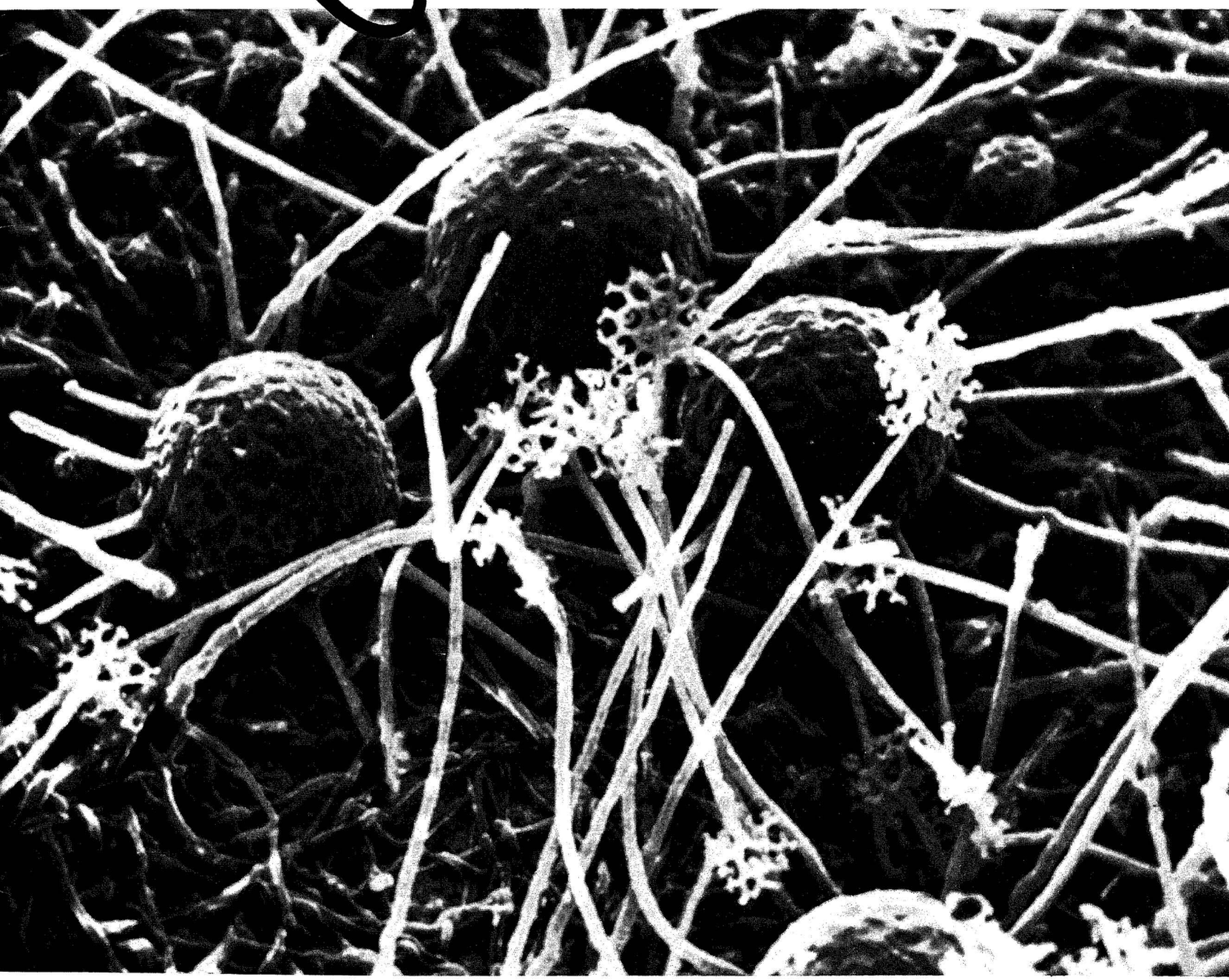
College of Agriculture University of Missouri-Columbia Oct. 1973 SR 145

Pathways of Knowledge



Science in the Public Service

The unusual photo above shows the fruiting structure of a powdery mildew fungus. It causes disease on rose and lilac bushes.

Editor's Note: As of July 1, 1973, the School of Home Economics became the College of Home Economics and therefore is no longer a part of the College of Agriculture. Dr. Margaret Mangel, former director of the School, is now dean, College of Home Economics. However, *Pathways of Knowledge* is a report on the College of Agriculture's past year of activity and the section on home economics is included.

The major portion of *Pathways* was prepared by staff members in the Agricultural Editor's Office.

SOME OF the early College of Agriculture research and Extension work dealt with ways to balance rations for farm animals and balance diets for farm families. Later work outlined ways to balance plant nutrients in the soil.

We are still striving to help people reach a balance. But, in addition to balancing diets and rations, we as a College must help citizens and groups balance their objectives and goals with the methods and resources needed to achieve them. We must help society balance man's wants and needs with a concern for conservation of resources and quality of environment.

This striving for a balance is a never-ending task. We find that new technology, new products, and new programs usually result in secondary or side effects.

Some examples of questions of balance we face today in agriculture include: (1) Increasing mechanization of farm production vs. the long-term need to conserve power and energy resources (2) Consumers' desire for fruits and vegetables free of insect and disease damage vs. concern about chemical pesticides, (3) Use of land and water for food production vs. use for recreation and urban development, and (4) A farm family's need for an efficient-sized farming unit vs. effect on community and families of a smaller number of farm units.

The list of examples could be long. And, as the College of Agriculture takes a leadership role in rural development research and programs, the question of a balanced growth will come more forcefully into the spotlight.

A major question is, "How can we provide more jobs and services in rural areas while still keeping the clean air, open spaces, and other advantages of rural Missouri?"

We strive for balance in the programs of the College of Agriculture and the Experiment Station. One way we attempt to achieve this balance is through the use of advisory committees.

Many of our departments have standing advisory committees made up of citizens from throughout the state. Our outlying research centers have been served well by advisory groups. Our Extension programs have the guidance of Extension Councils in each county.

Our College and all Missouri citizens are indebted to the persons who serve on these committees. I certainly give them my personal thanks.

We seek balance also in the financial support of our program. Of course, our basic sources of financial support are federal and state funds. But last year important support of our research program of the Experiment Station came from private funds supplied by producer groups, marketing organizations, agribusiness firms, chambers of commerce, and individuals.

I have been pleased with the private support provided for our animal waste management program during the past year. You will read more about that on page 27.

Overall, we think the outlook is bright for agriculture and its many related fields. Even though we face many problems, we are also making progress in many areas. We think that you will agree after reading this report. It is not a sugar coated tale of success. Instead, we give you a brief, realistic look at what the people who work for you at the College of Agriculture are attempting to do, and what they are accomplishing.

One other comment—you can do the young men and women you know a favor by suggesting they consider a career in agriculture. An education in our College will open many doors for them and they can help provide the leadership we need in agriculture in the years ahead.

I encourage you to give me your reaction, comments, or suggestions after you have read the report. Just call, write, or visit me here at Columbia.

Sincerely,

Elmer R. Kiehl

Elmer R. Kiehl
Dean

Striving to Achieve Balance

From the Departments

People Oriented Research

Rural sociology, as a branch of the discipline of sociology, is organized as a Department in the College of Agriculture. The work of the Department includes teaching, research, and Extension and is concerned with rural application of sociological knowledge. The Department is housed with the Department of Sociology (a part of the College of Arts and Science) which offers the opportunity to merge the talents and skills of all sociologists on campus.

The teaching program at both the undergraduate and graduate levels is integrated so that the full range of sociological offerings are readily available to college of Agriculture students and to other divisions of the Campus as well (most courses are cross-listed in the two departments).

The Extension role is concerned with the out-reach of the Department in practical affairs throughout the state.

The research program is carried out through the Missouri Agricultural Experiment Station and is concerned with "people oriented" issues. Consequently, research projects are currently involved with health care delivery systems, with population change, with communication and utilization of knowledge, with social change and rural development, and with structural characteristics in agricultural organization.—*Robert L. McNamara, chairman.*

Producers Aid Field Study

The research program in the Department of Poultry Husbandry is concentrated in problem areas related to growth and reproduction in both laying hens and turkeys.

Dr. A. B. Stephenson is studying the effects of genetic selection in turkey breeders on reproduction, while Dr. H. V. Biellier's research is aimed at identifying environmental and physiological factors which tend to limit reproduction.

Production and management research is conducted by Dr. J. M. Vandepopuliere, Prof. Walter Russell, and Prof. Glenn Geiger. Facilities of the Agricultural Experiment station serve for pilot studies and larger scale field studies are done in cooperation with off-campus producers. Marketing, environmental, and disease control problems are also now being studied in cooperation with other staff members in the College of Agriculture and School of Veterinary Medicine. A study of the use of turkey products in institutions, such as hospitals and nursing homes, has recently been completed and the potential for use of egg shells from egg processing plants is now under investigation.

Nutrition research is conducted by Dr. J. E. Savage. The value of high lysine and high methionine corns in computer formulated diets for growing turkeys and the effects of different carbohydrate sources on body fat and reproductive performance of laying hens are topics of current studies.—*James C. Savage, chairman.*

Living Quality Emphasis

Home Economics aims and objectives at the University of Missouri-Columbia are those of any profession which seeks to apply and integrate basic knowledge for a particular function or service.

We see Home Economics as a highly integrative field encompassing the natural and social sciences, the humanities, and the arts. It seeks to develop new knowledge in research, and to communicate this knowledge both to students on campus and to the people of the state and beyond through the Extension Division.

Our primary function is oriented to the improvement of quality of living for individuals and families and to improving their effectiveness as citizens in our changing society.

Specific orientation of our College's sections is toward 1) improvement of food, clothing, and shelter available to families; 2) improved understanding and application of principles of selection and utilization of these commodities and of the role they play in individual and community development; 3) development and dissemination of knowledge regarding child rearing practices; and 4) consumer economics and management in contemporary society.

We recognize that our goals can be achieved only through highly interdisciplinary approaches, both within Home Economics and with other disciplines on campus.

Efforts are currently underway to strengthen our focus on family development, and to increase coordination among faculty teaching courses designed to cover similar areas in the different sections. New faculty will be sought for such areas as the relation of housing environment to child and family development, and family food patterns in relation to socio-economic, ethnic, or other cultural factors.

We feel that we now have a vigorous research program in all sections of the College. We will continue to update and strengthen our research to support the aims and objectives we've noted here. —*Margaret W. Mangel, dean.*

Computers in Dairying

Emphasis on the interaction between environmental influences, nutrition, feeding, climate, and shelters and their effects on growth, lactation, reproduction, and behavior of dairy cattle are continuing in the Dairy Department's research, teaching, and Extension activities.

Among a number of recent innovations in our programs are:

1. The use of computer terminals for computerizing University Dairy Farm herd and management data to facilitate University research, teaching, and Extension programs.
2. Modification of our environmental research programs to include studies on air pollution as it relates to other environmental factors influencing the functions of domestic animals.
3. Addition of a new project on neurobiology and behavior as it relates to the management of dairy cattle.
4. Expansion of our reproductive physiology program to include an Extension effort for provision of reproductive management information.

These and other changes in our research and Extension programs, plus proposed new course offerings, are part of a continuing effort to meet the relevant needs of undergraduates, graduate students, and dairy industry clientele in the science of the dairy animal industry. —*Harold D. Johnson, chairman.*

How Everything Fits Together

From Miniature Landscape to Teaching Garden

Students come and go all day long at two UMC greenhouses where Leon Snyder's classes in micro-environmental and landscape design are held. They stop to look at and touch the miniature landscapes on display around the greenhouse, to ask questions about projects, and to absorb the atmosphere of exciting-things-are-going-on here. The smells of earth, and water, and growing plants are stimulating ones.

Snyder's classes are increasingly popular with students. So much so that he will add a second micro-environmental design class this year. And he will teach a two-week cram course in micro-design this summer.

As a horticulture professor in the College of Agriculture, Snyder is dedicated to helping people develop an interest in their environment, and from that, knowledge of how to protect and interpret it.

His students create living landscapes in miniature, micro-environments that change, grow, and develop in beauty before their eyes. Principles of art and design are used in creating these landscapes out of rocks, soil, plants, and trees.

Students also find themselves discovering geology, horticulture, botany, soils—all the earth sciences—as they track down the elements that go into a particular land formation and learn why they are there and what their purpose is in the environment.

The course is tailored to the individual student. Snyder says that a student's "design personality" shows up quickly because students create more easily when they use the natural materials of rocks, soil, and plants. Snyder then directs the student into an area where he can best express himself.

Micro-environmental design, however, is just one of several imaginative courses offered by the College of Agriculture in the area of man and his environment.

On a normal size scale, James E. Smith, professor of horticulture, teaches with a real garden, located in back of the Agriculture Building.

The garden, dreamed of and schemed for by Smith and Snyder, has become one of the University's beauty spots. Students and faculty fill up the benches there on pleasant days, enjoying the colorful flowers and plants, and a small natural-rock fountain.

But beauty is not the only purpose the garden serves. It is, primarily, a teaching garden. Smith feels that the only way to really learn about a plant is by being with it as it grows. His students plant the seeds for the 1,800 plants, put the seedlings into the beds, and learn to identify the plants at all stages of growth.

Smith names some of the 400 varieties in the garden with obvious pleasure—crocuses, tulips, daffodils, geraniums, hibiscuses, verbenas, petunias,

chrysanthemums, poinsettias, and marigolds are just some of the common and uncommon varieties found there.

Both Smith and Snyder involved their students in bringing the garden from dream to reality. Snyder's landscape design and landscape construction students were given the area as a design project. Smith's students planned what to grow and planted the seeds. The micro-enviromental class interpreted the natural landscape, producing a rock sculpture fountain for the area.

