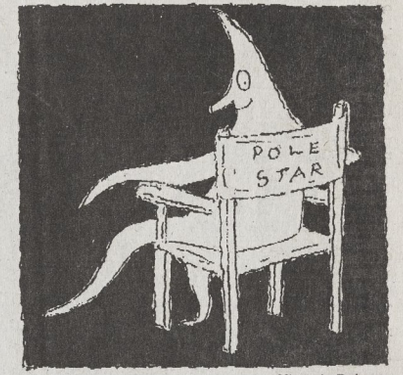
"It is open at many steps to environmental modifications," he said. "Our goal is to understand these environmental factors and how to manipulate them to enhance health."

Another prevailing view of aging — that a high metabolic rate places strong constraints on life span "as if there were just a certain number of calories you could burn and then you die" — has also been found invalid, Dr. Finch said. "Any pattern of metabolism could lead to a short or a long life span," he said. "Life span is not a strict function of size or metabolic rate."

To document this point, he examined the longevity of birds, which have very high metabolic rates. "There are lots of examples of birds that live more than 50 years and show no signs of aging," he said.

Then there are the very long-lived animals and plants — fish, clams, trees, among others — that age so slowly that their rate of aging can be called negligible. Dr. Finch said,

Q & A



Victoria Roberts

A South Star?

Q. *What is used as a pole star in the Southern Hemisphere, where navigators can't see the North Star?*

A. The closest thing to a "south star" for navigators south of the Equator is a pair of stars in the Southern Cross, Crux Australis or just Crux to astronomers. Alpha Crucis (its brightest star) and Gamma Crucis (the third-brightest) point almost straight to the south celestial pole, according to The Facts on File Dictionary of Astronomy.

The striking Southern Cross, which

What Is Nature Worth? For You, $33 Trillion

Continued From Page B7

they said, compares with $18 trillion for the gross national product of the world, which is all the goods and services produced by people each year.

The researchers, who based their conclusion on other published studies and their own calculations, freely point out that their estimate is a rough approximation, a first step that is mainly intended to determine whether ecosystem services amount to "big potatoes or small potatoes," in the words of Dr. Robert Costanza, an ecological economist at the University of Maryland who headed the study. "We come away from this thinking this is a minimum estimate," Dr. Costanza said.

Virtually everyone agrees that without the natural world, the human economy and indeed human life could not exist. In this sense, the value of nature is infinite, immeasurable. To some conservationists, this is all that needs to be said. "Common sense and what little we have left of the wisdom of our ancestors tells us that if we ruin the earth, we will suffer grievously," said Dr. David Ehrenfeld, a conservation biologist at Rutgers University. He said he accepted the results of the Costanza study, which he regards as conservative, but added: "I am afraid that I don't see much hope for a civilization so stupid that it demands a quantitative estimate of the value of its own umbilical cord."

Dr. Ehrenfeld and some other conservationists believe that moral arguments for saving nature are more persuasive than economic ones. But in the view of Dr. Costanza and others, moral and economic arguments should be pursued in parallel.

People make economic choices involving nature all the time, according to this view, but they do so without taking all the costs into account. For example, the dollar value of a wetland's flood-protection and water cleansing abilities has not traditionally been considered when it is lost to a shopping center. The result is a creeping depletion of natural wealth.

If such costs were reflected in day-to-day transactions, these theorists say, society would pay more attention to what is lost when land is "developed."

"We can't wait until we've disrupted the planet's life-support system beyond repair," said Dr. Gretchen C. Daily, a conservation biologist at Stanford University. She is the editor of a recent collection of papers on the subject, "Nature's Services; Societal Dependence on Natural Ecosystems," published as a book by Island Press. Once gone, she noted, many of these ecological assets would be difficult, if not impossible, to replace; it can take thousands of years to recharge depleted aquifers or replenish topsoil.

Until now, fledgling efforts at what is called "green accounting" have been pursued largely at the national level. In a widely applauded attempt of this kind, Dr. Robert Repetto, senior economist at the World Resources Institute, a Washington-based research organization, has analyzed the economies of Indonesia and Costa Rica. In Indonesia, he and colleagues calculated that losses from soil erosion reduced the net value of crops by about 40 percent and that the loss of value from deforestation was four times as high as the value of the timber extracted. They also concluded that depletion of Costa Rica's soils, forests and fisheries resulted in a 25 percent to 30 percent reduction in potential economic growth.

A nascent effort to introduce a measure of natural-resource accounting into the United States' official calculation of economic worth was made in 1993, but it is on hold pending a Congressionally ordered study of the soundness of the approach by the National Academy of Sciences. A report is due this year.

The new Costanza study is not really an exercise in green accounting, and some experts question its usefulness while others express skepticism about its basic finding.

"There's no way of knowing how good this number is," Dr. Repetto said of the study's estimate of $33 trillion for the global value of ecosystem services. "They've made some heroic assumptions. I suppose it's useful for rhetorical purposes." But the number, he said, is less important than the fundamental point made by the study "that ecosystem services are important; I don't think reasonable people would deny that."

Other experts see more utility in the analysis. The study has succeeded in providing "a conservative estimate of what the environment does for us," said Dr. Stuart Pimm, an ecologist at the University of Tennessee who wrote a commentary on the Costanza study in Nature. "So often," he said, "people concerned with protecting the environment go up against these very highly detailed economic analyses and feel they don't have anything in kind with which to respond." In the tables of specific ecosystem services that accompany the study, he said, "what Costanza et al. has done is provide a checklist" that national and local policy makers can use in attempting to make a rough gauge of the economic worth of their natural assets.

