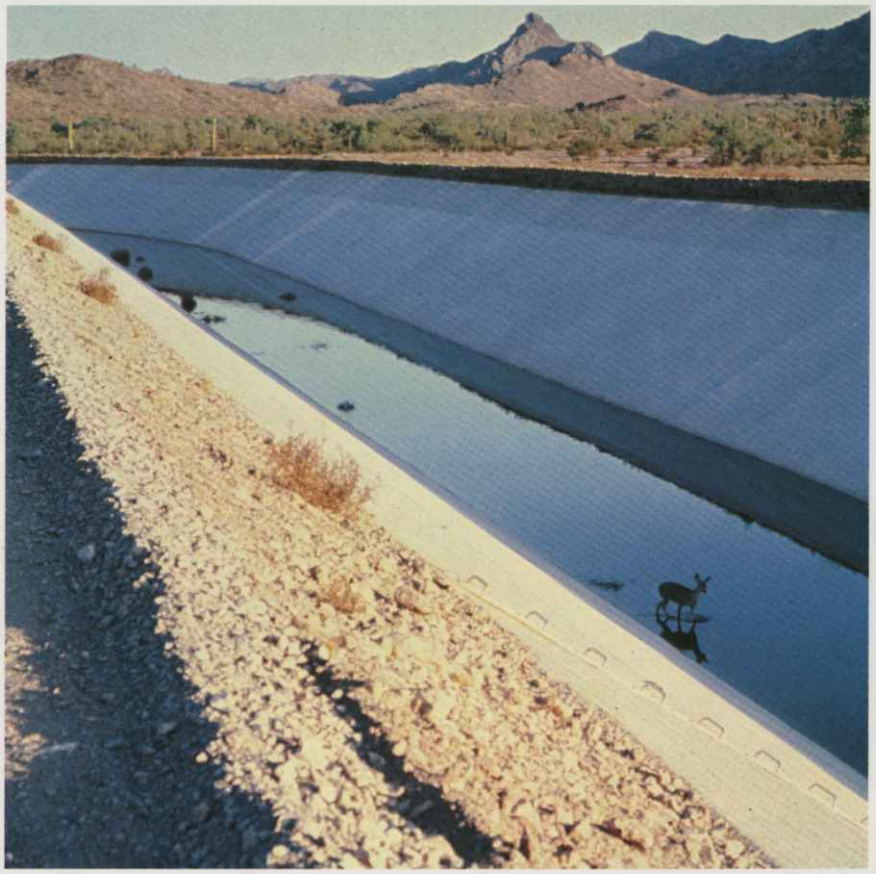
Formerly "PROGRESSIVE AGRICULTURE"

ARIZONA LAND&PEOPLE

Magazine of the College of Agriculture, University of Arizona Volume 33, Number 2



- **Deer, Bighorns and Canal**
- **Microbes That Help Plants**
- **Boyce Thompson Arboretum**

ARIZONA
LAND&PEOPLE
Magazine of the College of Agriculture, University of Arizona
June 1982
Volume 33, Number 2


page 1


page 6


page 10


page 24

On the cover: A young mule deer found its way into the Central Arizona Project canal near Tonopah, but couldn't find a way out. UA researchers are studying the canal's effects on movements of deer and bighorn sheep. (Photo by John Hervert.)

Arizona Land & People (ISSN 0744-5474, formerly *Progressive Agriculture in Arizona*) is published quarterly by the College of Agriculture, University of Arizona, Tucson, Arizona 85721. Bartley P. Cardon, dean. Second-class postage paid at Tucson.

The College of Agriculture includes the schools of Home Economics and Renewable Natural Resources, the Office of Arid Lands Studies, the Agricultural Experiment Station, the Cooperative Extension Service, and Resident Instruction. It is an equal opportunity employer.

Subscriptions are free on request. Letters to the editor are welcome. Information in *Arizona Land & People* becomes public property upon publication. It may be reprinted, provided that no commercial endorsement is implied. Please credit the authors, this magazine and the university.

Bighorn Sheep, Mule Deer and The Central Arizona Project

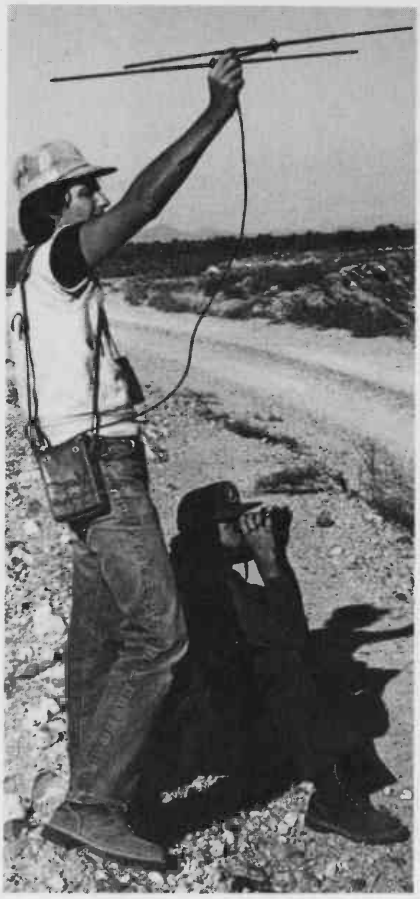
Some time last spring a young bighorn ram crossed the dozen miles of desert floor from the Harquahala Mountains to the Big Horn Mountains near Tonopah.

No one reported seeing it cross, but this ram happened to be one of 24 desert bighorn sheep wearing radio collars as part of a University of Arizona study. Thirty-three desert mule deer are also wearing the miniature transmitters for the project.

The project's goals are to learn where the Central Arizona Project canal might disrupt movements of bighorns and deer and to design bridges for the animals where they need to cross the 80-foot-wide waterway. Keeping close tabs on selected groups of deer and sheep pays the extra dividend of increased understanding of the animals' year-round habits and needs, said project leader Dr. Paul Krausman. He is a wildlife biologist for the UA School of Renewable Natural Resources.

Two things make that collared ram's trip to the Big Horn Mountains significant, according to Rick Seegmiller, a member of the study team. First, crossings by desert bighorns from one mountain range to another appear rare, but are probably crucial in preventing small iso-

Photograph: Tom Peeples of the Arizona Game and Fish Department releases a bighorn wearing a new radio collar. (Photos by Guy Webster.)



Researchers scan a hillside for bighorns: Steve Torres with a directional antenna, Rick Seegmiller with field glasses.

lated populations from becoming too inbred. Second, the canal, when complete, will cut along that ram's route and may interfere with future movements.

Deer in the Canal

Mule deer use the flat desert terrain around the canal more than bighorns do, and many have gotten into portions of the open aqueduct already built between Parker and Phoenix. Some who enter the canal find a way back out: One radio-collared doe has crossed 10 times or more. But some do not: Several have been found dead in the canal in the past two years. Others have been found exhausted and near death.

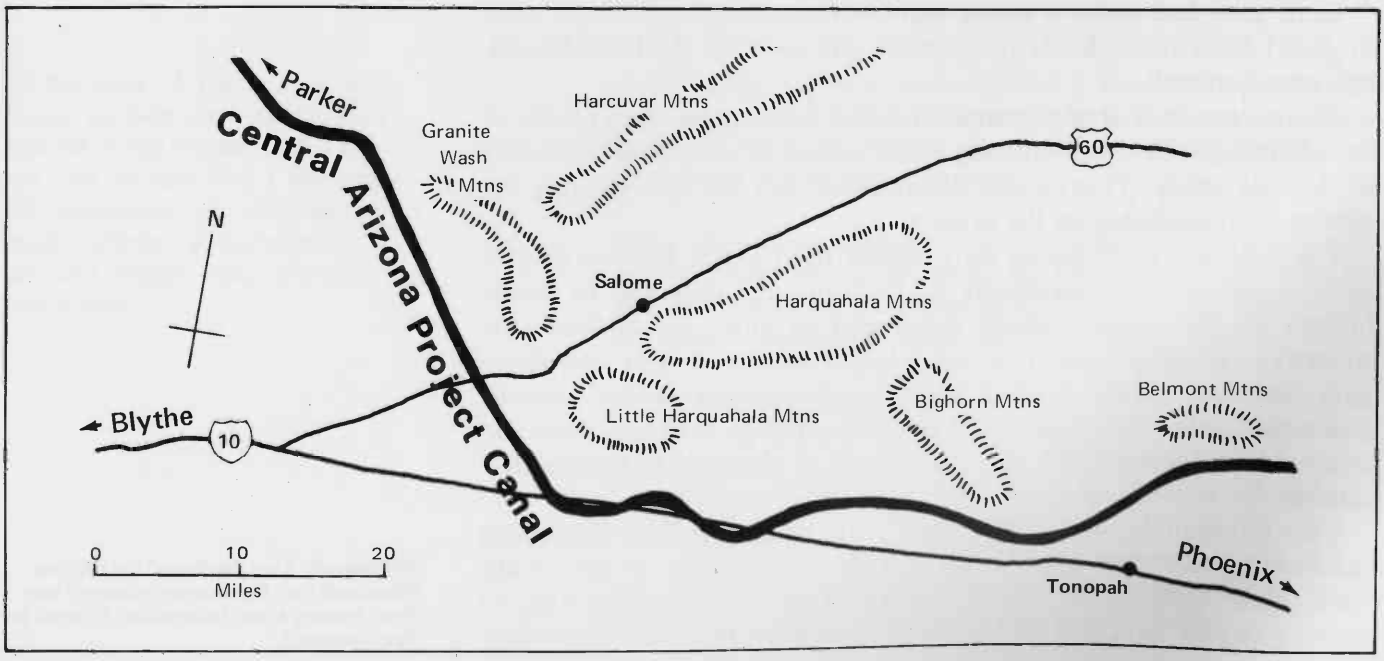
To get out, animals must climb a sloping, 16-foot-high concrete wall. In summer, temperatures at the bottom of the dry canal often hit 125 degrees F. Any water in the canal softens deer's hooves within two or three hours.

