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It appears to human beings who scurry around its surface that the land doesn’t change all that much.

We even base clichés on that notion: someone is solid as a rock; something is etched in stone.

But spend a while talking with USU soil scientist Janis Boettinger and you can begin to see mountains moving and horizons shifting. Turns out rock is plastic and constantly changing.

“There are hundreds of thousands of kinds of soil and they are cycling and evolving right along with us,” Boettinger says. “Soil is not a bunch of dirt. It’s the interface between the biological and the physical world. It’s tied to everything.”

Exposed surfaces of rocks, gravel, sand and silt particles are always being scoured by chemical and physical weathering. Boettinger says soil is a product of a combination of factors: climate, type of parent material, the slope of the land, the type and number of plants and animals and time.

All the factors combined can make the soil in one person’s farm or garden unlike soil of the field or garden next to it. The soil at the top of a field can be much different than the soil at the bottom. Because of that wide variance in soil types, soil surveys are taken and retaken. Those surveys amount to mankind’s accumulated knowledge about the adaptability of plants and soil management.

The more accurate the soil map, the better the farmer or gardener understands what the soil needs and the better the crop.
Brunger is a pedologist, which means she studies the soil as a natural member of the landscape that should be monitored and researched.

The largest factor in the construction of the landscape along the Wasatch Front in Utah was prehistoric Lake Bonneville (See page 19 for a map of ancient Lake Bonneville). All of the major cities in Utah sit on deltas of that once vast body of water. Cache Valley was a big bay of Lake Bonneville.

What that means today is some areas (ancient deltas) have soils with high rock fragment content and no bedrock, Boettinger says, while some benches and valley floors have no rock fragments. There are a lot of fine sands and silt deposits that give the area very low sheen strength and contribute to the "perpetual slumping" or slipping and falling of soil materials.

Bit by bit, season after season, rock is constantly flaking away under the stresses of physical weathering—water, wind, heat and cold and from the rock's own physical make-up.

Look at rock of any kind, including man-made concrete, and the expansion force of freezing water is evident. As water freezes it can exert a pressure of 150 tons per square foot. Freezing and thawing certain times of the year can almost chip away stone as if someone were taking a jackhammer to it every day.

On any hike into the hills, there is evidence of thin layers of rock being exfoliated by heating and cooling, a process that can eventually make a jagged rock round.

Change is constantly under way beneath the surface, as well as in a process Boettinger calls "exfoliation." Unloading of overlying rock by erosion initiates the process of exfoliation in the underlying rock. If heavy layers of sediment are removed through erosion or other changes, the rock beneath it will expand much like teeth will shift after a tooth is pulled (exfoliation). Cracks and fissures appear, and chemical reactions occur and tree roots can often penetrate through the pathways created by unloading and further split the rock (also exfoliation).

Above: The chemical and physical processes of weathering transforms the average igneous rock into sand, silt, and clay particles and dissolved salts.
Below: The geologic cycle: (A) A mass of molten rock rises slowly toward the surface and cools and solidifies. (B) Over millions of years the hard rock reaches the surface as erosion removes the overlying materials. (C) Over additional millions of years the mountains are worn away, forming parent material for sedimentary soils. Sediments that are ultimately deposited in the ocean become parent material for new sedimentary rocks. (D) The sediments that end up in the ocean are either uplifted as sedimentary rocks or subducted to provide the magma for new igneous rocks.
Plants send roots down, bring up water and nutrients, take in carbon dioxide from the air, synthesize food using sunlight. Their fallen leaves and other dead parts become food for small animals, fungi and bacteria in the soil. As they consume the organic matter, part of the minerals and nitrogen in it is released to the soil for other plants, part is sometimes leached down or out of the soil with rain or by irrigation.

Animals that dig can further reduce the size of rocks, as does the grinding action of moving rock and soil particles against each other. Wet and dry weather makes soils swell and contract, causing abrasion that further pulverizes the particles.

One of the most important ways rocks are eaten away is chemical weathering through hydrolysis, a process analogous to the way we digest food. The food material takes up water and then is broken down into its chemical components. Similarly, minerals in rocks essentially dissolve and break down into their chemical components.

Boettinger says even though people might think scientists must know everything about soil by now—"After all, dirt's been around a long time"—it has a lot of characteristics beyond its observable features and it is constantly being altered.

Qualities such as fertility, erosion risk and productivity can't be completely measured in the lab but must be inferred from a combination of history and other indirect factors.

In studying a given soil, the thickness and depth of each horizon are measured, and laboratory samples are taken. (See related story, page 5.) To interpret the observations and measurements, however, factors such as the whole soil profile, the shape of the soil body, the environment and the relationship of the one soil to its neighbors must be considered.

Plus there are hundreds of thousands of kinds of soil, each with a unique combination of characteristics. Soil types are not limited to specific countries or continents. That's why scientists at USU, for example, can be consulted about soil problems in other arid and semi-arid regions of the world such as eastern Africa, Boettinger says.

In addition, human manipulation of the soil, which can be good or bad, must be factored in. JT

**MORE INFO**

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The long-term effects of one kind of human manipulation of soil—irrigation—has not been well documented, especially its effects in salty soils prevalent in Utah.

But a group of USU soil scientists, Janis Boettinger, Lynn Dudley, and Jeanette Norton, are monitoring a catena of soils in Castle Dale, Emery County, Utah, a portion of which is saturated by irrigation water every summer.

The Emery County site involves four soils. One is naturally dry, another is strongly saline soil that is saturated for part of the growing season, as well as two soils on the lower slope that are less saline but saturated for longer periods of time.

Because the ditch and other unlined canals in Emery County are scheduled be enclosed in pipes in the next two to three years, the group will continue to take weekly and biweekly measurements of chemical properties to track the change in soil and microbiological properties. Some measurements such as redox potential and soil temperature are taken every 2 hours, automatically monitored with data loggers. Measurements such as watertable depth, pH, and electrical conductivity are taken biweekly.

Irrigation-caused wetlands, or hydric soils as scientists call them, are difficult to identify consistently. That's why alternative indicators of potentially hydric soils that are artificially irrigated and salinized are needed.

Wetlands are important sites of research right now because they have been shown to be excellent filters of heavy metals and other environmental pollutants. Wetlands facilitate settling of suspended solids and enhance nutrient uptake. (See story on page 6.)

It's another way soils, if managed well, can act as environment filters, says Dr. Paul Grossl, a USU biogeochemist who this past summer, together with Joan McLean of the Utah Water Research Lab, started monitoring an abandoned mine site along the North Fork of the American Fork River. They are investigating the use of natural wetlands to prevent lead, cadmium, arsenic and other toxic metals from finding their way into the river.