One table, for instance, lists specific ecosystem services, and their supposed value, for 11 biomes, or types of natural areas. These include the open ocean, estuaries, seagrass and algae beds, coral reefs, continental shelves, tropical forests, temperate forests, grasslands and rangelands, tidal marshes and mangroves, wetlands and flood plains and lakes and rivers.

The next step, Dr. Costanza says, is to delineate more clearly the explicit linkages between particular local ecosystems and local economies. For example, how much of the value of the Louisiana shrimp catch is attributable to the wetlands in which the shrimp reproduce and grow? But since wetlands perform other services as well, the wetlands' value as a shrimp nursery would be only a minimum indication of their overall value.

A price on nature puts a dollar cost on a lost wetland.

The same applies, for example, to the Catskill watershed, which serves other economic functions besides providing and cleaning New York City's water — attracting tourists, for instance. "Nobody thinks the Catskills are worth only $4 billion," Dr. Daily said, referring to the cost of replacing the Catskills' water-cleansing function.

Assuming the value of ecosystem services could eventually be established, how might economic policies be changed? For openers, Dr. Daily and others say, government subsidies that distort the value of natural resources — in fisheries and logging, for example — should be abolished. Also, tax incentives might be given to landowners to protect the long-term assets represented by natural capital rather than using them for short-term gain.

Some experts advocate applying traditional economic arrangements to ecosystem services. For instance, Dr. Graciela Chichilnisky and Dr. Geoffrey Heal, economists at Columbia University, have proposed selling investment shares in a given ecosystem. Using the Catskill watershed as an illustration, they say that the capital thus raised would pay for preserving the watershed. Returns to investors would come either from a share of the costs saved by not having to build a treatment plant or, if the investment were private, by actually selling ecosystem services. In the case of a watershed, clean water would be sold.

But, says Dr. Daily, "the first thing is getting the prices right."

Some say nature's value is incalculable.

The Value of the Natural World

A new attempt by 13 scientists to assign dollar values to essential services performed for the human economy by the natural world divides the services into the following 17 categories, with examples:

GAS REGULATION Carbon dioxide/oxygen balance, ozone for ultraviolet protection

CLIMATE REGULATION Greenhouse gas regulation

DISTURBANCE REGULATION Storm protection, flood control, drought recovery

WATER REGULATION Provision of water for irrigation, mills or transportation

WATER SUPPLY Provision of water by watersheds, reservoirs and aquifers

EROSION CONTROL AND SEDIMENT RETENTION Prevention of soil loss by wind, runoff, etc; storage of silt in lakes and wetlands

SOIL FORMATION Weathering of rock and accumulation of organic material

NUTRIENT CYCLING Nitrogen fixation

WASTE TREATMENT Pollution control, detoxification

POLLINATION Pollinators for plant reproduction

BIOLOGICAL CONTROL Predator control of prey species

REFUGES Nurseries, habitat for migratory species

FOOD PRODUCTION Production of fish, game, crops, nuts and fruits by hunting, fishing, gathering or subsistence farming

RAW MATERIALS Production of lumber, fuel or fodder

GENETIC RESOURCES Medicines, resistance genes for crops, ornamental plant species, pets

RECREATION Ecotourism, sports fishing, other outdoor recreation

CULTURAL Esthetic, artistic, educational, spiritual and/or scientific values of ecosystems

Source: Nature

Magnetic Fields on Distant Moons May Hint at Hidden Life

Continued From Page B7

Friday. (Experts writing last week in the journal Nature declared that the fourth and most distant of the large Jovian moons, Callisto, was magnetically barren.)

The positive findings about the three Jovian moons, scientists say, raise the odds that their depths may be habitable and may harbor alien life, perhaps swimming through dark seas. Such speculation is an increasingly popular topic among planetary scientists.

Magnetic fields could be beneficial to life not only because they imply inner heat and geologic vitality, scientists add, but because they would help shield the moons and any alien creatures from cosmic rays, the streams of highly penetrating particles that speed through space. Earth's magnetic field deflects many of these deadly radiations.

"It's very exciting," Dr. Margaret G. Kivelson, an astrophysicist at the University of California at Los Angeles who is the lead scientist interpreting the magnetometer readings of the Galileo probe, said.

"The images we receive show only surfaces, and sometimes you can infer a bit about what's going on below, like with Europa and all the floes. But when you measure a magnetic field, it gives you important clues. They're not always unambiguous, but they give you a sense of something going on deep inside."

Jupiter is the solar system's biggest planet, with 16 known moons, four of them quiet large. (Ganymede, the biggest moon in the solar system at 3,269 miles in diameter, is larger than Mercury.)

Increasingly, scientists say, the large Jovian moons are proving to be more surprising and interesting than Earth's planetary neighbors.

"This stream of data is strengthening our thinking of moons as worlds in their own right," said Dr. Louis D. Friedman, executive director of the Planetary Society, a private group in Pasadena that backs space exploration. "That change started to happen with Voyager, as we saw volcanoes on Io." The Voyager spacecraft flew past Jupiter in 1979.

"Now," Dr. Friedman added, "it's really happening as we see hints of all these processes going on."