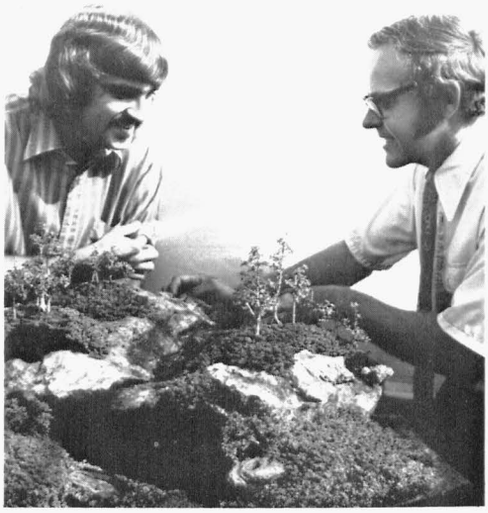
Money for the finishing touches—stone benches, cedar borders, and a water pump for the fountain— was not available in department funds. Dean of the College of Agriculture, Elmer R. Kiehl, solved that problem with $500 from the Ag Development Fund.

Snyder has some ideas for future development of the area. He would like to do some work with experimental plant material for home grounds use, such as different ground covers and unusual plants. His micro-environmental design class has discussed some plans for a bald cypress swamp and some larger interpretations.

Although a bald cypress swamp sounds like a large order, it isn't to the design students who create interpretations of such natural environments as Big Springs near Rolla, the sandstone bluffs of southern Missouri, the Black Hills in South Dakota, and Lost Valley in northern Arkansas.

A micro-environment, Snyder explains, is similiar to Bonsai, the art of growing a potted plant or tree that is dwarfed and shaped by special methods. But micro-environmental design differs in its emphasis on learning about the processes of nature, rather than on the end product.

Also, micro-environmental design incorporates all the elements of a living landscape. It is, as the word suggests, creating part of the environment, or the world, in miniature.



Leon Snyder, professor of horticulture, creates living landscapes in miniature—micro-environments. These designs are good learning devices for students who wish to create, protect, and interpret their own environments.

James Smith, professor of horticulture, also teaches with real gardens but they are of normal scale. Smith, along with Snyder, created a beautiful "teaching" garden in back of the Agriculture Building using the talents of their students.

"We start with a land form," Snyder explains. "This is how the land is shaped, how it rises and falls. Then the rocks that would be natural to the area are added. The soil comes next, followed by ground or 'underbody' plants."

For the trees, Snyder uses a variety of tree types that grow well in miniature and resemble the actual trees that one would find in the environment.

Finally, if it is part of the natural environment, water is added to the composition. Aided by a water pump, the water cycles into the earth, and starts over again, expressing one of the most common and necessary phenomena of nature, the water cycle.

Homer C. Folks, associate dean of the College of Agriculture, is enthusiastic about Snyder's major purpose: to help people understand that they are a part of the total web of life. He feels that students can understand the concepts of environment better if they actually create one. As he says, "They can project themselves into an environment and become a part of it."

"When a student, through a course or courses, begins to see how everything fits together and how he interacts with the world about him, that's really what education is all about," Folks remarks.

Today we are concerned more and more about the problems of urban growth and the destruction of our environment. Courses such as Snyder's and Smith's which teach an appreciation and understanding of the basic processes of nature and of our life on earth, are more important than ever before.

Dean Folks points out that these courses hold something for both the country boy and girl and their urban counterparts. "Our city students may never have had a chance to work with growing plants. And while our country boys and girls may think they really know about plants, they may find they haven't seen the total environmental picture.

"You know," he muses, "such a course provides a good meeting place for all sorts of people—maybe we can say it brings people to a commonality."

Snyder, too, has concerns for the growing urban population and the increased demands upon the land. He wants to teach people about the land, how to use small amounts of land well, and how to get enjoyment from the land.

He thinks that one answer for land use in cities is to reduce nature in scale, through such ways as micro-environments, and thereby use a small amount of land for maximum pleasure.

For example, one of Snyder's students is studying a system for micro-environments where they would be leased to such places as banks, libraries, and offices. Micro-environments would be changed on a regular basis, and literature about the environment, what it represents, a history of how the land developed, and information about the various plants would be included. All of this, Snyder remarks, is a way for people to learn about their environment and to gain a new appreciation for the wonders of the world in which we live •

In Touch With Students

STUDENTS DO NOT picket the College of Agriculture, for there is no impersonal dragon there for them to attack. The advisement system and teaching methods of the College of Agriculture faculty put them in touch with students.

Teachers like John R. Campbell provide the manpower, and more importantly, the human sensitivity that puts students and teachers in the College on a personal basis. And it's the dairy department's Campbell who has put it all together in a book, *In Touch With Students.*

"He's a great teacher," says Joe Barban, a sophomore. "He has a brisk and a new and invigorating way of presenting lectures. He tries to make you think."

"He's got his transparencies—and he'll whip 15 of those dudes on you. Some are funny: 'Lucy loves lactose'—it livens the class up and it warms the students towards him. It makes him a magnetic personality. And I think he has some of the fairest tests I've seen."

For example, instead of asking exactly what percentage of a housewife's budget goes for dairy products, Campbell will couch the question in ballpark figures. "He tries to get general concepts across with a certain amount of detail," Barban explains.

"His philosophy is a good one to read," says Dr. Robert Marshall, department of food science and nutrition, one of the editors of *In Touch.* "It's stimulating to read it. Very stimulating. Sometimes you want to fight with the author. And that makes you remember what he says."

Campbell asked roughly 50 students as well as 20 faculty members to review his book. *In Touch With Students* is an especially appropriate title for much of its content comes from the students.

"Ever since I began teaching I've been making notes on my experiences working with students and dealing with them. For almost ten years I've had students write papers on what they wanted in an adviser, what they wanted in a teacher, what they thought should be included in examinations, how exams should be constructed, and what they thought their study problems were," Campbell explains.

And it was several students' who first suggested that such a book be written.

Intended as a supplement to teaching methods or philosophy of education courses, Campbell's book focuses on student-teacher relationships. In doing that, he covers some controversial ground:

"I think of teachers as being professionals, just like doctors or attorneys, both of whom have definitions of malpractice. So far teachers have been immune to this kind of accountability, but I'm not sure they will be forever. The public is more aware of its investment in teaching. I think people will hold us more accountable for our activities and contributions in the years ahead."

Later, *In Touch* advises: "Social attitudes toward college 'drop-outs' should be changed. Students who have doubts about continuing in college or who are preoccupied with personal or political matters should be given an opportunity to take extended leaves of absence with guarantees of readmission and renewal of financial aid.

"This would encourage a more 'voluntary' university with freer entry and exit. Students should be allowed to 'drop in' and 'drop out' of college without social stigma.

"When he uses a visual, he uses it very, very well," says Marshall. "They're always interesting. In classwork he'll mix his visuals. Along with his point-making visuals are some that are incidental to the point he makes but high in student interest. He seems to have considerable success with this."

"One of his strong recommendations," Marshall observes, "is that you make learning attractive by giving examples ... I get the implication when reading this that all teachers in all cases ought to be able to do this. But he really doesn't mean that." However, "he succeeds in doing it himself—he and John Lasley (of animal husbandry) are past masters of this."

Campbell initiated an undergraduate research program while chairman of the Honors Council.

Barban worked on two of the five research projects that were approved. "It's basically the same as a lab experiment, but you get more inside information. You have direct contact. It's the same as a person working on his master's or PhD. It's a one to one outfit."

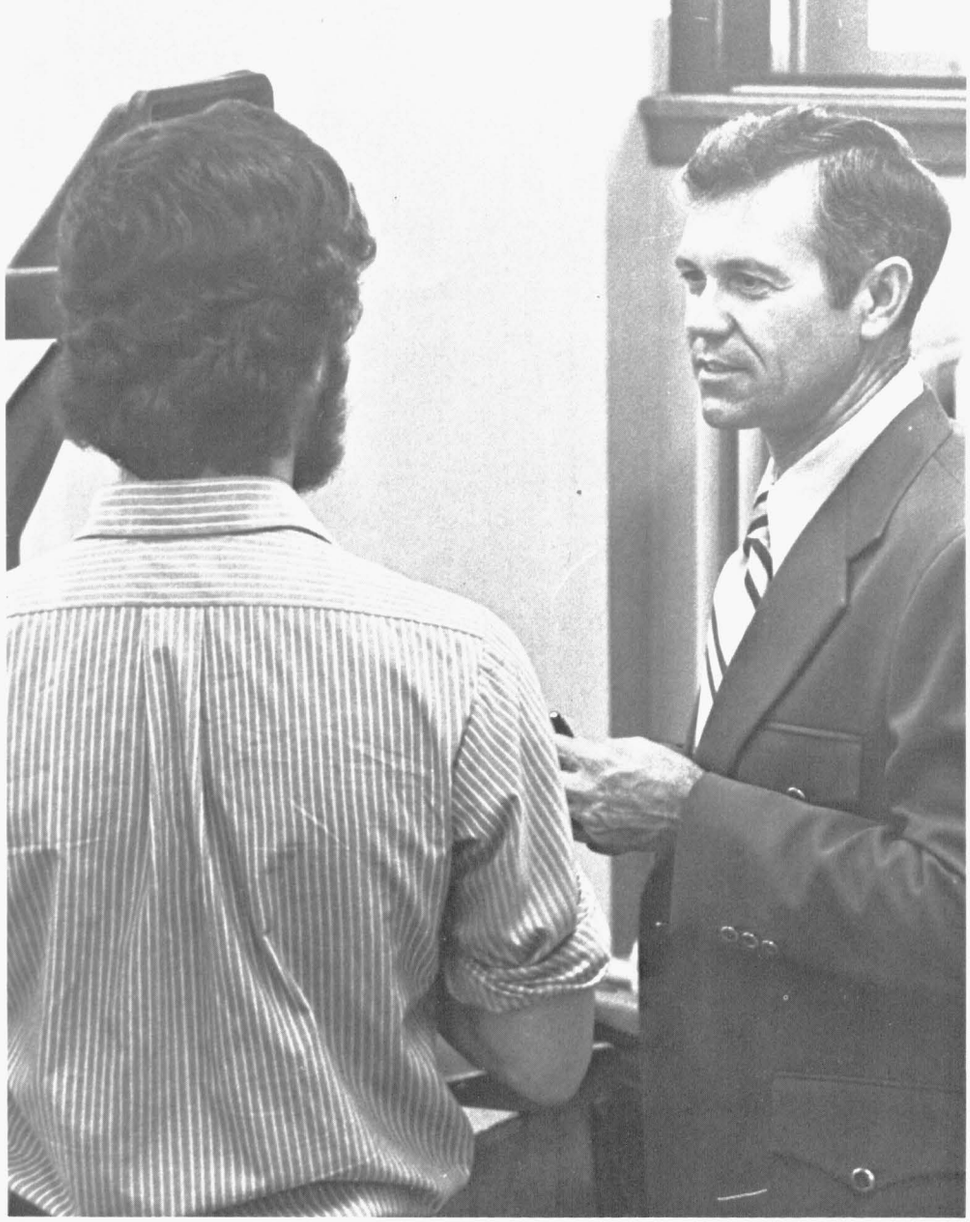
That makes Joe Barban feel he counts. In talking about research in the poultry department, Barban said, "The ideal situation is to work with the professor himself. You watch him work and the precision with which he works. And this makes you want to excell."

Barban has been moved to spend hours in the library in order to be able to talk with the poultry researchers who work with him (He says he was afraid of sounding like a "dummy.").

He credited Campbell, Lasley, and Dr. Ken Larson of Agronomy with offering research opportunities to undergraduates.

A trip to Europe to study the dairy industry and teaching methods used there has generated the plans for a travel course which Campbell and Larson have worked out.

In that course, students visited six South American countries and studied production ranging from sugar cane, bananas, and coffee in Venezuela to the operation of small farms in the Panama



Barban claims Campbell always has students in his office but would squeeze in Joe and others without appointments. When he wasn't there, "his secretary would ask if I wanted him to call me. He'd call at 6 or 7 at night. This is a genuine interest in students."

Campbell's book emphasizes the positive approach in dealing with college men and women.

"Too many administrators and teachers fail to use the best approach in dealing with students having problems. They should *not* point out to students what they have done that is *wrong*. Instead, they should point out what is *right* that they have *not* done."

Dean Homer C. Folks said this about Campbell's rapport. "I think Dr. Campbell's big strength is his interest in students and his dedication to the idea that good teaching or a good teacher are a very important part of any university. He gives himself generously to students."

It is no accident that the teaching and advising system of the College of Agriculture is noted for its orientation toward students: "If John Campbell or one of the other teachers sticks his neck out (in terms of time)," said Dean Folks, "and you reward him for it, then somebody else decides they also can do that."

Campbell has researched some learning concepts. He found "a better way" to report grades: Grades reported in relation to the class average, he said, produce a measurement that highly correlates what a student does in his classes with what he does in others. Scores would be reported as an 85/70, meaning the student scored 85 percent when the class average was 70 percent. "This takes into account those with high B's who just missed the A cutoff by two points." This system also would be a step toward overcoming differences in grades based upon differences in teaching standards. Showing the class average, for example, would reveal the class average is a B+ or A- when an instructor gives all As and Bs •

The College of Agriculture

Canal Zone. Slides taken on this trip, like those Campbell took in Europe, find their way into agricultural courses.