His previous research indicates that plants can absorb metals and fare well despite high concentrations.

Grossl and McLean have been studying metal-extracting plants that might be suitable for "mining" metals from the low-grade waste ores, as well as reclaiming metal-contaminated sites. JT
Cleaning up Soil

Several types of plants can accumulate relatively large amounts of harmful metals, such as nickel, copper and cobalt. Nevertheless, most of the so-called "hyperaccumulators" are not suited to Utah’s climate.

Soil chemist Paul Grossi has been working with a mustard plant, *Streptanthus polygaloides*, that can accumulate an equivalent of 50-100 pounds per acre. That would make it possible to harvest and burn plants and thereby reclaim the nickel stored in them.

Grossi says although the plants could one day be a useful though unusual cash crop, that "one day" is several years away.

Grossi says he thinks the plants might be most useful in extracting metals from low-grade waste ore.

The problem of harvesting plants on metal-contaminated sites until enough of the metals are removed to meet regulatory standards is compounded in the western United States because the region’s soils are alkaline and thus metals are less absorbable.

Grossi is also studying the ability in some plant roots to release chemicals that immobilize metals and prevent their movement through water. JT

Wet Soil

Although farmers and government agencies have built wetlands to treat waste and urban runoff, wetlands have not been evaluated for agricultural runoff.

Agriculture is acknowledged as a major contributor of nonpoint source pollution in surface waters. Designing a wetland for such applications are not available because the effectiveness of wetlands in mitigating agricultural runoff is not well defined.

To better predict the behavior of such complex systems under various conditions, the fundamental processes that drive wetland functions must be more fully understood.

The Texas Agricultural Experiment Station in Stephenville, Texas, is developing a wetland research facility. The project site is a tributary of the North Bosque River, which is known to be impacted by agricultural pollution. The river has shown elevated nutrient concentration, high oxygen demands and the presence of parasitic protozoa.

The Texas facility will provide much-needed data on the function of man-made wetlands in regard to agriculture. They are low-cost and fairly low-maintenance, but the performance of wetlands in different situations in not well understood.

Upon completion, the research site will include six field-scale wetland cells, 20 feet by 90 feet, and three wetland ponds each having a surface area of 3 to 4.5 acres. The wetlands receive water from a 1,700-acre watershed that contains a dairy, 500 acres of row crops, and a cheese plant. JT

—Source: Texas Agricultural Experiment Station

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Eating Dirt
by Brian Doyle

I have a small daughter and two smaller sons, twins. They are all three in our minuscule garden at the moment, my sons eating dirt as fast as they can get it off the planet and down their gullets. They are two years old, they were seized with dirt-fever an instant ago, and as admirably direct and forceful young men, quick to act, true sons of the West, they are going to eat some dirt, boy, and you’d better step aside.

My daughter and I step aside.

The boys are eating so much dirt so fast that much of it is missing their maws and sliding down their chicken chests. It is thick moist dirt, slightly more solid than liquid. I watch a handful as it travels toward the sun. It’s rich brown stuff, almost black, crumbly. There are a couple of tiny pebbles, the thin lacy bones of a former leaf (hawthorn?), the end of a worm, the tiny green elbows of bean sprouts. I watch with interest as Son Two inserts the dirt, chews meditatively, emits the wriggling worm, stares at it—and eats it again.

“Dad, they’re eating the garden,” says my daughter.

So they are. I’ll stop them soon, but for this rare minute in life we are all absorbed by dirt, our faces to the ground, and I feel that there’s something simple and true going on here, some lesson they should absorb, and so I let them absorb it. In spades.

Eventually my sons, filled with fill, turn their attentions to the other vigorous denizens of the garden; bamboo, beetles, blackberry, carrots, dockweed, cedars, camellias, dandelions, garlic, hawthorn, jays, moles, shrews, slugs, snails, spiders, squirrels—all made of dirt, directly or indirectly. As are mugs, vases, clothes, houses, books, magazines. We breathe dirt suspended in the air, we crunch it between our teeth on spinach leaves and fresh carrots, we wear it in the lines of our hands and the folds of our faces. We catch it in the linings of our noses and eyes and ears. We swim in an ocean of dirt, yet we hardly ever consider it closely, except to plumb it for its treasures, or to furrow it for seed, or banish it from our persons, clothes, houses.
I am hardly handy about the house and garden, and spend my hours on other matters, but enough of me feels responsible for the dirt that surrounds my home that I have often regretted the general abandonment of my garden, and felt a certain guilt that it is not productive, that the land lays fallow. But now, cradling my daughter, grinning at the mud monkeys, I see that the garden is itself hard at work, hatching honey ants and potato bugs, propelling bamboo and beans into the air, serving as a grocery store for shrews. I imagine it in one of those sped-up film clips, madly roiling with animals and plants, the sun and rain baking and hammering it at a terrific pace, the banks of clouds sliding over like vast battleships.

Such busy dirt.

The children tire, the sun retreats, in we go to baths and beds. I wash the garden off my sons. It swirls down the bath-drain, into the river, eventually to the ocean. So some of my garden ends up as silt, some sinks to the ocean floor, some becomes kelp and sea otters, some is drawn up again into rain; and maybe some returns to the garden, after an unimaginable vacation.

My daughter and I discuss dirt journeys.

And when the rain begins that evening, the first of the rains that define fall and winter here, she and I draw a map for our dirt, so that it will know how to come home, and we leave the map on the back porch for the dirt to read.

“Maybe there are dirt fairies,” says my daughter. “Or maybe the dirt can read. Who knows?”

Maybe my daughter is right about this. Maybe the dirt can read. Certainly, in a real sense, the dirt can write: Consider, for example, this essay, made by dirt worked in wondrous ways into bone, blood, protein, water and a heartbeat. So grizzled dirt leans against a fence with lovely dirt in his lap, and watches dirt demons devour dirt, and the world spins in its miraculous mysterious circles, dust unto dust.

Such busy dirt, such a blizzard of blessings.

Brian Doyle is editor of Portland magazine, University of Portland, Oregon.
RECENT GRANTS AND CONTRACTS

Howard Deer, Animal, Dairy and Veterinary Sciences, is coordinating Utah’s involvement in the USDA’s National Agricultural Pesticide Impact Assessment Program.

Paul Grossl, Plants, Soils and Biometeorology, is studying the chemical and physical stability of calcareous sands used for putting green construction. Washington State University is underwriting the research. Grossl also has Sandia National funding to determine the effect of electrochemical reduction and soluble organic matter on the bioavailability of trace minerals.

Quinn Weninger, Economics, is part of a study underwritten by Virginia Polytechnic to study vertical market structure, conduct and performance in agriculture.