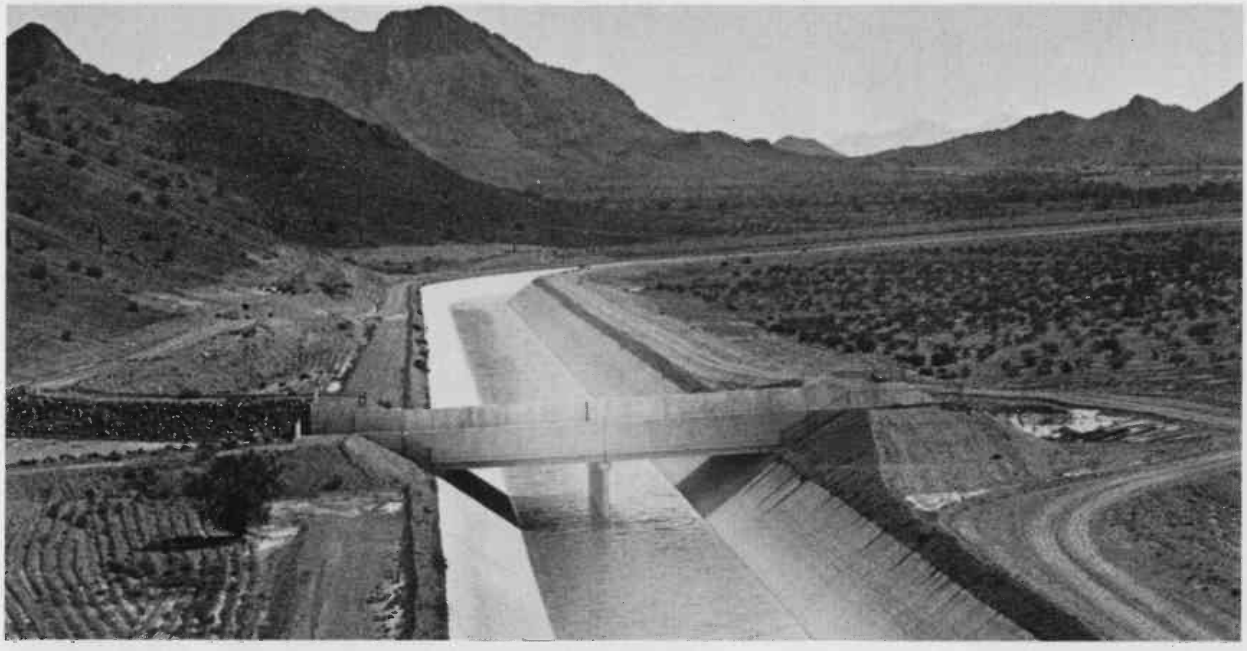
Once the canal begins carrying Colorado River water to Phoenix and Tucson, the current of three to five miles per hour will make escape more difficult for any animals that get in. Escape structures, such as wide steps, have not prevented the deaths of deer and sheep in the 15-year-old Wellton-Mohawk Canal near Yuma, Krausman said.

"There's not much we can do to help them get out once they're in," he said. "The real answer is to keep the animals out altogether." Crossing structures, such as wide bridges, will be built at key points along the canal. Some already in place for cattle are also being used by deer.

An experimental bridge installed this winter allows animals to cross the canal at one spot near the Belmont Mountains. The researchers chose a design that can be taken apart and moved from one site to another. They plan to test it in several places to find out whether animals will use a bridge on a regular basis.

The 1974 environmental impact statement for the Central Arizona Project called for the study Krausman now heads. Federal funding for the five-year project comes through the Arizona Cooperative Wildlife Research Unit at the university.





A bridge crosses the new Central Arizona Project canal at the base of the Little Harquahala Mountains. This Parker-to-Phoenix section of the canal is named the Granite Reef Aqueduct.

The researchers first surveyed bighorn and mule deer populations all along the canal's route from Parker to Phoenix. They even found bighorns in one mountain range, the Belmonts, where none had been reported before. Now, they focus on the daily and weekly movements of animals in the area from the Granite Wash Mountains to the Belmonts. They also monitor deer and sheep in the Picacho Mountains along the Phoenix-Tucson stretch of the canal route.

Field Work

Directional radio receivers allow the field team to find collared animals easily. "All the (collared) animals are located by plane once a week to see how they are distributing themselves," said Seegmiller. On foot, he observes selected bighorns in the Harquahala range almost daily. Research assistant Steve Torres keeps daily records on other bighorns in the Little Harquahalas. John Hervert and Leonard Ordway do the same with desert mule deer around the Belmonts and the Picacho Mountains.

The months of careful record-keeping from a distance are punctuated with occasional capturing and collaring of animals. Specialists from the Arizona Game and Fish Department and a charter helicopter pilot join the research team to replace old collars and add new ones.

The team split into two groups for collaring bighorns in the Harquahalas last November. Pilot Ron Black flew Krausman and AGFD specialist Tom Peeples to capture the sheep. Krausman used the radio receiver to find a group of sheep. From the air, he selected the ewe to be tagged. Black maneuvered the helicopter within a few feet of the fleeing animal, then Peeples shot her with a drug-filled dart from a rifle. The immobilizing drug takes a few minutes to work, so the helicopter followed from a distance until the animal lay down. Black let off his passengers then flew back to get the other men.

When the second group arrived, the ewe was wearing her new collar plus a hood to reduce the trauma of seeing humans close up. Krausman and Peeples left with Black to capture another sheep while the others finished processing the first. Torres and Hervert took several measure-

ments while Seegmiller drew a blood sample for analysis of general health. They checked teeth for wear and ears for ticks, then injected the ewe with a second drug that counteracts the first one to revive the animal. After a few woozy steps, she walked away quickly.

The personnel and procedures for collaring sheep and deer are flexible, Krausman noted, but the Game and Fish Department always handles the drugging. The information gathered about the individual animals tagged helps in understanding their biology and group behavior.

Above: Team members take measurements and a blood sample from a ewe immobilized for collaring. From left: Seegmiller, Torres, John Hervert and Peeples. Below: Quiet voices and a hood over the sheep's eyes help reduce unnecessary trauma.

The New Factor

The new Central Arizona Project canal may affect both species.

Some parts of the canal separate mountainous areas from irrigated agricultural areas. "In the beginning of this study, many people thought there was a summer migration of deer into the agricultural areas to get to the green feed and water available there," said Hervert. Last summer, "of the animals we've followed, one did move into the agricultural areas, but the others did not."

Bighorns rarely come out of the mountains. "The biggest concern about sheep is to keep the populations from becoming totally isolated from each other," said Seegmiller. "There's fear that by making conditions insular, you get inbreeding, and studies have shown that inbred young have lower survival rates."

Smaller populations have bigger chances of harmful inbreeding. The Harquahalas have about 30 to 50 sheep, the Little Harquahalas about 20 to 30. Seegmiller said, "these populations appear to be somewhat insular, but some rams do move across from one range to another, and that promotes genetic diversity."

Careful records of sheep movements will be needed to find out whether the CAP canal reduces the frequency of trips between ranges. Sometimes, desert bighorns are extremely wary of human obstructions. Other times they will even bed down right in a road.

Desert Habitat

The researchers are learning more about the animals than just the possible effects of the canal. The deer and sheep they are studying are both desert subspecies adapted to harsh environments.

"Before this, desert mule deer hadn't been studied much, partly because they live in such sparse populations," said Hervert. "But living in this rugged habitat makes them very interesting to study."

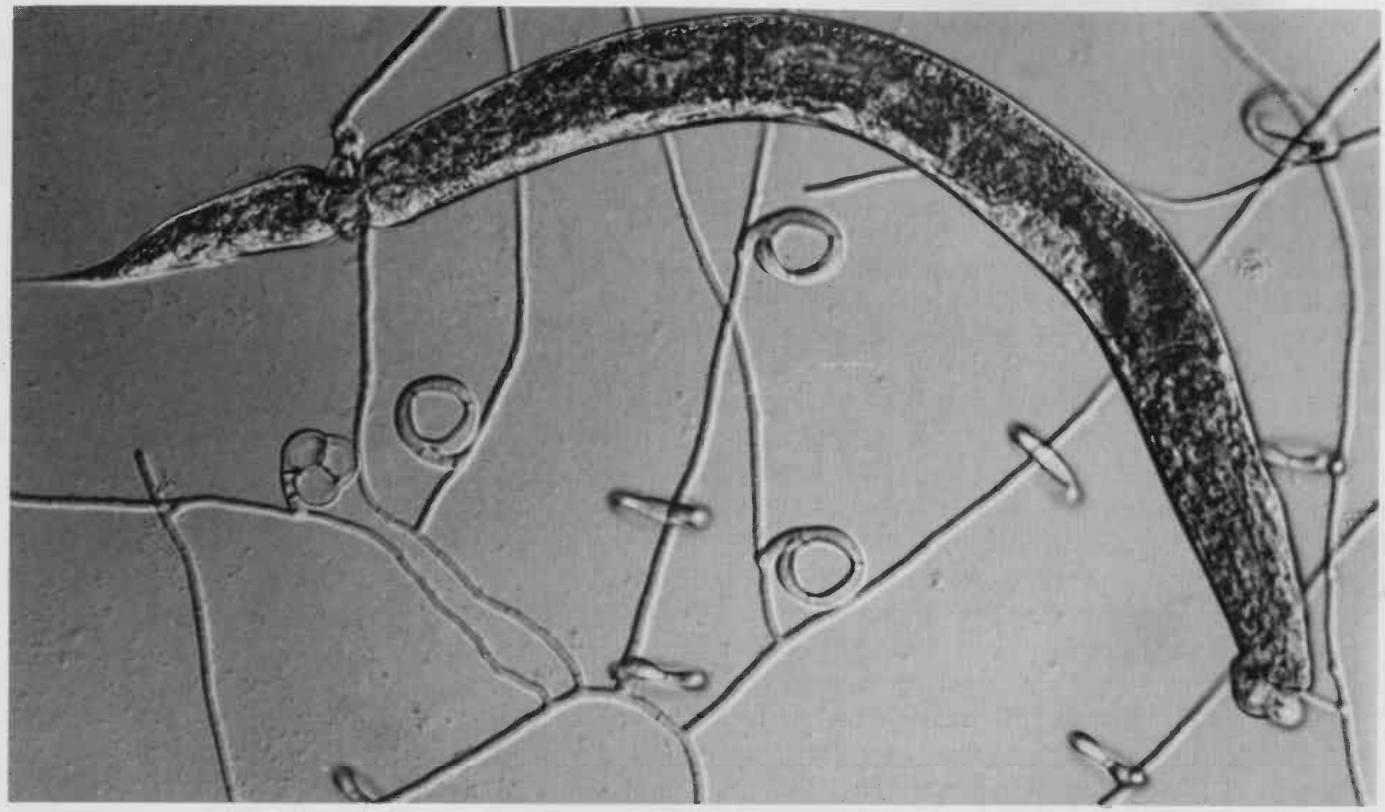
He is examining their use of water, such as how far they will travel from a water source. "Since water in the Belmonts is very limited, we may be able to manipulate conditions a little to understand how the conditions affect the deer. For example, we may open up a new water hole or close an existing one and see how it changes their range."