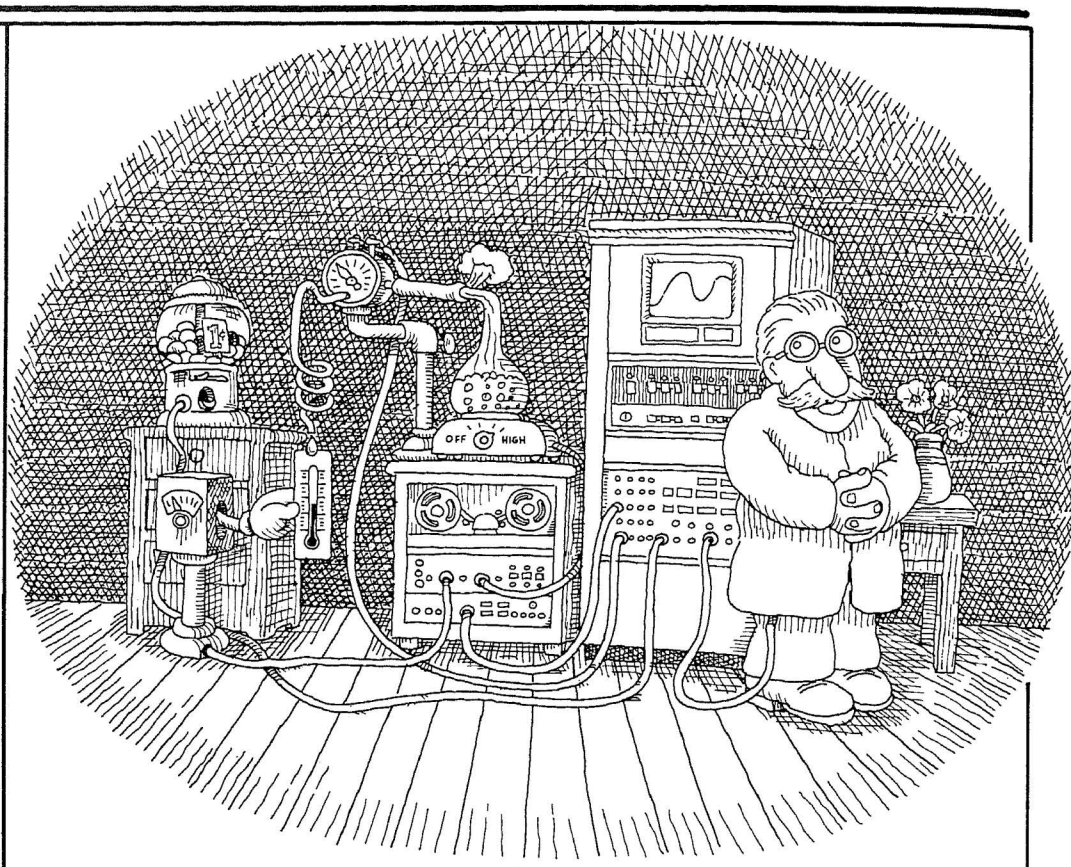
But interest-getting devices, a "smorgasbord approach" of techniques and course experimentation are only aspects of establishing student relevance. Another is Campbell's constantly recurring theme of getting and keeping in touch with students.






John Campbell relates well to students

A DREAM COMES TRUE!



NEW LABORATORY

IN THE ANIMAL SCIENCE RESEARCH CENTER

BENEFITS ALL

COLUMBIA, MO. (UMC)—"Hi. Can I use your analyzer?"

The lanky poultry science graduate student from north central Missouri turned from studying the dials and winking lights on the automated amino acid analyzer-scintillation counter in Dr. James E. Savage's ultra-modern laboratory. He looked around and down a foot to see the young handlebar-mustachioed student from a lab down the hall, clutching a brown paper bag.

"Sure thing, shorty. What ya' got there?"

"It's high lysine corn. For Doc Veum's hog feeding tests."

"Hey, that some of the shipment from Iowa?"

"Right."

"I can use an analysis of that, too, for our poultry tests. Here, I'll show you how to set up the machine."

Scenes like this are repeated daily in the new Animal Science Research Center at UMC's Ag Research Park. Poultry Scientist Savage, Geneticist John Lasley, Physiologist Billy N. Day, Nutritionist Bill Pfander, and other animal science researchers light with enthusiasm when discussing the good effects that their new laboratories are having on graduate students and their research programs.

Dr. Pfander, leader of the new Animal Nutrition, Physiology, and Metabolism project, explains the advantages of getting all of the related animal science laboratories under one roof so they can share expensive equipment and cooperate in projects. "We all have access to about all we could ask for in equipment as a result of this pooling," Pfander relates.

"But it's not just the sharing of equipment," Savage explains. "These students in the different fields mix together and give each other ideas," he said, and Lasley corroborated with enthusiasm: "They stimulate each other. It's something that's hard to measure but we sure can see it."

The multidepartmental research facility that has been in the planning, dreaming, and building stages since 1961, was opened early in 1971. Several units remain to be added when funds permit.

Central theme of the project is providing service to Missouri agriculture by developing greater understanding of the animals used in food production. To this end a coordinated program of nutrition, physiology, and metabolism investigation has been launched.

Although scarcely two years have passed since the new building opened, fascinating results are beginning to emerge. Under Dr. Pfander's guidance, metabolism studies with sheep are revealing a shortage of potash and magnesium in fescue pastures from February until they green up. The shortage is being measured and the amounts needed for supplements calculated.

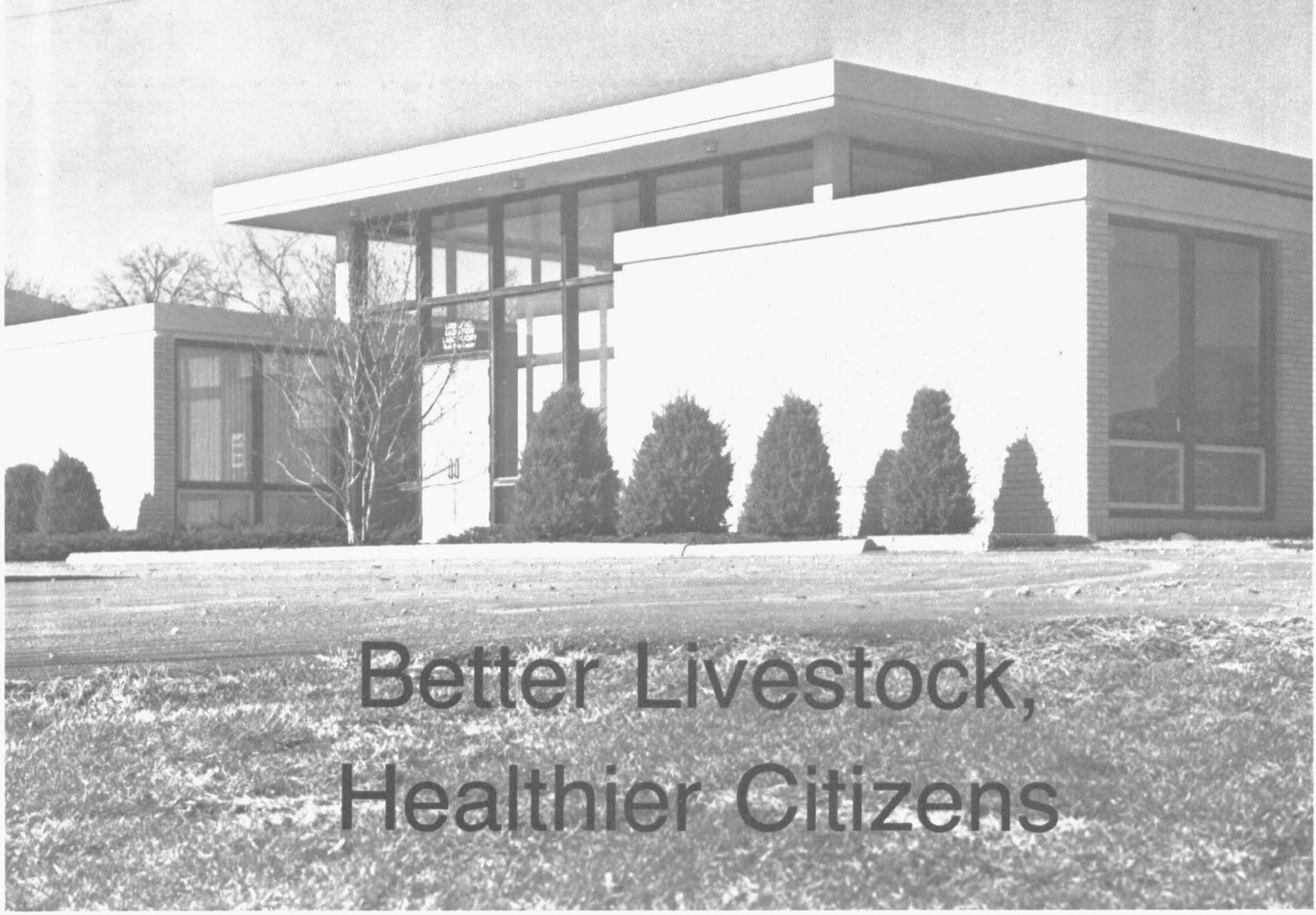
Drs. Veum and Savage, using similar combinations of laboratory analysis of feeds and feeding trials, are establishing bases for protein balance and cost comparisons when high lysine or methionine corn is used in swine or poultry feed.

Studies of blood cells of purebred and crossbred animals in Dr. Lasley's genetics laboratory are indicating that the crossbreds' extra vigor may come from more-efficient action by their enzymes. This gives the crossbreds more ability to withstand tough environmental conditions.

By studying chromosomes, cell parts which carry details of the animals' genetic patterns, Dr. Lasley and his group have developed a blood testing method to tell whether the female in a mixed set of twins will be a freemartin (unable to breed), as is frequently the case.

Studies directed by Dr. Day have shown that much bigger pig litters can be carried to the twenty-fifth day of gestation and, presumably, all the way to farrowing. Injection of PMS, a hormone from pregnant mares, is used to stimulate release of double the usual number of eggs in sows (super-ovulation). A higher percentage of eggs are lost but enough survive to develop into a greater number of pig embryos.

This new Animal Science building and its laboratories will mean a lot to Missouri agriculture. Drop in for a visit the next time you are around the Livestock Center for a sale or meeting. You'll have a chance to see some discoveries in the making. •



Better Livestock, Healthier Citizens

A HIGHLY specialized tool with a world of uses. That is the whole body counter in the Low Level Radiation Laboratory of the Missouri Agricultural Experiment Station.

This unusual laboratory, in a building all to itself at the north end of the agricultural research park area, is in many ways an example of the old saying, necessity is the mother of invention. The need was some way to test the body composition—fat versus lean—in research animals, breeding stock, humans, and other living creatures without injuring them in any way. Traditional methods had required slaughter and disection.

As Dr. Jack Clark, supervisor of the laboratory commented, "We haven't had any humans volunteer for the disection method."

The whole body counter is called by scientists, a liquid scintillation detector. Liquid in tanks above and partly surrounding the test subject reacts to radioactive rays passing through it by producing photo electrons. This ray can be an emission from potassium-40 in a person's body or from outside. A large steel chamber made of pre-atomic age steel has been built to house the counters and reduce outside radiation.

The whole body counter is not only non-destructive, it is totally painless. Faculty members who have participated in Dr. Margaret Flynn's research programs with the whole body counter see the test period as an opportunity to catch a short nap.

Human subjects in the test simply lie on a hospital cart for six minutes while the scintillation counter records their normal body radioactivity. Pigs are suspended in a special sling during the test, cattle stand in a special chute.

One of only a few such installations in the country, the UMC whole body counter has been tested, and integrated into the research program, by Dr. Clark and others. By now they are able to use it to predict body composition with a high degree of accuracy.

"We have shown that we can evaluate live animals with accuracy as good as or better than any other nondestructive method. Our accuracy, plus or minus 2½ percent, yields good research information when used with normal statistical procedures and adequate test numbers," Dr. Clark explains. The method is, in fact, nearly as accurate as some of the destructive analytical methods.

Two other methods for determining the fat-lean proportion are Sonoray and EMME. The Sonoray system is limited to loin eye area and back fat in animals. The EMME unit now being tested at UMC will be limited to animals the size of pigs and smaller.

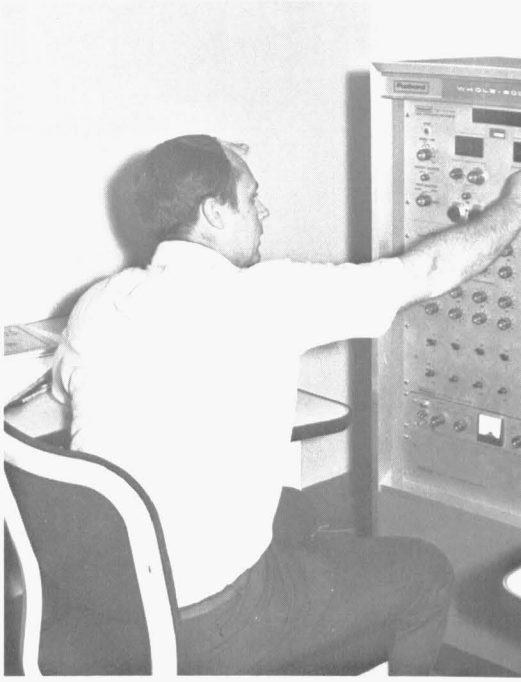
As a service unit, the low level lab helps livestock producers throughout the state and researchers and members of the medical profession at UMC and elsewhere.

