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**ABOUT THE COVER:** *This delicate pink cotton blossom is just one example of cotton farmer Carl Clapp's art. The Casa Grande farmer-painter captures on canvas not only the plants but the places and faces that make up the Arizona agricultural scene. A feature story about the man and his art begins on page 12.*

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*(inset) UA Plant Scientist  
Dr. Bob McDaniel  
examines a freshly  
harvested agave leaf from  
test plots at the Marana  
Agricultural Center.*

“The agave can take the desert heat in the summer and still keep growing.”

After 1,000 Years ...

# Agave Farming Is Back

by Lynn G. Ketchum

**T**he quest for alternative crops can take researchers way beyond the greenhouses and experimental plots of traditional agricultural research. Sometimes, they even turn to history for clues to developing a new crop. Such is the case with the desert agave or century plant. University of Arizona scientists are currently investigating the commercial potential of this quintessential desert plant.

Although agave has been and is still harvested from the wild in Mexico and other parts of Latin America, it has not been cultivated as a row crop, at least not in recent history. That is just one challenge facing Dr. Bob McDaniel of the Department of Plant Sciences.



To McDaniel the agave's appeal is as varied as the plants' use. First of all the agave with its giant rosette of heavy gray leaves is drought tolerant, ideal for the desert farmer. "The agave can take the desert heat in the summer and still keep growing." In fact agave literally can survive without irrigation, although some supplemental water will be required to grow the plants fast enough for the commercial market. Even with limited irrigation agave may help relieve the demand on the desert's limited resource. Agave, McDaniel expects, could be grown much like a tree crop with low input and a harvest every four to five years . . . when the agave has reached a height of four to five feet.



Ironically, it was near the UA Marana Agricultural Center where today McDaniel tends his experimental rows of agave that a thousand years ago, Indians cultivated agave. "The Indians probably grew a smaller species for food. They roasted the plant's heart and used agave to supplement beans, squash and other staple foods."

Although the ancient Indians used the agave as a food source, today's researchers look to agave to fill an entire shopping list of consumer products. A multi-use crop, agave yields alcohol, that can be used to make gasohol and tequila. Steroids, chemicals used in the manufacture of some pharmaceuticals, can also be extracted from agave

juice. And agave leaves provide fiber. Historically the leaves have provided material used in rope and baskets.

It's the fiber potential that has attracted the interest of the James River Corporation. The College of Agriculture currently has a proposal pending with the James River Corporation to explore the commercial potential of agave. As a first step the corporation has provided funds for collecting from the wild, various species native to Arizona and northern Mexico. Dr. Steve McLaughlin in the Office of Arid Lands Studies is coordinating this phase for the College of Agriculture in cooperation with Dr. McDaniel. In the months ahead the James River group will test the samples and evaluate them for their fiber potential. The team's work may ultimately lead to expanded research on agave as a fiber resource.

Finding those species with commercial potential is a major chore considering the staggering numbers. "There are hundreds of species," McDaniel says. He knows of at least eight in Arizona and hundreds more in Mexico, the center of origin for the plant. "We're hoping to find species that will do well under cultivation. So we're bringing them out of the hills, so to speak, from various area in Mexico and planting them as a row crop under our irrigated agriculture regime."

In this setting College of Agriculture researchers hope to find out, exactly how the agave or "century plant" can benefit both farmers and consumers in the 20th century. LP



More and more ranchers are using longhorn bulls in an effort to avoid calving problems.

## On the Comeback Trail ...

# A Longhorn Revival

by Lynn G. Ketchum

**S**ome say the Texas longhorn is part billy goat . . . an animal able to eat just about anything and live anywhere. They go, longhorn fanciers say, where other cattle don't want to go. And it's rumored a longhorn can even smell water ten miles away. The classic survivor, that's this historic breed.

The Texas longhorn is no stranger to Arizona, nor is its stamina. "Following the Civil War," UA Extension Livestock Specialist Al Lane explains, "a man by the name of Hooker, Colonel Hooker, brought in two drafts (1600) of longhorn cattle out of Texas. He established a ranch in the Sulfur Springs Valley, a ranch that still exists in the Hooker family." That venture . . . or rather "adventure" attests to the endurance of the

*(inset) A cowboy herds longhorns during roundup at the Jernigan ranch near Safford in southeastern Arizona.*

PHOTOGRAPHY BY LYNN G. KETCHUM







longhorn. Colonel Hooker brought his herd of 1600 over Apache Pass at the north end of the Chiricahua mountains. The Butterfield Stage Company also had to cross the rugged pass on its route between St. Joseph, Missouri and San Francisco, California. "On six miles of Apache Pass the Butterfield lost more horses, men and stages than all

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"If it hadn't been for these longhorned cattle, me and the bank would have been in partnership. They've paid their way."

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the rest of the 2600 miles put together. But Hooker never lost one longhorn." It is just one testimonial to the colorful, lanky survivor of the less than ideal pastures of the American Southwest.

By the 1870's their toughness . . . allowed the sturdy longhorn to follow in the wake of the vanishing buffalo. (Ironically, the longhorns eventually would also face extinction.) As UA Specialist Al Lane explains, "The longhorn had moved into a tough environment . . . taking the place of the American bison or buffalo. They made 'a living' where other cattle could not."

The ability to "make a living" has proved attractive to ranchers from the days of the Spanish conquistadors through the golden years of the cattle business, the decade and a half following the Civil War when drovers trailed longhorns by the millions across Texas to the railheads of Abilene and Dodge City. Although it is a fact that has been largely ignored in this century, it has not been forgotten. At least not by the Jernigan family of Safford, Arizona.

Dee Jernigan spent 40 years in the longhorn cattle business. "If it hadn't been for these longhorned cattle, me and the bank would have been in partnership. They've paid their way."