One of the bighorn questions puzzling scientists is why the populations in the Little Harquahala and Harquahala ranges are much sparser than populations in nearby ranges such as the Plomosa and New Water mountains that have similar habitats. Seegmiller is checking the availability and nutritive quality of forage, among other potentially limiting factors.

Bighorn rams generally live separately from ewes and lambs except during breeding season. By recording the foods and habitats selected by each group, Seegmiller hopes to understand why they split up. "Maybe there's a nutritional reason since rams are much larger and have greater food requirements than ewes or lambs," he hypothesized. "Rams may be better able to meet their forage needs in different habitats."

The deer and sheep that are the subjects of this reasearch, like virtually all wildlife, no longer live free of human influences. Projects like this one help hold the problems of that influence to a minimum and help show how to ensure the animals' long-term survival.

Peeples injects a drug that restores the ewe's mobility (above), and she walks off over the hill.



Underground Allies Aid Farmers

By Dr. Iraj J. Misaghi
and Mary W. Olsen
Plant Pathology

Under our feet, there's a war going on. Scoop up a handful of soil and you hold the battlefield.

Soil micro-organisms in life-or-death struggles use an impressive array of affronts against each other: poisoning, strangling, stealing nutrients, parasitizing and just plain eating each other.

Some of the soil's bacteria, fungi and other microscopic creatures can sicken or kill plants. Others, less well known but important, help plants. That's why the micro-organisms' battles with each other are drawing heightened interest from agricultural scientists. Tipping the balance in favor of the beneficial microbes and against the harmful ones helps plants thrive.

Some of the beneficial soil micro-organisms make specific nutrients available to plant roots. In effect, they supply fertilizers. Best known are the nitrogen-fixing bacteria that live on the roots of plants such as alfalfa and beans. The bacteria alter nitrogen from the form plentiful in the atmosphere into a from that plants can use.

Other microbes are good guys because they attack the bad guys that cause plant diseases. For example, in greenhouse tests, a bacterium called *Pseudomonas fluorescens* helps reduce rates of certain root rots and seedling diseases that damage many crops.

Some bacterial fertilizers and microbial controls for plant diseases are already in commercial use. Plant pathologists at the University of Arizona and elsewhere are studying many other potential microscopic

Photograph: A microscopic, disease-causing worm (a nematode) is trapped by the constricting rings of a soil fungus (*Dactylaria brocopaga*). The nematode's body diameter is about twice the inner diameter of the rings, but the worm has been captured at the tapered portions of its head and tail. (Photo by George L. Barron, reprinted from his book, *The Nematode-Destroying Fungi*.)

allies. The following rundown illustrates the diversity of beneficial microbes and some of the ways their advantages may be put to use.

Fitness Through Nutrition

Plants grow poorly in sterile soil, compared to the same soil before it was sterilized. Living microbes help put soil nutrients into usable condition for plants.

UA plant pathologist Dr. Homer E. Bloss is studying certain fungi that live in and around plant roots and help supply phosphorus. These fungi (mycorrhizal fungi) apparently provide other benefits, too. They can promote the growth of almost every type of plant, including cotton, wheat, barley, corn, alfalfa and most fruit trees.

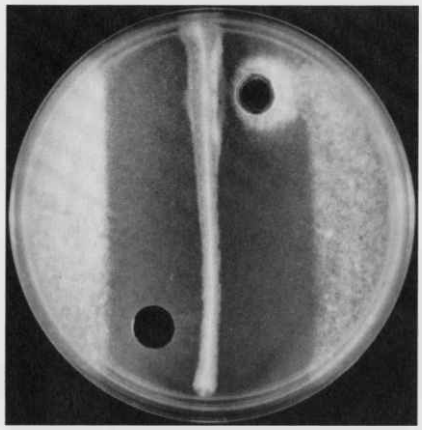
Some mycorrhizal fungi already live in most fields where crops have been grown regularly. However, added amounts may boost production further. Different varieties of the fungi work best with different crops.

Other fungi and bacteria also promote plant growth. Adding certain pigment-producing bacteria to the soil around alfalfa seedlings in one UA greenhouse test resulted in plants three times heavier than untreated seedlings.

In the Soviet Union and some other countries, many farmers have used bacterial fertilizers for several years as supplements to conventional fertilizers. The rising costs of mineral fertilizers make the supplements even more attractive.

Besides making simple nutrients available, some micro-organisms might also stimulate plant vigor by supplying growth hormones or other useful chemicals.

Well-nourished, vigorous individuals—whether plants or people—are less susceptible to disease than unfit ones. Thus, microbes that boost fitness help control plant diseases even without attacking a specific pathogen (a disease-causing organism).



The growth on this laboratory dish shows a bacterium controlling the spread of a fungus. The center line is a colony of the bacterium (*Pseudomonas fluorescens*). The fungus, a type that rots tomatoes, is growing in from the edges, but is stopped from entering the dark zone on either side of the bacteria. A chemical released by the bacteria apparently makes iron in that zone unavailable to the fungus. Where extra iron is added to the dish in the small circle at upper right, the fungus does grow. (Photo by Iraj Misaghi.)

Microbe Wars

However, many microbes do work against specific pathogens.

In laboratory tests at the University of Arizona, we have shown that a chemical released by some pseudomonad bacteria can stop the growth of several harmful types of fungi. The sensitive fungi include those that cause Texas root rot, Phytophthora root rot and seedling diseases due to Pythium. Texas root rot can kill more than 2,000 species of plants. In cotton fields alone, it cost U.S. farmers about $45 million last year. Alfalfa is especially susceptible to Phytophthora root rot and sugarbeets to Pythium diseases.

The UA research indicates that the chemicals from effective pseudomonads work by making iron unavailable to the fungi, which need iron for growth. Thus, the bacteria stop the fungi from growing, but do not kill them.

Following the laboratory results, studies under greenhouse conditions with plants exposed to disease-causing fungi have also shown significant reduction in disease level by pseudomonad bacteria. Field tests are now underway to determine whether these bacteria can reduce the severity of diseases under typical crop-production conditions.

At Montana State University, a type of pseudomonad reportedly has worked well as a control for Dutch elm disease, which has bared boulevards in many Eastern and Midwestern towns. An injection of the bacterium may help the tree resist succumbing to the disease.

Some other beneficial microbes kill pathogens outright. A virus-like particle can infect and kill the fungus that causes chestnut blight. Certain amoeba in the soil can perforate and kill the spores of some pathogenic fungi. And one beneficial fungus kills another fungus that causes root rot in many plants, including lettuce.

Fungi are just one type of pathogen. Bacteria also cause several plant diseases. One bacterial disease, crown gall, has an effective biological control already in commercial use. Crown gall can kill many fruit and shade trees, roses, and several other plants. The control agent is a bacterium closely related to the pathogen. Apparently, it successfully competes against the pathogen by occupying infection sites in the plant. The control bacterium also produces a chemical that may kill its disease-causing cousin.

Some major plant diseases result from nematodes attacking the plant. Nematodes—round worms less than one millimeter long—come in thousands of varieties. They have several natural enemies in the soil, including a fungus that snares them in hoops. On the other hand, some nematodes eat fungi that cause plant diseases. Telling the good guys from the bad guys can get complicated.

Plant diseases can even be beneficial to crop plants, provided the diseases strike weeds instead of crops. For example, in one Florida citrus orchard where strangler vine grew on many trees, concentrations of a local fungus, *Phytophthora citrophthora*, were applied to the soil. The treatment did not injure the trees, but killed more than half of the destructive vines after five weeks.

Some fungi help plants grow. The guayule seedlings on the left are growing in sterile soil. The seedlings on the right are the same age and in the same soil, except that a type of mycorrhizal fungus has been added to the soil.

Tipping the Balance

So, with all these tiny helpers, why do we need plant pathologists?

The hitch is that the micro-organisms competing with pathogens don't always win. Some do not survive well where they could do the most good. For example, the bacterium that can control root-rot fungi do not seem to thrive around roots. A few require specific moisture conditions that are not best for the crop. Others have specific enemies of their own.

In fact, no single microbe has been found that combines the beneficial features of promoting plant growth, controlling disease and surviving well under field conditions. At the University of Arizona, we plan to sidestep this obstacle by combining the desirable traits from two or more different bacteria into one bacterium, using the techniques of genetic engineering. These techniques are relatively simple to use on bacteria once the genes that control desirable traits are identified.

Our first such reconstruction effort will probably be to transfer a fungus-controlling trait of a bacterium to another bacterium that grows well around roots. It appears feasible to combine the traits of growth promotion, disease control and competitive survival into one super microbe. However, the microenvironment for one crop differs from those of other crops, so various microbes might have to be engineered for different crops.