Low Level Radiation Laboratory

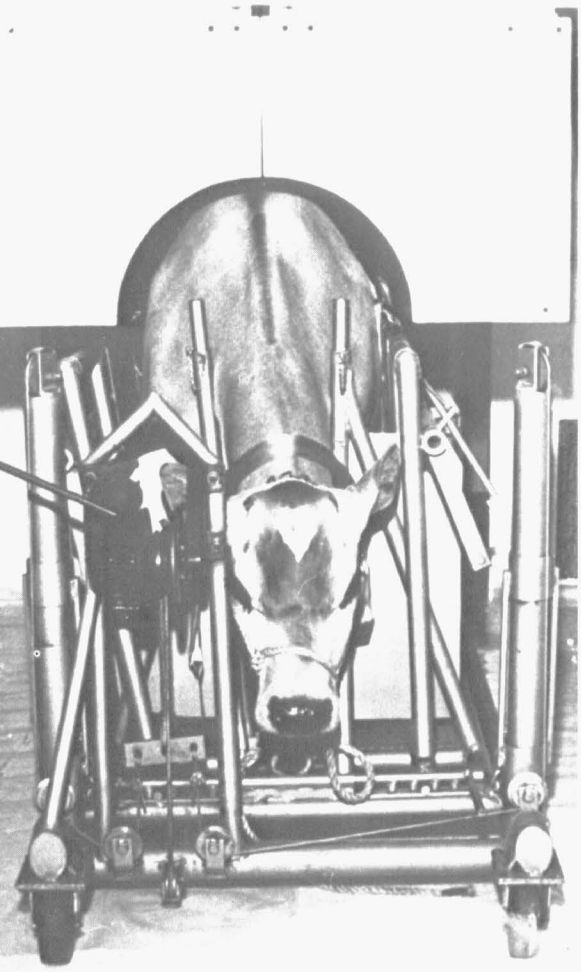
The most frequent use is to count the naturally occuring isotope, potassium-40. In all living animals, potassium-40 occurs in predictable amounts in the lean. It emits radiation in ways that can be detected by the scintillation counters in the Low Level Radiation Lab.

Tests by Dr. Clark and others have shown how to make an accurate calculation of the body composition once the weight and age of the subject and the emission count are available. Dr. Flynn has used the whole body counter to study the fat and related physical conditions of faculty members, state highway patrol troopers, children, middle-aged obese women, and other groups. She is continuing the work with some of these groups and has made specific recommendations to the University administration about the health and health habits of its faculty members.

Doctors from the Medical Center at the University of Missouri have used the whole body counter with the addition of other radioactive materials to help to



Dr. Margaret Flynn prepares the subject for the body counter. The patient simply lies on the hospital cart for six minutes while the scintillation counter records the normal body radioactivity. Dr. Jack Clark, right, monitors the counter and after the test is able to predict the body composition of the subject with a high degree of accuracy.



The body counter provides a means of measuring fat versus lean in animal bodies without slaughter and disection as was required in the past. Pigs are suspended in a special sling during the test and cattle stand in a special chute.

evaluate response to nutritional and physiological studies.

Both with animals and with people they have been able to use the counter as a diagnostic tool. In one test, anemia was diagnosed in a highly specialized situation. "I see a big future for this type of work with our whole body counter" says Dr. Clark.

Animal breeders, both University and commercial, continue to bring livestock to the counter for fat-lean tests. The animals with the most desirable proportions are selected for use in the breeding programs, something that would be totally impossible if they had to be slaughtered to determine how much fat they carried.

As Dr. A. G. Matches put it, "The comparative slaughter technique is one of the most positive methods for obtaining changes in body composition; however, it requires the slaughtering of selected animals at the beginning and end of an experiment.

"The whole body counter offers another method so the animals may be tested at both the outset and the end of the test and thus remove possible distortion in the test results that could come from selective slaughtering."

Agronomist Matches is a leader in the forage development programs at the University of Missouri-Columbia. He has worked out several pasture systems which provide nearly year-around grazing for Missouri livestock.

Continuing this research, Matches sought precise details on the results of pasture grazing. That is why he turned to the whole body counter. He explains, "Our objective was to develop techniques that could be used to evaluate the response of cattle grazing for pasture systems. Despite the many variables in the research, the animals could be clearly evaluated by the whole body counter at the end of a summer grazing season."

Surprisingly, there was no significant difference in the gains the animals had made which could be credited to the pasture systems. With this kind of information available without slaughtering the test animals, Matches gives high praise to the Low Level Radiation Laboratory. He declares, "We believe the whole body counter has much potential as a research tool in grazing research."

Dr. Matches' enthusiastic reaction to the whole body counter equals those of Drs. Clark and Flynn and the other researchers who have used this unusual laboratory at the University of Missouri. As anyone knows who has gone to the hospital for a day or two of testing, it is a rare test indeed that provides extremely valuable information and at the same time can be compared by the subject to taking a nap •

A student in Agronomy 30 ponders a film loop while listening to a taped discussion by Dr. Ken Larson.

New Methods for Learning

Auto-Tutorial Centers

IMAGINE you're a teacher with 296 students. Could you develop a laboratory period that would give a first-hand knowledge of insect physiology to a group that large?

Or, how do you make lab assignments so flexible that students can do them virtually anytime from 8:30 in the morning to 10:30 at night three days a week? How do you make help available, on a personal basis, during that time and for additional labs on Fridays?

How could a professor possibly repeat that many lectures for that many people, that many times?

By taping them.

Auto-tutorial (A-T) packages used in the College of Agriculture employ sound tapes, slides, motion picture film loops, and "stations." Stations are learning areas where students handle the plants, soils, or insects which they need to study.

The departments of Agronomy, Animal Husbandry, Food Science and Nutrition, and Agricultural Chemistry are working with A-T units now. Departments of Agricultural Engineering, Dairy, and Entomology are seriously considering moving in that direction.

In a typical Agronomy 30 lab, a student could spend more than three hours a week in the Plant Science Learning Center. Perhaps an hour before class and two or three hours after. He can do it in any way he wants to divide the time.

And, he also works at his own pace: Walt Russell, center supervisor, estimates that students spend from 1½ to 5 hours per week in the center, depending upon their interest and ability. That way even a "slow learner" can master the material.

Dr. Ken Larson's voice guides them through this self-learning experience:

"A student coming into the Plant Science Learning Center would listen to my tape. Maybe after five minutes, he would be instructed to read pages in his text or material in the booth folder. Or he may go over to the demonstration table, observe, and come back."

Larson, who is in charge of Agronomy 30, continues. "Then he may listen to another five or ten minutes of discussion regarding what he saw or read, including what he should have gotten from the material." Larson's taped voice also could help the student synchronize the film loop projector and his tape to get a narrated film.

"At the demonstration table," the agronomy professor explains, "we try to illustrate the principles that relate to the unit being explored that week. We do not have a lab period, nor do we need more than one lecture a week."

Instead, "the time normally used in lectures and lab is used in the learning center where students listen to tapes." Previous experience and student suggestions have led Larson and others to develop short tapes that are "more of a discussion with an individual student and less of a lecture. That is supervised study.

"The following Monday or Tuesday we have nine different sections where students can come to discuss the previous week's unit or to raise questions regarding the unit for that week."

The learning center approach offers definite benefits to students, Russell says. For example, the center was designed to allow every student to work on Agronomy 30 in an atmosphere that encourages him to work. The fact that other students in the center are working on agronomy, that equipment and plants are there, and that the center is staffed during all posted hours, helps build an atmosphere for agronomy learning. The center is open from 8:30 to 10:30 p.m.,

Top, the hands of instructor Chuck Biggar guide Charles Benham through a demonstration of how soil changes color. Right, agronomy instructor Walt Russell talks with Melvin Toellner about the freshman's independent research project. Below, sophomore Jan Fischer reviews log functions for Biochem 210 in the Ag Chemistry Auto-Tutorial Center.

three days a week, and on Friday mornings.

The idea is to make it possible for the student to finish all of the week's agronomy course work in the learning center's "agronomy atmosphere." Students have the opportunity to study the problems that concern them through the "Independent Research Projects" which Russell directs.

The Agronomy greenhouse is crowded with these projects. In it, one group is exploring the influence of sewage sludge on the growth rates of various plant species. Student project reports follow the same format as those of the *Agronomy Journal.* Like professional researchers, students are expected to review what has already been written on their topic.

Russell uses his own time to take students on a tour of the University library to better prepare them for the review section of the report. Russell said students learn to gather and report information on their own, much as they would have to after graduation.

Equipment and facilities of the Plant Science Learning Center are shared with those of Soils 100. Dr. Clarence L. Scrivner, Soils 100 director, talked about the individualized approach which they use:

"What we're trying to do is cut down on the amount of time spent in a conventional lecture with a large group of people listening to one person talking. Because in that setting there is no chance to get any kind of discussion between any reasonable percentage of the people. If one person out of 200 asks a question, the others may or may not listen."

So Scrivner and his colleagues have taken "concepts that formerly would have been carried in the lectures and married them with the laboratory via tapes, slides, and projectors." They stress the advantage of A-T in the way it interweaves the principles which usually are discussed in lectures with their demonstrations which would be found in a laboratory setting.

Chuck Biggar, in charge of the Soils 100 Learning Center, and Agronomy 30's Russell stress the personalized nature of the approach used in both courses. Auto-tutorial courses can be highly impersonal. Through them, teachers virtually have been replaced with machines. But in the Soils 100 and Agronomy 30 learning centers, as in the other learning centers of the College of Agriculture, instructors in charge of these courses, such as Larson and Scrivner, make a genuine effort to talk with students on a casual, personal basis.

What does it take to prepare an auto-tutorial class? Just setting up the materials for a single Soils 100 class, Biggar estimates, takes an equivalent of

two "man-days" of work. That does not include the vast amount of time needed to develop the original units, or the time needed to revise and update them.

An example of how the auto-tutorial units are produced comes from Animal Husbandry. Slide-tape sources for their center in Stewart Hall range from the Public Health Service to the National Livestock and Meat Board. Some are used as they are furnished. Others, unless their producer does not allow it, are modified to be more suitable for students and courses of the College of Agriculture.

Typically, Stan Starling, director of the center, furnishes professors like Dr. Wilbur R. Enns of Entomology outlines of the slide sets the center has received.

"Then he and I together,'" said Enns, "work up the sequence for the slides, based on the order in which I will present the material. Next, I work out a narrative to go with the slides and try to get Stan to do the taping," Enns smiled.

The entomology professor mixes the slides the center receives with a larger number of his own. He was working on a slide-tape for the Animal Science class, selecting photos, slides and illustrations to put with his narrative. The first slide showed a horse, hardly more than a skeleton, infected with Venezuelan Equine Encephalitis (VEE).

"That's to grab their attention," explained Enns. "Or I could have a copy made of this photo of a boy with elephantiasis. These are mosquito-borne diseases. What I'm really leading to is a discussion of mosquitoes and how they affect humans and livestock." Using the auto-tutorial approach, the professor tries to give his nearly-300 students an experience as close to a laboratory experience as he can. He also uses it to expand upon the amount of material he can present in his allotted time in the team-taught Animal Science course.

"You've got to bring their misinformation to the surface," said Enns regarding the pretests he uses. These tests help get the student ready to listen. Tuning the student to what the instructors think is important is the function of the post test:

"We review what we expect students to learn," said Starling. "This way you don't get them thinking they have to remember every little nitty gritty item. It gives students a guide of how much is expected of them on tests." Enns added that it also reinforces learning.

At all times when centers are open, they are manned by someone knowledgeable in the material presented there. Starling's office is right in the A-T center for Animal Husbandry. "One nice thing about me being here is that I can get feedback immediately after a student finishes a slide-tape." Starling uses this feedback to help revise A-T units to improve the ways they meet students' needs.

This process of writing and rewriting the script, narrating it, selecting and producing visuals and finally revising the unit can consume a considerable amount of time:

Joe Burnett, in charge of the A-T learning center in Agricultural Chemistry, used 80 man-hours of time to develop a slide-tape unit. The unit's content was roughly equivalent to that of two class lectures. A different approach was used to cover the same material in class.

Burnett reports a commercial company, which produced a 50-minute auto-tutorial unit, estimated these development costs at $30,000 to $40,000. National marketing reduced the cost-per-unit to the $100 Burnett was considering paying. This kind of expense is not incurred on the more straight-forward units produced by the College. Still, the cost and effort are enough that professors try to get as much mileage from them as possible:

Dr. A. J. Dyer, chairman of the Department of Animal Husbandry, is working on a slide set which compares the progeny of two bulls. The set will be used both in the learning center and in the field by Extension livestock specialists, thus doubling its use. And Professor Enns cited another example: Doctors in the School of Medicine and in the Veterinary School need to know about poisonous insects, ticks and other parasites. While "the needs are different and the tapes would be different," it all can be done with the same set of slides.

The role played by the auto-tutorial method varies from the large ones of Agronomy 30 and Soils 100 where students spend most of the "class" time in the learning centers to that of a supplement to lectures and labs.

Supplemental slide-tape makes it easier for instructors to deal with the amount of individual differences found in university classes today. Teachers often must reach a large number of students from different parts of the state and nation.

In Ag Chemistry, Burnett sees their sets as filling in for "weak backgrounds, forgotton material, and different modes of learning." He explained that the A-T approach gives "visual assistance to students who are not listening-oriented." The Ag Chemistry unit placed on slide-tape was chosen because "it had the highest rate of failure." So far, Burnett is pleased with student learning of the same unit with the assistance of slide-tapes.

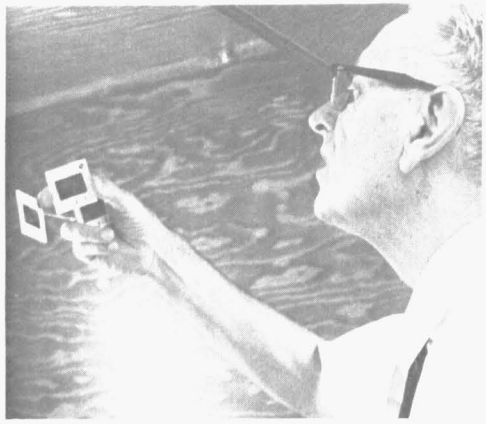
"When you're talking about diesel injection," observed Jim Frisby, associate professor of Agricultural Engineering, "I'm sure some students can't keep up with what you're saying because you have to use detailed, intricate explanations of where the fuel is going. If they had slides, they could go back and review it and take it a step at a time on their own time."