Sherman Thomson, Biology, is studying fire blight in nurseries for the Washington State Department of Agriculture.

Bart Weimer, Nutrition and Food Sciences, is conducting tests on food contaminant detection and extraction for Cultor Food Science.

Allen Rasmussen, Rangeland Resources, has EPA funding for upland, riparian and stream condition monitoring in intermediate size watersheds.

Donald Jensen, Utah Climate Center, is developing site-specific spillway evaluations for the Utah Department of Water Resources.

Dale Barnard, Animal, Dairy and Veterinary Sciences, is studying control of aleutian disease in mink for the Utah Mink Farmers Association.

Diane Alston, Biology, is studying the biology and management of plum curculio in Northern Utah for the state Department of Agriculture.

Frank Messina, Biology, is looking at potential pollinators of two rare astragalus species in Washington County, Utah, for the BLM.

Paul Rasmussen, Experiment Station, and Lynn James, ARS, are looking at toxic plant productivity and persistence in renovated and irrigated pastures. The USDA is funding the research.

NEW FACULTY

Jill Webster, most recently at Iowa State University and who has researched high school students’ knowledge of college-level animal science, has been hired as an assistant professor in the Agricultural Technology and Education Department.

Paul Johnson, formerly a research assistant professor and project coordinator in the horticulture department at the University of Nebraska, Lincoln, has been hired as an assistant professor in Plants, Soils and Biometeorology.

Lynn Hunnicutt, formerly of Southern Methodist University in Dallas and an industrial organization and international trade researcher, has been hired as an assistant professor in Economics.

Kevin Huang, who specializes in financial economics and macroeconomics and was formerly with the University of Minnesota, Twin Cities, has been hired as an assistant professor in Economics.

Keith Criddle, formerly acting director of the University of Alaska Fairbanks’ School of Management, has been hired as Economics department head.

Tiffany Julen Day, an assistant lecturer on equine care and behavior at Texas A&M, has been hired as an assistant professor by Animal, Dairy and Veterinary Sciences.

Dale Zobell, a regional beef Extension Specialist in Alberta, Canada, has been hired as an assistant professor in Animal, Dairy and Veterinary Sciences.
ADVIS PROFESSOR RECEIVES HONORS

USU Animal, Dairy and Veterinary Sciences Professor Noelle Cockett has garnered more recognition for her work.

This past summer, she received the 1998 Young Scientist Award for the Western Section of the American Society of Animal Science.

She was also renamed Coordinator for the Sheep Genome Project under the National Animal Genome Research Program for 1998 through 2003.

The American Society for Animal Science (ASAS) has roughly 3,500 members, most of which are faculty in animal science or scientists at USDA research facilities.

The mission of ASAS is to "advance animal sciences research and education through the exchange of scientific and technical information and applications to animal agriculture, public policy and public understanding."

The main functions of ASAS are to publish the Journal of Animal Science and coordinate a national annual meeting each year.

OLD TRADITION HAS SCIENTIFIC BASIS

A generations-old practice among Navajos to add juniper ash to food apparently has as much to do with maintaining good health as with keeping tradition alive, new research shows.

No one knows for sure whether using juniper ash as food flavoring happened by accident or on purpose. Nevertheless, doing so makes up for an inherent lack of calcium in the diets of many Navajos in the Four Corners area of the Southwest, according to research conducted by four USU faculty members and published this spring in the Journal of the American Dietetic Association.

The researchers report that ash is a good source of dietary calcium and iron, and is a moderately good source of magnesium as well.

One teaspoon of juniper ash is roughly equivalent to the calcium in one cup of milk, according to the study, which was conducted by
Nedra Christensen, Ann Sorenson, Deloy Hendricks and Ronald Munger, all professors in the USU Nutrition and Food Sciences Department. A teaspoon of ash also supplies 28 percent of the federal government’s recommended daily allowance (RDA) for iron, and 9 percent of the RDA for magnesium, the research shows.

Dr. Sorenson says that the study addresses a consistent concern among the USU Extension personnel that help senior citizen program directors and staff at Navajo chapters in Northern Arizona and Southern Utah—that many clients refuse milk, a good source of calcium and other nutrients.

Extension personnel noticed that many chapter cooks were adding juniper ash to cornbread and cornmeal cereal, Dr. Sorenson says. “So we wondered how the nutritional qualities of the menus would compare if we eliminated milk.”

Low calcium intake is one of several factors associated with osteoporosis. Lack of calcium might also increase risk for high blood pressure, stroke and colon cancer.

Ash is not only used as flavoring in a variety of food products, it is used in traditional ceremonies and healing rituals, including a sacred cleansing ceremony. It is also made into a tea and consumed for diarrhea or stomach ailments, and as a heat therapy for healing injured muscles. The ash is from burned branches and needles from the juniper tree.

Technically speaking, the burning process results in the calcium oxide form of calcium. Calcium oxide has a high solubility in water and is easily absorbed in the small intestine.

The ash doesn’t add particularly noticeable flavors to the food, Sorenson says, although it adds a noticeably gritty quality to the cornbread.

The authors note in their report that ash has an obvious important role in the Navajo diet. They advise dietitians to be aware of the contribution of alternative foods in the diet when analyzing menus and making recommendations for dietary improvements.

A diet similar to the traditional Navajo diet that is low in dairy products—the major calcium source in most diets—could fail to meet nutrition needs unless nutrients provided by milk products are supplied by other sources, the authors state.

“As nutrition experts, dietitians have a responsibility to create and recommend balanced and healthful menus while respecting the cultural needs and mores of the populations they are serving.”

Whether it happened by accident or on purpose, scientists can’t say. But Navajo’s in Southern Utah have been adding juniper ash to their diets to make up for lack of dairy products and calcium.

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In an effort to emphasize the diversity and functions of the soil food web, the Soil Quality Institute of Natural Resources Conservation Service is preparing a "Soil Biology Primer" scheduled to be available this fall to NRCS field staff and others.

The objectives of the primer are to help people understand the diversity of organisms in the soil, appreciate the importance of the functions they perform and to consider the soil community when making management decisions.

The early units of the primer describe the nature and functions of the major groups of organisms. Later units will discuss applied soil biology topics such as the effects of management practices on food web activity, the mycorrhizal relationship, nitrogen cycling, global climate change and monitoring of soil biology.

Soil ecologist Elaine Ingham and soil entomologist Andrew Moldenke, Oregon State University, and Clive Edwards, earthworm ecologist, The Ohio State University, as well as numerous other scientists have contributed to the primer. JT

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EVERYBODY IS SOMEBODY'S NEIGHBOR

Development in formerly rural, agricultural areas is placing increased pressures on watersheds. The growth in developed land and specifically urban and suburban land has natural resource implications far beyond loss of productive agricultural land. With development comes paved surfaces, automobile traffic, and residential chemical use, among others.