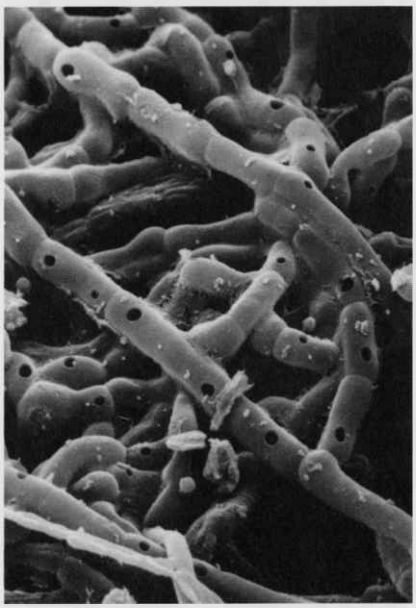
When a beneficial microbe's disease-fighting prowess lies in a specific chemical that it produces, growing the microbe in the field may be unnecessary. Selected natural strains of genetically engineered ones might be grown in vats churning out quantities of the valuable chemical.

Manipulation and genetic engineering of beneficial microbes depends on knowing exactly how they work to promote growth and fight disease. That's why current research focuses on understanding these mechanisms.

Many laboratories are making progress. Several plant pathologists prominent in the development of biological controls met in Tucson this winter to compare notes and coordinate strategies. They came from 10 states from coast to coast. Dr. Merritt R. Nelson, head of the UA Plant Pathology Department, organized and led the meeting. Plans were begun for a major conference in 1984.

By reducing the need for some synthetic fertilizers and pesticides, biological means for plant vigor and health offer potential for lessening energy use and environmental risks. So far, we have begun to exploit just a few beneficial soil micro-organisms. Many others are waiting to be discovered. Through manipulation including genetic engineering, they may eventually work to our advantage for growing healthier, higher-yielding crops.

A type of amoeba from the soil of a wheat field made the round perforations in this fungus. The amoeba eats out the insides of the fungus. The farmer benefits because this fungus causes take-all disease of wheat. (Photo by R. James Cook, reprinted from *Phytopathology*, Vol. 69 No. 10.)



Project in Yemen Aids Us, Too

About 12 hours after President Al Hamdi of North Yemen shook hands with UA plant scientist Dr. Robert L. Voigt, the Yemeni leader was shot dead.

That day in October 1977, Voigt had welcomed Al Hamdi's visit to the crop research farm the University of Arizona was helping to develop at Sana'a, North Yemen's capital city. He showed the president progress being made in the project. The university had begun work there about six months earlier on contract from the U.S. Agency for International Development.

The assassination was just one example of the political rumbling that complicated the four-year crop improvement project. During Voigt's two years as project leader in North Yemen, another president was blown up, a coup overthrew the government for a day, and the South Yemen army with Cuban advisers invaded the country.

When Voigt got to the Sana'a research farm one morning in 1979, he found bulldozers clearing a four-lane roadway right through the farm. Yemen's support and priorities for the A.I.D. project changed frequently.

Despite such extra challenges, the UA project managed several achievements:

– The usable field area at Sana'a research farm was almost doubled, the water system improved and the fields leveled. These improvements allowed the first reliable local comparisons of test plantings. The project team also built laboratory and seed-storage facilities.

– A second research farm was developed at Al Jaroubah, where growing conditions are different than at Sana'a.

Above and lower right: Farmers in Yemen still use centuries-old methods for separating chaff from sorghum grain by tossing them in a breeze and for turning soil with a donkey-pulled wooden plow. The second man behind the plow is dropping seeds and kicking dirt over them. (Photos by Robert Voigt.)

– Tests of several thousand varieties of sorghum showed that local varieties produced more grain than hybrid types bred for high performance in the United States. The project concentrated on sorghum because of its dominance as a staple food source for both people and livestock in Yemen.

– Selection and preliminary breeding of native Yemeni sorghum varieties over a four-year period resulted in superior varieties with twice the yield of unimproved local varieties in common use.

– More than 50 potentially superior sorghum varieties were tested at 18 working farms throughout the upland areas of North Yemen. This introduced some improved types to farmers as well as allowing evaluation under a variety of growing conditions. The contacts with farmers at these outreach sites included some demonstrations of pest-control techniques.

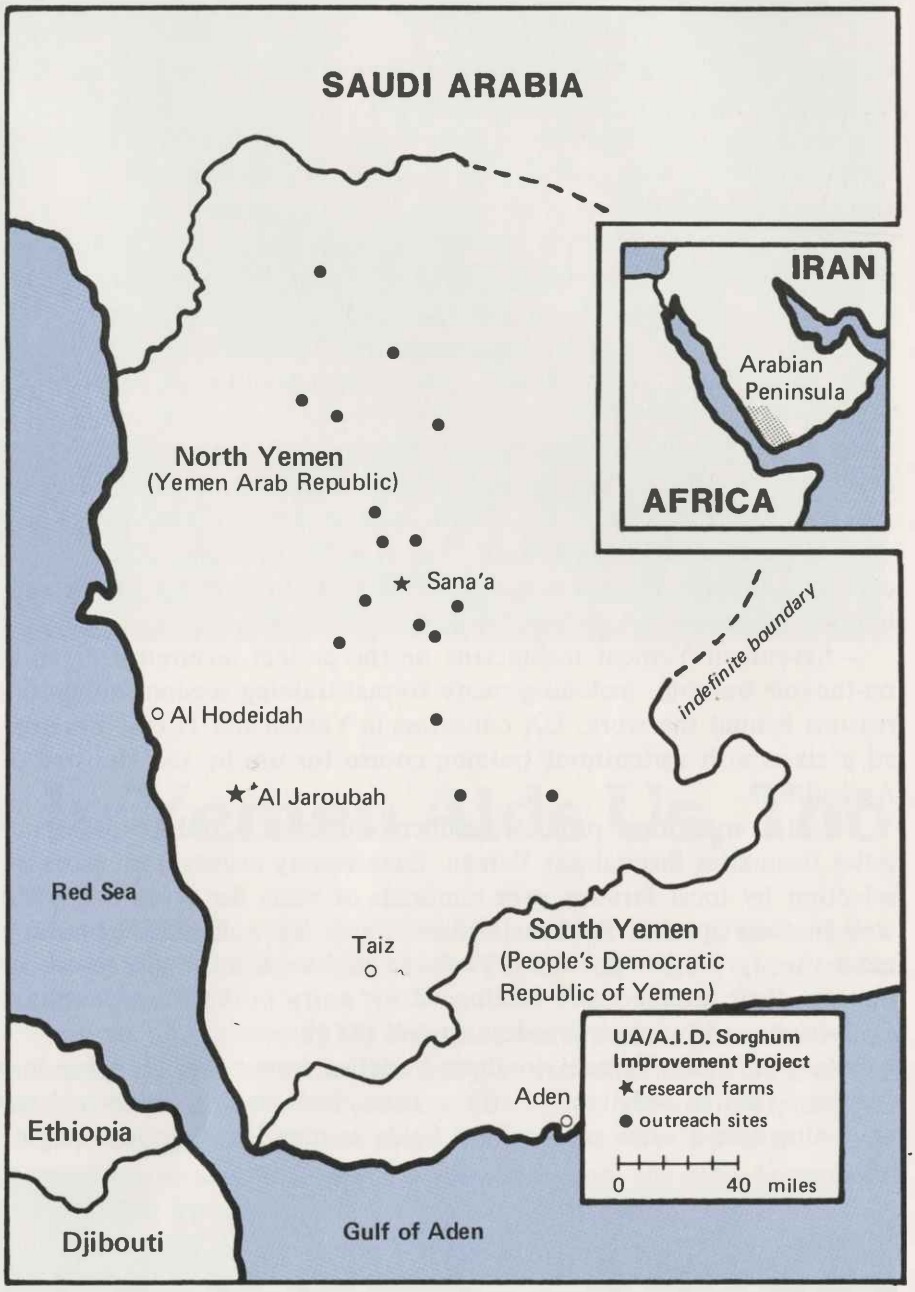
– Yahya Shuga of the Yemen Ministry of Agriculture worked closely with the UA faculty and studied crop improvement work in Arizona for six months as a potential leader for long-term crop improvement activities in Yemen. However, North Yemen has suspended sorghum improvement work since the end of the UA/A.I.D. project in order to concentrate efforts on water-resource development.

– Seventeen Yemeni technicians on the project received supervised on-the-job training, including many formal training sessions about the reasons behind the work. UA educators in Yemen and Tucson developed a six-month agricultural training course for use by the Ministry of Agriculture.

– Voigt and other project members collected 4,500 sorghum varieties from sites throughout Yemen. Each variety results from repeated selection by local farmers over hundreds of years for types that yield well in their specific field conditions. Thus, the collection includes a great variety of genetic traits. The collected seeds are being grown to increase their numbers and catalogued for entry in the World Sorghum Collection used by plant breeders around the globe.

Many of these Yemeni sorghum varieties were close to being lost forever: Though sorghum is still a basic food source, many villages have abandoned acres of sorghum fields as men leave for high-paying

At the research farm that the University of Arizona helped develop in Yemen, assistant engineer Madhu S. Acharya of India surveys a field for leveling.



foreign jobs instead of farming at home. About one-fourth of North Yemen's work force is in other countries, especially Saudi Arabia.

The sorghum collection from Yemen offers possibilities for direct benefits in the United States. Some desirable traits from Yemeni sorghums, such as drought-tolerance and early maturity, might be bred into varieties for use here. UA agronomists are evaluating some Yemeni samples in test plots at Yuma. An Oklahoma State University Researcher is already including a Yemeni variety in his sorghum-improvement breeding stock.

An international sorghum-improvement program working in 14 Central and South American countries is using several of the Yemeni sorghums. The University of Arizona is one participant in this program.

One sorghum and three millet varieties collected in Yemen apparently have resistance to a root parasite called witch weed. This parasite

devastates some grain harvests in many parts of eastern Asia, so the trait of resistance could be extremely valuable in breeding programs.

W. Gerald Matlock, director of international programs for the UA College of Agriculture, counts the potential of the Yemen sorghum collection as one of the three principal benefits to the United States and Arizona from the UA/A.I.D. project.

Another is goodwill toward America stemming from the assistance to Yemen. Yemen's location on the Arabian Peninsula gives it a strategic international importance that has attracted aid from many industrialized nations. An abandoned building at the Al Jaroubah research site that the UA/A.I.D. project fixed with a roof and a water supply was initially built by the Soviet Union during a period of poor American-Yemeni relations.