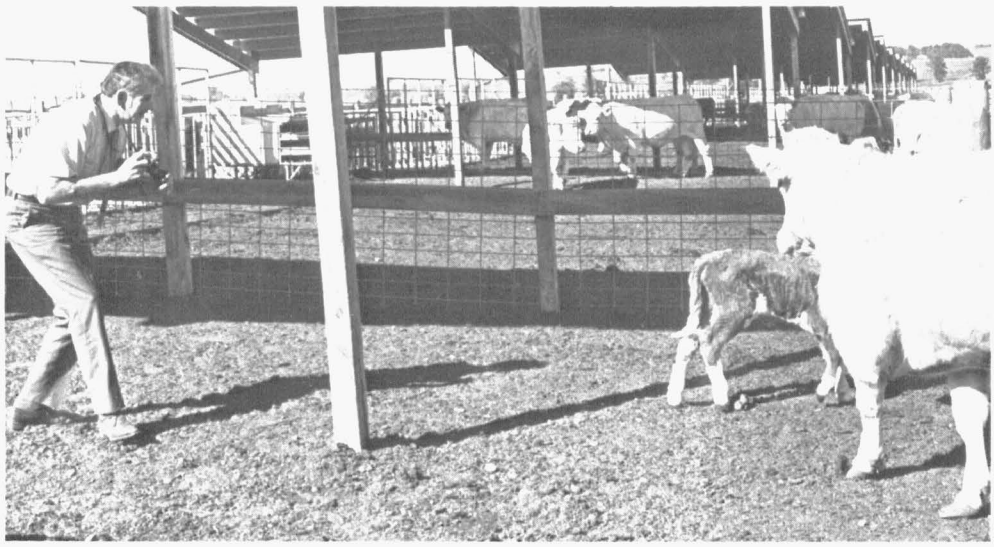
With large numbers of students entering agriculture classes without previous farm experience, G. B. Thompson, professor of Animal Husbandry, sees a need for slide-tapes to give those students information that is basic to most students from the farm. The slide-tapes "sure help keep what goes on in the lecture more interesting to everybody and yet not over the heads of those who have no farm background." Thompson estimates that number at 45 of every 100 students he has. Many of these non-farm students go on to study agricultural economics or veterinary medicine.

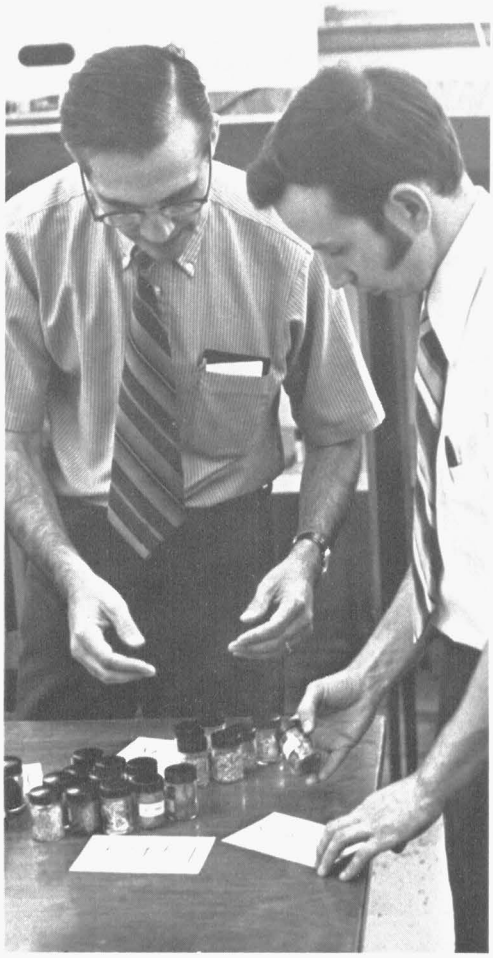
Thompson is considering the idea of putting the material for roughly one third of his class periods on tapes in the A-T center. Once those classes are on tape, the Animal Husbandry professor would replace those lectures with discussion periods to get "more two-way exchange."

With this type of system, D. M. Graham, chairman of the Department of

Right, Wilbur R. Enns, professor of entomology, studies transparencies for an auto-tutorial unit on mosquito-borne diseases. Below, stalking his prey, animal husbandry's G. B. Thompson tries to find the right angle for shooting slides. Far right, Joe Vandepopuliere, associate professor of Poultry Husbandry and Stan Sturling, A-T Center Director for Stewart Hall set up a display on feed ingredients to go with a slide-type unit.







Food Science and Nutrition, says that students who have missed class can fill themselves in on the material that was presented. That way they would not miss the subject matter or have to rely on second-hand information from student notes. Dr. Harold B. Hedrick of the Department of Food Science works with Dr. Jack Clark of Animal Husbandry in selecting auto-tutorial units for their cooperative Livestock and Meat Science course.

The auto-tutorial system also seems to be a promising supplement to Agricultural Engineering laboratory work. Frisby foresees students trying the techniques they heard on the tapes on the actual engines and then going back to the tapes when they run into problems. That way they could "look and see why it didn't work and then go back and try again."

Professors Charles P. Merilan and John D. Sikes of the Dairy Husbandry department also are exploring the use of auto-tutorial methods in labs. Merilan sees video tapes as "an additional medium of presenting lab material and lectures as well." He hopes to increase student understanding and retention of their material on artificial breeding.

Merilan and Sikes chose video tapes because they can record visual material at the same time they show it to the classroom. Nor do they have to wait for processing. Merilan said the video tape units might be integrated with slides and color film in the future.

Coordinator of teaching improvement, Dr. Elwood Leslie, said behavioral objectives are the key to good auto-tutorial units. "They must be measurable, observable." He explained this means the conditions under which the desired behavior is to take place and the level of excellence the student is expected to achieve must be specified.

For example, "The teacher should not say that the objective of a slide-tape is to enable the student to identify the types of beef cattle. Instead he should explain that the student will need to be able to identify nine out of ten types of cattle." Though, "rare," Leslie says this degree of specification is best. He considers the auto-tutorial approach used in the College of Agriculture "educationally sophisticated."

Applying Leslie's criteria to Ag Engineering labs, Frisby said, "To adjust a carburator, to adjust the timing—these would be very definite, easily tested objectives." In cases like engine timing, skill tests would be needed: "The only way to find out if a student has learned how to time an engine is to give him one that's out of time and tell him he's got 15 minutes to time the thing.

"I think students would get more out of having to do a skill test. If one did not do well, he would want to know why. In this process you'd probably teach him more than you had the whole time before."

The auto-tutorial approach may help teachers achieve the goal of presenting different material to students in different ways.

"Some lectures should be given on film—those where students have to see a small experiment or object," concludes Starling. "Some should be given the traditional way, some on a slide set because it's so much cheaper than film, and some in a learning lab where all they have to do is listen. Eventually, "we'll come to use it this way."

So, the "auto" in auto-tutorial is a bit misleading. The units are not self taught on the students' parts. Ag Chem's Burnett mentioned a study that showed a significant drop in learning when students were not given the opportunity to talk with other students and their teacher about the material presented on the slide-tapes. Burnett observed, "You've got to have teachers or there's nothing to it. In a learning situation you've got to have the teacher-motivator for the excitement, the testing, and the evaluation."

The fact that a student who is having trouble with a course can stay with the A-T units until he has mastered their content suggests a bright future for A-T •

Stemming the Farm Exodus

Education assistant Lewis Harbert, Unionville, right, and Jack Maulsby discuss farrowing arrangement they designed for Maulsby's barn.

The Small Farm Program

DEPARTURE from rural America turned into an avalanche in the 1950s and '60s, causing great concern for the future of the family farm. Some people say it is an unavoidable result of trends toward size and efficiency. Be that as it may, this population movement is causing serious social repercussions, states Ed Wiggins, Extension agricultural economist in charge of a UMC Small Farm Program pilot study team.

Cities are becoming too congested while many rural areas have lost so many people that support of educational and other services has become a crucial problem. Questions are being raised. Are savings in cost of food which are gained through mass production being offset by boosting other costs of maintaining our population?

Seeking to combat the rural exodus, small communities are striving to attract manufacturing plants to replace employment opportunities lost in agriculture. But many people ask if there aren't ways of saving more openings in agriculture itself, Wiggins observes.

Out of 137,067 farms in Missouri, according to the 1969 census farmers on 98,000 or 72 percent reported sales of less than $10,000, he points out. Almost 57,000 of those farm operators worked off the farm some of the year, but less than 100 days. Thus, they could be considered nearly full-time farmers.

Since the average farmer spends about 70 percent of his gross for operating expenses, the net agricultural income of these farms would be less than $3,000. The small amount of off-farm work couldn't increase this income very much.

Most present Missouri farm families say they want to stay on their farms. Is there some way to help them increase their incomes enough so they can?

This problem is being tackled by a team of UMC Ag Experiment Station and Extension specialists in a pilot study. Included on the team, besides Wiggins, are Associate Dean for Agricultural Extension Schell Bodenhamer, Ag Economists Tom Brown, Ken Schneeberger, and Jerry West, and Rural Sociologist John Holik.

These men have been aware of this problem for a long time. Their earlier studies had shown that only a few of the small farm operators in Missouri were using either government assistance (ASCS, PCA, FHA, etc.) or educational Extension programs.

As one result of their studies, 420 families in five Missouri counties began a cooperative project this year with the Missouri Agricultural Experiment Station, the Extension Service, and the U. S. Department of Agriculture to discover ways to increase incomes with the small acreages and capital that are available on these farms.

Twelve local farmers—trained by the UMC College of Agriculture specialist staff—have been hired as assistants to work personally with 25 to 35 families each. They work under direction of the area Extension directors and farm management specialists and, when really tough questions come along or when problems need research, they can relay them back to the area specialists or the College.

Although the project is barely started, some beneficial results are showing. Many rural families are taking part in special ASCS-sponsored, 80-20 cost-share program which will enable them to have adequate forage supplies for their livestock.

Some of the farmers took a soil sample for the first time this year. A change in marketing methods, involving a switch to the use of a local cooperative feeder pig market, brought pig producers $5 more net per pig, an increase in net family income of $300 to $500.

The assistants are helping the small farm operators work with money sources to finance projects and to plan the money's best use. The UMC Extension Centers in the five counties report a marked increase in visits by small farm operators.

Knowledge gained in the five beginning counties will point the way to a statewide program. While only a few of the small farm operators may ever achieve big scale, many should be able to increase their net income and improve the quality of family living •

The area directors and farm management specialists assisting with the study and the five counties involved are John Harper and Dale Hagerman, Oregon County; Doyle Jones and W. W. Thomas, Polk; Hubert Headrick and Burch Harrington, Putnam; Marion Gentry and Randall Reeves, Washington; and Willis Davis and Roy Hager, Wayne.

THINKING SMALL IN A

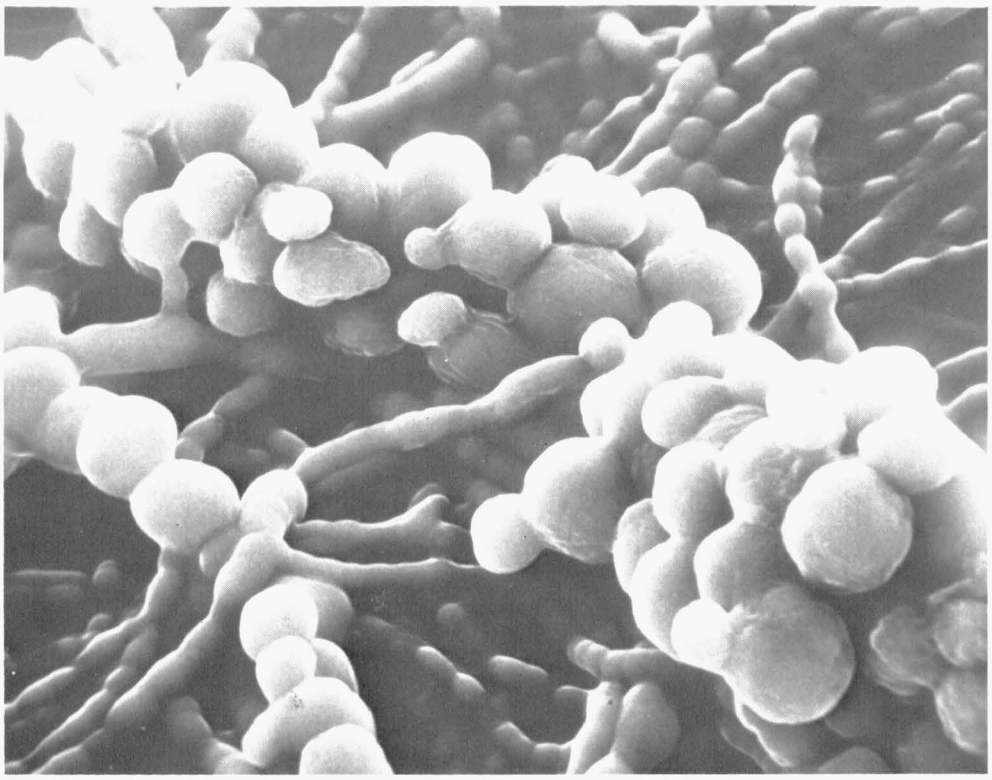
CURIOUS MAN is constantly pushing his frontiers of knowledge upward, outward, and even inward. As one result, today's University of Missouri researcher not only can examine individual cells, he can study the area between the layers of the cells' walls (photos at lower right, page 17.

Study of the internal parts of plant and animal cells now is routine for many UMC scientists. Disease prevention and control, plant and animal breeding, and plain old curiosity are some of the factors that motivate this interest in things that are very, very small.