SEPTIC SEEP
Like a full sponge, aging septic drain fields that treat sewage by slow filtration, and overloaded sludge-holding tanks can leak bacteria, nitrates, and liquid poisons into groundwater. Homeowners with septic systems can reduce this risk by pumping tanks regularly and avoid introducing solvents or other potential pollutants into the septic system.

ON THE FARM
As suburban sprawl intensifies, farm numbers are dwindling in many formerly rural watersheds. Remaining farms can help protect the watershed by improving pesticide and nutrient management, fencing livestock away from streams, and making use of natural predators in pest control to reduce pesticide use.

LEAKY BUFFERS
Lacking a cushion of wetlands, streams can still be partly shielded from runoff and sediments. Setbacks from lakes and creeks and planting of waterside shrubs and other vegetation can help to trap sediment, slow flow, and provide shade and wildlife habitat.

URBAN Ooze
As fields are paved for roads and parking lots, rainfall moves faster off the land. This torrent picks up debris and pollutants and can cause flooding, scour riverbanks, and prevent the slow filtration of water needed to recharge groundwater.

CONSTRUCTION
Soil erosion from development can be controlled with filter fences and water diversions, or trapped in sediment basins. Protective buffers can be planted or existing waterside vegetation maintained to further reduce sediment loss to nearby streams and rivers.

FORESTS
Logging can cause serious sediment problems for streams. Soil erosion from clear cut slopes and access roads can contribute large amounts of sediment to nearby streams and rivers. Greenways along streams and cutting practices that leave tree roots in the soil can help to trap sediment.

SEDIMENT TRAPS
Large development sites can install sediment traps that catch stormwater and control runoff. Ponds may be twotiered: one with an impervious lining to settle out sediment and potential pollutants and another that promotes slow infiltration of rainwater into the aquifer. Sediment ponds may also provide habitat for certain waterfowl species.
The land is never not on Pat Shea's mind.

On any spot he stands and in almost any direction you'd care to point, he sees land he's responsible for—264 million acres all told.

Shea has spent his first year as director of the U.S. Bureau of Land Management getting a notion of what that much land feels like. It's big, he says, and managing the public's land well is a big deal to him, Shea told an audience of western U.S. ag science research and Extension administrators and directors who met in July in Park City.

The meeting, hosted by the USU College of Agriculture, gave Shea a chance to set down his priorities and talk about his big picture for administrators of scientific research programs that are vitally linked to the land.

Shea said his agency's top three priorities are: to promote sound multiple use of the public lands to apply the best science and technology available in managing those lands and to be a good neighbor to the communities in which we work.

To be an effective steward of 264 million acres, the BLM knows it cannot carry out its complex mission of both development and conservation of public land resources by itself, Shea said, noting that the agency will have to work in partnership with public and private organizations.

"The BLM's partnerships with academic institutions are particularly important in the application of the best available science and technology," he said.

Shea said his agency is proud of its partnerships with state universities and land-grant colleges, "whose formation underscores the high regard that America has always had for agriculture—the art, science, and business of cultivating the land."

Congress paid high tribute to agriculture when it established America's land-grant colleges through the Morrill Act of 1862, Shea said. Part of the language of the act reads: "...to teach such branches of learning as are related to agriculture and the mechanic arts...in order to promote the liberal and practical education of the industrial classes."

The education of the "industrial classes" meant, in effect, that higher education should be open to all people, and not merely to the well-to-do, which until then had characterized the educational system that America inherited from England, Shea said. "That's why America's state and land-grant universities have been called 'uniquely American institutions' and 'people's universities' that 'represent a revolution in education philosophy.'"

One of the ongoing debates in agriculture is whether America's food production has become too concentrated in the hands of a few agribusinesses, Shea said.

A special report from the Department of Agriculture's National Commission on Small Farms earlier this year noted that farmers comprise only 2.9 percent of the labor force. But while technological advancements have made it possible for such a small percent of America's workforce to supply the country's food, any bona fide farming operation must operate as efficiently as possible," Shea said.
"As we look ahead to the role that small farms will play in our economy and the steps that we can take to help them survive, I urge you to take full advantage of your alumni networks. You have a wealth of talent and good will upon which you can rely. I urge you to put that resource to work to help the small agricultural interest maintain their edge."

Research will play a key role in the future of both small and large agricultural interest, Shea said. America must and will turn for that research to its institutions of higher learning, including the state and land-grant universities.

“That is why it is so important for this and all academic research to be an unfettered quest for the Holy Grail of truth," he said. “The last thing that American agriculture or any U.S. industry need is research on less relevant but safer topics.”

Shea is the 15th director of the 51-year-old BLM. The agency has an annual budget of more than $1 billion, and a workforce of about 9,000. In addition to practicing law in Salt Lake City and the District of Columbia, Shea is an adjunct professor of political science at the Brigham Young University Law School.

In mapping out what’s ahead for the agency, Shea mentioned several research projects now under way.

He said in an effort to control the number of wild horses and burros that roam the public lands, the BLM has used immunocontraception in five herd management areas in Nevada. He noted that while Americans adopted more than 8,500 of the animals in 1997, overpopulation remains a problem. He said that 43,000 wild horses and burros live on the public lands, or about 16,500 more than the BLM thinks the land can handle.

Shea said the BLM is also working with government agencies and universities to stop the spread of noxious weeds, which have infested about 10 percent of the land under federal management in the West.

The BLM has an agreement with USU for biological control research on Canadian thistle in riparian areas, and on knapweed in the Tintic area. In Montana, the BLM is supporting research by Colorado State University to develop effective, environmentally sound leafy spurge management, including the use of sheep, biological control agents and herbicides.

“The bottom line is that western wildlands and deserts are a vital part of America’s natural heritage, and we must protect them from destruction by invasive weeds.”

The BLM and four other Department of Interior agencies and the U.S. Forest Service have recently formed a Joint Fire Science Program to advance the use of science in wildland fire management.
Shea said the scientific focus is taking place in the framework of Interior Secretary Bruce Babbitt's "Fight Fire With Fire" policy that recognizes the vital, beneficial role fire plays in nature.

Past policy emphasized fire suppression "to the point that it produced an unhealthy buildup of vegetative fuel, causing wildland fires to burn bigger, hotter and faster," Shea said.

The BLM is underwriting fire-related research at the Shrub Sciences Lab in Provo, the Squaw Butte Experiment Station in Oregon, the University of Idaho, USU and other universities and stations.

Shea said his agency has formed a National Riparian Service Team, which is comprised of BLM employees, the Forest Service and the Natural Resources Conservation Service, to apply research to restoring riparian-wetland areas.