At several of the remote sites UA scientists reached for field tests or seed collections, villagers said they were the first Americans ever to visit the village.

A third benefit brought home by the project is the experience it provided UA participants. Voigt and agronomists Dr. Donald M. Stewart, Dr. Deran P. Markarian and David L. Robinson each worked for more than a year in Yemen. Other UA faculty members, including soil scientist Dr. Fred Turner and entomologist Dr. Donald M. Tuttle, made brief trips to help with specific tasks. On campus in Tucson, project director Dr. R. Phillip Upchurch, plant scientists Dr. Melvin L. Schonhorst and Dr. Victoria Marcarian, and several others provided backup support.

The international experience adds perspective to faculty members research and teaching within Arizona. Working with sorghum and other crops under diverse conditions increased their understanding of the plants' capacities and limitations. Voigt feels he can be more helpful to foreign students because of his Yemen work. He is faculty adviser for three foreign graduate students, including one from Yemen.

The Yemen project ended last year, with recommendations for future crop-improvement work in that country. The University of Arizona is still helping to expand agricultural capacities in Brazil, Saudi Arabia, Gambia, Portugal and a different project in Yemen. An old proverb describes the underlying goal: "Give me a fish and I'm fed for today; teach me to fish and I'm fed for life."

At the research farm in Sana'a: Above: superintendent Yahya Abdo (left) supervises three-man crews planting sorghum. Below: Abdo and worker bag seed heads from test plots.

Arboretum: Garden, Classroom, Lab

By Leverett T. Clark
Executive Secretary
Friends of the Arboretum
and Guy Webster

When you visit the Boyce Thompson Southwestern Arboretum, stay long enough to let your amazement at the diversity of plants cool off a bit.

Then you notice more of the other things, like the trail along the creek at the foot of the cliff, like the birds from hawks to hummingbirds, like the lake with rare species of small fish, like the lizards among the geological displays and the squirrels around the abandoned rock house, like the refreshing smells and sounds of a desert canyon.

Seventy species of animals and 144 of birds have been seen at the arboretum.

There's more to the arboretum, too, that you might not see: educational and research activities for advancing the understanding of desert plants and the desert environment.

But the plants themselves, more than 1,500 varieties of them, are the stars of the show. Mainly for them, about 80,000 people a year come to the arboretum 60 miles east of Phoenix, near Superior.

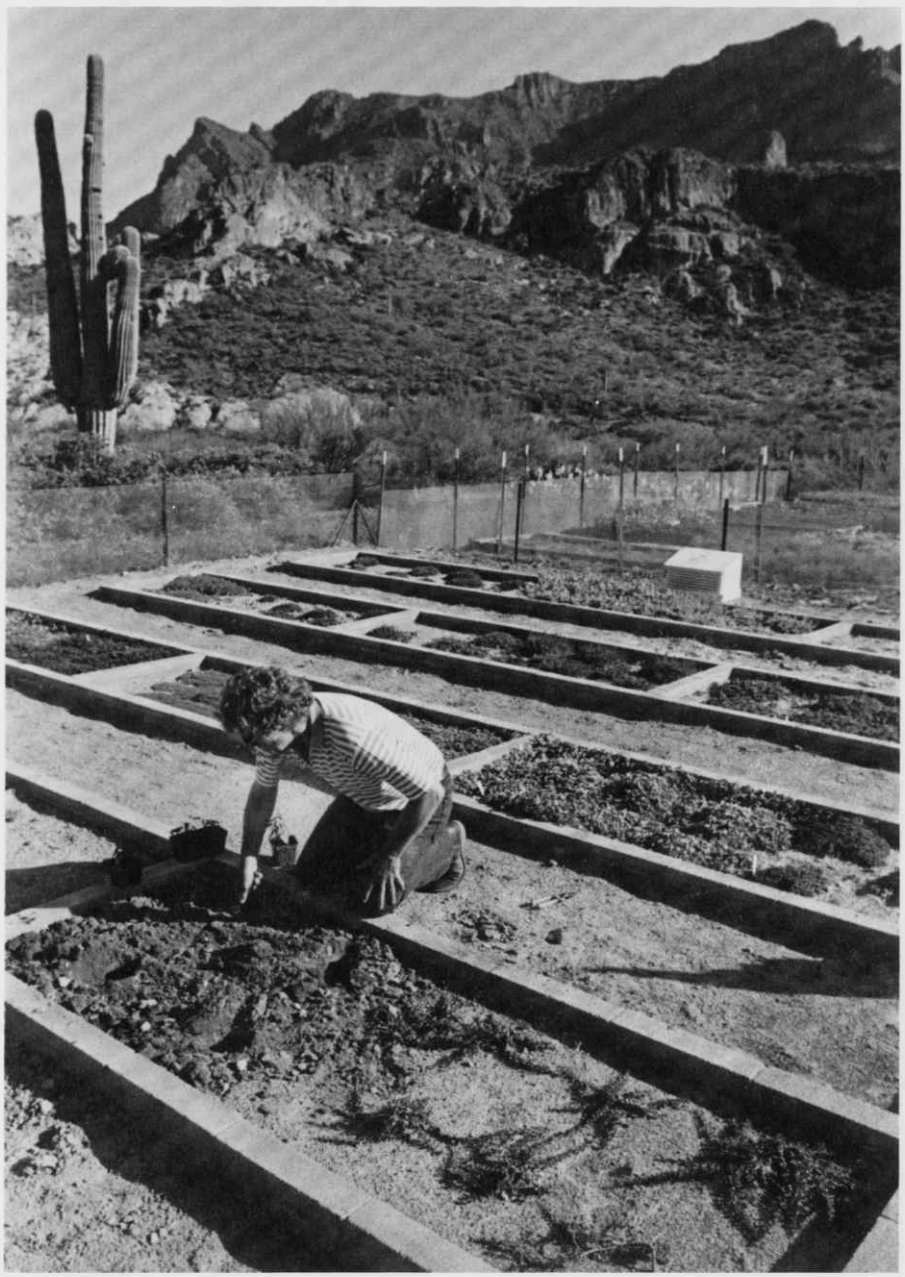
Specimens from dry regions throughout the world grow in 35 acres of botanical gardens. Many visitors say their favorite is the big boojum tree from Baja California. Grouped plantings of cacti, yuccas and agaves show off the varieties of shapes and sizes of these families. Some of

the many wildflowers grow under a grove of eucalyptus trees from Australia or near the olive trees from southern Europe. Besides the botanical gardens, the arboretum includes more then 1,000 acres of natural Arizona desert. The plant life ranges from huge 200-year-old saguaros to what arboretum curator Dr. Frank S. Crosswhite calls "belly flowers" because they are so small you need to lie on the ground for a good look.

Also, two greenhouses allow the public to see many desert plants that might not survive the cool winters at the arboretum's 2,400-to-4,000-foot elevation. One features cacti; the other, other succulents. The names of some specimens catch the flavor of their curious appearance: creeping devil, Peruvian old man and elephant's ear.

Two miles of marked trails, a shaded picnic area, and a visitors' center with bookstore and gift shop add to the learning and enjoyment possible at the arboretum.

Still, the Boyce Thompson Southwestern Arboretum is not as good as the three groups that manage it want it to be. It is run by a unique



Far left: One of the arboretum's walking paths offers this view of Ayer Lake.
Near left: In research plots at the arboretum for testing low-lying plants as ground covers, Tim Clark adds some new plantings. (Photos by Ted Bundy.)

partnership of the University of Arizona, the Arizona State Parks Board and Boyce Thompson Southwestern Arboretum, Inc., a non-profit corporation. The U.S. Forest Service also owns part of the land used by the arboretum. The three managing groups have adopted a master plan for improvements to the arboretum.

Some parts of the plan are already under way. A new parking lot has been completed. The trail network, plant collection and irrigation system are being expanded. Demonstration gardens being planted and grown will show how water-saving plants can be used in home landscaping.

Future plans call for a discovery area for hands-on learning experiences with plants, an auditorium and a classroom. Increased space is planned for the library, seed storage, research facilities and greenhouses. These improvements will allow expansion of the arboretum's educational and research programs.

Many such programs already take advantage of the arboretum's setting and facilities. Guided walks, lectures and interpretive programs are provided regularly to school classes, garden clubs and other groups. The

New 'Friends' Group Helps Arboretum Grow

Membership in a new group, Friends of the Arboretum, helps people take full advantage of the offerings of the Boyce Thompson Southwestern Arboretum while helping the arboretum improve itself.

The group began this winter as part of the University of Arizona Foundation. Members' benefits include:

– a free subscription to *Desert Plants*, the arboretum's colorful quarterly magazine. *Desert Plants* is described on page 19 of this *Arizona Land and People*.

– free admission to the arboretum, which is open from 8 a.m. to 5 p.m. every day except Christmas. Admission for non-members costs one dollar.

– two free guest tickets of admission.

– an invitation to Friend's Day, a yearly fall program about desert plants.

– a special preview of the Annual Spring Plant Sale the day before non-members see the sale.

Dues for regular membership are $25 annually. Special types of membership are available for higher levels of support. The dues will help fund improvements under the arboretum's master plan for enhancing its plant collections and facilities for educational and research programs.

For further information or a membership application, write to Friends of the Arboretum, P.O. Box 3607, College Station, Tucson, Arizona 85722, or call Leverett T. Clark at 626-0261.

school groups range from elementary pupils on a one-day field trip from Phoenix to university classes that may spend several days or weeks at the site. The arboretum's educational coordinator, Dr. Carol D. Crosswhite, also visits many schools in the state.

Research projects began at the arboretum more than 50 years ago. Some early studies of how roots hold soil in place led to a cooperative project with the U.S. Forest Service for growing thousands of erosion-controlling plants.