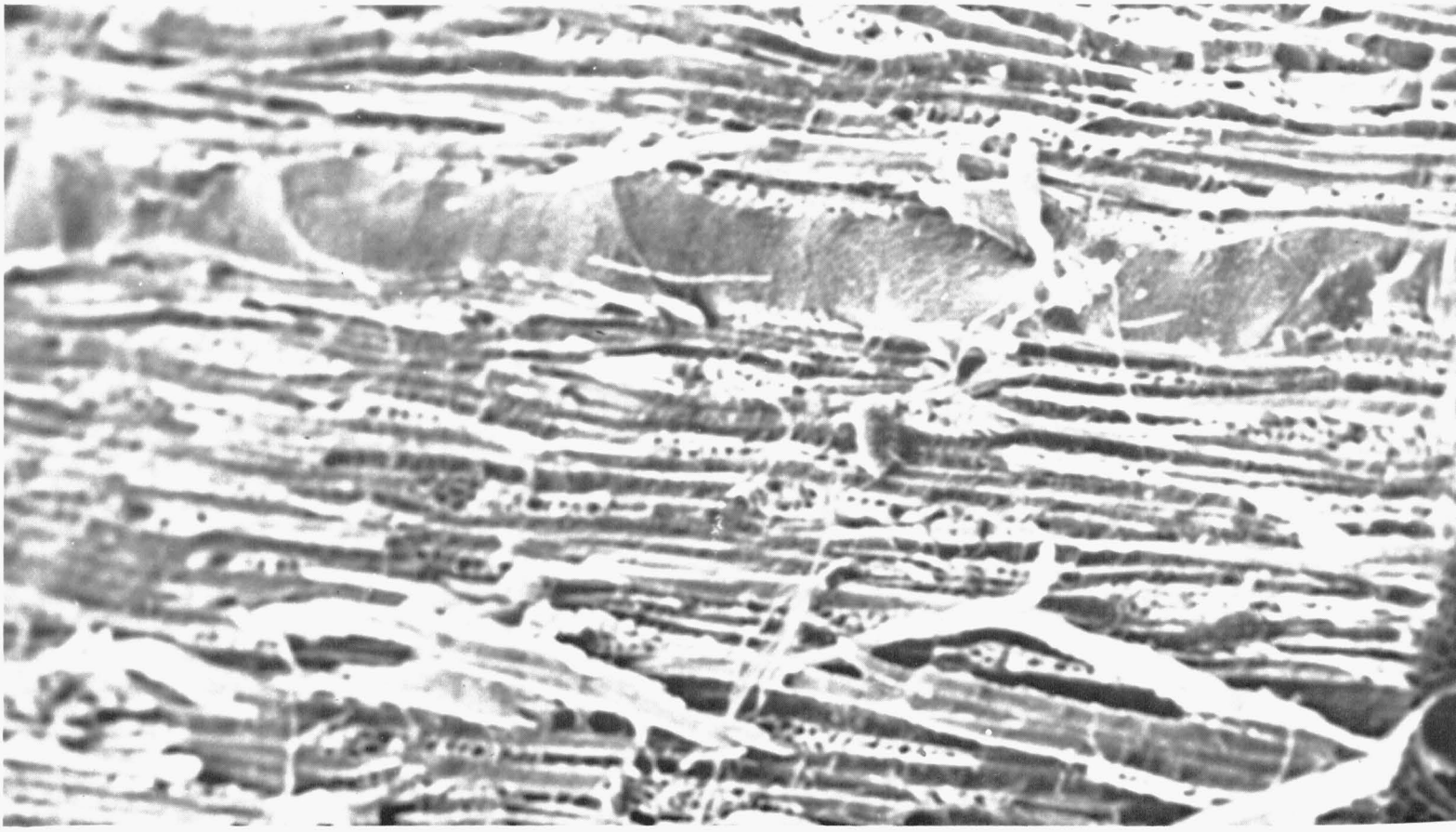
In the College of Agriculture, such research with electron microscopes is part of the regular programs in more than a third of the departments and schools. Why the electron microscope? It permits enlargement far greater than anything possible with visual (light) microscopes. And the scanning electron microscope gives a special 3-D view of specimens.

The benefits to UMC research are tremendous, but the benefits to students and to science in general may be even greater. That is because there are few places in the world to learn the art of microscopy, and there is a resulting demand for microscopists in teaching and industry.

"We offer students a rare opportunity to study and grow in this field," says Ag Experiment Station Assoc. Director Richard Aldrich •



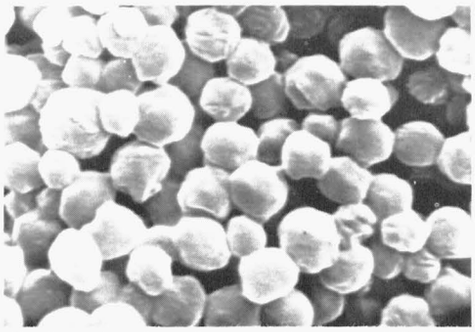
Overwintering body of the fungus that causes Verticillium Wilt on field crops and shade trees. Magnified 1,700 times.



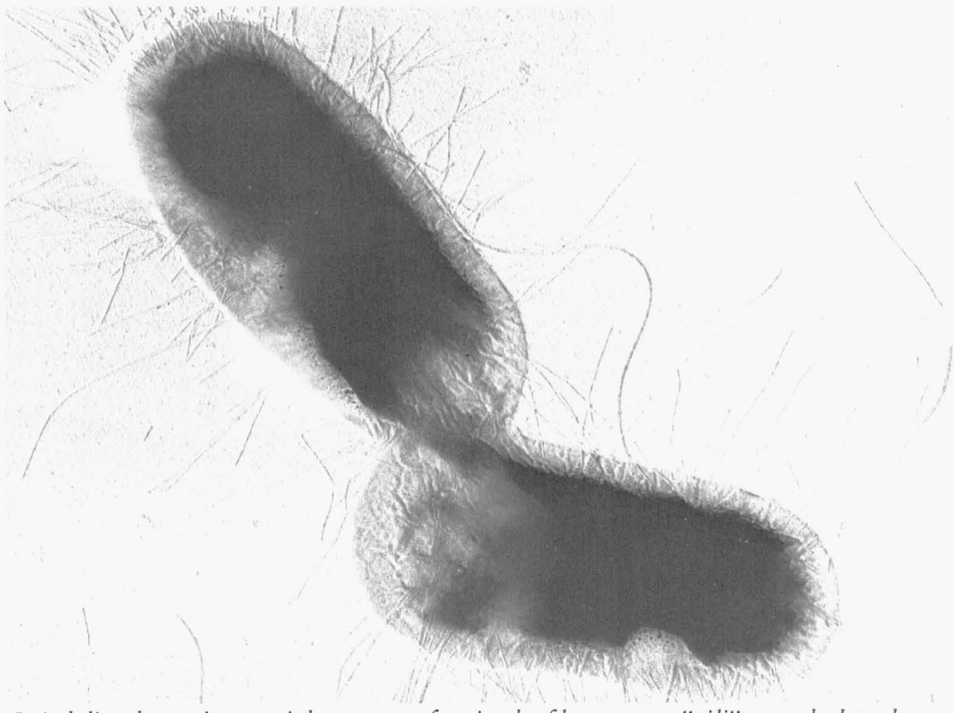
"Shake separation," a defect in Black Walnut where the wood is not joined properly, is being studied by U. S. Forest Service and UMC forestry scient

BIG WAY

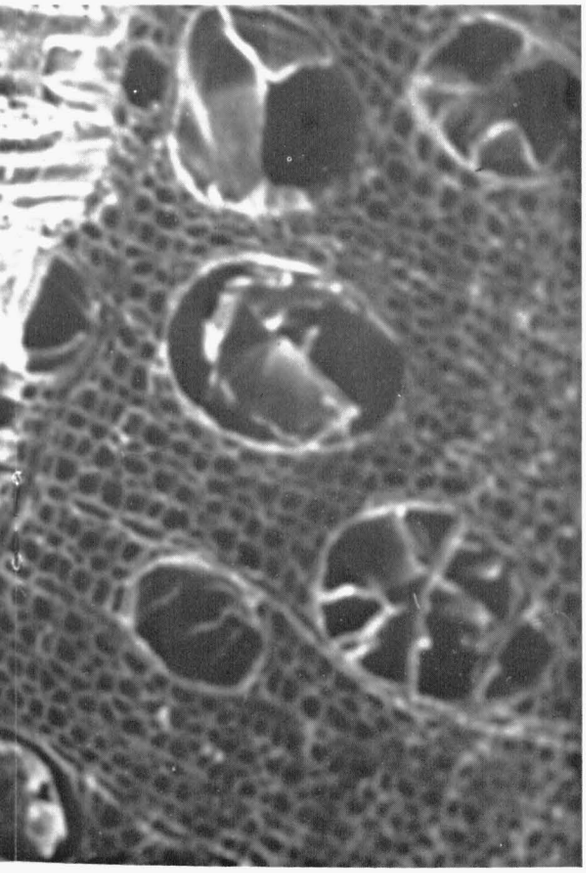
Chloroplast from leaf section of Arabidopsis, a plant used in genetic research. Magnified 8,000 times.



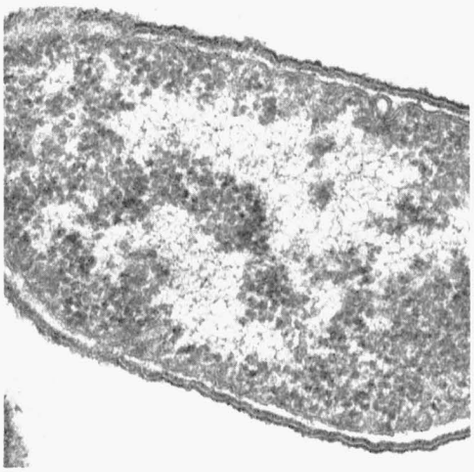
Bodies of a virus that attacks cotton bollworm. Magnified 10,000 times.



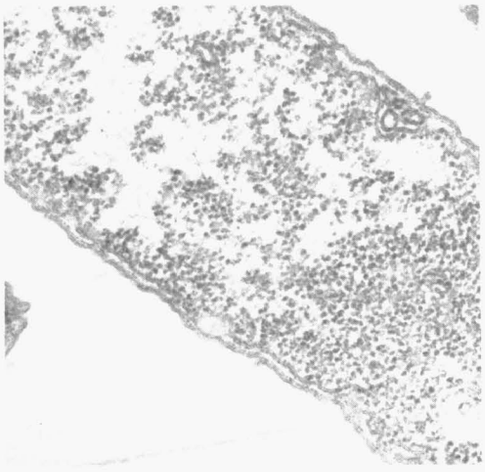
It is believed genetic materials can transfer via the filaments or "pili" attached to these two Escherichia coli *cells. Magnified 23,800 times.*



Magnified 170 times.



Scanning electron micrograph of the Fireblight bacterium. Magnified 10,000 times.



Cross section of one of the bacterial cells at left. Magnified 52,000 times.

There is much work to be d

F

Clockwise: Patty Garrett, student lab assistant, tests meat which has been stored for various lengths of time for growth of micro-organisms. Dr. Joe Edmondson, professor of food science and nutrition, demonstrates some space foods for a group at Ag Science Week. Dr. Don Naumann, professor of food science and nutrition, compares several types of frankfurters that have been experimentally prepared. John Apple, lab technician, puts the finishing touch on some pork-burger that has been prepared in the UMC meat lab.

n the world of
OD SCIENCE

AT THE DAWN of recorded history no one took food for granted. It is only in the relatively recent past that it has been possible for the majority of Americans to be free of the dawn to dusk chores of food acquisition and preparation. Increased yields, preservation, refrigeration, transportation, commercial processing, mass merchandising—all have contributed to our almost casual acceptance of the food on our tables.

Making up for all of our casualness is the work-to-be-done approach of the College of Agriculture's department of food science and nutrition. "Our goals," says Department Chairman D. M. Graham, "are to provide expertise in areas of food manufacture, preparation, and applied nutrition, and to prepare our graduates to go into the food industry as capable workers and leaders."

One measure of the department's success is the placement of graduates. Says Dr. Graham, "Even when jobs were the most scarce, all of our graduates had a choice of positions. We have sent about half of them to industry, about a fourth to teaching or graduate study, and about a fourth to military service.

"We now have former students working in almost every major food company. Many of our food service graduates go into business for themselves —some even while they still are attending classes."

The teachers who prepare these students for the food industry also are researchers. Not only does their research help the food service industry in the areas of food handling and processing, but it also increases the market for Missouri-grown foods and products. Let's take a look at some examples of the work now being done.

Food preparation studies include microwave cooking and reconstitution, integral heating for reconstitution, and low-temperature cooking. These methods have special interest for the airlines, for institutions such as hospitals, and for large restaurants and hotels.

Once developed and refined, some or all of these methods may be scaled down for use in the home.

Dr. Donald Naumann is seeking ways to retard the growth of the micro-organisms which have held "shelf life" for meat to a few days in the past. When this is solved, it will become practical to do a large part of the meat cutting and packaging in central processing plants instead of in the local stores.

In addition to gains from volume handling, this also can cut waste and pollution because it will concentrate scraps into sufficient quantities to allow them to be recycled efficiently.

Drs. Ruth Baldwin and Bernice Korschgen are studying the preparation of frozen prepared foods, partial pre-cooking, and food reconstitution. Others are trying to develop new curing agents for meats. And in one project, a study is being made of bacteria that are so heat-resistant that they don't even grow at temperatures below 140°F.

Efforts are being made to find ways to cut both production and marketing costs for the milk industry. In one project, Dr. R. T. Marshall is working to increase the "shelf life" of milk, as will be needed in the longer distribution channels from the bigger dairies and producers of the future.

Dairy processing has been associated in the past with pollution. Eliminating that problem is a major target for the UMC food scientists. Their attack is directed at cutting waste: No waste, no pollution.