Much of that land, which amounts to 8 percent of the land under BLM purview, are not functioning properly because of intensive upland watershed uses, increased water diversions, the movement and deposition of runoff pollutants and the effects of poorly designed or maintained roads.

This past April, the BLM established a Science Advisory Board to help the agency improve the use of science and technology research in managing public lands. The five-member board is coordinated by Dr. Raymond Gesteland, chairman of the University of Utah's Department of Human Genetics, 801-581-5190. JT
HELPING THE SOIL STAY PUT

Farmers get their soils from the natural composting of organic life and land from the passing ages.

They also have available arable soils that have been made better or poorer through use.

Making soils better—not poorer—through use is the heart of soil conservation, and at the heart of conservation is Sustainable Agriculture and Research Education (SARE), a USDA program first authorized by the 1985 farm bill.

SARE began funding competitive research 10 years ago and has underwritten about 1,200 projects totaling $80.6 million.

Dr. Philip Rasmussen, who directs the largest and most diverse region of SARE, says the purpose of the program is essentially to “trade food of ages past for food today.”

Rasmussen, a soil scientist who is also head of the USU Department of Plants, Soils and Biometeorology, says sustainable agriculture is a concept that focuses as much on putting nutrients back into the soil as it is on increasing the crop production that takes them out.

The program literally tries to ensure that the nation’s and the U.S. Island Protectorates such as Micronesia and American Samoa stay a step ahead of a famine, Rasmussen says. “Pests and diseases are evolving right along with us, and we can’t ever be off guard.”

Rasmussen says Americans have gotten so used to having an abundance of food that many don’t realize that well-stocked grocery stores don’t happen simply by good fortune.

Abundant crops don’t grow on trees, and Americans would do well to think about that from time to time, Rasmussen says, noting scientists estimate that the country’s supply of grain would only last two months in a famine. “Fortunately, nature hasn’t yet forced us to find out.”

Many of today’s farmers and ranchers practice a type of agriculture that is far different from how their grandpar-
ents or even their parents worked the land, he says. Change is the way it has been and the way it will always be, Rasmussen says, noting that early farmers such as George Washington and Thomas Jefferson recognized that the search for alternative methods to constantly improve agriculture was how to sustain agriculture.

Jefferson toyed with making a better kind of plow. Nowadays, many farmers practice reduced tillage or “no-till” methods to prevent loss of soil due to wind and water erosion.

SARE has the long-term, three-pronged aspect of agriculture: farm profitability, environmental stewardship and quality of life, Rasmussen says. The program doesn’t promote a set of agriculture practices, but challenges producers to think about the long-term implications of practices and the broad interactions and dynamics of agricultural systems.

The program invites consumers to get more involved in agriculture by learning more about and becoming active participants in their food systems, he says.

And according to SARE’s mission statement, it is also trying to develop an understanding of agriculture from an ecological perspective in terms of nutrient and energy dynamics, and interactions among plants, animals, insects and other organisms in agroecosystems—then balance it with profit, community and consumer needs.

The program recognizes that farming methods that improve sustainability in one area might not work on another. One that is being utilized in several regions to reduce the guesswork is the use of satellite communications.

With a small machinery mounted dish and tapping into the Global Positioning System of orbiting satellites, a farmer can pinpoint within inches a position on a map. By then combining location with computerized geographic information systems that have mapped specific soil types down to the foot, a farmer can determine exactly the amount of water, pesticide and fertilizer to use.

Abundant crops don’t grow on trees, and Americans would do well to think about that from time to time, Rasmussen says, noting scientists estimate that the country’s supply of grain would only last two months in a famine. “Fortunately, nature hasn’t yet forced us to find out.”

The process involves hardware and software purchases, but Rasmussen says the recent boom in computers and other electronics is making farmers less hesitant to use new technology.

He adds that one of the most important pieces of software in precision agriculture is the individual farmer’s mind.

“The farmer’s own history of yields over the years combined with what the information the technology can allow them to manage smaller areas within a field and literally farm the specific soil, not the whole field.”

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The Utah Agricultural Experiment Station 17
SOIL ON THE MOVE

The dust bowl of the 1930s will be forever associated with The Grapes of Wrath. Images of migrant people leaving the blowing, lifeless soil they had once farmed in the Midwest, and their struggles to start new lives and new farms in California.

"They talked of the land behind them," John Steinbeck wrote of the conversations in the migrant camps. "I don't know what it's coming to, they said. The country's spoilt. ...Maybe, they thought, maybe we sinned some way we didn't know about."

The "sin" was no more than plowing the land and leaving bare, fallow fields for dryland farming and a series of drought years. The combination proved too much for soils that had formerly been kept moist and in place by thick mats of native prairie grasses.

USU soils scientist Janis Boettinger says the Midwest's silty soils, which are formed in a wind-blown parent material called loess, are very susceptible to being transported by nature's moving crew—wind and water. It's unlikely the soils would have remained stable over time. But geological change typically requires measurement in millennia and eons rather than years or even decades.

As they pushed plows, humans also pushed the geological time clock until the dry, minuscule particles of soil were unable to support crops. The fine soils that cover much of the Midwest and many other regions of the
The reach of ancient Lake Bonneville.

United States are the remnants of rocks and boulders that were ground up by ancient, moving glaciers. The bits of rock were carried away by water from the melting ice and settled where the currents slowed. The wind then picked up, transported and deposited the silt-size particles.

In the Intermountain West, ancient lakes filled valleys while there were glaciers in the mountains. Boettinger says Lake Bonneville left vast areas of Utah's mountain valleys covered with silt and clay particles like those that filled the dust bowl.

"Ancient lakes like Lake Bonneville, the mother of all Pleistocene, pluvial lakes, are huge sources of silt-size sediment," Boettinger says. "Our dry environment means our soils are naturally more susceptible to movement by wind. Consequently, we have a lot of dust in Utah."

And like the farmers who fled the dust bowl, Utahns have also accelerated nature's time clock by clearing even the plant stubble from plots for dryland crops.

Boettinger says the results can easily be seen in areas that have been clear-cultivated, especially during fallow periods when the ground is left bare to recharge its water supply. Where the tops of hills appear almost white, and lower-lying areas are dark, wind and water have been at work moving fertile topsoil downhill until the hilltops produce very little.

"Some places are so badly eroded that the pale, poor soil exposed at the top is moving down and covering the topsoil that had already settled, Boettinger says.

Dust is a generic term for any kind of windblown sediment. In Utah, Boettinger says, it usually refers to silt-sized particles which a soils scientist would classify as particles from 2 to 50 micrometers. Slightly larger particles, which can be seen individually with the unaided eye, are considered sand and are also susceptible to being blown or washed away. Clay soil particles are smaller than two micrometers.
Boettiger also saw a vivid demonstration of just how large an area blowing dust can affect when dust from the Sahara Desert clouded the air when she visited Spain.

