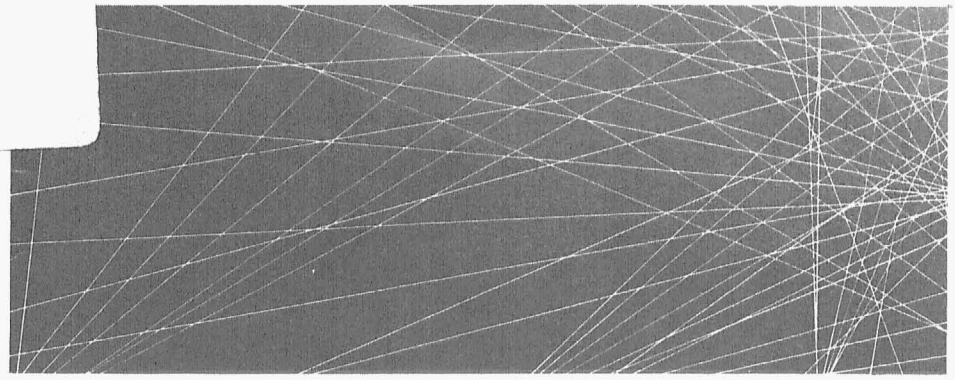
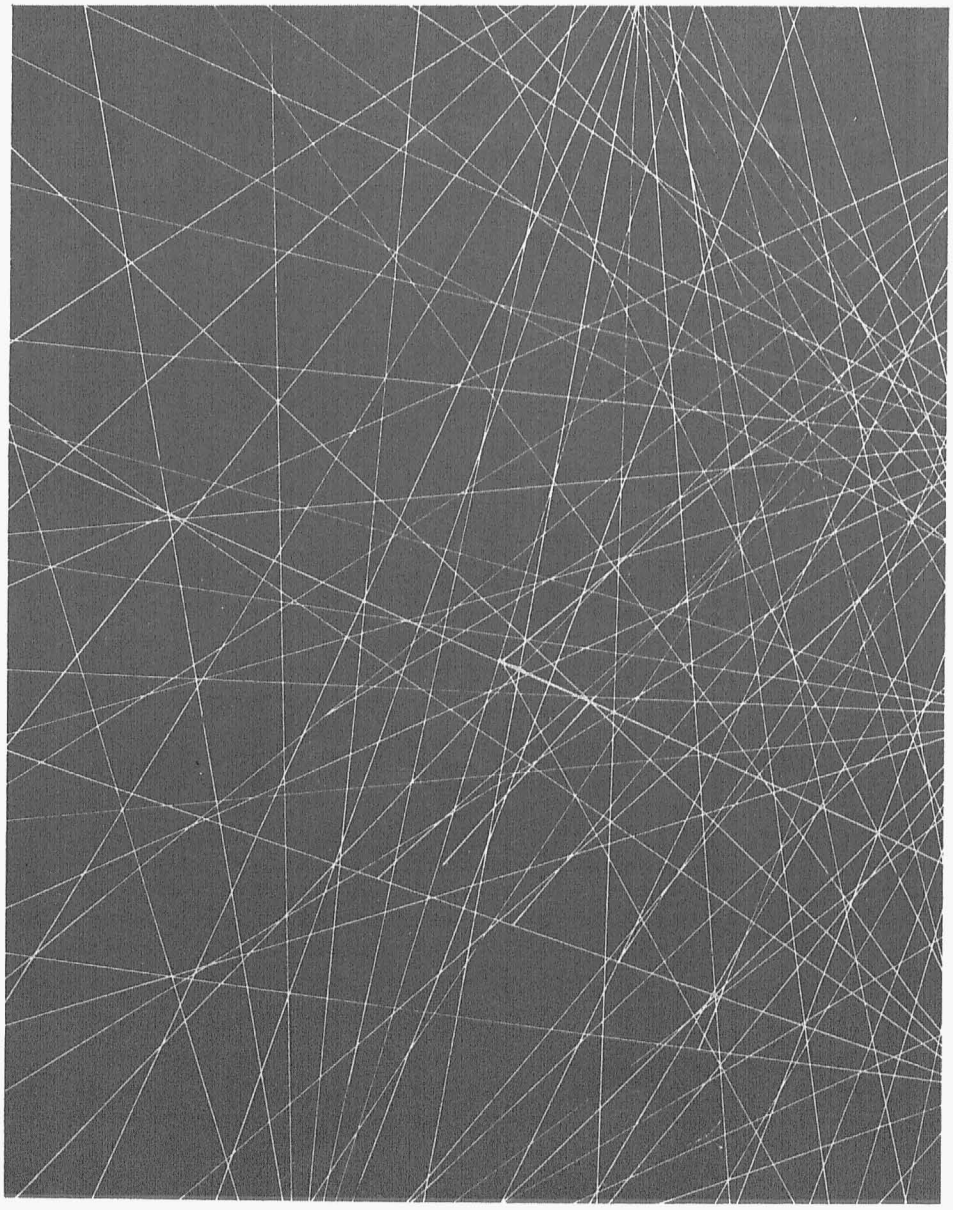


PATHWAYS OF KNOWLEDGE

HIGHLIGHTS OF 1967 • COLLEGE OF AGRICULTURE • UNIVERSITY OF MISSOURI • B869



SCIENCE IN THE PUBLIC SERVICE

SCIENCE IN THE PUBLIC SERVICE

TEACHING RESEARCH EXTENSION

A NEW PROGRAM in landscape design has added an important field of specialization to the courses offered in the College of Agriculture's Department of Horticulture. This subject is taught by Leon Snyder, center. Students Pete Melby, left, Joy Schaefer, and Terry Lintern, all of St. Louis, discuss residential landscape models with Snyder and Extension Horticulturist Charles Sacamano, right. Rapidly expanding residential areas with increasing buying power of Missouri home owners, plus the tendency toward institutional, industrial, and municipal landscaping, make landscape design a busy career field and a popular course of study at MU.

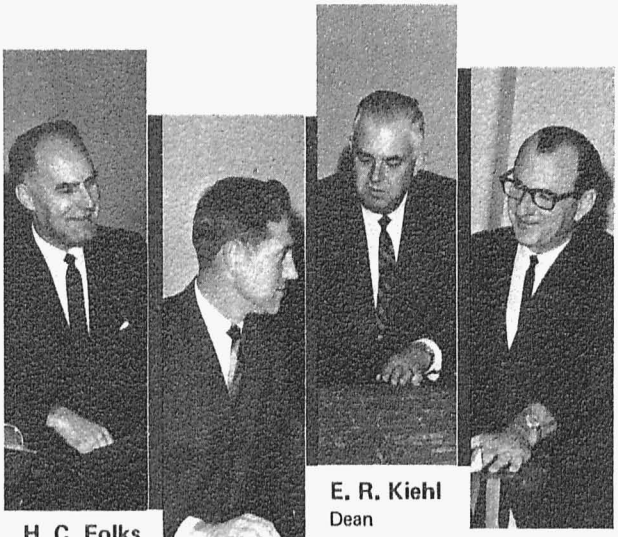
COLLEGE OF AGRICULTURE

PATHWAYS OF KNOWLEDGE

UNIVERSITY OF MISSOURI

AN EXCITING CHALLENGE

A message from the Dean



H. C. Folks
Assoc. Dean
Resident Instruction

R. J. Aldrich
Assoc. Dean
Research

E. R. Kiehl
Dean

S. H. Bodenhamer
Assoc. Dean
Extension

WE ALL KNOW that agriculture is the most important Missouri industry. We also know that it's a dynamic industry. Keeping up with the growing and changing agricultural scene is a constant, continuing, and exciting challenge for the College of Agriculture. It's the kind of challenge to which our faculty likes to respond.

One of our recent responses to this challenge involves changes in the College's departmental structure. Four new departments were created and two old ones merged into a single unit. The new departments include atmospheric science, food science and nutrition, genetics, and plant pathology. A department of agronomy was created by merging two former departments—field crops and soils.

In making these changes, the College developed administrative units to coincide with program areas of teaching and research. The restructuring plans were based on staff expression and studies extending over a period of years. Such plans also reflect the recommendations of consultants and national and local studies.

So, we feel that these changes permit us to do a better job of organizing to meet the research and Extension challenges in agriculture. Such changes also allow us to do a better job of training the young men and women that are to provide leadership in Missouri agriculture in years to come.

At times we may seem to show the greatest concern about our agricultural research and Extension programs. However, we do have a great interest in the challenge to meet the educational needs of the young people enrolled in the College of Agriculture. This includes the challenge to do a better and more thorough job in teaching, and to teach a growing number of students.

National enrollment in colleges of agriculture has been increasing steadily in recent years. Agricultural enrollment in the fall of 1967 was seven percent higher than in 1966. In the Missouri College of Agriculture, the increase was from 1,124 to 1,269, or 11 percent. Most of our students come to the College from rural areas. Approximately 55 percent of our freshmen students have lived on a farm. Another 20 percent have a rural, non-farm background. Twenty-five percent of our students come from urban areas.

We've reported in recent years on innovations in our teaching programs. We've mentioned new courses and the team approach to teaching. These innovations have met with decided approval on the part of the students. We're continually updating our course offerings and adding competence to our teaching staff.