Already they have shown that detergents used in dairy plants can be used several times before dumping. This cuts waste, saves money, and reduces the detergent load in the rivers. It also has been found that most of the milk waste from washing whole milk processing systems is picked up in the first 15 seconds. The rinse water from that first 15 seconds can be stored for special treatment and the follow-up rinse can be re-used.

"The dairy products in that first rinse could even be filtered out for use in processed foods or feed," Dr. Graham suggests.

Of interest to almost everyone is the development of new foods. Some of the possibilities are almost surprising. Take porkburgers (not hamburgers) as an example. These unseasoned, unspiced patties of ground pork are not at all like sausage and not at all like hamburger. In fact, they may give both of these old stand-buys a lot of competition, say UMC food scientists who have tasted the results of Bill Stringer's porkburger efforts.

Of course it's not really a new food when you make it go farther by adding an extender, but sometimes the extender improves texture, serves as a binder, or helps the appearance of the original. Says Dr. Joe Edmondson, "Hamburger extended with soy protein is about the same nutritionally as a regular hamburger, and it may be better looking, better tasting, and have a better texture than the original.

And Dr. Edmondson is looking into the possibilities in extending the scrap from fish filets. In usual processing a lot of perfectly good fish gets trimmed off and thrown away. This can't help but add to the pollution problem.

Dr. Edmondson thinks the scraps could be mixed with soy protein and made into fish patties that would be as tasty as the originals. In this way he would eliminate that source of pollution while providing good food from material that has been going to waste.

One of the big needs for information on food extenders is in the school lunch program. And UMC's Edmondson works with school cooks to show them how to use extenders. It makes it possible for them to provide better lunches without raising the costs.

But all of this effort could go to waste. It makes no difference how nutritious a meal is if it is not eaten. "Food acceptance is one of our big concerns," Dr. Graham explains. "We are studying the factors that influence food acceptance in school lunches. What makes kids eat or reject things in the school lunch? Are eating habits or food presentation the cause? What about the attitudes of food service personnel?"

One example of the puzzles they run into, says Dr. Graham, concerns milk consumption in nine different UMC food service units. The total milk consumption was normal for the number of students being served. However, the consumption in some units was far above the national average and in others it was way below.

No easily identifiable differences of sex or age or income group could be found to explain the differences in milk consumption patterns. Furthermore, when soft-serve ice cream was added to the choice of desserts, total milk product consumption went up, Dr. Graham reports—but not necessarily in the previously low units.

A new field of emphasis in the College of Agriculture's department of food science and nutrition has to do with food distribution.

It's far more critical than ever before to get the food to the right place at the right time. With supermarkets stocking some 8- to 10,000 items, the problems of stocking, shelf life, and storage become tremendous. They are complicated by the fact that many items you purchase in your supermarket should not be shipped or stored together (example: pesticides and high-fat perishables like butter).

Drs. Stringer and Naumann point out that a grocer can add as much to his profits with better distribution as with any other form of improvement.

They are especially proud that they have been able to establish a department specialty in distribution without having to establish any new courses. The necessary courses were already being offered on the campus as parts of various other curriculums. By carefully picking the courses, Naumann and Stringer found the right ones they needed to meet this demand of the food industry.

This has been a necessarily brief look at a busy and active department. The examples can be taken as clues to the whole, just as you can assume from a bite of cake that you know the flavor of the whole thing •

Believe it or not— It's Home Ec

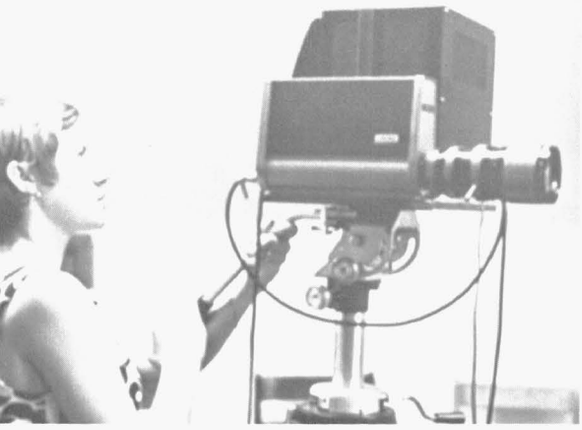
FOR YEARS home economics has been the silent partner to agriculture. (Its popular image would drive a public relations man to manic depression.) Its traditional role appeared to be simply keeping homemakers up-to-date with the latest in practical family-care and home-making techniques.

What's more, people generally have felt that home-making was something you learned in grade or high school or that it simply was passed on from mother to daughter. Higher education in home economics was thought of as an easy way for a girl to get through college. And research—well how much scientific research could go into baking a new type of cake or sewing with different fabrics?

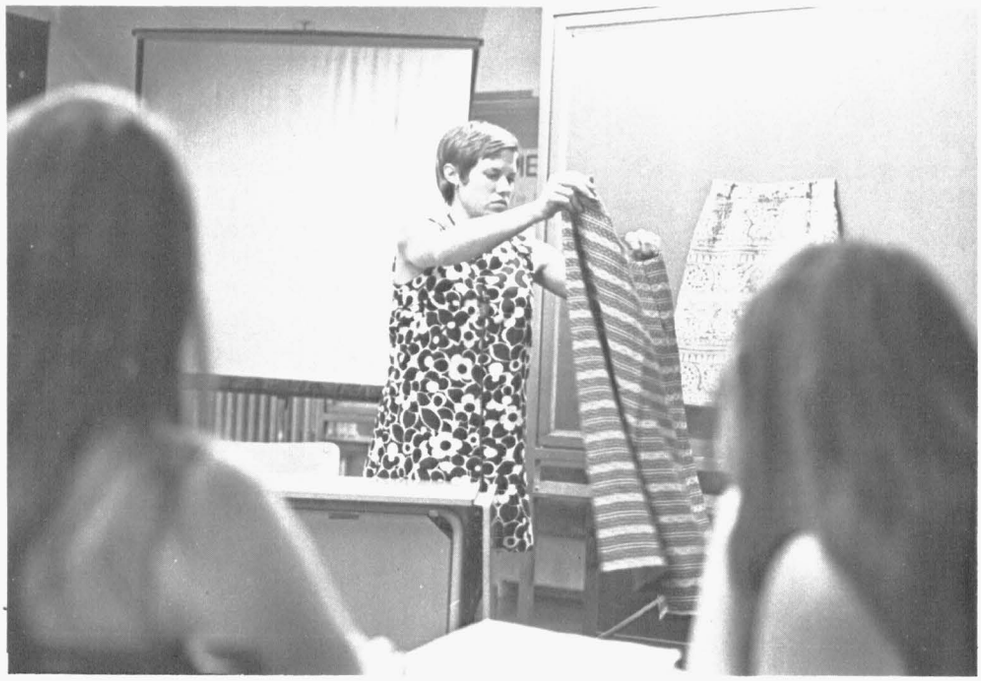
These are typical attitudes of the past (and they're still held by many) about a school that's not very typical.

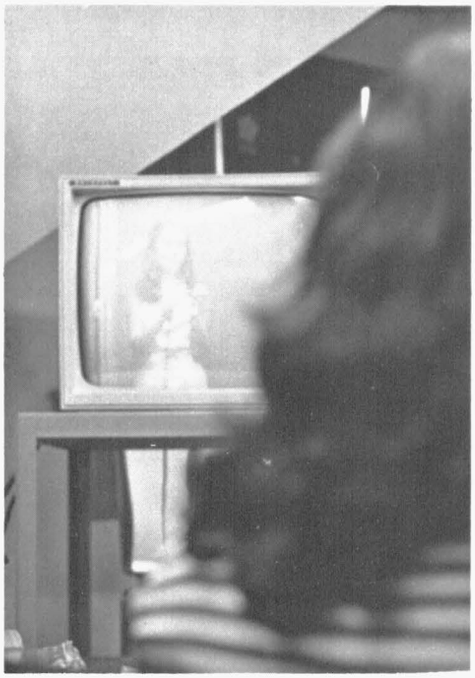
Today, home economics at UMC is concerned with the basics of man and his relations with the world. Teaching and

Joseph Falsetti, professor of home economics, discusses a stained glass project with his design students.



Adapting modern electronics to the problem of teaching is a project of the home economics education department. The students prepare a brief lesson that is presented in a mock classroom situation. The lesson is videotaped and then played back during a critique session.





research are moving away from concentrating mainly on commodities and aiming into areas that have wider social implications.

Today's home economics is coming up with unique answers to some old problems. It no longer is content to be relegated to the end of any line.

For example, Dr. Beverly Crabtree, professor of home economics education, and her staff have initiated a program for University students that adapts modern electronics to the problem of teaching.

Microteaching, as the program is called, creates a miniature teaching situation under controlled conditions. The students who want to become teachers prepare brief lessons, about 5 minutes long, and present them to a "class" made up of fellow students. Each lesson is videotaped, then played back during a critique session with the microteacher, other students, and a faculty advisor.

Then, the student teacher is faced with the reteach phase of the program. She must improve her lesson and teach it again to a new group of students.

With microteaching, the teaching situation can be controlled and manipulated to get as much out of the learning experience as possible. The videotape provides the student teacher with immediate feedback. She can easily see where her strong and weak points are.

But, perhaps most important of all, Dr. Crabtree believes, this education program prepares future teachers for real classroom situations in a far better and more meaningful way than ever before.

In another area of home economics, Joseph Falsetti, professor of home economics, is concentrating his teaching efforts on solving contemporary local environmental problems. He is striving to develop building and land designs that stir man's awareness of the world around him.

"Environmental art, of a type people can identify with and relate to, is desperately needed in an environment that many feel is impersonal and alienating," says Falsetti. This criticism of the environment is commonly voiced by

college students who have the idealism and vigor to want to bring about concrete change, adds Falsetti.

In recent years the College of Home Economics has been finding an increasing relevance in the study of practical concerns of man and family and that teaching environmental awareness fits into this new relevance. This is why courses which emphasize contemporary environmental problems are being developed.

Students learn to evaluate environmental settings, identify needs, and finally formulate and carry out actual design solutions in Falsetti's classes. The first large-scale design was a 9-foot high experimental sculpture in epoxy called "Family Unity." It was produced by Falsetti with student participation and was placed in the entrance court of the home economics buildings.

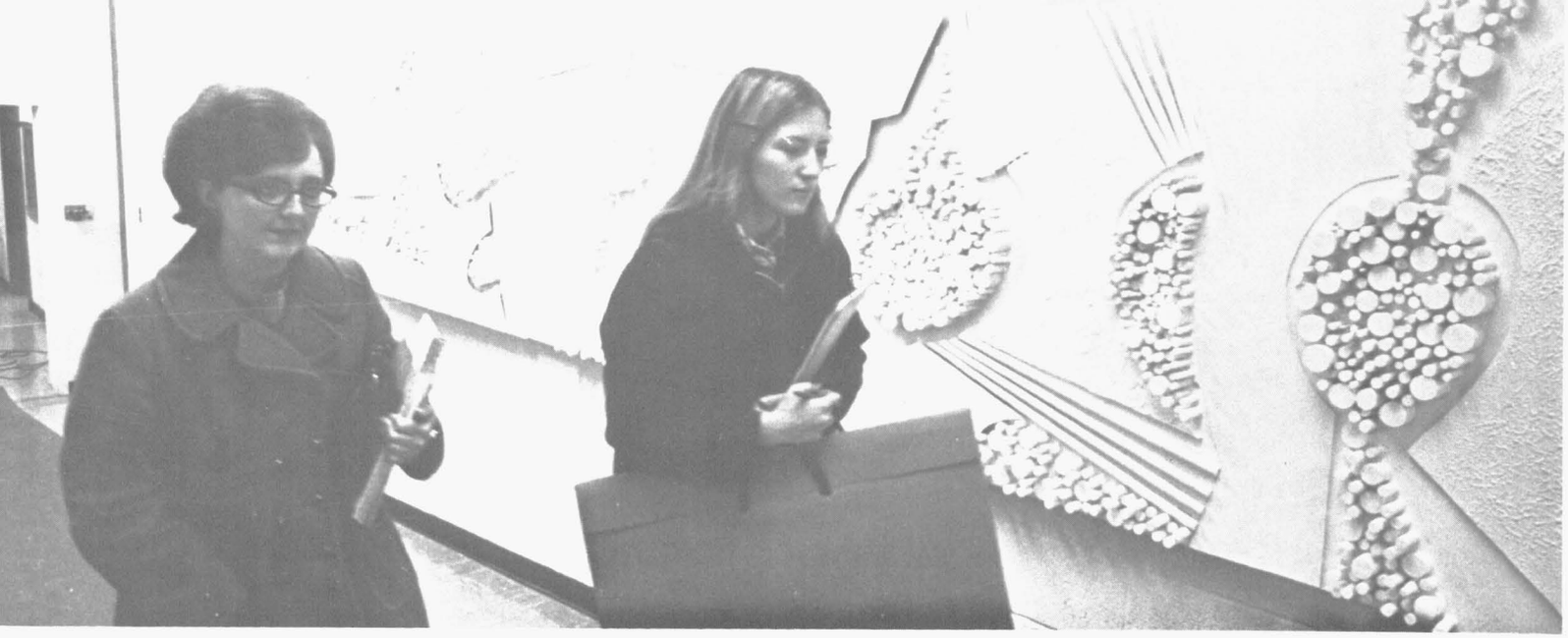
Next, the University Research Council awarded Falsetti a grant for an environmental art experiment in Cor-Ten steel. The results of this student-oriented work stand in the College of Home Economics and in front of a dormitory complex.

Today, 4 years after the first experiment, student environmental work brightens areas inside and outside the Memorial Union, throughout various dormitories and classroom buildings, and in various other spots on campus. Plans also are being made to work with downtown Columbia businessmen to begin community projects and design large graphics on local buildings.