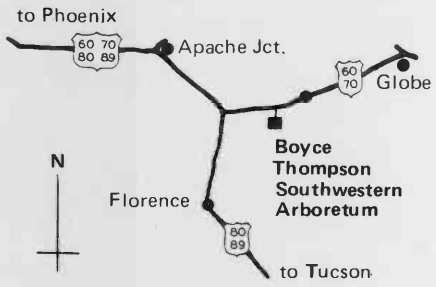
University of Arizona researchers in a current project at the arboretum are growing several low-lying, spreading plants in test plots. They want to identify desert plants that would work well as ground covers for landscaping.

Another research program at the arboretum focuses on desert legume plants. Legumes are plants related to peas and beans whose roots harbor nitrogen-fixing bacteria. Researchers are collecting and screening many of the thousands of little-known legumes from arid lands to check for species that have potential as water-saving crops or landscape plants.

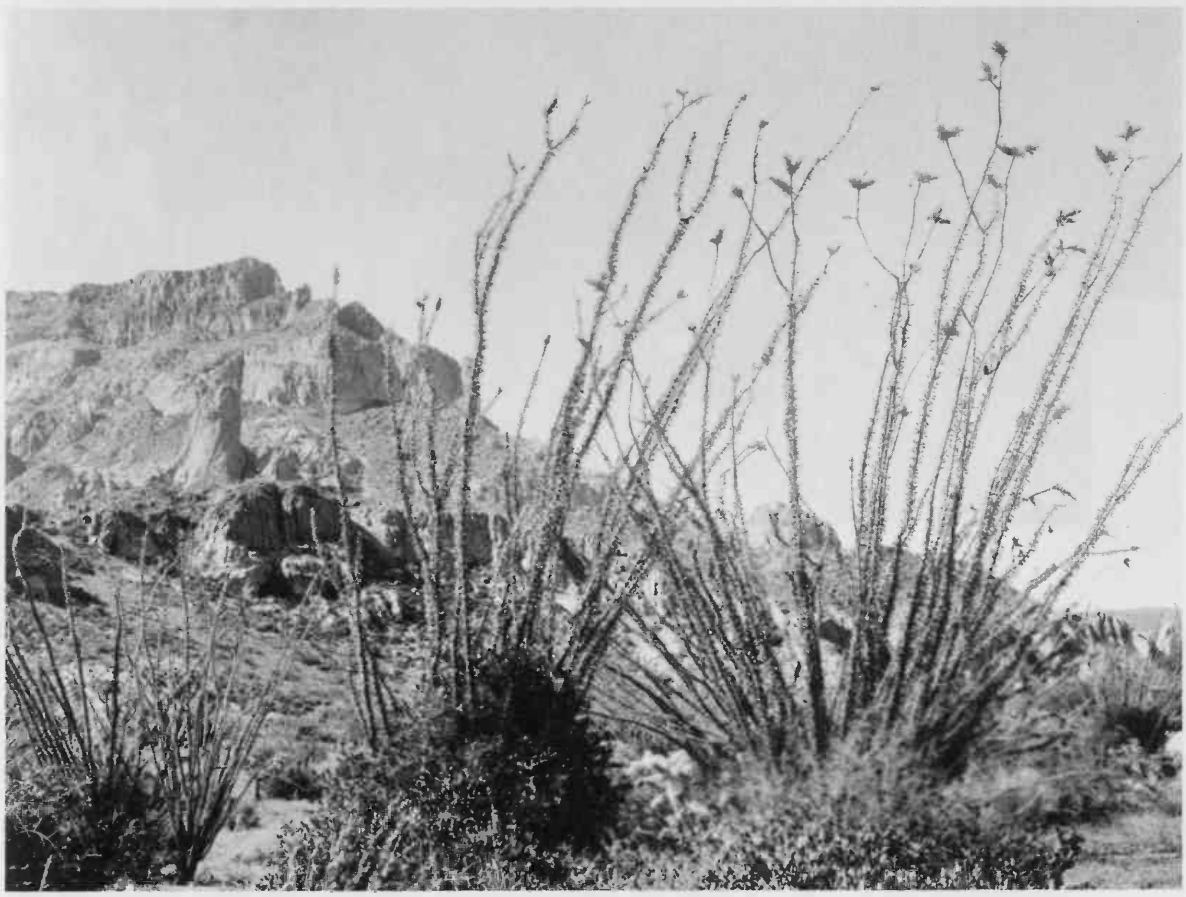
The arboretum also advances the international understanding of desert plants by providing seeds from hundreds of species to research institutes, public agencies and botanical gardens around the world.

The public has a chance to buy water-saving plants at the arboretum's most popular event, the annual Spring Plant Sale. The specimens and seeds sold include trees, shrubs, cacti and other plants for landscaping and houseplants. About 10,000 people came to the two-day sale this April and bought hundreds of varieties of plants.

The timing of the sale gives customers a chance to enjoy the springtime wildflowers and blossoming shrubs in the arboretum and the sur-



Ocotillos in bloom at the arboretum. (B.T.S.A. photo.)



Cacti and succulents with an assortment of shapes attract attention from a visitor to the 1982 Spring Plant Sale. (Photo by Ted Bundy.)

rounding desert. However, visitors to the arboretum can see flowers abloom almost any time of year. Various cacti and agaves blossom throughout the summer and early autumn, and some shrubs such as jojoba carry flowers through the winter.

The Boyce Thompson Southwestern Arboretum is already close to what philanthropist William Boyce Thompson envisaged when he founded it in 1927. The improvements now planned will make it even better. He predicted it would become "the most beautiful and most useful desert garden of its kind in the world."

Other Periodicals Available

Readers of *Arizona Land and People* may also find information of interest in some other periodicals affiliated with the UA College of Agriculture.

Most of the college's publications are one-time information packages about specific subjects. About 400 of them from *Cotton Seedling Diseases* to *Buying Home Insulation* are available through county offices of the Cooperative Extension Service.

Of the serial newsletters published by the college, most stick to fairly specific subject areas or are meant for people in one county. Six periodicals of wider interest are *Desert Plants, Arid Lands Newsletter, ACCES, ACCES-Energy, RE:SEARCH*, and the *Cradle Crier* series.

If you just want to know when to water your windowsill cactus or want pictures of saguaros at sunset, *Desert Plants* may not be for you. But if you would like to learn details about ferns in the Huachuca Mountains, grasses that grow in seawater, the evolution of saguaros, and the uses of plants by Indians of the Sonoran Desert, think about subscribing.

Desert Plants is a semi-technical magazine published quarterly by the University of Arizona for the Boyce Thompson Southwestern Arboretum. Since it began three years ago, it has attracted almost 4,000 paying subscribers worldwide.

"It's aimed at an educated public," says editor Frank S. Crosswhite, plant curator for the arboretum. "We have many professional plant people who subscribe, but also doctors, lawyers, libraries, the whole gamut. We have many plant enthusiasts without formal training but with plenty of interest."

Many of the major articles are written by researchers in a scientific style. Topics of such reports in the autumn 1981 issue ranged from the floral preferences of various hummingbirds to the types of plants growing near the Gila River northeast of Safford.

Articles in a more popular style include some "how-to" features and profiles about specific desert plants. The winter 1980-81 issue explained propagation techniques for desert plants and told "The Story of Jimson Weed." Every issue includes book reviews, an editorial and a report on projects at the arboretum.

Last year, *Desert Plants* started an annual supplement called "Living with Desert Plants Throughout the Year." It has many short essays about ways to use desert plants, such as planting a living fence of ocotillo and using *Aloe vera* to treat burns.

In a summer 1981 article, Dr. Jon Rodiek of the UA School of Renewable Natural Resources described possible landscape uses for trees that grow in Arizona wetlands:

> "Most of these tree species are tolerant of urban growing conditions established within desert habitats. In fact, with some minor supplemen-

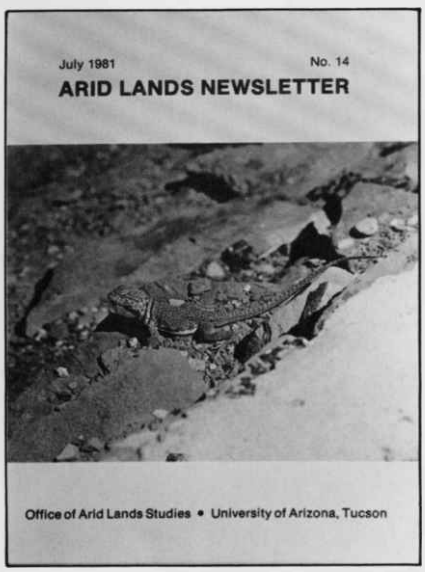
This photo of a matilija poppy appeared in a *Desert Plants* article about seed varieties available from the arboretum.

> tal irrigation, most species will thrive quite nicely. The costs of maintaining a man made landscape in a desert setting will eventually force the urban dweller to select the most water- and energy-efficient plant species. . . . These tree species could adequately substitute for less efficient plant species now being used."

He then gives brief descriptions of Fremont cottonwood, velvet ash, Arizona sycamore and five other trees.

Each issue of *Desert Plants* is illustrated with many photographs and drawings, including several in full color. The magazine averages about 60 pages, but a double issue later this year will be much longer. It will describe each of the major environmental communities of the Southwest.

Subscriptions cost $12 a year. Currently, the arboretum is offering a complete file of past issues along with a subscription through 1982 for $29.50, or all issues through 1983 for $39. To subscribe, write *Desert Plants*, Boyce Thompson Southwestern Arboretum, P.O. Box AB, Superior, Arizona 85273.



The *Arid Lands Newsletter* is global in scope and personal in style. It gives readers views of the challenges and opportunities of deserts and near-deserts worldwide.

Some recent articles have described the cooling features of traditional Southwestern homes, the wildlife of India's Thar desert and children's books about deserts.

The most recent *Arid Lands Newsletter* (April 1982) is a special issue about the potential of desert plants as energy sources. A special issue in 1981 focused on the retreat of forests and efforts to re-establish them, with reports about work in six countries from Australia to Upper Volta.

Some articles feature projects of the Office of Arid Lands Studies, which publishes the magazine. The new special issue, for example, tells of progress at the office's Bioenergy Research Facility in Tucson. However, both the topics and the readership are more international than Arizonan.