The late Dee Jernigan never saw the Texas longhorn as just a relic of the wild and wooly west. The longhorn, Jernigan believed, offered not only a colorful past but a promising future. It was

belief that started back in 1945, the year the longhorns came to the Jernigan spread by way of Oklahoma.

In 1927 the federal government set up a refuge to protect the dwindling herds of longhorns. It was from this preserve that Dee Jernigan started his forty year romance with the sturdy cattle. "I heard about a refuge in Oklahoma," the rancher said. "I wanted something different. So I wrote to 'em and after a year or so they decided to sell me three or four head."

When the cattle arrived at his Graham county headquarters the Oklahoma transplants, with their generous rack of horns became an instant curiosity, a novelty to the neighboring ranchers and the brunt of jokes. "People thought I'd gone slap, dab crazy," Jernigan recalled, "but I knew someday the cattle were going to be worth money."

That was forty years ago. Today, Dee's hobby has turned into a full-fledged business, with Dee's son Lee overseeing the family ranch. But instead of three or four longhorns, you'll find several hundred pure and cross bred longhorns grazing "billy goat style" amid the rocky, scrubby hillsides of the Jernigan ranch.

Like father . . . like son. The romance with the West's most recognizable symbol, the Texas longhorn, continues with Lee, a former UA Agriculture student and second generation longhorn fancier and the current president of the Arizona-Texas Longhorn Association.

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"They made 'a living' where other cattle could not."

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Although the cattle have long been associated with Texas, Lee argues that longhorn history actually started far west of the Pecos . . . in Arizona rather than Texas. "They've been here for more than 400 years." The Spanish explorer Coronado brought a herd through the Southern Arizona in 1540. Some accounts say he left 500 head behind to run wild in the southern Arizona deserts. For that reason, Jernigan explains, "they are more or less native to Arizona."

Wild longhorns not only survived in Arizona but were commercially bred until the 1860's. By

*Rancher Dee Jernigan spent 40 years in the longhorn cattle business.*



*A "longhorn roundup" on the Jernigan ranch means first finding the bardy cattle that roam the scrubby, rocky ridges along the Graham mountains, then gathering them and finally branding the calves. It's a twice a year chore.*

PHOTOGRAPHY BY LYNN G. KETCHUM

the end of the Civil War, Arizona longhorns apparently all but disappeared, gone to feed not only the California miners but the Confederate and Unions armies. But the longhorns were not gone long. Arizona cattlemen could not afford to ignore the longhorns renown sturdiness, its vigor, its

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**"They are more or less native to Arizona."**

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ability to survive on less than ideal range. Colonel Hooker, of the Sulphur Spring valley recognized that fact, when he brought his herd from Texas. Hooker's move was just part of what would become the heyday of the longhorn. The 15 years between 1865 and 1880 saw 15 million head of wild longhorns roaming the desert southwest. It was a time when longhorns fed America. Ten million were trailed north and shipped to eastern markets.

But as America approached a new century,

other larger domesticated breeds gained popularity. Interest in the longhorn, with it's hard earned reputation, began to fade. Like another symbol of the wide open west, the buffalo, the longhorn faced extinction. Saved by a federal refuge organized in 1927, the longhorns existed as a novelty, a relic of our western history. But then almost a 100 years after its heyday, some ranchers looked "back" and rediscovered the traits that can be as important today as they were a century ago.

When Dee Jernigan bought his first longhorns back in the 1940's it was more or less to satisfy a curiosity. He was a rancher looking for something different. It was kind of a serious hobby. The exotic, sometimes, speckled cattle with their wide expanse of horn, first gained local notoriety in the movies. The family provided cattle for television shows, commercials and western movies. But after twenty years, Lee remembers, the cattle became more than just props for the entertainment business. "We noticed they were doing well on the range. They were survivors.



They use the whole range. Longhorns go places where other cattle don't want to go. Like billy goats they'd go where the rocks are and where the trees are thick. That's where they like to range."

Veteran ranchers agree longhorns are "easy keeping" animals, but their features go beyond efficient grazing and range use. During the last 20 to 25 years the emphasis has been on producing bigger cattle — resulting in bigger calves. Bigger calves can create problems particularly for first time heifers. It's a concern that attracts ranchers to the longhorn.

More and more ranchers are using longhorn bulls in an effort to avoid calving problems. This situation, according to Livestock Specialist Lane, has a lot to do with the longhorn's apparent comeback. "These cows produce a small calf, but a vigorous calf." An average calf weight will run between 75 and 100 pounds at birth, whereas the longhorn calf weights only 45 to 50 pounds. But despite the light weight Lane says the calf is vigorous. "It bounces up and he's ready to go."


This fact makes the longhorn bull an attractive breeder for first time heifers.

"Typically 30-40 percent of first time heifers would have some problems and lose 10-12 percent of the calves, but with longhorns," Lane says, "calf loss can be cut 3 or 4 percent and practically no loss to the heifers themselves."

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**"With longhorns, calf loss can be cut 3 or 4 percent and practically no loss to the heifers themselves."**

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And Lee Jernigan has found at least three other reasons for bringing back the longhorn. "They're a low cholesterol beef and that's attractive to the consumer." The longhorn cross performs well in the feed lot and on the range. And last but not least, Jernigan says, longhorns are more intelligent than other cattle. "They make better cowboys out of our help." 



## Carl Clapp: Arizona's Ag Artist

by Lynn G. Ketchum

**C**arl Clapp is a member of the Pinal County Agricultural Extension Advisory Board. He is also a "rural realist". His calling card says it all . . .

**Carl D. Clapp**  
Cotton Farmer/Artist

The 45 year old Casa Grande farmer discovered the pencil and brush a long time ago as a boy



growing up in Willcox in the southeastern corner of Arizona. "I was one of the first 'underground' artists. In those days, in the 1950's," Clapp explains, "it was kind of 'sissified' to be an artist. I did a lot of art but I never did let anybody know it. I wouldn't show my work."