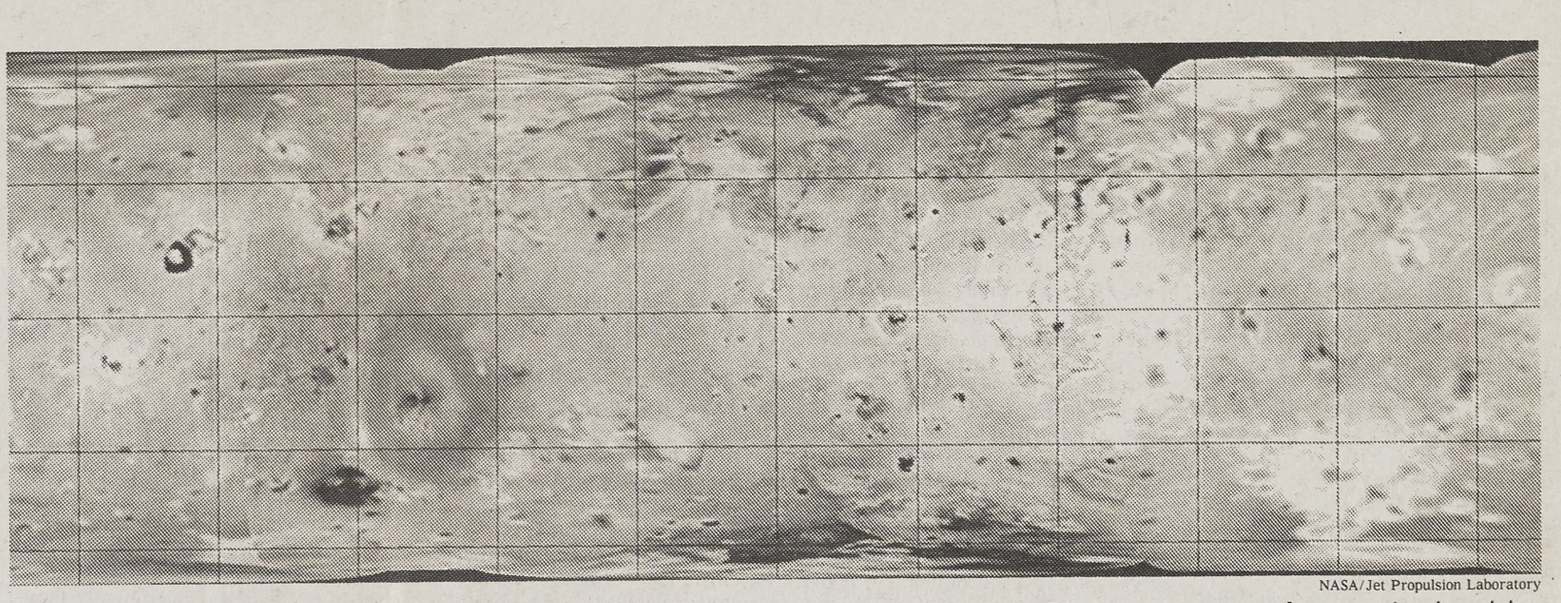
People have long known of magnetic fields. The ancient Chinese, Arabs and Italians are variously credited with inventing the magnetic compass, which aligns itself with magnetic lines of force.

A magnetometer is a modern tool that measures the strength of magnetic fields, simple ones being akin to compasses. Magnetometers hurled into space in the last few decades failed to find signs of substantial fields around the Moon, Mars and Venus. But in 1974 and 1975, the Mariner 10 spacecraft while studying Mercury found signs of a field whose strength was less than 1 percent of Earth's, suggesting the planet has some degree of inner activity.

All the gas giants of the outer solar system — Jupiter, Saturn, Uranus and Neptune — were found to have magnetic fields, though the means of generation is thought to be the inner movement of materials much lighter than the molten iron of Earth and Mercury. And that rules out the kind of geology that interests life scientists. Of all the planets, Jupiter was found to have the most powerful magnetic field, which stretches through space for millions of miles, and is the solar system's largest planetary feature.

This potent force complicates the job Galileo's magnetometer is now facing in trying to find and measure the magnetic fields of the Jovian moons. The spacecraft, launched in 1989, reached Jupiter in December 1995 and ever since has been engaged in detailed studies.

Last December, the space agency announced that Galileo had found a strong magnetic field around Ganymede — the first for any moon in the solar system. It appears to be about 10 percent as strong as Earth's, or fairly substantial. The implication is that Ganymede has a molten metallic core.



NASA/Jet Propulsion Laboratory

Composite image of swath of Jupiter's moon Io, from data obtained by Galileo on its first two orbits. Black spots are areas of recent volcanic activity.

Galileo also found signs of a magnetic field around Io, which lies much closer to Jupiter's own powerful magnetism, making the clues more ambiguous. Moreover, the data were scant. Galileo flew by Ganymede four times taking magnetometer readings, but did so only once for Io.

In the current issue of Science, experts from the University of Exeter in England and the University of California at Los Angeles report computer simulations of these moons' interiors based on Galileo's readings. They concluded that Io's magnetic field was possibly derivative of the main Jovian field, and might collapse in its absence.

But Ganymede, the team found, was "almost certainly operating as a dynamo in its own right." The dynamo theory holds that planetary magnetism arises as inner flows of metals produce electromagnetic fields.