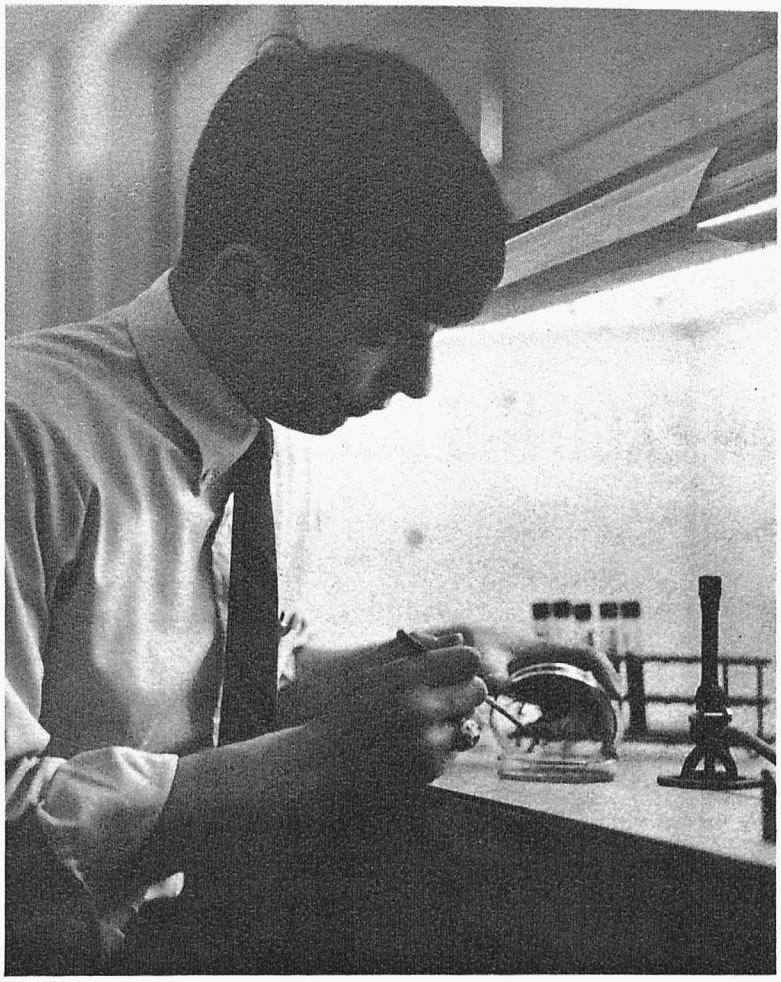
My space here is too limited to tell you all about the College of Agriculture. However, the following pages note some of the more exciting and valuable developments in the College. We do hope that they sketch a few highlights of what we're doing to help Missouri agriculture move forward.

Elmer R. Kiehl

Elmer R. Kiehl
Dean

EDUCATION

OUR PRINCIPAL COMMODITY



PETER WHITMAN, Columbia, grad student in food science/ nutrition, does his research in dairy lab of Dr. R. T. Marshall.

YOUR GRANDFATHER, maybe even your father, learned from his Latin reader that ancient Gaul had three parts. Like Gaul, our College of Agriculture has three parts, but modern, of course, and up to the minute. These parts of Agriculture are concerned with formal teaching (the College of Agriculture and the Schools of Forestry and Home Economics), research (the Agricultural Experiment Station), and extension of new knowledge to all the people of the state (the Extension Division).

Too often, people see university research as isolated, having no connection with the instructional program and very little contact with reality. Not so at MU. Instead, most of our research is directly involved with our teaching program and practically all of it is designed to help people in Missouri solve specific problems that they face today or will encounter soon. Thus, the principal commodity we offer is education.

On-campus education at the MU College of Agriculture is far more than soaking up "book learning." It is designed to create habits of study, to develop seeking minds, to teach methods of finding answers, and above all, to help students develop higher aspirations.

Over and over again we see a student come to the campus with every intention of "putting in his four years." Before many months on the campus, he catches the fire of enthusiasm for learning. He develops aspirations for success and accomplishment beyond anything he once knew. And he goes on to unimagined heights, contributing significant original research on the way to his doctoral degree. This graduate then has no diffculty finding an attractive place for himself in life work which brings generous rewards for his labors.

The MU College of Agriculture offers a strong graduate level program with advanced degrees available in every department. Research and education definitely merge at the Ph.D. study level. To quote

from the catalog, "The Doctor of Philosophy degree in the College of Agriculture is generally considered to be a research degree."

A peculiar twist of scientific modesty and detachment has caused many of the nation's best researchers to be virtually unknown outside of their laboratories. Things are different at MU. Our scientists are real people with names. There's Boyd O'Dell and his work with trace minerals, Herb Lionberger and his studies in rural sociology, M. S. Zuber and his plant breeding projects. These are just three from the long ranks of outstanding scientists at MU who are our friends and co-workers.

That's why we say the emphasis here is on people. That's why you'll see so many names in this booklet. It's the same with our educational program.

Our graduates enter every phase of agriculture, agri-business, and completely non-ag-related activities. Here are some of the fields of study in the MU College of Agriculture:

Agricultural biochemistry. Graduates find top positions with food processing industries, pharmaceutical companies, and livestock feed industries.

Agricultural business. This broad field provides opportunities for those who combine agricultural knowledge and a knowledge of business principles, management, and sales.

Agricultural chemistry and soils. Graduates find jobs in research and technical service in chemical and fertilizer industries, state and federal government work, and in teaching.

Agricultural economics. Hundreds of firms offer jobs to these graduates in marketing, farm and ranch management, financing, storing, transporting, buying, and selling agricultural products.

Agricultural education and extension education. More teachers are needed on every level of agricultural education. These include agricultural extension, colleges, high schools, and related public service work.

Agricultural engineering. Farm equipment and building companies, irrigation firms, government agencies, and others need men trained in the many phases of agricultural engineering. Included is the special curriculum in farm mechanization.

Agricultural journalism. A great demand exists for those with training in the combined fields of agriculture and journalism to work with such communication outlets as radio, television, farm magazines, and newspapers.

Animal science. This is a broad field for research, teaching, production, and service. Including livestock and poultry, it offers opportunities in marketing meat, poultry, and dairy products, working for breed associations, commodity organizations, feed companies, and processing industries.

Entomology. Scientists who study insects are in great demand in industry, teaching, and government.

Food processing technology. This is a growing area of opportunity. Processing, packaging, preserving, and storing food for the consumer's use is involved with almost all of our nation's food supply.

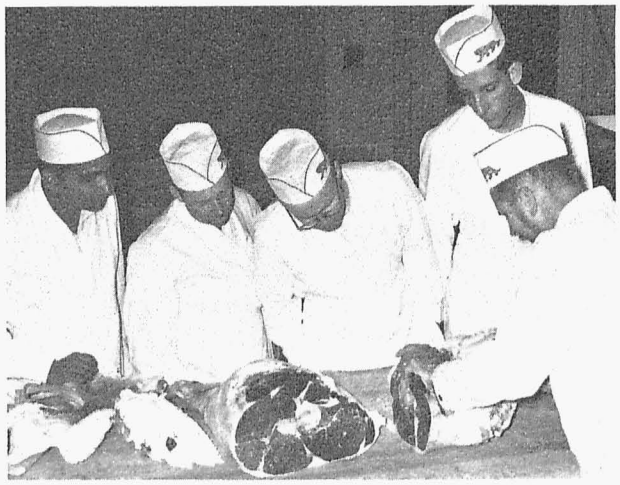
Horticulture. Commercial fruit and vegetable industries, landscaping, chemical companies, food processing firms, research, and service offer opportunities for graduates.

Plant science. Positions with seed, grain, and agricultural chemical companies, farm crop processors, and state and federal agencies await men trained in field crop production and improvement.

Rural sociology. Graduates with this training are in demand for jobs as teachers, research workers, government employees, and in foreign service.

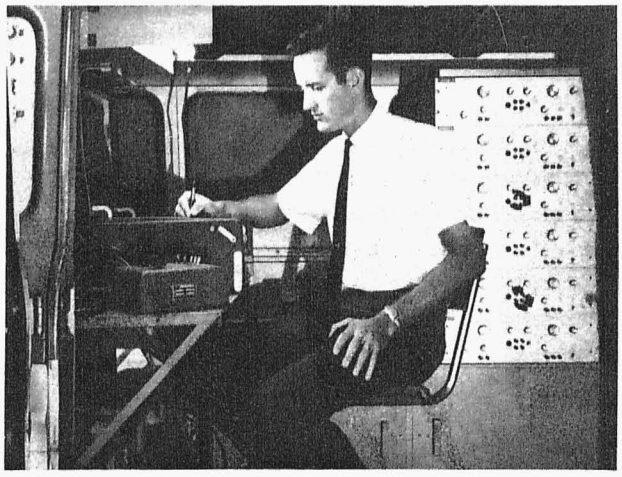
Forestry. Graduates work in technical and administrative jobs in forest management, wood products utilization, distribution, construction, and research.

Pre-veterinary medicine. The course of college work required for admission to the School of Veterinary Medicine is offered by the College of Agriculture. It leads to opportunities in large or small animal private practice, government service, or other work.



MEATS CLASS students watch instructor show fine points of trim.