One regular feature of the magazine, "??? Have You Seen ???," gives one-paragraph descriptions of some of the hundreds of publications received by the Office of Arid Lands Studies every month.

"We're trying to say in a low key, lay way what the arid world is all about and how we can work out problems," says Patricia Paylore, editor of *Arid Lands Newsletter*. "The arid world is one world. Our problems are common problems, and we can help each other if we listen to each other."

Paylore's editorials in each issue often stress themes of international cooperation. A person-to-person flavor comes through several parts of the magazine: the editorials, Paylore's frequent interviews with foreign students at the University of Arizona, listings of international visitors to the Office of Arid Lands Studies, and requests to readers for correspondence and reports.

Some excerpts from *Arid Lands Newsletter*:

> (From "Traditional Low Desert Shelter Design in the American Southwest," by Helen J. Kessler and John F. Peck, November 1981.) "The basic passive sources of coolth–evaporation, ventilation, earth contact, and night sky cooling–were all used by the Indians and early

European settlers. As energy becomes more expensive, we need to develop better understanding of these concepts. We are not assuming that mechanical cooling is not needed to maintain our modern concepts of comfort, only that less of it is needed if we only build our houses right."

(From "Afforestation at the Village Level," by H. S. Mann, March 1981.) "The Indian desert is by far the most populous (48 persons per square kilometer) among the arid zones of the world. The inhabitants. . .depend on local trees for their fuel requirements but in doing so they devastate the woody biomass. An estimate suggests that fuel requirement in the Rajasthan desert has increased from 1.64 in 1951 to 3 million tons in 1971, to cope with demands of the increasing human population, up from 9.4 to 15.5 million during the same period. . . . As a consequence, serious attempts are being made to plant trees in the three major arid states of India."

Arid Lands Newsletter comes out about three times a year. It is usually 24 to 32 pages with a colorful cover and many photographs. Subscriptions are free on request. Write to Editor, *Arid Lands Newsletter*, UA Office of Arid Lands Studies, 845 N. Park Ave., Tucson, Arizona 85719.

Arid Lands Newsletter editor Patricia Paylore.

The College of Agriculture's Council for Environmental Studies publishes two newsletters of interest to a broad range of people: *ACCES* and *ACCES-Energy*.

Both summarize significant recent publications and keep readers posted about activities and information sources in Arizona. They differ in subject area. *ACCES* covers an assortment of environmental issues from groundwater supplies to aircraft noise. *ACCES-Energy* narrows in on energy concerns, still a broad field. A third newsletter of the council, *ACCES-Pesticides*, is similar in style but specializes more than the other two. Most of its readers are licensed pesticide users.


College of Agriculture Council for Environmental Studies

Acces

CAPSULE REPORTS

The University of Arizona Tucson, Arizona 85721

The March-April 1982 *ACCES* summarizes two recent analyses of the worth of environmental impact statements in federal decision-making. The same four-page issue gives capsule versions of a report on agricultural research needs and a book about nuclear waste disposal. It also describes a new series of Arizona groundwater maps and U.S.D.A.'s 1981 *Fact Book of U.S. Agriculture* and lists notices that have appeared in the *Federal Register* and are relevant to Arizona environment.

For all of the publications it mentions, *ACCES* tells the cost and address for obtaining a copy. Many are federal agency reports that readers would not run across in bookstores or newsstands.

The summaries in the newsletter's "Capsule Reports" section are meaty. Here is about one fifth of the *ACCES* report on *Assessment of Technologies for determining cancer Risks from the Environment* by a U.S. Congressional agency:

". . . the Office of Technology Assessment recently issued an evaluation of current methods for gathering data, testing, predicting occurrence, extrapolating risks, and setting regulatory standards for exposure to carcinogens.

"The OTA report states that a number of different studies have estimated that up to 90 percent of cancers could be prevented by

avoiding associated environmental factors. In this context environment means any influence that interacts with humans, except inborn genetic factors.

". . . The report cites the major areas of difficulties in federal regulation of environmental carcinogens: 1) differing methods of collecting data; . . . 2) equitable evaluation of risks and benefits, and distribution of costs; . . . and 3) determination of the most effective level of government control over involuntary exposure."

Other listings in *ACCES* are briefer. For example:

"*Promise of the Land* is a 40-page, color-illustrated book on public land resources, intense competition for these resources, how users are chosen, and how the public is involved. $2.75 from Government Printing Office, Washington, DC 20402; order No. 024-001-00086-1."

ACCES-Energy, too, summarizes new publications and tells how to get them. In recent issues, the newsletter has reviewed several books forecasting U.S. and world energy needs for the next few decades and describing options available for meeting those needs. Some projections for the amount of energy the country will be using in year 2000 differ from each other by more than 50 percent, and even the high estimates are only about half of pre-1974 predictions.

ACCES-Energy lists many resources and activities of the Arizona Energy Office and the Arizona Solar Energy Commission. For example, from a 1981 issue:

"An evaporative cooler fact sheet has been issued by AEO to present advantages of these systems, help in selecting correct size and type, discuss care and maintenance, compare evaporative cooling with refrigeration, and describe advantages of a combined system. The fact sheet is free from AEO Public Information."

Helen E. DeVries edits both *ACCES* and *ACCES-Energy*. Dr. Roger Caldwell directs the Council for Environmental Studies. Each newsletter has four pages and is published six times a year. Subscriptions are free on request. Write to the council, UA College of Agriculture, Tucson, Arizona 85721.


RE:SEARCH

Number 1
Winter 1981

Published by the School of Renewable Natural Resources
College of Agriculture, The University of Arizona, Tucson, Arizona 85721

Ducks Take to Islands at Pintail Lake

RE:SEARCH, the newest periodical listed here, chronicles research at the School of Renewable Natural Resources. Its premiere issue this winter described 10 projects. They range from a study of why Alamo Lake produces an unusually large number of largemouth bass to the improvement of methods for measuring evaporation rates from plants.

The newsletter is for "professionals in fields of natural resources and other interested people," says editor Mary Lou Stengel. "We are trying to keep the articles interesting to a broad audience because people who are knowledgeable about wildlife are not necessarily experts in hydrology and people who work in forestry might not know much about fisheries."

One article begins:

"It's no secret to most Arizonans that the ponderosa pine forest is one of the state's most valuable resources. What remains a secret is the role plant nutrients play in the growth and function of the pine forest. In order to understand that role, Dr. James Klemmedson, Division of

Forest and Watershed Resources, initiated studies 13 years ago on the accumulation and distribution of nutrients and the effect of forest management on the nutrient regime."

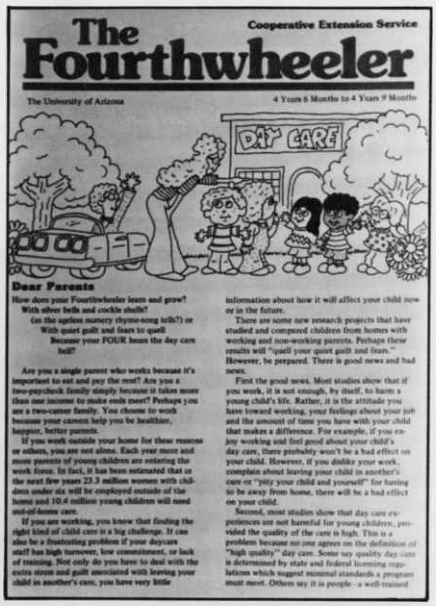
Several photos and a drawing illustrate the eight-page newsletter. Future issues will come out about every six months. For a free subscription, write to Editor, *RE:SEARCH*, SRNR, Bio-Sciences East, University of Arizona, Tucson, Arizona 85721.

The *Cradle Crier* newsletter and others in its series aim to provide parents of young children with timely information about child development and care.

The twelve issues of *Cradle Crier* each deal with one month of an infant's first year. Number 10, for example, comes when the baby is 10 months old. Each issue tells the developments typical for that age and gives suggestions for helping the child's (and parent's) learning and happiness.

After *Cradle Crier* come four issues of *Crib Courier* during the child's second year. The newsletter continues quarterly with a succession of names for three more years. For example, the third *The Fourthwheeler* for age 4 years, 6-to-9 months, says:

> "How do young children develop values? They develop values from the people around them and from the experiences they have.... They watch how you react under crisis. Do you tell 'white lies'? What do you say when trapped or cornered in a difficult situation? Fourthwheelers (4-year-olds) are beginning to form their own ideas of good and bad, right and wrong....
>
> "... It might be a good time to sit down and make a list of the values you want your child to have now and for the future. When you look at your list, figure out how you are teaching these values through your behavior."


Cooperative Extension Service

The Fourthwheeler

The University of Arizona

4 Years 6 Months to 4 Years 9 Months

DAY CARE

Dear Parents

How does your Fourthwheeler learn and grow?
With silver bells and cockle shells?
(as the ageless nursery rhyme-song tells?) or
With quiet guilt and fears to quell
Because your FOUR hates the day care hell?

Are you a single parent who works because it's important to eat and pay the rent? Are you a two-paycheck family simply because it takes more than one income to make ends meet? Perhaps you are a two-career family. You choose to work because your careers help you be healthier, happier, better parents.

If you work outside your home for these reasons or others, you are not alone. Each year more and more parents of young children are entering the work force. In fact, it has been estimated that in the next few years 23.3 million women with children under six will be employed outside of the home and 10.4 million young children will need out-of-home care.

If you are working, you know that finding the right kind of child care is a big challenge. It can also be a frustrating problem if your daycare staff has high turnover, low commitment, or lack of training. Not only do you have to deal with the extra stress and guilt associated with leaving your child in another's care, you have very little information about how it will affect your child now or in the future.

There are some new research projects that have studied and compared children from homes with working and non-working parents. Perhaps these results will "quell your quiet guilt and fears." However, be prepared. There is good news and bad news.