"It's all very intriguing," Dr. Gerald Schubert, an author of the paper who is a planetary scientist at the University of California at Los Angeles, said in an interview. "I wouldn't have predicted this prior to Galileo."

A riddle is what powers Ganymede's strong field. Io, much closer to Jupiter and moving in a slightly elliptical orbit, is alternately squeezed and stretched. These so-called tidal forces heat its interior, powering its intense volcanism.

But Ganymede experiences much less tidal heating. Dr. David J. Stevenson of the California Institute of Technology has proposed that Io, Europa and Ganymede were once in orbits that exerted a much greater gravitational pull on Ganymede, heating it up many millions of years ago and generating a strong magnetic field that lingers today.

"This is a very important and exciting discovery," he said of Galileo's findings about Ganymede. "It's very exciting because we have so few examples of internal fields" in rocky planets and moons.

And now Europa, one of the solar system's most enigmatic bodies, is also reportedly showing signs of magnetism. Its bright surface of water ice is broken into a chaos of lines and ridges, looking something like shattered glass. The moon is almost entirely free of impact craters, suggesting they were wiped clean by ice movement and turnover.

Friday's issue of Science is to carry a report on Europa's magnetism by a team of researchers based at the University of California at Los Angeles and led by Dr. Kivelson, scientists said.

Europa, closer to Jupiter's potent magnetic fields than Ganymede, is a more difficult target to study. Moreover, Galileo had its magnetometer in working order only once in a Europa flyby, last December. A cosmic ray apparently knocked the magnetometer out of action temporarily just before a February pass, which was meant to bolster the readings.

Even so, Galileo found sketchy signs of a field.

"It's much weaker" than Ganymede's, said a scientist who spoke on condition of anonymity because researchers are barred by the journal from taking about their findings before publication. "But it's intriguing."

The possibility is that Europa is geologically alive beneath its craggy surface ice, its core hot and astir, creating a deep warm ocean perhaps teeming with alien life.

Dr. Kivelson, who refused to comment on the coming Science report, said the Galileo team was eagerly looking forward to future data that might clarify the situation.

The space agency recently decided to extend the Galileo mission so the hardy spacecraft could zero in on Europa in its final days. Originally scheduled to end in December 1997, the mission is now to go through 1999 so the probe can repeatedly swing past the icy moon for a series of close-ups.

"We believe that will settle the question," Dr. Kivelson said, of whether Europa has a strong magnetic field of its own, and perhaps a deep extraterrestrial sea as well.

Sex Aloft? Astronauts Avoid Topic

HOUSTON, May 19 (AP) — Ten American and Russian astronauts carrying out a resupply mission for Russia's ailing Mir station were participating in a live call-in show on the C-SPAN cable network today, when Caller No. 4 brought up NASA's No. 1 taboo:

"I was just wondering, has anybody ever thought about having sex in space?" a Chico, Calif., man asked. "Raising a family in space?"

Yes, tell us about the rules on that, the C-SPAN interviewer interjected.

"Well, we don't have to worry about the rules for that, we're all so busy and we're professionals, of course," replied Col. Charles J. Precourt, commander of the shuttle Atlantis, drawing a big laugh from his crewmates.

He turned to a Russian astronaut, Elena Kondakova, a member of the Atlantis crew, for help.

"I don't understand the essence of this question," she replied in Russian after the question was translated. "Is that a meeting of people who are unmarried or are we talking about life in space?"

She added: "Let's first conduct experiments on lower forms of life and then we will see how can a human life develop in microgravity."

Caller No. 9, from Phoenix, wanted to know whether the two Russians living on Mir "have seen anything unusual, possibly U.F.O.'s?"

"Sorry," replied a Russian, Alexander Lazutkin, "I haven't seen anything unusual though I would like to see something unusual very much."

Other questions for the space travelers were whether their spiritual beliefs have changed in orbit and whether the Martian atmosphere should be altered to allow for human habitation.

The astronauts, whose spacecraft have been docked for three days, spent most of the day hauling more supplies between the two spacecraft and taking air and water samples from the station to check for contaminants from broken equipment.

Atlantis is to return the samples to Earth on Saturday, after undocking on Wednesday night. Dr. Jerry M. Linenger, a NASA astronaut, will return to Earth. He will be replaced on the Mir by Dr. C. Michael Foale.

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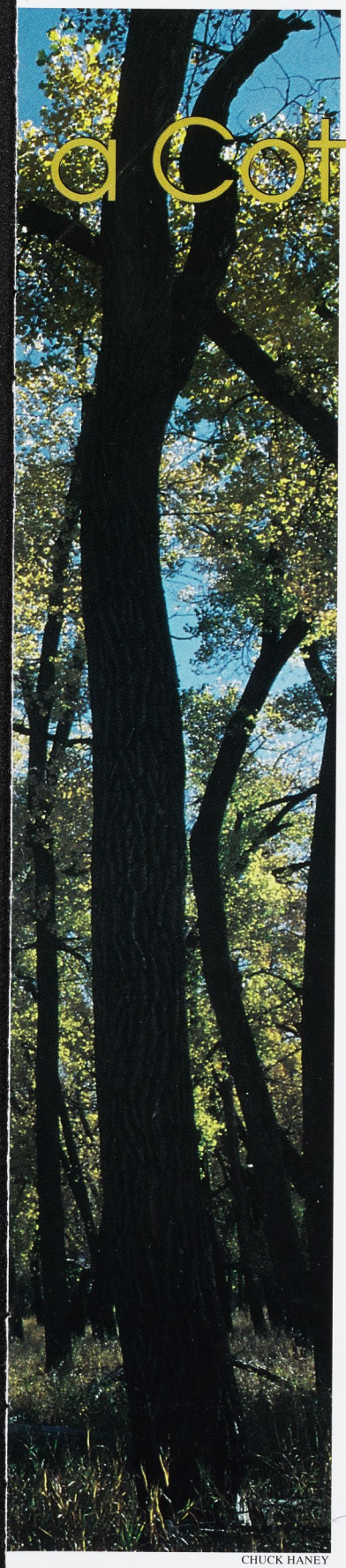