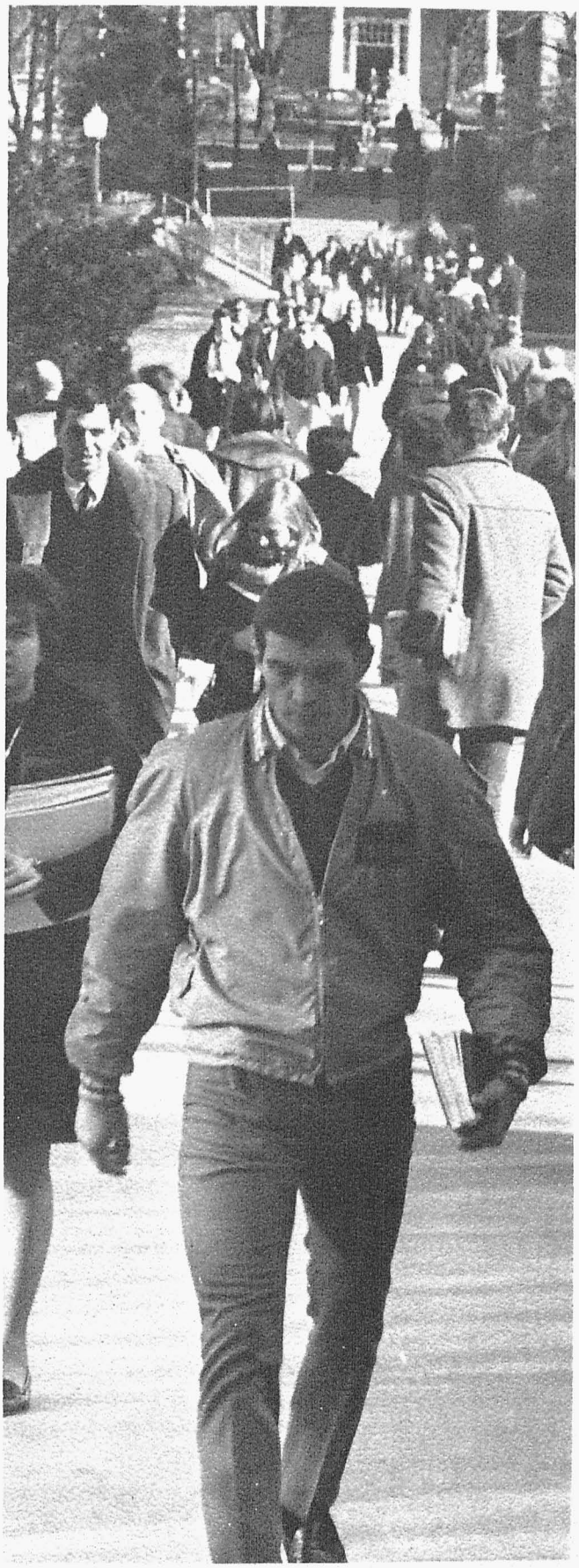
HOME EC grad student Marion Cloninger uses microwave oven.



AG ENGINEERING graduate Larry Gutekunst is employed as a supervisor in Allis Chalmers research laboratory at Independence.

ABOUT THE STUDENTS

SERIOUS MINDS IN A REBELLIOUS AGE



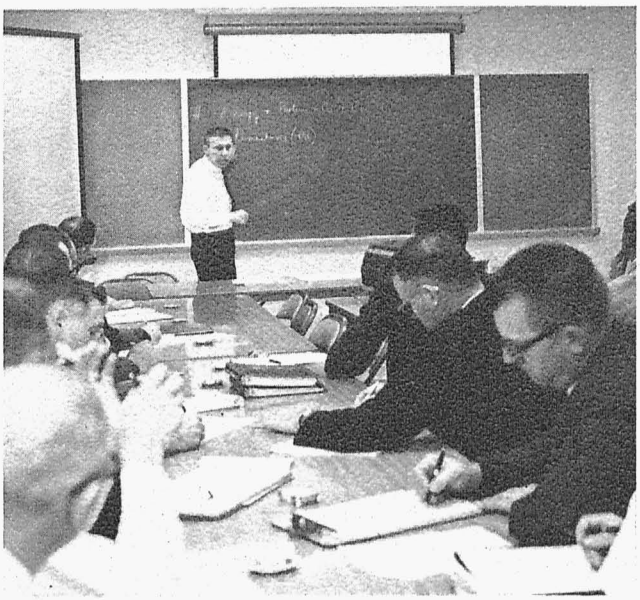
EMPTY-HEADED, party-going, selfish non-conformists may predominate on some campuses (as the doom-criers would have us believe), but they are rare birds at the University of Missouri in Columbia. Despite wild stories to the contrary, the major use of LSD at MU is still in mathematical analysis where it stands for least significant difference.

"I want the University to help my future career." "It takes a college education to get a job these days." "The University will provide me with a stable future." "You can't get ahead without a degree." These were the kinds of answers students gave College of Agriculture researchers recently. Profs. H. F. Lionberger and C. L. Gregory worked with graduate student H. C. Chang to determine reasons why 300 typical male students came to this campus.

Broad general education was rated high by these students. They put it ahead of status achievement. Most of these members of the oft-criticized "hippie" generation even expressed a strong hope of getting a "well-rounded" education and of "having a purpose in society." A very few were trying to escape military service or parental control. A few others were just marking time between childhood and adulthood. But another group revealed a desire to "make one's life count for others."

Students interviewed came from the Colleges of Agriculture, Education, Engineering, and Arts and Sciences. Many reasons were given by the students for choosing this campus. The "attraction of course offerings" was most frequently mentioned by Ag College students. Most of the students were getting some financial help from their parents. Many students were working while attending college, more in the Ag College than in the other colleges and schools.

All in all, the MU sociologists found little sign of the doom-crier's drop-out, hippie-infested, rebel generation.



SWINE RESEARCH

BOOSTING PROFITS

AND SAVING LIVES

AGENT TRAINING seminars such as this one led by Dr. Rodney Preston help county Extension personnel keep up to date on latest developments and projects at MU. This one on beef cattle rations is similar to others about various phases of research. These include the swine estrus control and birth defects projects mentioned on this page.

ONCE MORE, the impossible has been done. Today, it is still difficult. Soon it may become commonplace. When it does, the pig producer's dream will have come true. He will enjoy a fantastic gain in labor efficiency and huge marketing advantages for his pig operation. Added profits can be taken for granted.

Here's how it will work. Up to now, sows had to be bred on dates determined largely at random by their hormones. Pig men had to expect sows to be farrowing night and day (mostly at night, it seemed) for as much as a month on either side of the desired date. This meant that all the normal activities of pig production have had to be carried on at the same time. While one sow was farrowing, pigs from another litter had to be vaccinated. Others needed still different attention, all because of age variations.

"If only . . ." the pig men dreamed. "If only we could get all of the sows to farrow the same week. Then we could concentrate on farrowing care. Once we started vaccinating, we could treat the entire herd and be done with it. It would be the same with all our chores. What's more, a short farrowing period should greatly reduce disease problems in a central farrowing house. Marketing would be a cinch and . . . But that's impossible," the swine men would add, sadly.

But it's not. Not any more. It's being done all over Missouri as part of a gigantic project designed to determine whether heat synchronization for sows is practical for normal farm application.

To do this, a state-wide study has been launched. Financed by the Extension Division, it involves Research and Extension personnel from Columbia, county Extension directors, local veterinarians, and swine producers. Supervising the project is a committee consisting of Dr. Terrence M. Curtin of the School of Veterinary Medicine and Drs. Bill N. Day, A. J. Dyer, John Massey, and Melvin Bradley, all of the animal husbandry department.

In effect, the state is the laboratory for this study. In this new research method, the proposed practice is being tested right on the farms—to succeed or fail in contact with actual Missouri farm conditions.

Only gilts are being used at present. Dr. Day's preliminary tests have shown that 85 percent of a group of gilts can be brought into heat within a 3-day time span. Much of this project is based on his studies of heat synchronization by hormones over the past several years. He also spent a year studying synchronization of sows in England where it is a more common on-farm practice than it is in this country.

Also involving swine and also on a state-wide basis, another new MU project seeks to find the causes of birth defects in baby pigs. Once these causes are identified, the object will be to prevent such birth defects from occuring. This saving of pigs will provide a substantial economic boost for the pig producer.

What's more, the possibility that the same findings can be used to reduce human birth defects is extremely good!

HETEROSIS

THE INSIDE STORY OF CROSSBREEDING

HYBRID VIGOR or hybrid nonsense?

Personal prejudices have been the forming factors in most livestock men's opinions of crossbreeding. This has not been caused by a refusal to accept facts, however. Until now, there simply have not been enough facts about beef cattle hybrids for a person to make a reasoned evaluation.

Hybrid vigor is the popular term for heterosis (heh-ter-OH-sis). Heterosis in turn is the technical name for results of crossbreeding. In this article we are talking about crossbreeding beef cattle. In fact, people have been talking about it and debating it for a long time.

Even the most dedicated purebred man will agree that heterosis would be wonderful if it were half as good as the most extravagant backers say it is. In fact, it wouldn't have to be nearly that good to be a profit-making practice for livestock men. Trouble was, up until a short time ago, no one really knew how good it was if it was good or how bad it was if it was bad.

That's where things were three years ago when Researcher John F. Lasley and his colleagues at the University of Missouri set about to replace the rumors with facts. Their heterosis project is located at the North Missouri Center near Spickard.

Angus, Hereford, and Charolais breeds were purchased originally for this research—72 purebred heifers from each breed. Three sires of each breed are used each year by artificial insemination. These sires are selected because they are superior in performance and conformation.

Matings have been made each year in such a way that each bull produces purebred as well as crossbred calves. All possible crosses between the breeds as well as purebreds are produced each year.