But today he shows his work all over, in galleries around the state, including the De Grazia gallery in Tucson and in national and regional



PHOTOGRAPHY BY LYNN G. KETCHUM

agriculture magazines. Carl Clapp is an “ag artist,” a handle he proudly displays on his auto plates and cultivates in his paintings of farm life.

How do farming and art mix? Clapp thinks the two professions do share some common ground. “I think a farmer has one of the most critical eyes for color there is. The way a farmer gauges how his crop is doing is by the color. For instance cotton — there’s about one thousand different col-

ors of green and about 980 of those are bad . . . (laughs).”

Besides ideas, the farm environment also produces its own brand of helpful art critic. Farmers are honest critics, Clapp believes. “If they like a painting, they’ll say. And if they don’t, they’ll sure tell you.”

Although he started painting when he was six his first formal training came when he was a



*"Wheat Harvest Dinner" (pencil drawing)*

"I think a farmer has one of the most critical eyes for color there is. The way a farmer gauges how his crop is doing is by the color.



*"Two of Iowa's Best" (pencil drawing)*

teenager, not in school but through the Cochise County Extension Office. "The first art classes I ever took were from the U of A. They had an extension class down in Willcox. Myself and thirty little old ladies painted together. I used to get a lot of razin' from my peers about that."


His interest in art grew — through his years at the Arizona State University where he graduated with a degree in art education, during his teaching and coaching days and now as he divides his time between cotton farming and painting in his Casa Grande studio.

The third generation Arizonan says he gets many of his ideas while driving a tractor. Cultivating quarter mile rows of cotton offers plenty of time to think. Clapp avoids what he calls the "trite" agricultural scenes, the windmills, the cliché farm scenes. "I'm a farmer and I feel more comfortable painting what I know . . . and I know agriculture." That knowledge allows Clapp the insight to paint those scenes that say something about what is more than a business but a way of life. In Clapp's paintings you'll find variety from

the delicate beauty of a cotton blossom to farm faces that show the wear and tear of an enterprise full of ups and downs.

"I paint everything from cotton to cattle," the easy going artist says, ". . . but I really like doing people and trying to capture their moods, their feelings on canvas."

That sensitive approach is apparent in a drawing called "Wheat Harvest Dinner", a picture of a grandfather stopping in the middle of a harvest day to share dinner in the field with his granddaughter. Moments like this are worth saving . . . worth recording. Carl Clapp hopes to build his artistic reputation on these "slices of farm life."

Someday, he'd like to pick up where the last of the famous agriculture artists, Grant Wood, left off. It's Carl Clapp's dream to travel the country with brush and palette in search of those people, those places, those scenes that show us in human terms the meaning of agriculture. "I hope," Clapp says, "to someday be agriculture's artist." 



COURTESY DELTA PINE AND LAND CO.

*"Claude Evans" (water color)*

From Runway to Park ...

# Landscape Students Leave Their Mark


by Lorraine Kingdon

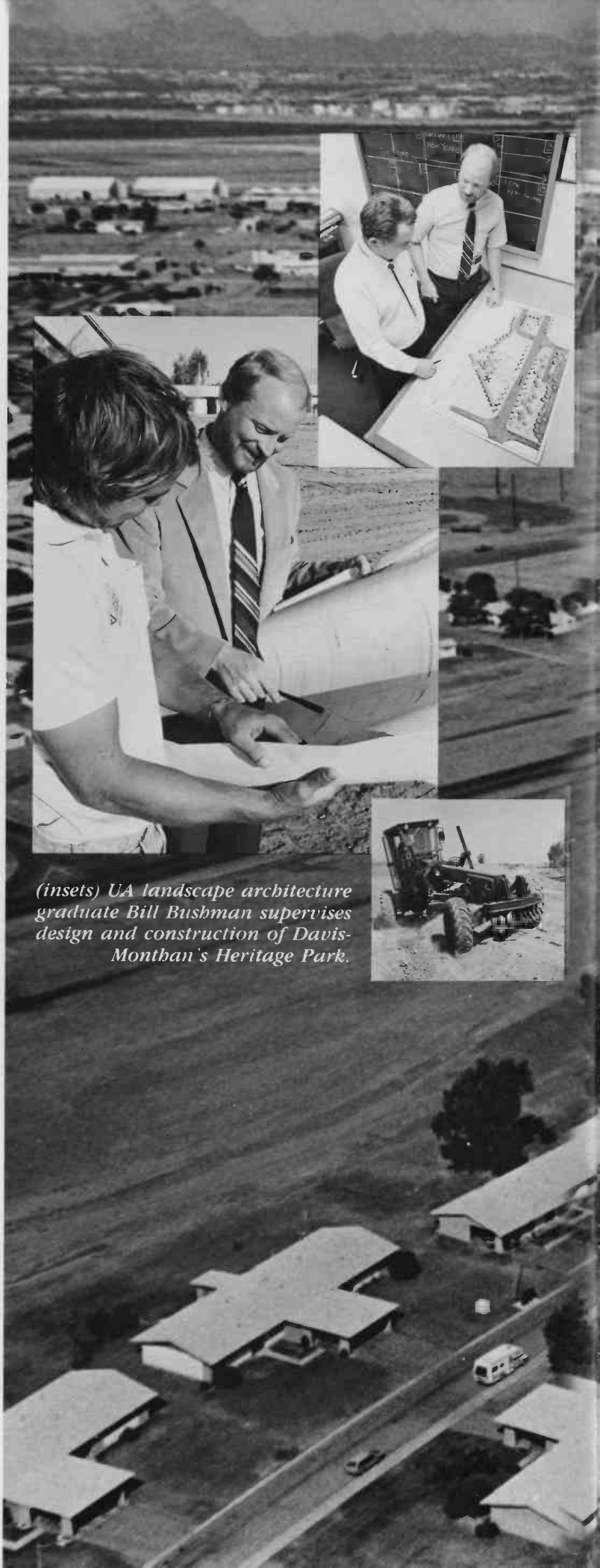
**F**rom barren desert and overgrown runway to tree-lined garden and well-planned recreational areas. Four UA landscape architecture students are largely responsible for the transformation now underway at Davis-Monthan Air Force Base in Tucson.