CHUCK HANEY

a Cotton to Cottonwoods

Suburbanites complain about the mess, but out on the plains where few trees grow, cottonwoods offer vital shade and wildlife habitat.

by BRUCE AUCHLY

GARY LEPPART

Cottonwood seeds await a breeze.

IF THE COTTONWOOD were the predominant tree east of the Mississippi River, American history, literature, even sports might have taken on a different flavor. Picture schoolchildren learning the poem, "Under the spreading cottonwood tree, the village smithy stands." Would George Washington have "fessed up" to cutting down a cottonwood tree? Maybe Babe Ruth would have whacked home run number 60 with a cottonwood bat.

Instead, botany and climate have conspired to make the cottonwood the major tree of the American plains where few people live. So it's underappreciated; or, maybe not.

In 1995, a quiet Great Falls neighborhood erupted when several residents circulated a petition to force a neighbor to cut down five cottonwoods because their floating, feathery (well, cottonlike) seeds were clogging up screens and gutters and noses. The petition drive eventually failed—perhaps, as the city forester said at the time, because people who live on the plains appreciate their trees and the difficulty it takes to grow them in this climate.

Yet, cottonwoods along some of Montana's rivers and elsewhere throughout the West are slowly disappearing, and that could have devastating effects on wildlife. "In the West," says Paul Hansen of the University of Montana, "One to five percent of the landscape is riparian, yet seventy-five percent of wildlife is associated with riparian areas."

As any good whitetail hunter knows, riverbottoms with brush and trees grow big deer. And

where there are trees and rivers there are beaver. Then there are the animals we don't hunt or trap, like voles, bats, and chipmunks. And, because cottonwoods are found near water, they are the perfect rest and refueling stop for "neotropical migrants," birds that breed in northern latitudes but winter in Mexico and beyond. To imagine what these birds could face in a landscape devoid of riparian forests, think of driving cross-country on an interstate highway where the only gas stations are 500 miles apart with no exits in between. One could only hope the gas gauge and bladder don't give out! In Montana, cottonwoods are gas stations and rest stops along the avian interstate system.

W. STEVE SHERMAN

Cottonwoods are a major component of most riverbottom plant communities, providing habitat for everything from black bears (right) to Merriam's turkeys (above).

Montana lays claim to three cottonwood species: black (*Populus trichocarpa),* Great Plains *(Populus deltoides*), and narrowleaf (*Populus angustifolia*). Black cottonwood is the dominant family member west of the Continental Divide, although it is also found east of the divide. According to Hansen, narrowleaf and Great Plains cottonwoods are restricted to areas east of the divide and found at altitudes between 2,000 and 6,600 feet. In central and eastern Montana, black cottonwood tends to grow at higher elevations than the narrowleaf variety, which grows at higher elevations than the Great Plains version.

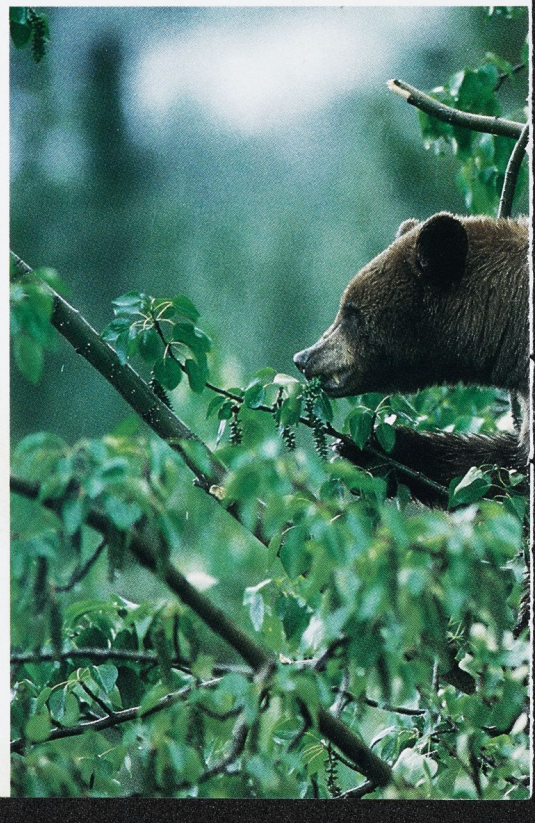
Modern knowledge about cottonwoods in Montana starts, like so much other natural science, with Lewis and Clark. Along the Teton River on June 6, 1805, William Clark noted cottonwood trees with narrow leaves like those of the wild cherry. A few days later Meriwether Lewis described the tree, and hence is given the honor of discovering the narrowleaf species. That same month, the expedition set about portaging the Great Falls of the Missouri with cottonwood dugouts mounted on wheels carved from cottonwood.