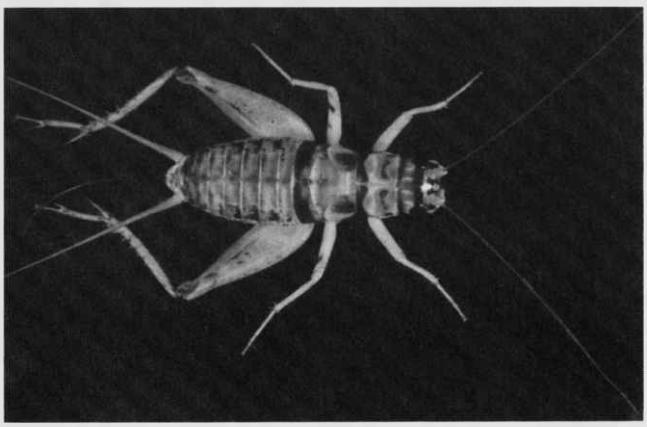
First the good news. Most studies show that if you work, it is not enough, by itself, to harm a young child's life. Rather, it is the attitude you have toward working, your feelings about your job and the amount of time you have with your child that makes a difference. For example, if you enjoy working and feel good about your child's day care, there probably won't be a bad effect on your child. However, if you dislike your work, complain about leaving your child in another's care or "pity your child and yourself" for having to be away from home, there will be a bad effect on your child.

Second, most studies show that day care experiences are not harmful for young children, provided the quality of the care is high. This is a problem because no one agrees on the definition of "high quality" day care. Some say quality day care is determined by state and federal licensing regulations which suggest minimal standards a program must meet. Others say it is people—a well-trained

Dr. Shirley J. O'Brien, human development specialist for the Cooperative Extension Service wrote these newsletters. About 4,000 families are now getting them. Of 519 parents who answered a survey about the newsletter, 73 percent said that, as a result of reading it, they had altered their actions with their child.

Distribution is handled differently in different counties, but coordinated by the Extension Service home economists serving each county. To find out about subscribing, call the Cooperative or Agricultural Extension Service in your county. It is listed under county government in most phone books.

Knowledge in the Making



Indian house cricket, unwelcome lodger in many homes.

Who Are These Crickets And What Do They Want?

Dr. Robert L. Smith gets hundreds of calls every year about crickets in Tucson area homes. He is a specialist in urban entomology for the UA Cooperative Extension Service. Some people find household crickets unsightly, but the crickets' noise, especially nighttime chirping, elicits the most complaints. The human hosts also worry about their guests' eating habits, since crickets elsewhere are known to nibble on paper and fabrics. However, no verified reports of such damage have come from the Tucson area, says Smith. He tells people the best way to control crickets indoors is to seal cracks and crevices, keep the area clean, and put out non-toxic sticky traps of the type marketed for catching roaches.

To help provide more specific answers to questions Smith gets about crickets, entomology graduate student Nathan M. Schiff is offering various textiles and other materials to hungry Tucson crickets to see what they will eat. Another graduate student, Patricia J. Figuli, is finding out what types of crickets invade Tucson homes. Unsystematic reports have suggested that an increasing proportion of them are Indian house crickets rather than common house or field crickets. Figuli distributed sticky traps to 50 homes throughout the area, and will identify what is caught.

Hard Times for Cochise Farmers Lead to Search for Cost Cuts

Forecasters this winter were estimating that up to 30 percent of the irrigated farm acreage in Cochise County in 1981 would go out of production in 1982. About 40 of the county's farmers feeling the pinch of low market prices and high production costs met in March with County Extension Agent Larry Sullivan and representatives of other farm agencies and lending agencies. That meeting in Willcox led to the formation of the Integrated Production Management Program. In this program, a committee of consultants will work closely with eight selected farmers for the next two or three growing seasons looking for ways to lower production costs or to increase the ratio of yields to costs. The consultants are eight UA Extension specialists in agronomy, engineering, economics, soils and pest control, coordinated by agent Sullivan. The selected farms are in four different agricultural areas of the county, range in size from about 200 to 2,000 acres, and grow a total of 14 different crops. The types of information to be considered include tests of soil, water and plant tissue, and measurements of the efficiency of all irrigation pumps. "This will be an intensive, time-consuming effort," says Sullivan. "We expect that it will not only help these eight growers, but that we will be able to use the basic data we get to help all of the farmers in the county."

Dairy Farms' Problem: When It's Hot, Breeding's Not

Heat stress in cows causes trouble for Arizona dairymen. One part of the problem is that cows due for breeding often fail to begin a successful pregnancy during the summer. Pregnancy rates are low, and deaths of embryos in the first weeks after conception are an even bigger factor. The net result: Of cows inseminated in summer, less than 20 percent bear calves. Insemination in other seasons succeeds at two to three times that rate. The lower calving rate nine months later also means fewer cows are beginning to give

milk at that time, making steady production levels difficult for dairies. UA veterinarian and physiologist Dr. D. Ed Monty has begun experiments to identify how heat stress kills young calf embryos. To pinpoint the problem, he is looking at the heat's effect on secretions of the uterus that nourish the embryo. He has found hormonal changes in heat-stressed cows that may be linked with uterine secretions. Monty works with culled cows at the Arizona Dairy in Higley, which milks about 3,600 cows three times a day. The dairy's veterinarian, Dr. Thomas J. Fuhrman, is cooperating in the research. Monty came to the University of Arizona in 1981 after 12 years on the faculty of Arizona State University.

Cotton Update: Short Season from the Front End

The spring 1980 issue of this magazine described testing of a shortened cotton-growing season as a way to cut pest-control and irrigation costs and to ease double-cropping with wheat or barley. Test fields in 1981 indicated for the third year in a row that shortening the season by cutting off irrigation early was not profitable. Cotton growers Paul Prechel of Coolidge, Bob Layton of Gilbert and Bill Wade of Goodyear participated in 1981 testing by halting irrigation in middle to late August in one field each and continuing irrigation until early to middle September in comparable fields. On average, the higher yields of longer-season cotton more than outweighed the cost savings of a shorter season. As in the 1979 and 1980 tests, 1981 weather favored a long growing season. According to UA agricultural engineer Dr. M. Dale Cannon, head of the short-season study project, "If we'd been trying to prove the early cut-off date was practical, we picked the three worst falls in my memory." Such tests will be cut back this year in favor of tests shortening the season from the other end. Cotton is being planted as a double-crop following the harvest of early-maturing barley. Also, the short-season group will be looking at test plantings of an experimental, early maturing cotton developed by UA cotton breeder Dr. Warner D. Fisher.

Squash Blossom Nutrients And Other Navajo Specialties

Menu planners at hospitals and other institutions on the Navajo Reservation have, in the past, lacked adequate nutritional information about many traditional Navajo foods. However, some patients or clients, especially elders, do not eat well when given an unfamiliar diet. For the Navajo Tribe, Dr. Charles W. Weber of the UA Department of Nutrition and Food Science is analyzing about 80 traditional Navajo foods. The tribe's Food and Nutrition Service, headed by Katherine D. Arviso, helped collect and prepare the foods. Weber and co-workers on campus are measuring levels of major nutrients and six minerals.

A few of the ingredients in Navajo foods are unusual, such as ashes from juniper or tumbleweed mixed into the dough for some breads. Besides flavoring the bread, the ashes add extra minerals to the diet. Wolfberries, bitter if eaten plain, are blended with a white clay that makes them taste sweet. The analyzed foods include wild spinach, squash blossoms, and mutton and organ meats from sheep. The degree to which Navajos still use traditional foods varies greatly in their population. Nutrient information on the old foods will help allow diets in institutional settings to reflect the diversity of the reservation as a whole.

Weber has also studied nutritional values of Papago Indian foods. In some cases, the traditional foods such as tepary beans had nutritional advantages over the foods that have replaced them in the diet.

Terri Johnsen runs lab tests on Navajo foods.

ARIZONA
LAND&PEOPLE
College of Agriculture
The University of Arizona
Tucson, Arizona 85721

Arizonans You Should Know

Dr. Albert K. Dobrenz, professor of plant sciences, won a major University of Arizona teaching award each semester of the 1981-82 school year. Students in the College of Agriculture selected him as their Professor of the Year in the fall. The University of Arizona Foundation gave him its Creative Teaching Award in the spring. The second award included a $1,500 prize. Dobrenz teaches introductory plant sciences, one of the largest courses in the college. He serves as faculty adviser for 16 to 20 undergraduate students and several graduate students each year. In addition to his teaching, he leads an active research program focusing on the adaptation of alfalfa and other forage crops to production in desert conditions.

Dr. Albert Dobrenz.

Bertha Jane Virmond, who taught economical homemaking skills in southeastern Arizona through the Great Depression, celebrated her 100th birthday in Tucson this spring. She retired in 1946 after 21 years as a county home economist and 4-H agent for the UA Cooperative Extension Service. In those days the job title was home demonstration agent. She worked mostly in Cochise and Santa Cruz counties, driving about 700 to 1,000 miles a month from her Willcox office. She taught safe food preservation, nutrition, clothes-making and other subjects to adults and youths. Virmond grew up in Hays, Kansas and during World War I worked for the War Trade Board in Washington, D.C. After her retirement, she kept active with foods and clothing projects and watercolor painting. Her memoirs written in 1976 give a descriptive picture of her territory and work. The UA Library has a copy in its Special Collections.

Melissa Kay Campbell, a May graduate of the UA College of Agriculture, has recieved a prestigious Phi Kappa Phi Graduate Fellowship to study veterinary science at the University of Colorado. Campbell was first selected as the sole UA nominee for the $4,500 fellowship, then chosen as one of the 40 recipients out of 144 nominees nationwide. The graduate of Tucson's Saguaro High School studied pre-veterinary sciences at the University of Arizona. Phi Kappa Phi is a national honor society for students in the top percent of their class.

Dr. Darrel S. Metcalfe will end 24 years of administrative service to the UA College of Agriculture by retiring on June 30. Three-fourths of the students who have ever graduated from the college have done so since Metcalfe became director of resident instruction here in 1958. He returned to that post in 1980 after serving three years as acting dean, then dean, of the college. "Darrel has been a superb advocate for students of the College of Agriculture, and the counseling and guidance he has provided have been unsurpassed at the university," said UA President Dr. John P. Schaefer, who will leave the university the same day as Metcalfe. Metcalfe's future plans include continued overseas consulting and work on textbooks.