In the two calf crops produced to date in this research at the North Missouri Center, heterosis has resulted in six more live calves per 100 cows at birth. This involved purebred cows bred to produce crossbred calves. It is one of the most clear-cut conclusions that can be drawn from the tests thus far.

Birth weights for crossbred calves were higher than for purebreds. Among the crossbreds, heifer calves showed a greater heterosis effect than did bull calves. Crossbred bull calves were ahead of purebreds by 2.7 percent at birth. Crossbred heifers topped purebred heifers by 4.2 percent.

Not only did the crossbred calves start out heavier, they gained faster to weaning time. Crossbred heifers weighed 4.1 percent more than purebred heifers at 205 days. Crossbred steers had a +2.8 percent heterosis effect at 205 days. This maintained approximately the same crossbred-purebred and heifer-steer weight relationships that had prevailed at birth.

Results of one year's feeding tests showed that weaning was the end of the large heterosis weight advantages.

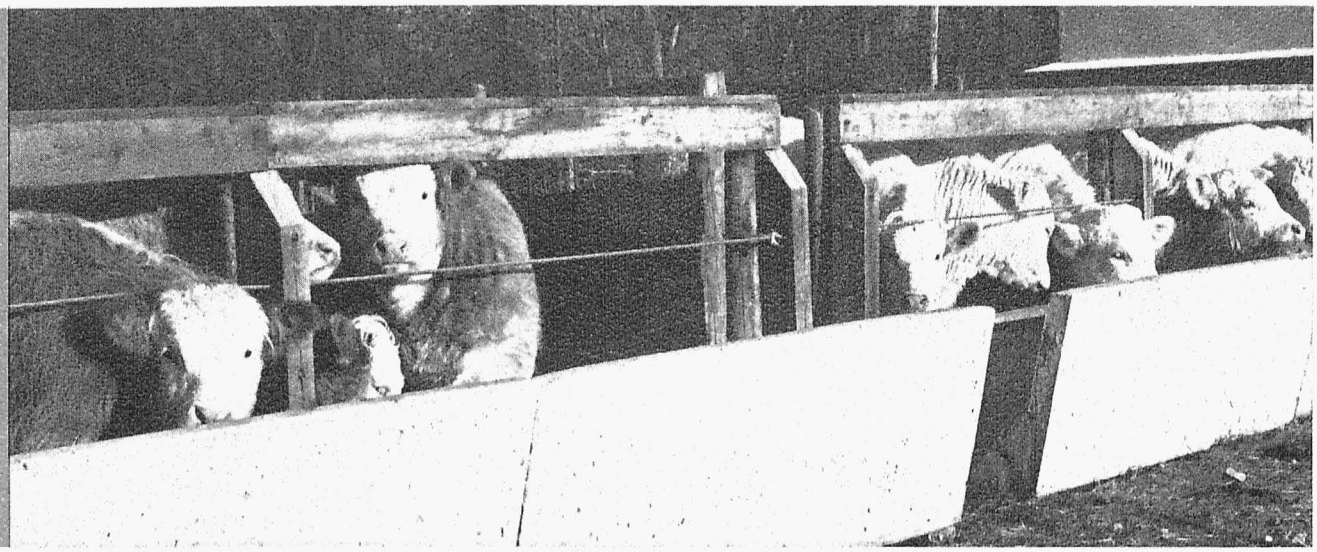
When the full-feeding period was 183 days, crossbred heifers gained .34 pound per day faster than purebreds. That's a difference of 15.8 percent. But when the full-feeding period was 267 days, the heterosis advantage dropped to 7.4 percent. However, the crossbred heifers required 20 pounds less feed (2.4 percent) per hundred pounds of gain than did purebred heifers.

Many of the differences were small ones. Crossbred steers on pasture gained faster (.05 pound per day or 6.6 percent) than purebreds. When full-fed 139 days after being grazed on pasture all summer, purebred steers had the advantage, gaining 2.77 pounds per day as compared to 2.74 pounds per day for crossbred steers. When fed for 196 days, purebreds gained 2.52 pounds per day compared to 2.50.

During the 139 days on feed, the crossbred steers required 802 pounds of feed for 100 pounds of gain. Purebreds took 807 pounds. From 140 to 196 days on feed, purebreds required 1,336 pounds of feed per 100 pounds of gain. Crossbreds needed 1,219.

The preceding figures show some heterosis advantages, some disadvantages when considered simply as crossbreds versus purebreds. Even that can be misleading. Take marbling of carcass for example.

Harold Hedrick of the food science and nutri-



CROSSBRED CALVES bring new markings, new conformations to Missouri pastures and feedlots. Researchers working at the North Missouri Center near Spickard are trying to determine advantages or disadvantages of crossbreeding. A herd of purebred heifers, some of them shown below, are used with purebred bulls to produce both purebred and crossbred calves for this study.

tion department made carcass studies of the slaughtered steers. When Angus (purebred) steers were full-fed 139 days, they produced a marbling score of 6.5; Hereford-Charolais scored only 4.9. However, other purebreds were even lower with the result that the purebred vs. crossbred score shows the advantage in favor of crossbreds—as indeed it was when averaged.

Specifically, the marbling score showed Angus 6.5, Charolais-Angus 5.4, Angus-Hereford 5.2, Hereford-Charolais 4.9, Charolais 4.3, and Hereford 4.2. In this particular test, the generalization that heterosis improves marbling would be correct. At the same time, as Hedrick's records show, it is also correct to say that crossbreds did not score nearly as high in marbling as did purebred Angus.

Again, it can be pointed out that all crossbred situations involving Charolais sires and bull calves also involved calving difficulties. Yet Angus cows had the most difficulty in all calving situations and Charolais cows had the least.

The one message that comes from this research is that it is not safe to generalize about heterosis. Certain factors in heterosis appear to be definitely advantageous. Most significant of these is the heavier crossbred calves at birth and at weaning. These calves did not continue their superior rate of gain in the feed lot. Sometimes they did not even keep up with the purebreds. Says Lasley, "At weaning, you probably have most of the hybrid vigor you'll get."

This project will continue at the North Missouri Center until more questions have been answered. New research will include three-way crosses such as Hereford-Angus-Charolais or Hereford-Angus-Hereford, using some of the animals from earlier crosses.

Work at the center is superintended by Larkin Langford. Bob Sibbit is herdsman-technician for the animal husbandry department. Profs. J. E. Comfort and A. J. Dyer and graduate student J. A. Sagebiel of animal husbandry also work on the heterosis project.

This is just one of the projects under way on the 1,600 acres at the North Missouri Center. Located seven miles west of Spickard in Grundy County, this center also has soils, crops, and entomology work.

Soil fertility and crops research at the center include studies of ways to improve old bluegrass sod, and tillage methods on corn as well as population and row spacing with differing applications of nitrogen. Maintenance of alfalfa and trefoil stands, soil treatments for wheat, rate and depth of liming, and soil test correlations also are important research subjects at the North Missouri Center.

SECURELY in the wonder crop role, called variously the Cinderella and the Superman of the farm scene—definitely a Horatio Alger-type hero—soybeans today are a great crop with great problems.

Not too many years ago we still thought of soybeans as an oriental curiosity that was not far removed from China and birds nest soup. And despite their steady climb from near obscurity, soybeans as a U.S. crop have been the subject of more than one obituary. "They're done for." "Growers are overplanting." It's all a fad." What's more, within the past decade we have been assured that soybeans were soon to be replaced by castorbeans, crambe, safflower, or high lycine corn.

Today, this amazing crop is firmly in first place, the top-ranking cash crop in Missouri and the nation. Missouri ranks fifth in U.S. soybean production, and the U.S. is the world's top producer. Soybeans occupy nearly 3,500,000 acres, or more than one out of every four harvested acres in Missouri. Across this state soybeans have exceeded corn in acreage.

While soybean acreage has been increasing, so have yield and use. This space-age sensation provides important amounts of the world's feed, food, vegetable oil, and raw material for plastics. With so much going for them, it is obvious that soybeans are coming on strong. However, they are not without problems. This is where the Missouri Agricultural Experiment Station comes in. A substantial number of first-class scientists in the experiment station are working to solve the soybean growers' problems. Here is a quick look at that situation to date:

The soybean cyst nematode has been making the most soybean news recently. This past fall the nematode was positively identified in northeast St. Louis County, giving us the dubious distinction of having the northern-most location for soybean cyst nematode in the United States.

"This nematode is a member of a very large class of round worms, or eel worms," explains Dr. E. W. Palm, MU Extension plant pathologist. They are very tiny worms, but can be observed with a low-power microscope. They feed inside the roots of the soybean plant, causing serious injury to the plant.

The most promising method of nematode control developed to date is the use of resistant varieties. Crop rotations, although not always satisfactory to the farmer, are very worthwhile in holding back nematode buildups and reducing losses. Rotation works because the nematode cannot feed or reproduce except on suitable host plants.