Their design for the 48-acre Heritage Park helped the base win the General Thomas D. White Environmental Quality Award in competition with all other Air Force bases. Building the park will cost the Air Force \$2.4 million and take approximately two years.

When the park is finished, trees will line the runway, converted to a park road. A once-straight wash will wind along a desert plant interpretive garden and beside several recreational areas. A youth center for military personnel is part of the plan, along with a baseball-softball diamond, volleyball court, jogging trail, group ramadas and grassy areas.

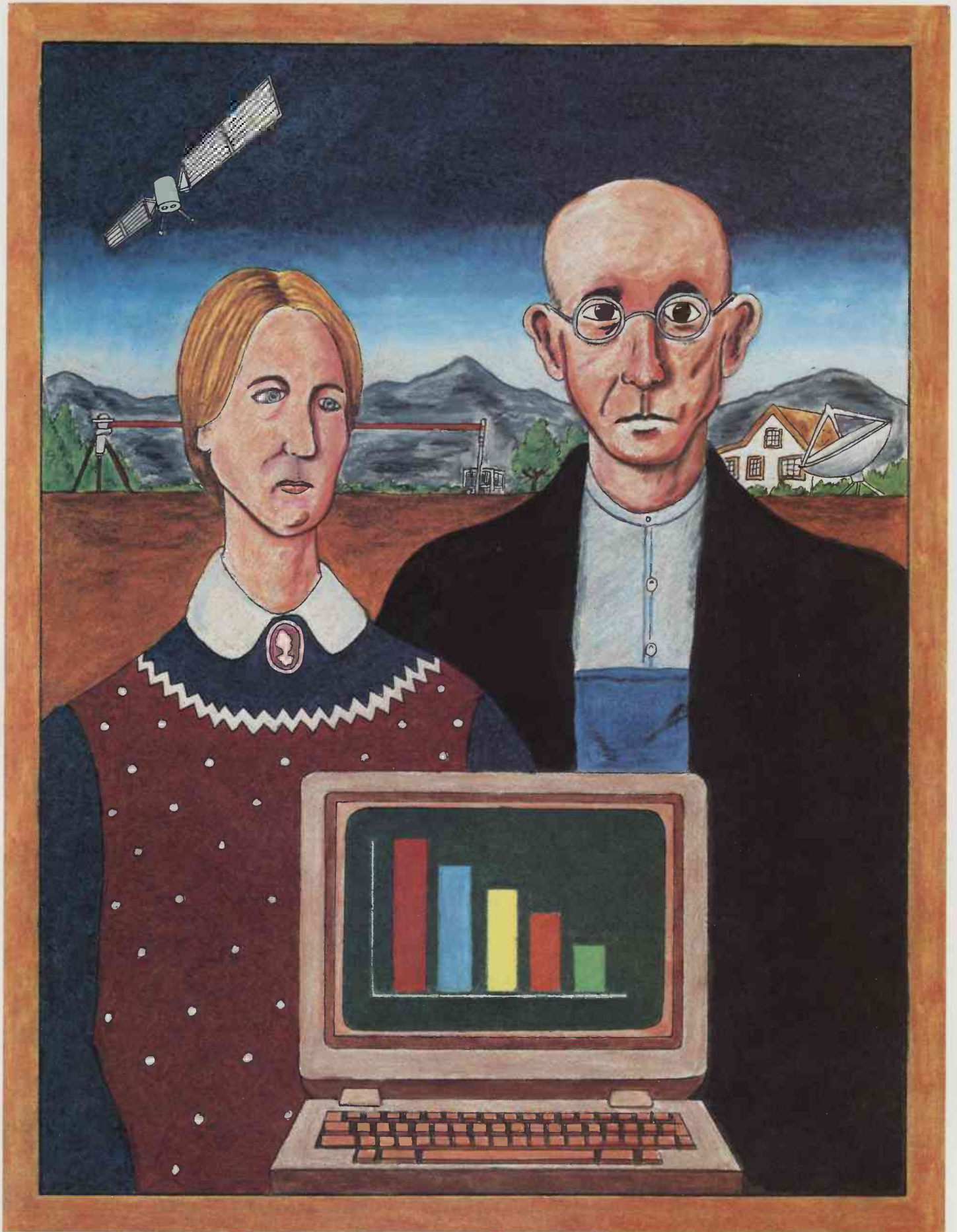
Bill Bushman, a graduate from the class taught by Susan J. Hebel and Warren Jones, UA landscape architects, was hired to supervise park construction. Each year, the fifth-year landscape architecture class works on initial design concepts for non-profit groups, Hebel says. "We've done a series of exciting projects, including plans for landscaping an elderly residential facility, streetscapes and a water conservation demonstration garden. Jeff Kratzke, Wendell Oliphant, Karen Wedge and Bushman were the students working on Heritage Park.

Bushman is particularly proud of the way the park design conserves water. "Water use was a big thing. The turf areas take up less than 20 percent of the acreage; we'll use 65 percent less water. That's unique in our park." 



*(insets) UA landscape architecture graduate Bill Bushman supervises design and construction of Davis-Monthan's Heritage Park.*





From lasers to satellites,  
technology helps farmers  
conserve water and  
use it with the utmost  
efficiency.