West of the divide, Lewis was the first person to collect specimens of black cottonwood, which he took back to Philadelphia. The expedition members were already well acquainted with the Great Plains cottonwood, having used it to build their 1804-05 winter fort in present-day North Dakota. Of all the western trees encountered by the expedition, no other contributed as much to the party's success, says Paul Cutright in *Lewis & Clark: Pioneering Naturalists*: "Though we think it probable that they would have successfully crossed the continent without the cottonwood, don't ask us how!"

The Indians Lewis and Clark met did more than appreciate the cottonwood, they made it part of their culture. Besides forage for horses, Indians tapped the tree in spring for sap to eat, extracted a yellow dye from the buds, and concocted medicines from the leaves, bark, and buds. Blackfeet warriors even rubbed themselves with the sap to conceal their human scent when stealing enemy horses.

This native understanding of the tree that survives and thrives in the extreme climate of the plains did not immediately pass from one culture to another. European settlers, accustomed to omnipresent trees, were shocked when entering first the treeless tallgrass prairie of the Midwest and finally, as they neared the Rocky Mountains, the shortgrass prairie. But as nineteenth century settlers headed west and passed the 96th meridian (Montana's eastern border lies at the 104th parallel), they soon learned to look for cottonwoods: The trees grew near water, a sign of grass for livestock as well as timber for repairs, firewood, shade, even food.

"Settlers once cut white inner pulp from the tree and made a delicacy called cottonwood ice cream; but no one remembers the recipe, and people no longer know how to eat a cottonwood," writes William Least Heat Moon in *PrairyErth.*



BILL JONES AT 81 has seen a tree or two grow in his lifetime. Jones ranches along Blackleaf Creek west of Bynum in a house surrounded by cottonwoods and willows. "There's something about cottonwoods," he says. "We're used to willows and brush along the creek. But there's something about these cottonwoods that reach up 25 to 30 feet above the brush."

Jones grew up on a treeless homestead about 20 miles away. "We planted a nice shelterbelt of poplar, box elder, Chinese elm, green ash, and black willows." He figures only people who have lived on the plains can cherish trees because there are so few. Where trees are commonplace, Jones says, a person might love them but not appreciate what they mean or what an individual plant can do. Along the creek by his current home, Jones sees pheasants and partridge. He figures it's the cottonwoods. He's right, but it's more.

"It's kind of hard to separate out cottonwoods from riparian areas," says FWP wildlife biologist Dennis Flath. "Riparian habitat has major importance for wildlife. Seventy percent of neotropical birds use riparian areas. In the floodplain you'll find all the amphibians and reptiles. For fisheries, cottonwoods provide bank stabilization and shading."

Flath, stationed in Bozeman, has spent years studying riparian areas. He's currently researching the bald eagles of the Yellowstone. Cottonwoods are water-loving trees that can grow taller than 80 feet and live 100 years or more. As towering riverbank sentinels, they make perfect nesting sites for our fish-eating national symbol.

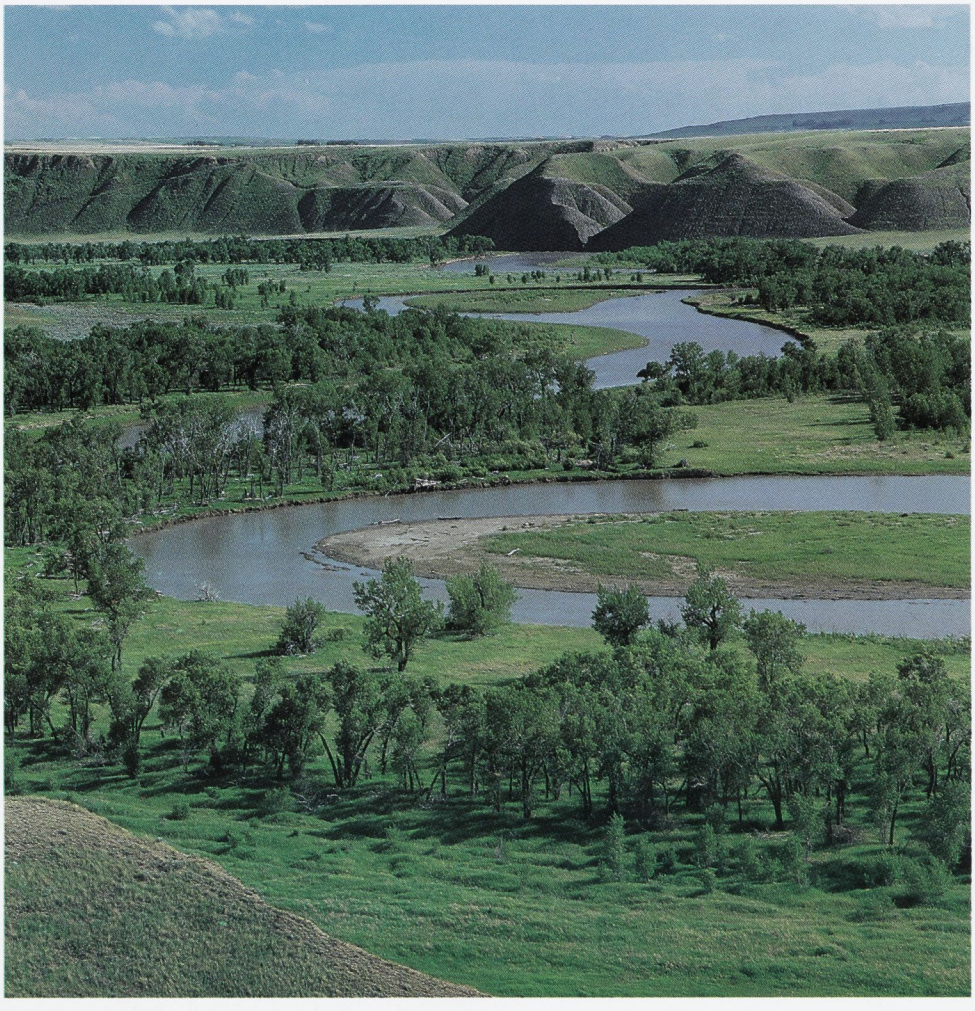
Unlike oak, hickory, and walnut trees, cottonwoods do not depend on mammals and birds for seed dispersal. This tree survives despite and because of weather extremes: wind and water. Cottonwood seeds need bare soil and full sunlight to grow. Floods, then, become the perfect cultivator, creating gravel bars and depositing silt on them as flows recede. When a female cottonwood releases its wispy seeds in early summer, a fortunate wind may float nature's cotton candy to the proper germination spot. The seeds have just a handful of weeks to sprout or die. Once sprouted, they cling tenaciously to life. In the first growing season, seedlings can send a taproot three feet down in search of water. Saplings, under perfect conditions, in one year can grow to twice the height of a man.