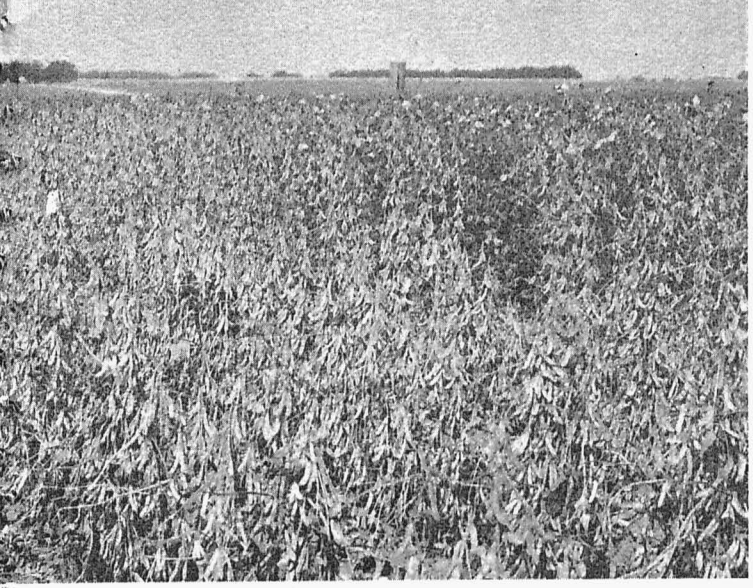
SOYBEAN RESEARCH into fertilization rates, row spacing, and mulching is directed by Dr. George Wagner, above. A major pest of soybeans is corn earworm, right. It attacks both leaves and pods.

SOYBEANS

GREAT CROP BUT WITH PROBLEMS

Nematocides have been helpful, but costs have been almost prohibitive because treatments must be repeated. Development of new and less expensive nematocides is a prospect that could change this picture.

"There are three nematode-resistant soybean varieties available to Missouri growers with cyst problems," reports soybean breeder Virgil Luedders. These are Pickett, Custer, and Dyer. Seed for these varieties is being increased, but still is in limited supply. "Custer variety, which also has *Phytophthora* root rot resistance, will be more desirable than Pickett for the heavier soils of the northern Delta counties and will probably be the best for St. Louis County until other resistant varieties are developed," Dr. Luedders explains.



Root rot is just one of the diseases attacking soybeans in Missouri. Dr. Palm estimates that the dozen or more commonly occuring soybean diseases cost growers in this state $25,000,000 in 1967.

Then there is the insect problem. Dr. David M. Daugherty lists four principal insect pests of soybeans. They are the corn earworm (also known as soybean podworm, cotton bollworm, and tomato fruitworm), the stink bug, the green clover worm, and the bean leaf beetle.

Soybean growers claimed for years that the crop was immune to insect attack—or at least that it had no serious pests. Unfortunately, the explosive increase in soybean acreage has proved this wrong and brought a rapid increase in insect activity.

Insect control projects at MU are directed along three lines, Daugherty explains. In one, the known corn earworm controls for use with corn and cotton are being re-evaluated for use on soybeans. Rates and dates of treatment have to be established, as well as economic limits that can be expected to preserve grower profits.

Another part of Daugherty's work involves testing and evaluating new chemicals developed by commercial chemical companies in order to establish the Missouri insect control recommendations.

The third approach is through biological control of the soybean insect pests. Both insect pathogens and predators are being evaluated by MU scientists. Insect pathogens are disease-producing micro-organisms (commonly called germs) that attack insects and cause sickness or death. Properly administered, these germs can cause widespread disease among specific insects in a given area.

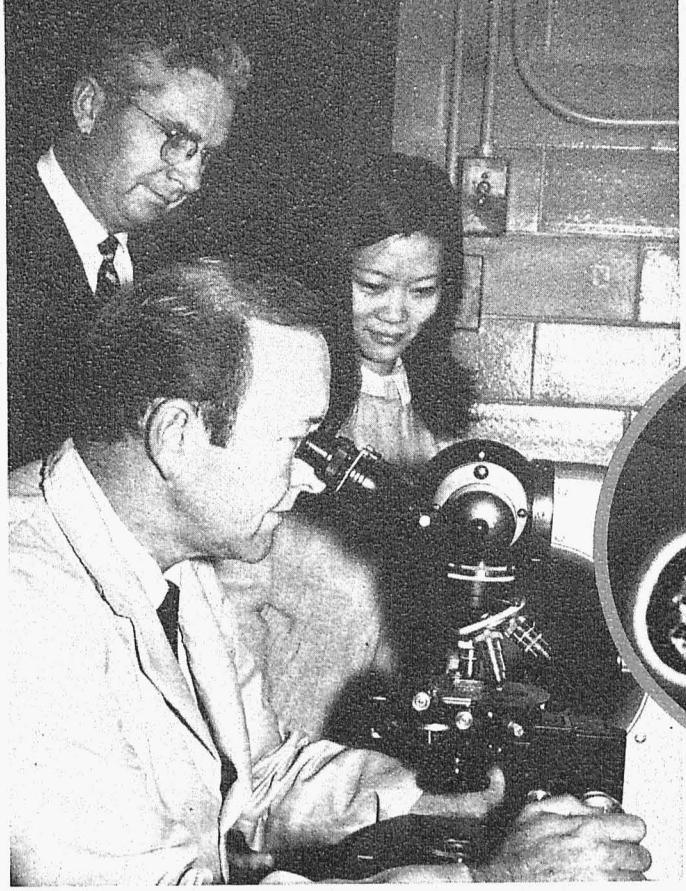
Predator insects prey on and devour other insects. Since both predators and pathogens attack specific insects, there is no danger to beneficial insects or man.

Because soybeans are legumes and fix their own nitrogen, they need soils that are well limed. They also need adequate amounts of phosphorus and potash, points out soil scientist George Wagner. Studies in southeast Missouri have shown that more than a fourth of the land has only a marginal supply of potash in respect to soybean needs. The same is true of the claypan prairies of northeast and west-central Missouri. Fertilization of soybeans is a subject that can no longer be ignored, says Wagner.

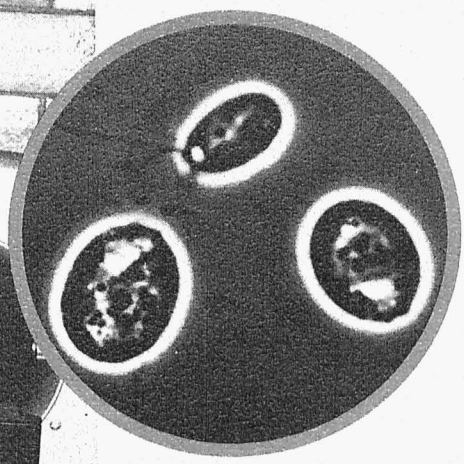
In a further College of Agriculture soybean effort, a joint Extension service/producer/agri-business committee numbering more than 100 persons (and broken down into project groups) is looking into every phase of soybean production from machine design to land prices.

Headquarters for this committee's activities has been the Delta Center of the ag experiment station, near Portageville. This center has been at the forefront in nematode resistance work. It was there that nematode resistance in a soybean of undesirable color was transferred to a commercial variety to give us Custer, one of the recommended varieties of today.

The Delta Center operates on 676 acres under the leadership of Superintendant Norman Brown. Research at the center includes plant breeding, variety testing, weed control, soil fertility, insect control, and irrigation for cotton, corn, small grains, sugarbeets, pulpwood, and soybeans.



THE MYSTERIES of some of life's processes are probed in the MU genetics department by Dr. Charles S. Gowans and Orchid Chu, a graduate of National Taiwan University. Among other projects, they are studying a green algae shown here in microscope view. Looking on is head of the new genetics department, Dr. M. G. Neuffer.



GREEN ALGAE

LIGHT INTO THE DARKNESS

YOU'RE TRAVELING on a space mission... without room to carry all the food you'll need...and you don't have time to grow, harvest, and process conventional food even if you had the room. Besides, oxygen is getting dangerously low. How do you, the resourceful space traveler, solve this problem?

You open your pop-top cannister of special MU green algae and your troubles are over. When exposed to sunlight, air, and water, these tiny chloroplasts (each containing its own chlorophyl) will multiply rapidly. Not only will they provide nourishment for your journey, they'll convert life-snuffing carbon dioxide into live-giving oxygen. And they'll keep on multiplying as long as you need them.

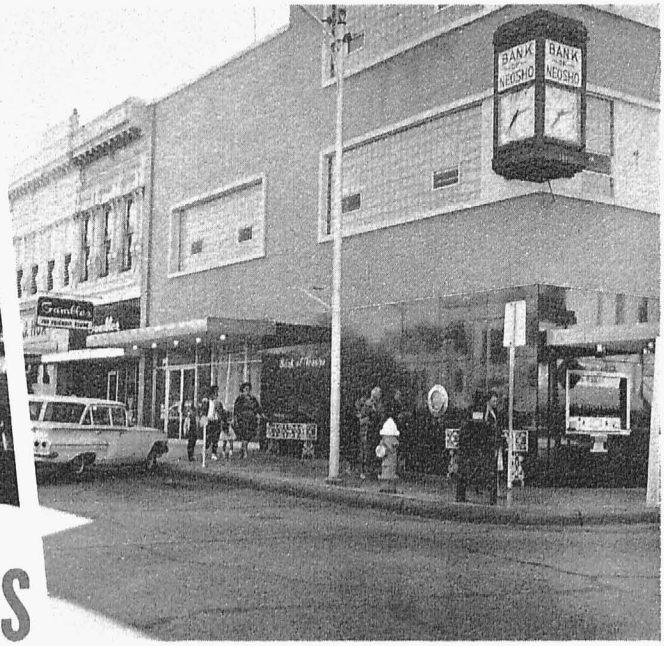
The green alga (chlamydomonas) being studied in the MU genetics department today has several drawbacks. One is nutritional balance. Despite its many good qualities, it just does not meet all the human body's needs in its present form. Dr. Charles S. Gowans is inducing changes (mutations) in the basic structure of chlamydomonas. When he gets the right changes, your space dinner will be ready.