# Space Age Technology Down on the Farm

by Lorraine Kingdon

**R**unning a profitable farm or ranch in Arizona has long since moved into high technology — sophisticated equipment with a “Star Wars” or “James Bond” touch.

From lasers to satellites, technology helps farmers conserve water and use it with the utmost efficiency. With new kinds of energy-efficient fencing, ranchers can run more cattle on less land and still do the land a favor, ecologically.

Using a laser beam to help level land is not new in Arizona; farmers started using this technology about eight years ago in Yuma. Nearly half the irrigated acreage, some 700,000 acres of farmland, are leveled this way now, says Dr. Harry Ayer, UA economic policy specialist.

Irrigation experts Walt Hinz and Allen Halderman describe laser leveling as a laser beam sent from a rotating command post; the beam is set at whatever level the field is to be graded. A receiver is mounted on a mast attached to a scraper; the laser signal keeps the scraper at the desired grade by operating hydraulic control valves automatically.

The laser signal operates so accurately that the land can be leveled to within plus or minus .05 of a foot — about half an inch. Farmers can simply smooth the slope of their existing furrow irrigation system or they can make their fields dead level at zero slope. Approximately 400,000 acres are lasered dead level in Arizona and 300,000

acres are lasered to slope.

Both leveling techniques save water by making irrigation more efficient — reducing runoff and preventing the water from percolating beyond the root zone. Ayer says farmers save on the cost of the water, plus they also may increase crop yields from 10 to 30 percent. However, he adds that laser leveling is not cheap, although it costs less than half as much as another water-saving technique, drip irrigation.

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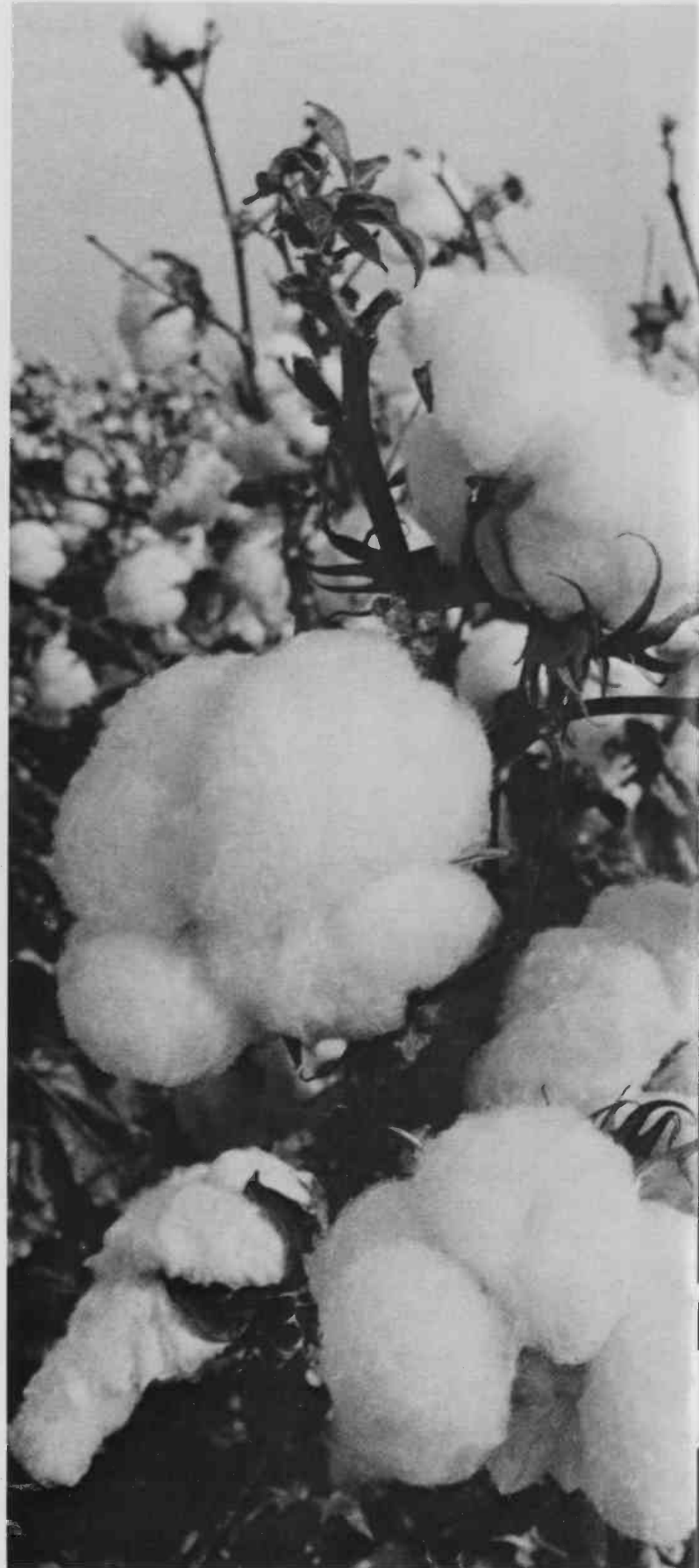
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A working definition of drip irrigation is the precise, slow application of water in the form of drops, tiny streams or miniature sprays through mechanical devices at selected points along water delivery lines.

The idea is hardly new; Nebuchadnezzar used a drip system to irrigate the Hanging Gardens of Babylon. But modern drip irrigation dates from the mid-1960s when techniques were commercially developed in Israel. By 1984, Arizona growers were irrigating more than 20,000 acres using both aboveground and subsurface systems.

They do more than just put water through plastic pipes. For example, Arnie Schlittenhart, manager of Regal Farms, Eloy, can vary the level of water and fertilizer by simply making a change on the computer control. He also can control insects and weeds by putting pesticides and herbicides also may be delivered through the pipes.