LYNN BACON

LANCE R. PECK

DONALD M. JONES

Cottonwood forests are logged today for pulp, posts, firewood, and lumber for pallets, water tanks, caskets, paneling, and a variety of other products. Because younger, healthier trees are usually chosen for harvest, there will be fewer of the large, old trees preferred as nest and perch sites by bald eagles, ospreys, hawks, owls, and woodpeckers (like the flicker above) in the future.



JOHN LAMBING

Along the Marias River in north-central Montana, cottonwood seedlings are far less numerous below Tiber Dam than above. Dams limit cottonwood regeneration by preventing the river channel scouring and silt deposition that creates ideal seedbeds.

Water and wind. Floods and breezes. Man hasn't conquered wind, yet. Dams we know about.

Dams, especially those built for flood control, hold back runoff in the early summer when cottonwood seeds need it to scour river channels and create new gravel bars. No floods mean no new gravel bars with just the right amount of silt for the seeds to germinate successfully. By late summer and early fall, when the water is released, the seeds are no longer viable.

"In the Flathead we're not seeing any cottonwood regeneration," says Paul Hansen. "We have to re-educate people about floods. Just as we had to relearn our fire behavior, we have to accept that not all floods are bad."

A similar situation is occurring on the Marias River in north-central Montana. Cottonwood seedlings are far less numerous downstream from Tiber Dam than upstream, according to a 1995 study by a University of Lethbridge scientist. "If the operation of the Tiber Dam continues in the pattern of the past four decades," he concludes, "it is probable that the deficiency of seedling recruitment will continue....This would result in a gradual loss of riparian cottonwoods over the next half-century downstream of Tiber Dam."

Adds Hansen about the West in general: "We're still getting cottonwood regeneration, but less than we were getting before the dams." As the state's main rivers east of the Continental Divide, the Missouri and Yellowstone contain critical wildlife habitat. Both rivers sport healthy cottonwood groves, though threats to the trees' future are real. The Yellowstone has no major dams along its entire 670-mile stretch. The Missouri has lots of dams and their effect on cottonwoods is being studied.

In 1992, scientists with the U.S. Geological Survey (USGS) began to look at cottonwood growth on the Wild and Scenic section of the Missouri River between Fort Benton and the Fred Robinson Bridge—about 150 miles. The area does not have a lot of cottonwood groves, although Mike Scott of the USGS believes there never were many.

"Extensive cottonwood forests need a wide, meandering channel," Scott says. The Wild and Scenic Missouri is anything but that. The river narrows as it runs through this area because the constrained valley is geologically new. Geologists believe the Missouri River once turned north at Little Sandy Creek, just downstream from Fort Benton, and ran through the present-day towns of Big Sandy and Havre. Then it followed the valley now occupied by the Milk River eastward, rejoining the present Missouri channel east of Glasgow. Over thousands of years, a series of ice age glaciers created a new river channel, with the last ice age about 10,000 to 12,000 years ago pushing the river south on its current course.

The few exceptions to the Missouri's narrow channel are at the mouths of tributaries like the Judith River, where extensive cottonwood groves thrive. Without an actively meandering channel, exceptionally large floods are needed to provide the right conditions for regeneration. "In constrained sites," Scott says, "it takes a really big flood to establish a good seedbed."

To understand how a big flood helps, picture a bathtub as a river and the dirt rings as cottonwood seedlings. The ring that gets covered every time the bathtub is filled will get wiped out. But the ring from that Saturday night when you were filthy and filled the tub near the brim will remain. Exceptional floods can prepare seedbeds high enough in the Missouri's narrow channel that the seedlings will escape high water and ice in following years.