"On certain days there was so much silt from the Sahara that it was like looking at everything through a veil," Boettiger says. "The Sahara has gotten larger. At its margins the semi-arid savannah has been cleared due to overgrazing, population pressures and reduced plant cover. Once that happens the land is very difficult to restore."

Locally, agricultural practices are just one source of dust, she says. The equipment Utahns have become familiar with during months of intensive road and building construction churn up tremendous clouds of dust.

"We pride ourselves in Utah on great community spirit and community values," Boettiger says. "It's time we decide as communities whether we value clean air and good soil, whether we want to lose prime agricultural land to development and push agriculture on to marginal land. We need to look at places that have experienced this kind of growth and decide what we want Utah to look like."

by Lynnette Harris
UAES Information Office
If USU Extension Soils Specialist Rich Koenig had to pick the single most prevalent fertility problem he deals with, it would be iron deficiency.

Iron isn’t lacking in the soils here; it is abundant in fact, Koenig says. The problem is that a convergence of soil conditions and chemical reactions render the iron unavailable to many plants.

The most noticeable symptom of iron chlorosis is a bright yellow leaf with dark green veins. (See photos at right.) Yellow leaves indicate a lack of chlorophyll, the green pigment responsible for photosynthesis (sugar production) in plants. Any reduction in chlorophyll during the growing season can reduce plant growth and vigor.

In severe cases, leaves turn yellow or white, and the outer edges can scorch and turn brown as plant cells die.

Koenig says it is common for individual branches to be affected. In many silver maples, for example, part of the tree will appear normal while part will be infested with bright yellow leaves.

The causes of iron chlorosis are not completely understood, although scientists know that in soils common in Utah, iron rapidly forms solids in combination with oxygen, and hydroxide and carbonate ions, and becomes insoluble in the process and cannot be absorbed by plant roots.

Koenig says many home gardeners have tried to correct the problem by adding iron to the soil. Iron shavings or rusty nails only turn into unabsorbable solids.

Chlorosis is often more severe where topsoil has been removed by erosion, land leveling for irrigation, or for new housing developments.

The best way to control iron chlorosis is don’t pick plant species and cultivars that are susceptible to iron deficiency. Trees and shrubs that often turn chlorotic are red maple, silver maple, pin oak, sweetgum, dawn redwood, amur maple, bumal spirea, azalea, rhododendron

For a complete list, contact the USU Extension agent in your local county.

One way to help control iron chlorosis is to avoid saturated soil conditions, Koenig says. Reduce watering or install drainage systems. Aerating compacted areas around the base of affected vegetation can help, and avoid using plastic sheeting as a mulch for susceptible plants. Sheeting will prevent oxygen movement into the soil, he says.

The main thing to keep in mind in dealing with chlorosis or any other soil deficiency is that the ground is not lifeless, Koenig says. “We have a tendency to think because it’s hard and doesn’t move much that nothing is going on down there. So we compact it and misuse it and water and fertilize too much. Soils are acting and reacting all the time, and we would be a lot better served if we reacted to them before investing a lot of time and money in plants that will have a tough time making it.”

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The Utah Agricultural Experiment Station
Worms on a Pedestal

The famous biologist Edward O. Wilson calls them "the little creatures who run the earth."

Charles Darwin said he doubted whether any other animal plays a more important role in nature.

The prolific newspaper cartoonist and amateur biologist Gary Larson came out of a self-imposed sabbatical to write his one and only book about them.

They're talking about worms, earthworms to be exact.

The first research project of the Utah Agricultural Experiment Station in the late 1800s was to design a better plowshare. That project, though a successful enhancement of mankind's most valuable invention, didn't match the design and competence of the lowly earthworm, which can move soil particles up to 40 times its own weight.

Long before the station was established and long before that project was funded, earthworms were plowing the soil. They're still at it, and at about a million worms per acre they continue to make the path less resistant for all plant and animal life by opening tunnels for air and water to get in.

They do all their work in the dark. They don't have eyes and have to breathe through their skin. They beach themselves on sidewalks trying not to suffocate during heavy rains if the lawn or garden they inhabit is over-irrigated.

They speed up decomposition and bring nutrients to the surface of soils. They move, loosen, mix and condition the soil, then make it even better when they die by offering up their remains as food for other life forms.
Dr. Wilson points out in the foreword of Larson’s book, “There’s a Hair in My Dirt,” that earthworms are prime creatures in nature, which he says biologists have known all along “really is red in tooth and claw. While it is true that all organisms are dependent on others, the ecological web they create is built entirely from mutual exploitation. Life is tough!”

He invites humans to see worms at eye level by putting their noses in Larson’s book and accepting its invitation to put their chins to the ground. In the process, readers might not only become better adjusted about life in general but most of all might better understand that “Nature is part of us and we are part of Nature.”

“There is no free lunch, and what one creature consumes, another must provide,” he writes. Humans, too, are organisms “subject to the same physical laws, still tied to the planet, totally enmeshed in food webs, energy flows, nutrient cycles, predator-prey cycles, territorial imperatives and even slavery of other species, such as cows and dogs.”

The human who plows through Larson’s book doesn’t have the sense of an earthworm about nature. Harriet, a naive and high-haired maiden who once upon a time lived in a forest not too far from the worm family, is the subject of a little moral lesson that Larson tells through a father worm who is angry with his son worm who is angry at his lowly station in life after finding a human hair in his plate of dirt.

The son yells, “We’re the lowest of the low! Bottom of the food chain! Bird food! Fish bait. What kind of life is this, anyway? We never go swimming or camping or hiking or anything! Shoot, we never even go to the surface unless the rains flood us out...Oh, and how can I forget? We eat dirt! Dirt for breakfast, dirt for lunch, and dirt for dinner! Dirt, dirt, dirt! And look—now there’s even a hair in my dirt! The final insult—I can’t stand it any longer!”

“Harriet loved Nature,” the father worm tells his son. “But loving Nature is not the same as understanding it. And Harriet not only misunderstood the things she saw—vilifying some creatures while romanticizing others—but also her own connection to them.

“Take us worms, for example. We till, aerate, and enrich the earth’s soil, making it suitable for plants. No worms, no plants; and no plants, no so-called higher animals running around with their oh-so-precious backbones! Heck, we’re invertebrates, my boy! As a whole, we’re the movers and shakers on this planet! Spineless superheroes, that’s what we are!”

Larson, an amateur biologist who stopped doing his newspaper panel in 1995, told The New York Times this past spring that entomology “is my fantasy, the road not taken.” He said he had been thinking about doing a book on a family of worms for years.