It's not an exact science. Not yet. UA entomologists, weed specialists and plant and soil scientists are testing the response of cotton plants at Regal Farms. Dr. W.C. Hofmann, plant breeder, checked three different cotton varieties for their response to five different water levels; Dr. Jack Stroehlein, soil scientist, looked what happened with four different nitrogen fertilizer treatments. Entomologist Dr. Irene Terry checked the effectiveness of pesticides applied early in the season through the drip pipes. And weed specialist Stan Heathman is trying to fine-tune weed control.





*(inset) The neutron probe is used to measure the water needs of cotton and other row crops.*

PHOTOGRAPHY BY LYNN G. KETCHUM

Scott Tollefson, manager of Sundance Farms, Coolidge, has had five years experience with sub-surface drip. He says automation — high tech — is a big factor. "One man can irrigate 1,200 acres with our system. One rig will do all our tillage, for instance. We wanted to reduce the labor needed to grow a crop, but the water required and break the yield plateau of cotton. We've accomplished all three."

Water scarcity and water prices have more or less forced Arizona farmers into using a combination of high technology, automation and common sense to make sure they use as much water as their crops need. But, no more.

Neutron probes measure the water needs of 65 percent of the crops in the Wellton-Mohawk area of Yuma County, says Roger Koewers, Bureau of Reclamation irrigation specialist. Taking regular probe readings tells the grower how much moisture is being used out of the root zone in the soil.

Add a computer to do the calculations automatically and farmers can tell when to irrigate and how much water is needed to fill the soil to capacity. They also will know how many hours it will take to apply the needed water.

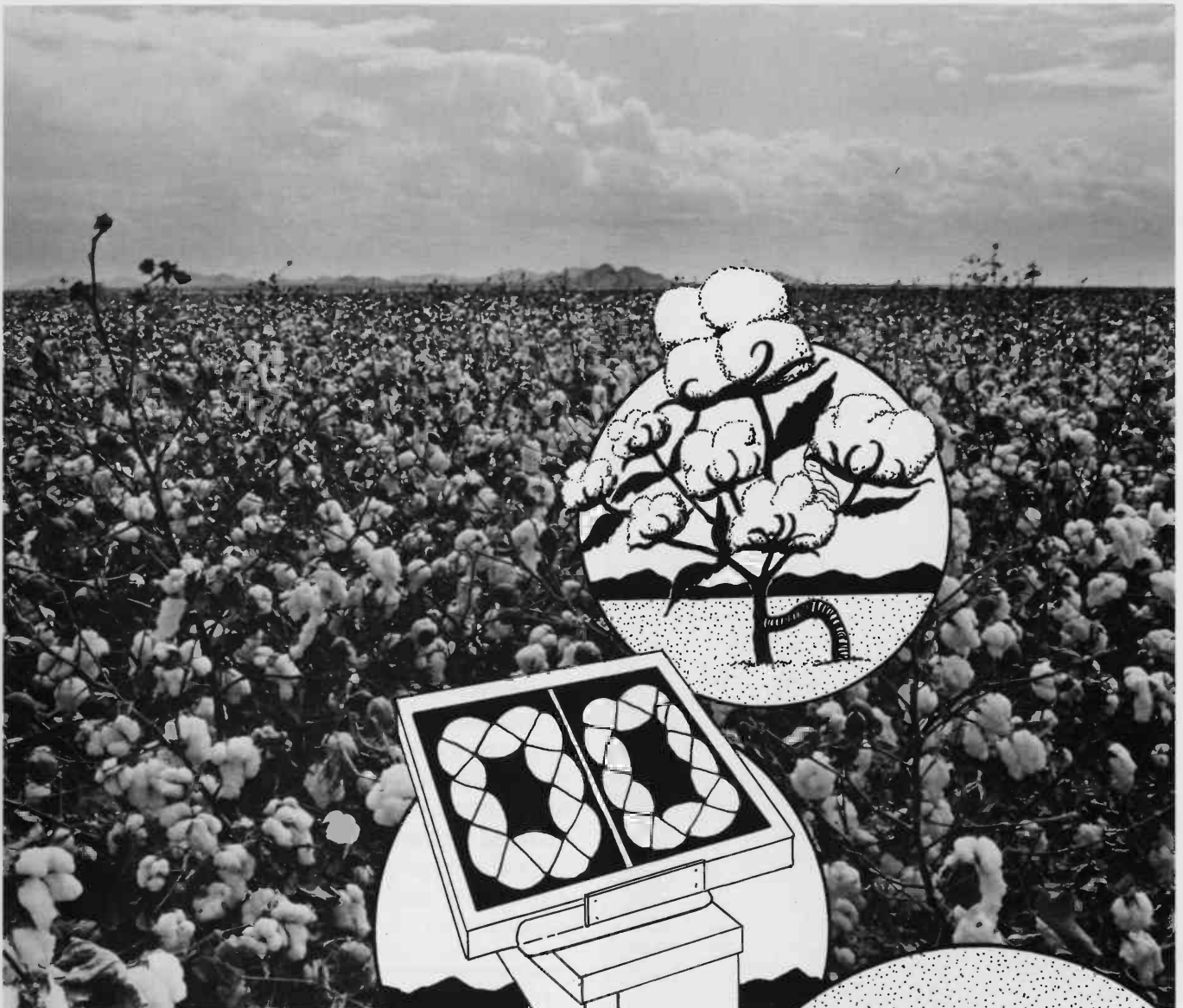
The probe measures hydrogen atoms in the soil; the fast neutrons the probe emits are slowed down when they collide with hydrogen and are then counted by the detector tube. The only hydrogen source is water; when the count is high, the moisture level is correspondingly high, and vice versa.

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Information from the satellite may someday reveal the vitally important fact that could finally put an end to Texas root rot.