This is just one possible product from one of the University's newest and most unusual departments. The men of the genetics department devote most of their time to research in pure science—really basic, like the genetic pattern of life itself. These staff members started out in the departments of biology, botany, animal husbandry, crops, gynecology, radiology—and in this new department form a rare link between all those fields of study. What's more, while this unusual department has a strong graduate level program, it offers no undergraduate curriculum at all.

Says Dr. Myron G. Neuffer, chairman of the department, "Geneticists are specialists who must first be botanists, zoologists, chemists, agronomists, etc., before undertaking their advanced training. There is therefore no need for a B.S. degree in genetics. The major portion of our undergraduate courses is done as a service to other departments and for the purpose of inspiring a few graduate majors in genetics."

There is so much to study in genetics that it would be impossible for one institution, let alone one department, to cover all aspects of this field. The MU geneticists are concentrating on research to apply recent discoveries in microbiology to higher organisms—such as the plants and animals we all know, along with some smaller and intermediate stages.

It is clear that the genetic code that resides in a cell can eventually be translated into a complete living thing, yet most of the details of that all-important development are still unknown. It is into this dark area of man's accumulating knowledge that the MU geneticists intend to shine some light.



WE LOOK AT OURSELVES

SEEKING THE KEY TO OZARK GROWTH

WHY DOES one community dwindle while another one prospers? Take Springfield and Rolla, for example. Both are on the same major highway, both are in the northern edge of the Ozarks, both lack good north-south routes. Why is one growing more rapidly than the other?

That's just one of the big questions being asked about the Ozarks by University of Missouri agricultural economists and rural sociologists and the Economic Development Division of USDA in a typical team project.

Take for example, graduate student Herbert Hoover, a USDA research associate. He is looking at the Ozarks from a regional point of view. He has just completed a survey of 1,413 Ozark households in southern Missouri, northern Arkansas, and eastern Oklahoma. More than 500 Missouri families were interviewed.

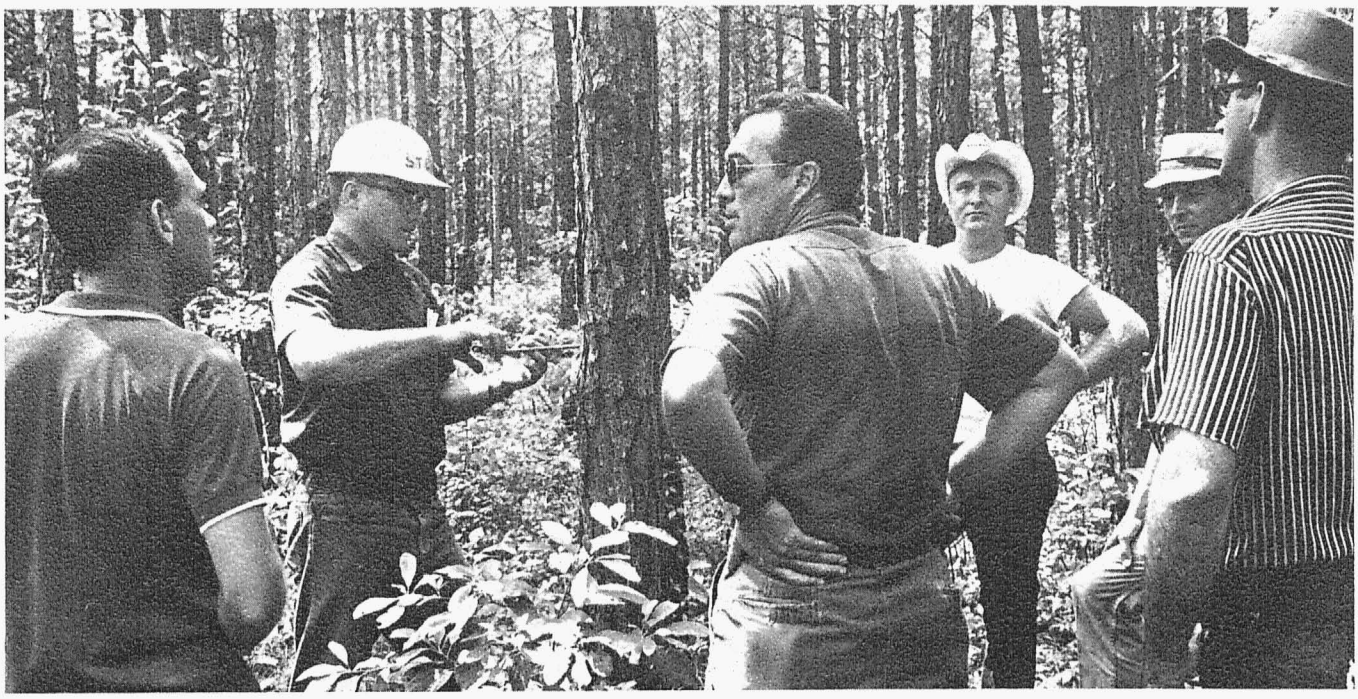
Once the evaluation of this survey is completed, it may be possible to point out which factor or combination of factors has held back so many Ozark families. Graduate student Robert Bradley is studying growth patterns of Ozark towns and reasons behind them. Results of that research will provide important guides for regional planners.

Most of us are aware of an exodus of farm workers from the Ozarks. Did you know that there also is a strong in-migration to the Ozarks? Drs. Lloyd Bender and Melvin Blase and their colleagues are asking who these newcomers are, what skills they bring, what services they need.

At the same time, Dr. Robert Bevins, a joint research-Extension economist, is looking into the problems of Ozark land use and planning. If better uses can be found for current labor and land resources, prosperity may be courted without causing extreme changes in present ways of life.

To help Ozark residents develop the form of prosperity they want for themselves, the Ozark Regional Development Commission is encouraging formation of county and multi-county development groups to plan and guide local projects. Three of these are now in operation in Missouri. More than a man-year of time has been invested by the MU staff to provide these groups (and the public) with a listing of all publications and information most appropriate to regional economic development.

This long-range effort will not end when these questions are answered, Blase points out. The next step will be to formulate proposed solutions to the problems, win state and federal support for the projects involved, and work with the Ozark residents to achieve the goals of economic and social prosperity and a sound, promising future.



FORESTER Lee Paulsell, center, tells class about nearby pines while student Steve Lindsey, La Cygne, Kan., takes core sample for clue to tree's history. Class is part of School of Forestry annual summer session at University Forest near Poplar Bluff.

UNIVERSITY FOREST

SPECIAL EDUCATIONAL SERVICE TOOL

WHEN YOU come right down to it, it's almost impossible to move a forest into a classroom or a laboratory. Faced with this problem and having forestry classes to teach, instructors in the MU School of Forestry treat the forest just as Mohammed treated the mountain. They go to it.

"Research, teaching, and short course (Extension) activities are conducted at the University Forest near Poplar Bluff whenever this will improve the results," says Dr. Donald P. Duncan, director of the school. The University Forest includes some 7,000 acres under the direction of a resident forester. It is completely surrounded by Clark National Forest with its gross area of almost 2,000,000 acres.

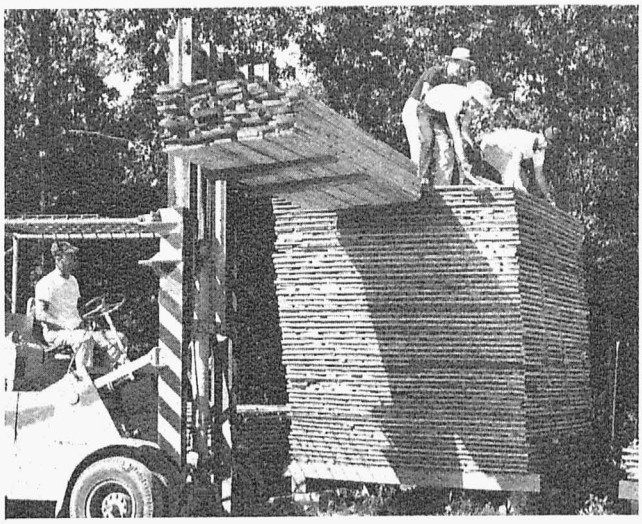
"Recent physical improvements which have been made within the University Forest have strengthened our research potential," Dr. Duncan points out. These include watershed gauging weirs, an extended road system, a small greenhouse, and growth chambers for seedling propagation and study.

A summer camp for forestry management students is held there each year. A short course program attracts many people to the forest—an example is the one that drew sawmill specialists from throughout eastern states last year. Youth group activities make up an important part of the University Forest educational program. These include 4-H, FFA, Boy Scouts, and others.

Says Dr. Duncan, "A better name than forestry might be resource management. Timber management is just one phase of that.

"**We're putting increased emphasis** on outdoor recreation, and on watershed, wildlife, and range management in our program. Our new forestry curriculum reflects broad over-all approaches to wildland management problems. The forester of the future will be dealing more and more with people. Therefore, the humanities and social sciences will receive more attention in our program."

Range management involves land that mainly supports grasses, herbs, and shrubs which can be grazed by livestock. Forest recreation includes everything from nature trails and ski slopes to camping. Watershed management—increasingly important as the demand for clean water increases—includes sub-



WIDE RANGE of professional skills taught School of Forestry students includes saw mill training and timber management as related to outdoor recreation. Summer camp students select trees to harvest for lumber. Later, they stack freshly cut boards for seasoning. Increasing need for public recreation areas brings foresters into action with timber management programs that will boost the recreation value of lakes such as this one, a Forest Service project in Southeastern Missouri.

jects from reduction of flood crests by changes in land management to control of erosion by reforestation and other management practices.