On the Missouri those are floods measured as greater than 50,000 cubic feet per second at the Fort Benton river gauge. "There have been twelve of that size since the 1890s," Scott says. "The biggest flood on record was in 1908 when the flow measured 107,000 cfs."

The last flood close to 50,000 cfs was in 1981. The top five flood years were 1908, 1953 (75,000 cfs), 1964 (69,000 cfs), 1892 (66,000 cfs), and 1975 (59,000 cfs). "In normal years the peak spring runoff reaches about 15,000 cfs," he says. For cottonwood regrowth on the Missouri, dams are not the villains they are elsewhere. Scott says that dams have changed the river's flows and in turn have influenced cottonwood growth, but it's not clear that the trees are declining on the river.

"Cottonwoods along the Wild and Scenic Missouri are much the way they were described in Lewis and Clark's time," Scott says. "Above Cow Creek [25 miles upstream of the Robinson Bridge] Lewis and Clark said there was no timber except pines. The same above Arrow Creek [80 miles downstream from Fort Benton]. Above Coal Banks [42 miles below Fort Benton] there was more timber and at the Marias, they were into many cottonwoods."

While floods are necessary for cottonwoods to have a good start, it takes more than high water to grow a big tree. Winter ice and summer cattle grazing are tough on the young plants. "We think that ice is limiting how close they can grow to the river," Scott says. The term is ice scouring. On the Missouri, ice jams build up each winter. Like an SOS cleaning pad, they have the potential to scour the river banks clean. Mature trees can be pushed over by an ice jam; survivors show gouges and cuts from ice. Seedlings don't stand a chance.

Cattle grazing along the riverbanks in summer also can reduce seedling survival. The USGS team, in cooperation with the Bureau of Land Management (BLM), is including grazing in its cottonwood regeneration study. The BLM administers both recreation and grazing on the Wild and Scenic Missouri.

Joe Frazier, hydrologist with the BLM in Lewistown, feels that grazing does play a role in limiting cottonwoods along this section of river. "For generations," he says, "ranchers and farmers have grown wheat, barley, or hay on the uplands and grazed the rough breaks along the river during summer. Because the breaks are so steep and rugged, about the only water source for their livestock is the river itself. The cattle typically spend summer next to the river trampling and eating the vegetation until they are moved back to the uplands after the fall harvest."

Ice, floods, drought, dams, disease, and summer grazing are all taking their toll on the cottonwoods, willows, and other riparian species, says Frazier. "Our data show a huge difference between ungrazed areas or those with winter use only and those with continual summer use. Seedlings are established every year, but in summer-grazed areas they never grow to the sapling or pole stage." Frazier fears that hunters, floaters, ranchers, and birdwatchers are all facing an extended period when there will be virtually no mature trees.

What is a riverbank with fewer cottonwoods? On a morning in mid-May at Woodhawk Landing about 20 miles upstream from Fred Robinson Bridge, Frazier posed the question in a statement: "Close your eyes and listen." Then block out the orioles, yellow-rumped warblers, rufous-sided towhees, yellow warblers, and house wrens.

Silence is not a pretty sight.

But birds are not the only beneficiaries of cottonwoods. For hundreds of years, we have relied on them for fuel, forage, medicine, shelter, shade, and comfort. Today, despite the grumblings of suburbanites, we all benefit directly or indirectly from these hardy, drought-resistant trees. Perhaps it's time to give cottonwoods the respect they deserve. ■

RIPARIAN AREAS and cottonwoods will be the focus of a symposium sponsored by the Society of Wetland Scientists (SWS) at Montana State University in Bozeman June 3 to June 5. For registration information call MSU conference services at (406) 994-3333. For the complete agenda or to register electronically, use the SWS home page at *http://www.sws.org*

DUSAN SMETANA

White-tailed deer emerge from cottonwood groves to feed in adjoining fields, but retreat to the shelter of the trees when danger threatens.

A Gathering of

by DENNIS FLATH

AT MONO LAKE in Inyo County, California, an estimated 800,000 eared grebes arrive each September to feed on an enormous population of brine shrimp. Migrating at night, flocks of grebes slip in under cover of darkness, building to a density that blackens the lake's 60-square-mile surface. It's one of the most impressive concentrations of a single wildlife species in the West.

Some biologists believe this gathering may represent up to 25% of the eared grebes in North America. Their presence in such numbers, not surprisingly, draws birders from near and far. Then in November and December the grebes begin to leave, disappearing at night as mysteriously as they came, continuing on to wintering areas in Mexico and Central America.

Grebes are a unique group of birds, adapted to a way of life that is thoroughly dependent on water. Worldwide there are 21 species. Seven of those occur in North America, with six found in Montana. Three of Montana's species, the eared, horned, and red-necked grebes, also occur in Europe and Asia.

Relatively little is known about grebes. In perusing the literature, one often finds the term "mystery" associated with them. Perhaps it is partly because many species are secretive and difficult to study, or because they spend so much time underwater where we can't see them. The eared grebe is the most common and familiar member of the grebe family found in Montana and the United States. Thus, by default, we possess better knowledge of this species than the others.

BELOW: *To protect them from predators, grebe chicks are brooded on their parents' backs until they are several weeks old. More than 100 pairs of red-necked grebes nest each summer at Georgetown Lake near Anaconda.*

KEITH A. SZAFRANSKI

RIGHT: *At Freezout Lake Wildlife Management Area west of Great Falls, eared grebes tread water in a "penguin dance" mating display.*