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Knowing the soil water level helps a grower avoid wasting water in unnecessary applications. Fewer applications mean less labor required and fewer nutrients leached out of the soil. Some evidence shows an increase in crop yields, according to UA Extension County Agent Barry Tickes. In 1982 tests, 600 more pounds per acre of wheat were harvested from fields monitored with the probe than from fields not monitored.



HECTOR GONZALEZ

*A palladium probe inserted into the plant's main stem constantly monitors the plant's condition. The information is sent to a computer buried in the field. The computer takes similar measurements from other plants in the area. The result a visible readout that tells the grower if the plants are stressed and need water. Eventually the information will be transmitted directly to the farmer's home or office.*

*(opposite page) Dave Ammon, UA pilot and technician, double checks aerial photo equipment before flying over research plots at the UA Maricopa Agricultural Center.*



PHOTOGRAPHY BY LYNN G. KETCHUM

Measuring the moisture level in the soil is one way to tell when crops need water, but UA electrical engineer Dr. William Gensler has an even more direct method. Now a cotton farmer can watch his plants in the field just as closely as a human patient is monitored in a modern hospital.

Working with a U.S. Department of Agriculture grant award, Gensler has developed and successfully tested his solar-powered device. A palladium probe inserted into the plant's main stem directly measures the plant's condition and sends a message to a small computer buried in the field.

The computer takes similar measurements from other plants within an area about one-fifth the size of a football field. An easily visible readout at the edge of the field allows the grower to tell at a

glance whether plants are stressed and need water. Next year, Gensler will test using a radio signal to transmit data from the probes in 20 to 30 fields at one time. Growers will even be able to get a hard copy printout.

It's quite a distance from buried computers to satellites flying high, yet both can detect when plants are stressed by lack of water. The neutron probe does it one spot at a time; the palladium probe does it one plant at a time; the satellite scanner detects stress for fields of plants in several counties at one pass.

Information from the satellite may someday reveal the vitally important fact that could finally put an end to Texas root rot, says Dr. Michael C. Parton, UA geographer. He believes that satellite imagery combined with an interactive computer system can eventually result in early warning maps showing where and when the disease will break out next. And, he thinks the imagery could lead to cost effective controls for a disease that has long been a puzzle.

The problem with data from the Landsat TM satellite is that it takes so long to get to researchers. Soon the UA Remote Sensing Center at the Office of Arid Lands Studies will update equipment with a multispectral video-imaging system that will be able to give detailed information about plants within hours. Perhaps someday farmers will be able to get the same service.

Every 16 days David Ammon, UA pilot and technician, flies over research plots at the UA Maricopa Agriculture Center to collect data to cor-

relate with the satellite pass. The new apparatus will consist of a video camera shuttered with a spinning wheel with six slots, each with a narrow-band filter for visible, near-infrared or polarized light, operating with a frozen frame of 1/250 second. The data can be analyzed in the analog form on the videotape monitor or put through a computer in digital form.

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## High-technology solar-powered electric fencing can effectively control high-spirited range cattle at a fraction of the cost of barbed wire.

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“UA researchers hope to tell what is causing stress to plants — whether it’s lack of water or fertilizer or insect or disease damage, Ammon says.

Modern ranchers in Arizona use fencing to help cattle avoid stress — to move them from pasture to pasture before the land becomes overgrazed and the cattle underfed. Four-strand barbed wire has been traditional, but it now costs between

\$3,000 and \$4,000 per mile to install.

High-technology solar-powered electric fencing can effectively control high-spirited range cattle at a fraction of the cost of barbed wire. Brad Rein, UA Extension agricultural engineer, says the new fence can be installed at a cost of approximately \$300 per mile.

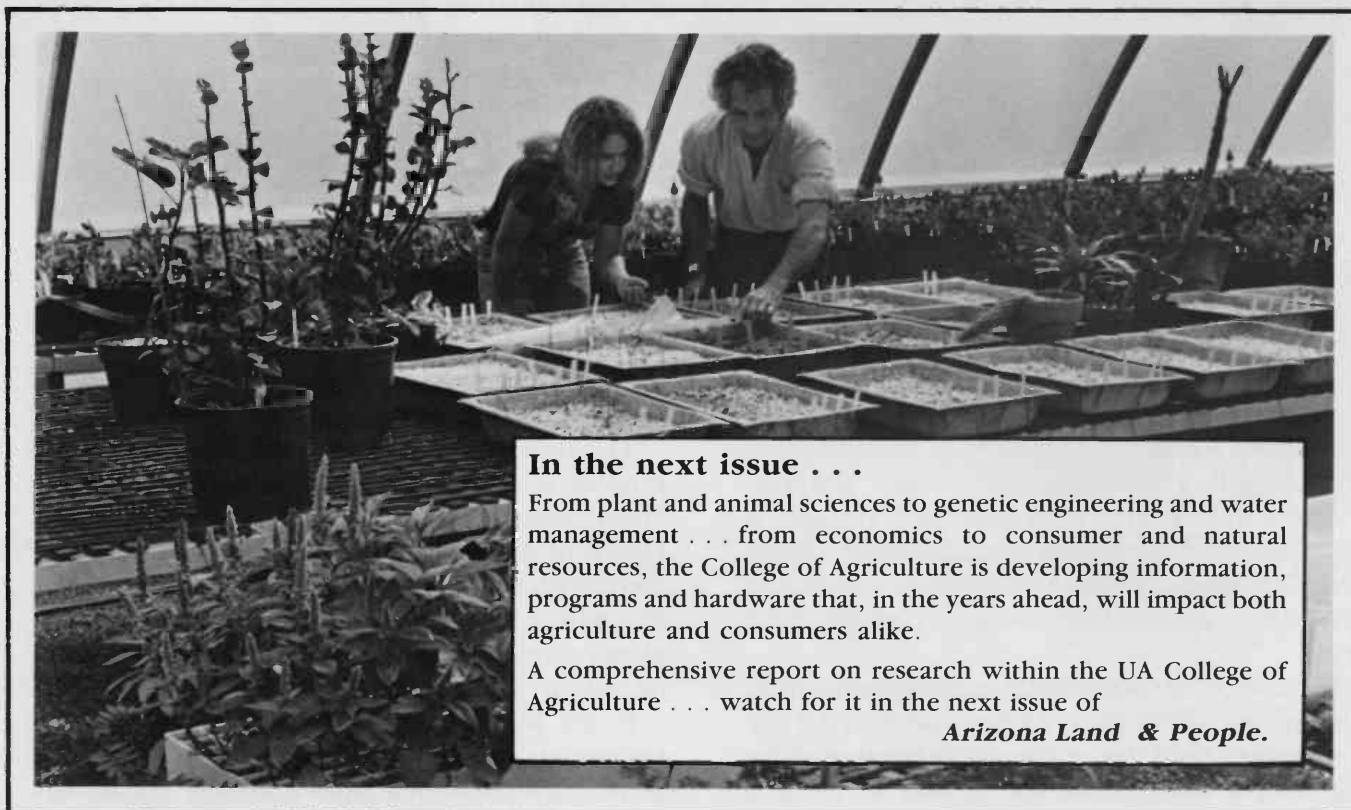
Russ Cline, Wagon Bow Ranch manager, worked with Rob Grumbles, Mohave County Extension agent, to test the electric fencing — the first time a new combination of technologies was tested in the field.