Three major courses are offered by the MU School of forestry. These are forestry, wood products and building materials management, and residential and light construction. The school's research program is strong at both the master's and Ph.D. levels.

Most of the school's 235 undergraduates are enrolled in the forestry program, but the demand for graduates is good in all three fields. State and federal agencies employ a great many professional foresters. Private industry needs large numbers of forestry management majors. Pulp and paper companies are particularly active employers of foresters.

The classroom moves to the forest and stays there each summer for the annual summer workshop. The session lasts 10 weeks with a final 14-day tour of other forested regions of the United States. These may include the Great Lakes states, southern pine forests, or the central Rockies, all of which are noted for their progressive wildland management.

At the summer camp, up to 40 senior students will get instruction in forest measurements, forest ecology, tree identification, silviculture, forest utilization, and forest engineering. They earn 12 credit hours from the session.

Research has dealt with problems faced by Missouri Christmas tree growers. Improved varieties are now being grown in Missouri plantations. It was largely through Forestry Extension efforts that an independent organization of Missouri Christmas tree growers was formed. Because of these two efforts, it is estimated that more than a fifth of the Christmas trees in Missouri homes this year will be Missouri-grown. This is an increase from practically zero 20 years ago.

Research in wood utilization has included studies of the finishing problems of red cedar products. Now black walnut finishing problems are getting principal attention. Another project concentrates on the problems of shake, a defect of walnut and oak. Development of a wood utilization extension program and establishment of a regional wood technology program under the Technical Services Act will draw heavily on the school's research program.

Rehabilitation of present timber stands is an important subject of MU research. Cutting methods are sought that will increase the rate of growth of high quality trees in a stand while promoting natural reproduction to start new trees for the next stand. Another study looks into the influence of forest cover and the manipulation of that cover on water supplies and recreation needs, Dr. Duncan explains.

FORAGE RESEARCH projects outnumber others at the Southwest Missouri Center near Mt. Vernon. Orchard grass, lespedeza, pearl millet, and others are getting special attention. Many departments are active at the center in projects from building design (ag engineering) to plant breeding (agronomy).

FORAGE UTILIZATION

A BETTER PASTURE PROGRAM

WHEN SOMEONE yells "Hay" in southwest Missouri, everyone listens. It's real cow country, both beef and dairy, and cow men get their living from forage and hay.

There were 657,000 acres of forage and hay in Newton, Polk, and Stone counties at the time of the last census, and they're fairly typical southwest Missouri counties. At the same time, these three had only 59,000 acres devoted to all other crops. Quite logically, then, major emphasis at the Southwest Missouri Center near Mt. Vernon is on forage crops—pasture and hay.

The southwestern part of Missouri has long been known for its dairy enterprises. Recently there has been a phenomenal increase in beef cattle numbers in that area—beef cows have more than doubled since 1958. But there are problems. Small fields of shallow rocky soils are the rule in much of southwest Missouri. And fertility generally is so low that it is a serious limiting factor. Forage test plots have shown significant response to fertilizer, in some instances doubling the yield with addition of phosphorus alone.

Seasonality of forage grasses is a big problem, too. Typical Missouri pastures produce 60 percent of their total growth in April, May, and June and only 15 percent in July and August. This causes a serious summer gap. Several projects are underway at the center to find ways to fill the gap.

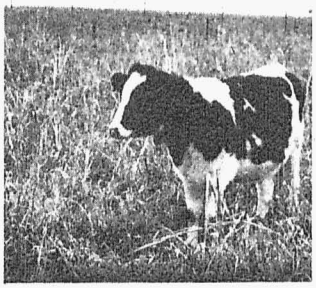
One of the best looking prospects is Gahi-1 millet, being tested by Drs. A. G. Matches and F. A. Martz. It appears to be doing everything hybrid sudans have done in July and August. Furthermore, it does not have the prussic acid hazard.

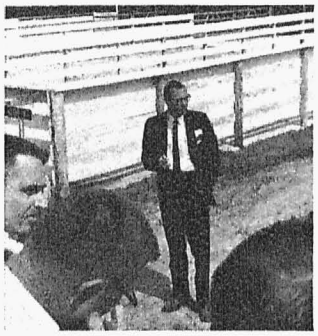
Midland bermuda, Caucasian bluestem, and some of the switchgrasses look promising among the warm-season perennial grasses. Two legumes that are new to the area, birdsfoot trefoil and crown vetch, have done well in tests for summer stockpiling.

Information is being sought on different pasture mixtures in other work being done by Matches and Martz. A group of two-acre plots has been grazed for five years and results of these pasture management studies are being measured by actual gains of Holstein heifers and steers. Best total gains have been made on a brome-alfalfa combination.

Fescue and orchardgrass are two leading grasses in the area, but both have major problems, too. Dr. K. A. Asay is working to solve these problems. He is using an extensive breeding program to improve fescue palatability, yet keep the high yields, vigor, and drouth resistance that make it so popular.

Fescue-lespedeza is another forage crop that holds good prospect of filling the summer grazing gap, says researcher E. M. Kroth. His studies of fescue-lespedeza test plots have shown that annual yield is about the same with added nitrogen as without. The non-nitrogen pasture seems to reach its peak later





in the summer than does the nitrogen-fertilized, and just about fits into the July-August forage gap.

The queen of forages, alfalfa, is gaining popularity in southwest Missouri. Dade County nearly tripled its acreage of alfalfa in a recent five-year period. Original establishment of alfalfa is expensive and leaves the soil highly vulnerable to erosion for about three months. Therefore, long life plus high yields are of great importance, explains researcher R. D. Horrocks. An experiment started at the center in 1962 has shown Cody to have the best survival, plus excellent yield and high quality.

There are other important projects at the Southwest Center.

In recent years much interest has been shown in narrow rows and high plant populations for corn. To gain information from scientifically designed and controlled tests, the University began a three-year program in 1966 to determine whether or not grain yield could be significantly increased by these practices. These tests by Dr. M. S. Zuber and graduate student N. G. Weir indicate that narrow row spacing can increase yields in southwestern Missouri fields, especially with high plant populations. Populations of 16,000 plants per acre and higher did not differ significantly from each other in producing increased grain yield, but all were better than 12,000, Dr. Zuber points out.

Irrigation studies based at the center have shown substantial corn yield response to water application, says Kroth. Farmers in the area, anxious to learn more about irrigation's possibilities, are following this research with special interest.

Missouri farmers began planting Scotch pine trees in increasing numbers in the 1950's largely because of Missouri Agricultural Experiment Station research with Christmas tree production. But there were problems, explains researcher R. B. Polk. Seeds from some origins yielded trees that yellowed badly in fall and winter, grew slowly, grew crooked, or in other ways lacked good Christmas tree traits. One result is the present study which includes a large planting at the center. The object is to determine the patterns and extent of genetic variation in the species in order to develop improved strains of these trees for use by Missouri growers.

Two new barns designed by MU agricultural engineers have been constructed at the center for dairy husbandry research.

These are the types of work being done at the Southwest Missouri Center under the local direction of Superintendent Norman Justus. As you can see, the projects are largely of a nature to help the area's dairy and livestock economy. The College of Agriculture departments of agronomy, agricultural engineering, and dairy, and School of Forestry are active in the center's research.

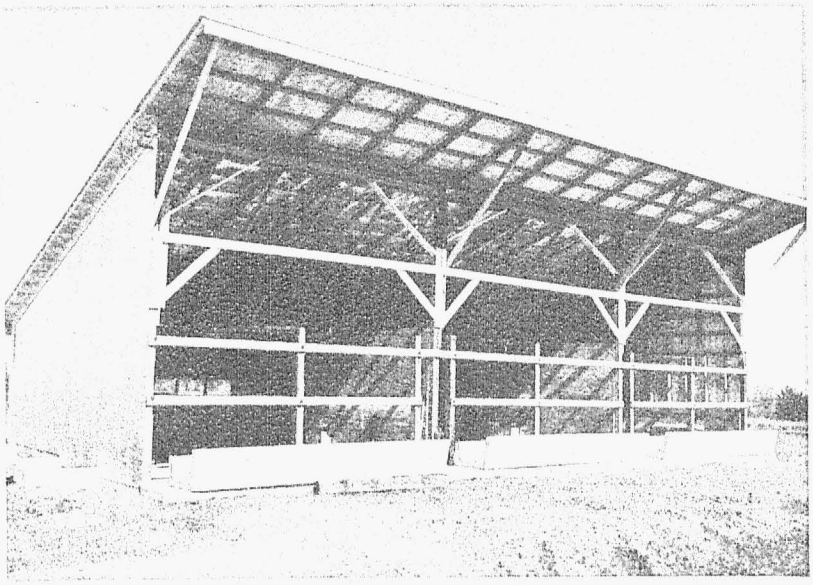
Research results are made available to local livestock men by Extension specialists and through Extension publications and the press and radio. These results also get immediate use in the University's classrooms as the researcher-instructors take them directly to the students from their field work.

In a further dissemination of research findings, Extension workers have actively promoted good attendance at Southwest Center field days and have acted as guides at the events. Smaller groups with special interests have been brought to the center by their County Extension Directors on other occasions.