Larson has had a butterfly and a louse named after him: a species of butterfly from the Ecuadorian rain forest is now the Serratoterga larsoni. A species of chewing louse found only on owls and been named the Strigiphilus garylarsoni. JT
Although a farmer's or home gardener's connection to the land is as plain as the dirt under their fingernails, the needs of the soil they work often go unnoticed.

"What's below the crops needs to be managed as well as what's above ground," says Janice Kotuby-Amacher, director of the USU soil testing laboratories.

Without soil test information, a farmer or home gardener may be adding too much fertilizer and throwing money away in the process. Or they could be adding too little and not seeing maximum crop yields.

Kotuby-Amacher says soil tests won't supply all the answers, but they can help people decide how to handle fertilizer, salt, irrigation or drainage problems.

Farm managers and home gardeners should keep complete soil test records for all farm fields and gardens. Those records combined with fertilizer application records—kinds and amounts—will allow the overall improvement of soil fertility, she says.

Soils can be sampled any time, although the laboratory recommends either late fall or early spring. Fall fertilization has the advantage of incorporating applied fertilizer with fall plowing. However, spring soil testing for nitrates will provide a more accurate evaluation of nitrogen availability as crops establish themselves in the spring.

"Soil sampling well in advance of planting is important to allow time for samples to be analyzed and any corrective measures to be taken."

The lab recommends a standard fertility test, especially for first-time users, to determine the pH, salinity, lime, texture, and available phosphorus and potassium content of the soil. From that information, the lab can make fertilizer and management recommendations.

Kotuby-Amacher says that nitrate-nitrogen content of the soil is important because nitrogen is a major nutrient for plant growth.

"We often make recommendations for nitrogen fertilization based on the crop to be grown and yield history," she says. "But because of possible nitrate contamination of surface and ground water, plus the increasing cost of fertilizer, soil testing for nitrates is more important than ever."

Information on how to properly take a soil sample, and specific types of tests can be obtained from the Extension agent in your county.

The lab does not recommend using home soil test kits that can be purchased at a local nursery or garden center. The tests are not accurate, especially for alkaline soils that are common in Utah, plus their fertilizer recommendations are not calibrated for area soils. JT
LAND DEGRADATION SYMPTOMS WORLDWIDE

If soil is the skin of the Earth, it has some serious blemishes, the German Advisory Council on Global Change recently reported.

The government agency identified several various symptoms of poor soil health and land degradation around the world. Some are:

**The Huang He Syndrome:** Refers to intolerable soil loss resulting from drastic changes in land use in a short period of time without conservation. The Huang He (Yellow River in China) watershed is one of the most severely eroded areas in the world, with a sediment load exceeding 600 tons annually.

**The Sumatra Syndrome:** Refers to destruction or degradation of entire ecosystems such as forests, savannas or marshlands as in the Amazon and Congo.

**The Aral Sea Syndrome:** Refers to mismanagement of large-scale projects that depletes a watershed. The German scientists refer to the Aral Sea region as an “ecological catastrophe.” The sea was once the fourth-largest freshwater lake on Earth. Rivers that fed it have been dammed and the water level has dropped and salinity has increased. The process is termed endoreisation and takes place when water in a watershed is completely siphoned off. Mono Lake in California is another example.

**The Dust Bowl Syndrome:** Refers to soil degradation through industrial agriculture. Destructive agricultural practices converging with an historic drought transformed the West and Southwest United States into a dry landscape in the 1930s. The storm of May 9, 1934, removed 350 million tons of soil. As a consequence, the USDA created the Soil Conservation Service (now the Natural Resources Conservation Service).

**The Acid Rain Syndrome:** Refers to long-range transport of pollutants. Discharge of industrial wastes in the rivers can contaminate large areas of land, particularly if the water is used for irrigation. An example is the Indus River in Pakistan.

**The Bitterfield Syndrome:** An ecological catastrophe through non-adapted farming, over-grazing and fire.
The Small Ruminant Collaborative Research Support Program (or SR-CRSP) has been a long-term activity of the Office of Agriculture and Food Security at the United States Agency for International Development (USAID). Originally targeted toward increasing the productivity of goats, sheep, and camels (llamas, alpacas) held by the world’s poorest peoples, the SR-CRSP has included Utah State University as a major participant since 1978. The Department of Rangeland Resources at USU has led range management components of the SR-CRSP in Brazil, Morocco, and Bolivia.

The old SR-CRSP has recently been re-engineered into the new Global Livestock CRSP (or GL-CRSP). The new GL-CRSP has a broadened mandate to include more livestock species and more attention to human welfare, the environment, and development policies that affect livestock-keeping peoples worldwide. The initial regional focus of the GL-CRSP is now in East Africa, the emerging republics of Central Asia, and Latin America.

The Department of Rangeland Resources at USU has continued its involvement with the GL-CRSP through a new project in northern Kenya and southern Ethiopia. This region is home to more than one million pastoral people from 10 ethnic groups. This research and outreach project is entitled “Improving Pastoral Risk Management on East African Rangelands” and is funded for up to six years, starting in 1997, at a core level of over $3 million.

Compared to the SR-CRSP projects, this one takes a very different approach. Rather than a focus on livestock ecology and production, this project is oriented more toward development of human capabilities to facilitate progress in mitigating poverty, with livestock being a tool in that process. The Horn of Africa has been caught in a downward spiral of poverty, famine-risk, drought, and violence for many years and is thus a priority of USAID.

“The essential elements of improving risk management include asset diversification, income diversification, and improving access to information and key resources,” said Dr. Layne Coppock, Principal Investigator. “The key idea is that East African pastoralists have lost over a billion dollars in wasteful livestock deaths due to inefficient marketing, drought, and heavy stocking rates over the past few years,” according to Coppock, “and we want to capture that lost wealth by giving attention to alleviating marketing constraints and teaching people how to be more efficient in using price and weather information in that process. Once people learn to sell in a more clever fashion, they need to learn how to save, diversify, and invest money, both in themselves and their communities.”

An outreach network of some 52 governmental and non-governmental development organizations in Ethiopia and Kenya has been brought together in the GL-CRSP by USU in the past year. The network is deliberating on how best to implement this new strategy.

E-mail and a project web site make international communication much easier than even a few years ago. Not just “livestock people,” this group now also includes specialists and policy makers in cooperative development, public education, telecommunications, conflict mitigation, infrastructural improvements, and rural finance.

“We have come a long way from a range focus solely on forage and water development”, Coppock said. “This broadened, human-oriented approach has opened up many doors of power to the project, precisely because everyone wants to see these problems solved and are optimistic that we are asking the right questions.”