Rein says a technological breakthrough in photovoltaic cells led to the potential savings. A small panel of the cells converts solar energy into electrical energy. Stored in a battery, the electricity is controlled by an energizer that emits short, periodic 5,000-volt electrical bursts into the wire. This power supply, readily available in remote areas, combines with new high-tensile wire and improved insulators to make the solar-powered fencing possible.

And, it works. Cline says, “The cattle learned to respect it in a short period of time. For the price, you can’t beat it.”

Being a successful farmer or rancher in Arizona has never been the easiest of occupations. Today, technology offers a helping hand.

lp



### **In the next issue . . .**

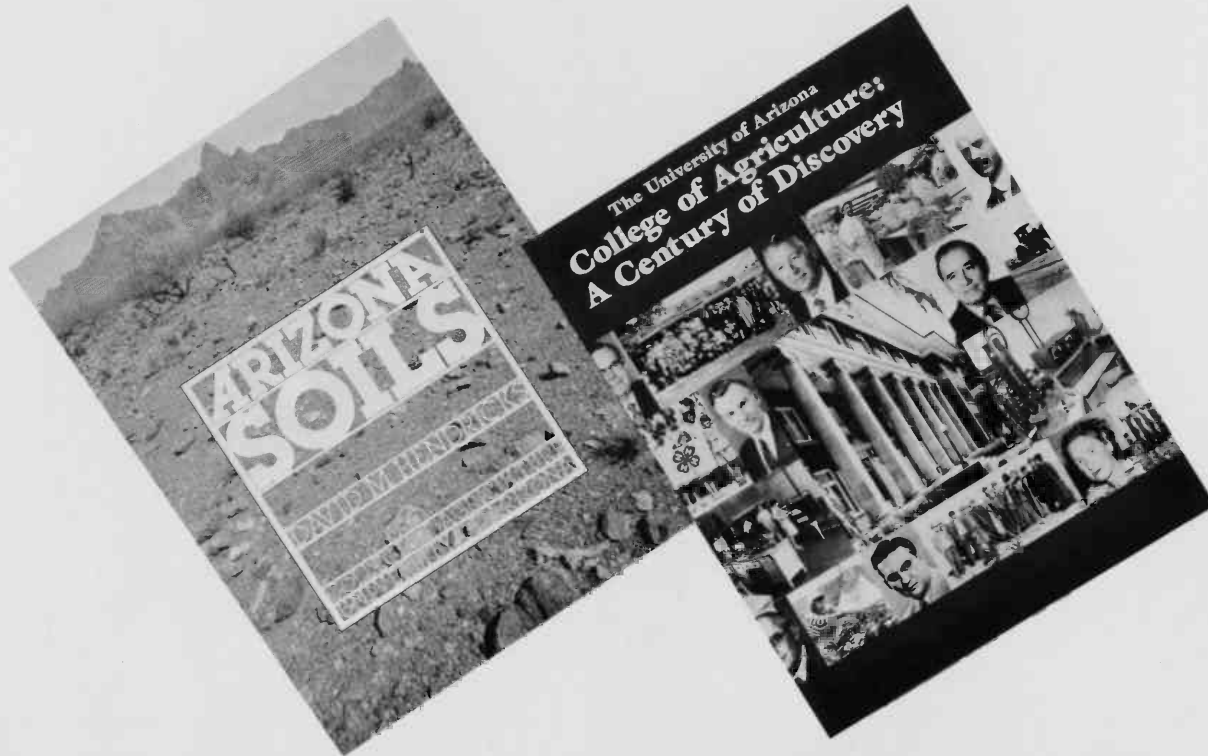
From plant and animal sciences to genetic engineering and water management . . . from economics to consumer and natural resources, the College of Agriculture is developing information, programs and hardware that, in the years ahead, will impact both agriculture and consumers alike.

A comprehensive report on research within the UA College of Agriculture . . . watch for it in the next issue of

***Arizona Land & People.***

# Special Discount to Readers of *Arizona Land & People*

Two Books of Significance for Arizona Agriculture



**ARIZONA SOILS** is a modern, comprehensive look at the nature and distribution of the state's soils. The formation, composition, history and geologic framework of Arizona's soils are examined. Author Dr. David M. Hendricks also explains the delicate relationship of the soils to the plants, animals and peoples that thrive in this diverse land.

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