The center was established to fill a need recognized by leaders in 22 southwest Missouri counties. These leaders were concerned about the opportunities for specialized research in this area. They led efforts which resulted in the passage of a bill by the Missouri legislature allowing the University to create an agricultural research center for southwest Missouri.

After the legislature provided $75,000 for land, 590 acres were purchased near Mt. Vernon in Lawrence County. The center was formally dedicated in November of 1959.

FEEDLOT FACILITIES



MOVING TOWARD MORE MISSOURI-FED BEEF

HARNESSING the power of nature has long been one of man's top goals. Complete control of nature is still far in the future, but little bits come under man's control from time to time. Take the new semi-confinement beef feeding barn at the University's Weldon Springs Research Center. It is designed to *use* natural weather factors, not fight them, explains Dr. A. J. Dyer.

To begin with, the building's open front faces south, toward the prevailing winds. Straight-through ventilation can be prevented, controlled, or encouraged by the amount of opening on the north side of the structure. The openings, incidentally, are handily covered with protected overhead garage doors.

The sun's warming rays can enter the building through the open front. The sloping, overhanging roof is so designed that the entire interior will be shaded when the sun is high over head during the heat of a mid-summer day. Yet the low winter sun's rays will reach clear to the farthest inside corner, drying and warming when these are most needed.

Even gravity is being put to use with slotted floors. Manure falls through the floors to a collecting pit below, greatly reducing labor needs and providing animals in the barn with cleaner living conditions. This is expected to increase the rate of gain.

This new building received its first batch of steers in December of 1967. They will be fed and handled in the same way that others are treated in the feedlot facilities research at Weldon Springs. Details of the open pens were related in an earlier *Pathways of Knowledge* and in other publications. The intention of the project, says Dr. Dyer, "is to determine the best feeding facilities that can be used by Missouri livestock men when all aspects of feeding and management have been considered." The project is a cooperative venture including the MU departments of animal husbandry, agricultural economics, and agricultural engineering. Actual design of the new semi-confinement barn is by ag engineer Ralph Ricketts.

Graduate students are taking advantage of the facilities project to increase their educational opportunities and help Missouri livestock men at the same time. A recently completed study done at Weldon Springs by graduate student Jack Riley showed that a cattle feeder who keeps monthly individual weight records of his feedlot animals can increase his profits by culling low performers on the basis of growing-phase gains.

Work at the Weldon Springs Center, just west of Weldon Springs, is directed by Superintendent Gerald Wright. In addition to the facilities project, there is a wide range of research involving soil fertility. Much of the University's beef cattle breeding and forestry research has been done at this 8,000-acre center. Other beef cattle studies now underway include 200 Hereford cows in a selection project supervised by Prof. James Comfort. A grade herd of 150 cows at the center is being used to compare fall calves with winter calves for feeder calf production.

THE COLLEGE OF AGRICULTURE

LOOKING AHEAD

IN THESE FEW pages we have shown a small fraction of the MU College of Agriculture activities. We have only hinted at the vast educational programs, both resident and Extension. We have barely touched on the far-reaching research into crops and soils. We have hardly scratched the surface of livestock research . . . or entomology, rural sociology, ag engineering, home economics and all the others.

Far from being the whole cake, this is just a bite. But you—our friends and supporters—know that you don't have to eat a whole cake to know how it tastes.

We want you to put down these pages with the firm conviction that you have read about a sound, resourceful institution of higher learning—an institution designed and operated to provide the guidance and opportunity that college-age youth need today. It is an exciting institution, too, up-dating the heritages of Greece and Rome and 1776 with the challenges of 1968, the atom, and space.

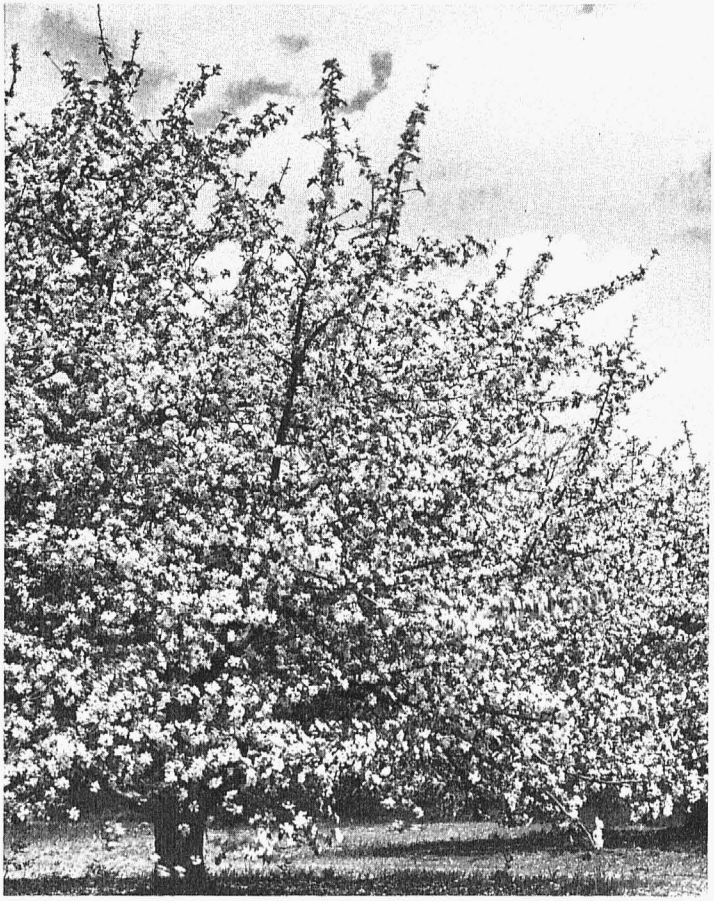
The MU College of Agriculture today is as different from the "cow college" of 1910 as today's manned space vehicle is different from the 1910 flying machine—as different as today's 6-row corn combine is from the 1910 binder.

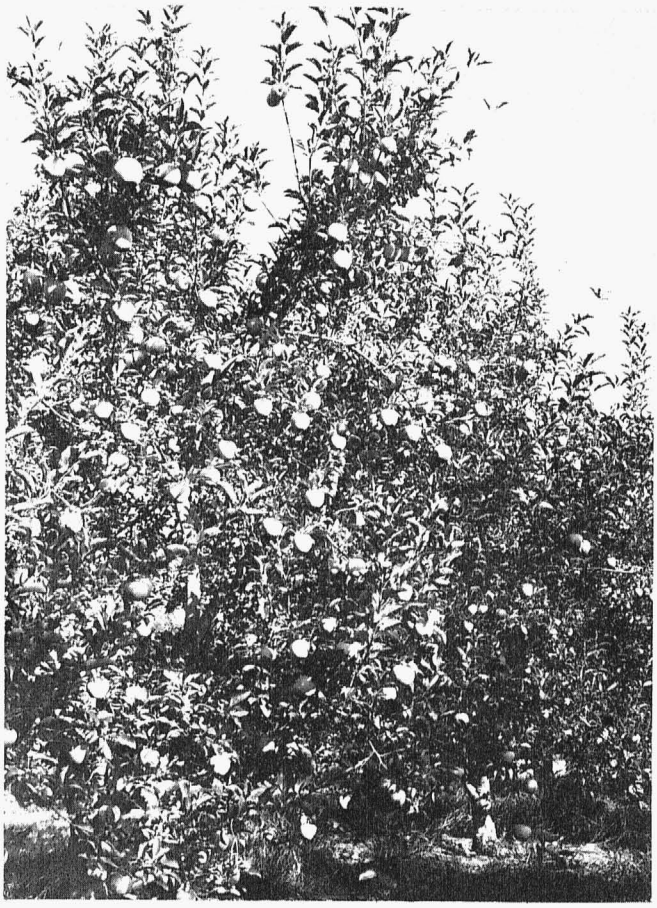
Our graduates who return to the farm are prepared to manage the $100,000 investment that modern farming demands. They know the significance of trace minerals in soil and fertilizer and animal nutrition. They know confinement feeding, narrow rows, pest control, market trends, and management.

Even more of our ag college graduates enter other fields, particularly the ag-related or agri-business activities. Many enter professions that are completely non-agricultural, for much that is taught in agriculture is essential to success in other vocations.

It is a big, bold, stimulating institution, this College of Agriculture. The halls ring with the sound of young voices. In classrooms we share the knowledge of the ages and of tomorrow. Our laboratories probe the unknown and make simple what was once thought impossible.

It is a great challenge, this responsibility of training and guiding the untrained and seeking mind. Our strength is in your support. Our principal commodity: education.





YOUR CHANCES of ever seeing an apple tree such as this one were pretty slim a few years ago. As recently as 1960, virus-caused losses were threatening the existence of apple orchards in Missouri and across the nation, explains MU plant pathologist Daniel F. Millikan. Yields were being cut severely, with one virus causing total loss. Then, following years of work, MU pathologists solved the virus problem. Now, several million apple trees are sold each year by Missouri nurseries. This sale simply would not exist if the viruses remained uncontrolled, Dr. Millikan declares. Missouri-grown trees account for about 30 percent of the apple trees planted within the continental United States each year. Increasing sales of trees to Canada and Mexico are solidly based on the quality of Missouri's nursery-grown apple trees. Add the income from the sale of apples by farmers and orchardists to the income from the sale of trees, and it is easy to understand how important it is to the state's economy to have these viruses controlled.

SCIENCE IN THE PUBLIC SERVICE

UNIVERSITY OF MISSOURI

COLLEGE OF AGRICULTURE