Other USU faculty participating in the project are Deevon Bailey (Economics), Paul Box (Geography & Earth Resources), Upmanu Lall (Civil & Environmental Engineering), Jon Moris (Sociology, Social Work & Anthropology), and Allen Rasmussen (Rangeland Resources). Graduate student Solomon Desta—also in Rangeland Resources—has played a vital role in the project. Other academic partners in the project include Egerton University in Kenya, Cornell University (Dr. Chris Barrett), the University of Kentucky (Dr. Peter Little), and Williams College, Massachusetts (Dr. Cheryl Doss).

“We have also learned that improved risk management is very important for farmers and ranchers in Utah,” noted Coppock, “and hopefully some good ideas from East Africa can influence work back here at home.”
Tarrah Henrie's grandparents, who spent much of their lives farming in their native Germany, reacted to her decision to study soils rather than civil engineering this way:

“They said, ‘You’re going to study dirt?’” Tarrah says, her voice and mannerisms portraying her grandparent’s German accents and absolute dismay. “‘You’re going to be a farmer? After four years of college, you’re going to be a farmer?’”

Most people look at the ground and see dirt; horrible stuff their mothers warned them not to track into the house or get on their good clothes.

Tarrah looks at the ground and sees an amazingly complex, fascinating field of science, as well as a path to a career.

Some people wonder out loud what a soils scientist does when Tarrah says what she studies. Some announce they’ve never heard of the field. Others seem to understand her fascination with dirt and pronounce the work “cool.”

For a while her parents and grandparents thought perhaps they had let Tarrah and her brother spend too much time playing in the vegetable garden’s dirt corner, an area always left free from plants specifically so the children could dig there. Or maybe growing up in Sandy, Utah, had something to do with it.

Pleasant childhood memories aside, what really attracted Tarrah to soils science was its unique combination of many of the things she loves and finds fascinating: math, chemistry, physics, biology, geology, laboratory experiments, field work and, yes, getting her hands dirty.

USU professor Janis Boettinger says soils science is a perfect example of integrated, applied science, and requires students to have a solid understanding of the basics of all the sciences because they all affect soil as a system.

“Soils are very complicated systems,” Tarrah says. “So, for example, you need to understand chemistry. But chemists can use dilute solutions of very pure chemicals and those clean, easy equations don’t work when you study soils. You have to understand all the other things in the system.”

The heavy dose of diverse sciences attracts many prospective soils science majors who never dreamed of studying in the College of Agriculture.

“I’m a city kid,” says Tarrah. “I wouldn’t have thought of agriculture as a major. Most people don’t know about the diversity of sciences and disciplines in the college.”

Boettinger calls Tarrah “a great student. The kind of student who makes your job as a teacher just a dream.”

Asked to pinpoint her favorite thing about studying soils, Tarrah says it’s the diversity of the work that she enjoys.

“Studying soils lets me use all the sciences, and I enjoy the field work and the lab work,” she says. “The thing I really like is that soils are always changing. Seasonally the same site is made totally different by something as simple as the water table changing.”

This past summer, she worked in USU professor Jeanette Norton’s laboratory where the research team studied the soil’s shifting microbial population on 28 research plots at the Utah Agricultural Experiment Station’s Greenville Farm in North Logan.

“I’ve learned a lot from doing this research,” Tarrah says. “Microbiology was an area I thought I needed to know more about so I was glad when Jenny offered me this job.”

This fall Tarrah shifted research gears from microbiology to soil chemistry when she started graduate work at the University of California-Davis, with plans to study heavy metals chemistry and mine reclamation.

From there, Tarrah says the future could lead to a university research or teaching position. One thing is certain though—her career will follow a dirt path. LH
As is typical for too many of us so-called higher forms of surface-dwelling vertebrates, I haven't spent much time bending my beloved backbone to take a look at the earth I traverse.

Sure, I have the innate understanding that there is more to the land than being The Great Nonwater. And, yes, I appreciate how it partitions the oceans and channels the snowmelt and can be grooved for irrigation. But it took preparing this issue of Utah Science for me to get a feel for the land and how it busily supports all of us little live things, vertebrates and invertebrates alike, above and below the surface.

This is a curious and perhaps embarrassing confession, given the job I have, not to mention that I am literally reconstituted land myself and like everyone else is inexorably becoming plain old dust again.

In any case, my beaten path has shifted a bit beneath me the past few months. What follows, reconstituted from interviews with Experiment Station scientists, Natural Resources Conservation Service people and their down-to-earth (What else would they be?) publications, are ways—some of them admittedly elementary ways—the lay of the land looks different now:

Soil is how we recycle what was once living into new life. In other words, through food produced by the soil, what is dead today walks and talks tomorrow.

Soil drinks our water first. Most of the water we use falls first on the land, then either percolates to the groundwater, runs over the land surface to a stream or lake, or moves laterally through the soil to a surface water body.

If the soil quality is deteriorating, the ecosystem is probably deteriorating as well.

It is a curse and blessing that obtaining adequate food, water and shelter is no longer a result of each person understanding and relating to the land that supports him.

Soil conservation gains are seldom permanent.

Soil erosion threatens sustained production on at least a fifth of all rangeland acres.

Soil salts, which can be concentrated by irrigating arid and semi-arid regions, might turn out to be an unsolvable problem for scientists.

Sustainability of the land means that resources should be used to provide for the needs of the present generation without compromising the ability of future generations to meet their own needs.

The 2 percent of the population that still farms and ranches determines the health of 50 percent of the U.S. landscape. Fortunately, most of those 4.7 million private landowners are inclined to do the right thing when it comes to looking after the health of their 907 million acres.

Not only do soil, water, plants and animals form a dynamic system that changes and rearranges itself, scientists are constantly developing new methods to assess it that reveal as many questions as answers.

Private land constitutes the single largest portion of the country’s landscape. The federal government spends about $2 per acre to conserve private land. It spends $10 per acre conserving and managing public land.

Soil is the Earth’s skin. Not only does it sustain all life it buffers all manner of harmful invaders, many of which are created by the modern human being.

Ultimately, what’s going on with the land indicates what’s going on with us. Whether we’re traversing it on foot, farming it, cruising it at 80 mph down a concrete freeway or slipping at light speed across the World Wide Web, we’re connected. We all stop and reach for that loaf of bread.

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Answer to last issue’s photoquiz: Microinjector used on a microscope for the microinjection of cells or embryos.
Utah Science is on line. Check out our Web page at: http://agx.usu.edu/agx/

*PLEASE NOTE OUR NEW WEB SITE ADDRESS AS OF OCT. 1998.

FEATURED RESEARCHERS

Janis Boettinger  Paul Grossl  Phillip Rasmussen  Rich Koenig