In these ways, home ec design students have been personally involved with improving their campus and community environment while still being a part of a formal course curriculum.

A communications study has sought ways educators can use mass media more effectively. Led by Mrs. Orrine Gregory, associate agricultural editor and associate professor of Home economics, this study was designed to learn how extension educators can use mass media more effectively and to develop a better understanding of media potential for future use in educational programming.

Students learn to evaluate environmental settings, identify needs and finally formulate and carry out actual design solutions in Falsetti's classes.



Students are surrounded with art work in the home economics building. Above, a white wood relief spans the hall joining Stanley and Gwynn. The art work was a semester project of a design problems class. Below, Falsetti holds a personal critique session with a student.

A random sample in three representative areas of the state was taken to determine the characteristics of the people, their attitudes and preferences, and their patterns of mass media use. A mass media series using television, radio, newspapers, and a farm magazine was developed to test these findings.

Results indicate that by using a "mass media package" approach in communications efforts, extension educators are able to reach many more people than they could reach through the traditional methods. Once material for one medium is planned, it is relatively easy to adapt it for other media. Through this type of coordinated media approach, researchers found, it is possible to reach 85 percent of a projected audience.

An investigation of heart disease risk certainly does not fit the old idea of home economics. However, it's part of the new UMC home economics research.

In 1969 a study was begun to determine the coronary heart disease risk factors in the male faculty at the University. Portions of this study, supported by the College of Agriculture and the Medical Center, are under the direction of Dr. Margaret Flynn, associate professor of food and nutrition, and Dr. William Yamanaka, assistant professor of food and nutrition, and Dr. Sherwood Baker, professor of community health.

The study delves into the changes that occur in the body because of age, exercise, and diet, and it seeks to relate those changes to heart disease risk. The experiment has attracted 850 faculty members. These volunteers are given an EKG by Dr. Baker; a body composition evaluation by Dr. Flynn (see "Better Livestock, Healthier Citizens," also in this issue); and a blood lipid profile by Dr. Yamanaka. The results of these tests indicate whether the volunteer has a tendency toward heart risk.

Out of the 850, about 200 men proved to be in the high risk category, according to Dr. Flynn. These men all voluntarily began an individually designed rehabilitation program and, through diet control and/or exercise, sought to reverse their heart-risk factor.

All except one person have improved their body composition and lost between 2 and 40 pounds each, Dr. Flynn commented.

The researchers are now beginning to study the growing evidence of coronary heart disease risk in working women using the female faculty as volunteer subjects. With this study we hope to find if woman's competition for equal rights has also led her to take on a higher risk of coronary heart disease," says Dr. Flynn.

Many other research projects, from the study of independent development in nursery children to developing nutritious meals from commodity foods, are underway in today's College of Home Economics at UMC.

The College has grown in numbers from fewer than 50 students in 1911 to more than 900. And it has expanded in ideas. Home Economics no longer is content to follow tradition. It is moving in the '70s with some space-age thinking generated by faculty and students who probe expanded fields with their research and teaching innovations •

Editor's Note: Dr. Beverly Crabtree is now the assistant director for Home Economics Extension.

From the Departments

Snack Time Popular

Eating seems to be just as popular as ever. In fact, one of our most deeply ingrained customs relates to "three square meals a day." As society has changed in other ways, the increasing popularity of snack foods has influenced even our eating patterns—we are rapidly becoming a "four-meal a day" society!

Providing an adequate supply of wholesome, nutritious, and tasty foods, at the right time and place, in an attractive and wholesome form, with a reasonable profit, and at an affordable price comprises the major mission of the Department of Food Science and Nutrition. The teaching, research, and continuing education objectives of the Department are geared to the needs of consumers as served by the food industry and regulated by appropriate government agencies.

Employment of graduates, at BS, MS, and PhD levels has been good during the tight economy of 1971-72.

Research on the safety of additives used in curing processed meats seeks answers to current questions concerning nitrates and nitrites, including potential for conversion to nitrosamine in the stomach and practical ways to reduce nitrate/nitrite use levels in curing meat.

Microwave and integral heating methods show promise for speedy cooking with maximum nutrient retention. Hospital and airline food service systems are particularly promising applications for these improved food preparation methods. In-plant tests indicate a new rinse-filter method may help food processors better predict the useful storage life of refrigerated foods.

Just as the need for food ever increases, we recognize a continuing need of strong, vigorous approaches to the solution of problems.
—*D. M. Graham, chairman.*

University Without Walls

The Department of Extension Education was created in 1960. It offers courses in Extension education and serves as the academic department for youth and 4-H, Extension administration and supervisory staff, editorial staff, and others as designated by the dean.

The Department of Extension Education teaches undergraduate courses in communications and graduate courses in Extension education.

The University of Missouri was the first institution to offer a master's degree in Extension education. This degree was awarded in 1938. Students have come from 22 states and 15 foreign countries.

The graduate program in Extension education is now an adult education degree. Since adult education is perhaps the largest, fastest growing segment of education today, the Extension education program is equipping many people to assist in this effort.

The Department of Extension Education is exploring the possibility of alternate ways to the degree of bachelor of science in agriculture. External degree programs and the university without walls programs, open university, and others are being examined with the purpose of developing such a program soon.
—*John G. Gross, chairman.*

A. H. Stressing Students

It's not a surprise that the Department of Animal Husbandry advises 20 percent of the students enrolled—1,600—in agriculture at the University of Missouri-Columbia. Historically, more than half of the cash farm income in Missouri is derived from the sale of cattle, swine, horses, and sheep and the majority of students come from livestock farms. About 20 percent of the animal husbandry majors return to the farms.

Normally, the graduate student enrollment is 40, with two-thirds at the master's degree level; the remainder are doctoral program students. Genetics, physiology, nutrition, and production and management are the areas of study available.

Rounding up all the research facts and making a careful assessment thereof is one of the very important missions of the Extension specialists. Through regular newsletters, guide sheets, and short-courses this valuable information is available to our clientele. Putting good research into practical application is exemplified by the livestock testing programs. The breeder response, purebred and commercial, has been great. More efficient, more valuable livestock is the result. Individual and progeny testing will be more sophisticated through the application of modern techniques and methods. Field trials, where feasible, will be increased to secure answers with a minimum of time and cost. More of the total effort must be put with the highly popular horse segment of the economy.

Each research staff member has the dual responsibilities for teaching and research and attendant duties. Projects underway include the following: cow-calf management, cattle feeding, digestion and metabolism, heterosis in beef cattle, cattle selection, nitrogen utilization, reproductive physiology, sheep production, swine production, and whole body counter.—*Albert J. Dyer, chairman.*

People and Plants

The use of plants by people and the relating of people to plants is, in a broad concept, horticulture. Fruits, nuts, and vegetables are grown to eat. Flowers and foliage plants are grown and admired. Grass is grown and used for enjoyment. Trees, shrubs, and vines are grown to create a beautiful landscape. Horticulture is a close interrelationship between people and plants.

The undergraduate teaching efforts of the Department of Horticulture continue to improve. New courses include landscape appreciation, micro-environmental design, and plants for interior design.

The Department is continuing its long tradition of fusing fundamental and practical research and directing such efforts toward finding workable solutions to current horticultural problems and then carrying these solutions to the people of our state through our Extension programs and publications. In general terms much of our research is concerned with optimizing the combination of environmental and hereditary variables that determine the success of growing or producing horticultural crops.

With the horticultural crops that are consumed as food, our research is concerned with their nutritive quality and their freedom of compound harmful to human health.—*Raymond A. Schroeder, chairman.*

Disease problems understood—

Better Days for Turkeys

Today, after years of concentrated research on the turkey cholera problem, Dr. LeRoy Olson, associate professor of veterinary pathology in the School of Veterinary Medicine, University of Missouri-Columbia, has developed some unique theories about the transmission and control of turkey cholera. They may open the way to profits and success for Missouri turkey growers.

"As recently as 1965 there was essentially no printed information on turkey cholera available to the growers," Dr. Olson points out. "Yet at that time there was a steady increase in the number of turkeys involved in cholera outbreaks and the disease was becoming a very serious problem."

Turkey cholera had put several Missouri growers out of business and ranked as the most-fatal disease confronting the turkey industry in Missouri and in the United States.

Olson noted that the disease appeared to be most serious when turkeys were raised on the range, as they are in most Missouri areas. "You can raise turkeys in total confinement and cholera is less of a threat. But, those buildings cost a lot of money and take up most of the profits," said Olson.

He also noted in 1965 that there was chronic disease in certain flocks and the disease seemed to be prevalent in particular areas of Missouri. Those outbreaks, he now thinks, probably were caused by growers not recognizing cholera symptoms and failing to treat the disease in time.

Olson wanted to know how the cholera got started in these flocks. The more he studied them the more it appeared that most cholera outbreaks were preceded by predator attacks. "We found large raccoon populations were building up around turkey range areas. And, they seemed to be the largest predator threat," says Olson.

About two years ago Olson and his research assistants began to study the raccoons to determine if the animals carried cholera. A raccoon may wound several turkeys in an attack. The turkey may be able to escape, but they apparently are infected with the cholera organism through the raccoon bite. Soon they spread the disease from turkey to turkey by discharging infected mucus from their mouths into communal drinking facilities.

Turkeys can carry the organism in their mouths for many months without an immediate outbreak of the disease. Olson feels that stress on the turkey also ties in with cholera outbreaks. Preliminary results from his research seem to show a correlation between high temperature and cholera outbreaks, said Olson.

"There was an upsurge of cholera in Missouri during the hot days of August," he added.

Research now is being concentrated on stress factors that bring about cholera outbreaks and the actual growth and transmission of the cholera in the predatory animal. Ultimately Olson wants to use this information to develop methods to further prevent and control the disease in the field.

"At present there is practically no chronic cholera because the growers and field service staff have become aware of the problem, and are watchful—particularly during hot weather. Growers immediately treat the flocks as soon as a few die," Olson said.

Vaccination has not been successful for turkey cholera. However, medication is available and losses are minimal if the problem is recognized and treated quickly.

"Income losses from cholera have been greatly reduced in the past few years for Missouri turkey growers. But, it is an everpresent danger and you dare not let up on it," Olson warned. Olson recommends establishing a predator control program as the first step in preventing the disease.

"Growers are just beginning to realize that erecting barriers, such as an electric fence, around turkey areas to protect them from predators is the first step in breaking the chain of spreading turkey cholera," Olson said.

Olson's main research interests are with diseases of food-producing animals. This work on turkey cholera has been supported principally by the Missouri Agricultural Experiment Station. Backing also comes from the Missouri Turkey Growers Association.

Continued research into this major turkey disease problem area should help the Missouri economy. The more we understand and control all the factors leading to cholera outbreaks, the more Missouri will be able to grow in turkey production •

Dr. Leroy Olson, near right, has conducted concentrated research on turkey cholera problems over the past several years. Below, Dr. Olson, center, swabs the tonsils of a raccoon to determine if the animal is carrying the cholera organism.

the UMC Animal Waste Program begins to find the answers

THE QUESTION of how to handle animal wastes has created a near-crisis for many livestock producers. More livestock concentrated in smaller areas coupled with public concern for clean air and water have made this a top priority problem for the livestock industry.

Lawsuits and talk of restrictive legislation have spotlighted the need for new approaches to manure handling. The economic implications in the long run are tremendous—for producers as well as consumers.

We've come a long way in the last two years but we've only begun to find the waste management answers we need. Missouri with its thousands of farmer feeders scattered throughout the state has different problems than the Plains states with their many big feedlots.

Progress we've made includes:

1. Developed the *Missouri Approach to Animal Waste Management*, a manual which outlines how Missouri livestock producers can handle waste in an approved manner.

These guidelines were developed by UMC specialists working closely with the Missouri Clean Water Commission, State Department of Health, and the Soil Conservation Service. Many Missouri livestock producers are now building waste management systems according to these guidelines.

2. Established an animal waste laboratory to provide the analytical services needed for a broad range of research projects.

3. Sponsored tours, demonstrations, and educational meetings to acquaint groups and individuals with the Missouri approach to animal waste management.

Let's look at this progress in more detail. The Missouri guidelines were developed to fulfill the Clean Water Commission's overall policy that animal wastes should be kept out of surface and subsurface waters. The Missouri guidelines do this by keeping the livestock wastes on the land and reusing the nutrients in crop production.

Three additional criteria were used in developing the guidelines:

1. Any waste management system must be acceptable to the regulatory agency which represents the public. At the same time, any system must fit the needs of Missouri agriculture. For example, waste treatment plants used by industry and municipalities generally are not suitable for livestock producers.

2. Guidelines must be flexible to fit individual producer situations. A large feedlot located on the banks of a stream has far different pollution potential than a small feedlot far back from a stream.

3. A producer must receive some assurance that he is disposing of wastes in an approved manner.

With the Missouri approach, there is no direct discharge into surface or subsurface water as is the case with most industrial or municipal waste treatment plants. Instead, animal wastes are collected and applied to the land.

Another important part of the Missouri approach is the letter of approval by the Missouri Clean Water Commission. This letter is issued to producers who voluntarily apply and who can show that their system meets basic requirements.

A livestock producer has considerable incentive to apply for a letter of approval. It puts a record of his disposal system on file, indicating that the system will handle wastes satisfactorily.

The Missouri approach offers unique advantages to producers with its flexibility, economy, and Clean Water Commission approval. These advantages are important to a continued healthy livestock industry in the state. At the same time, the waters of the state are protected.

Some producers may require little more than an inexpensive diversion terrace. Others may require diversion and settling terraces, lagoon, soil-plant filter, and some type of irrigation system.

A soil-plant filter is simply a land area where liquid from a lagoon system is spread. Crops grown on the land will use the nutrients in the liquid wastes. In turn, the crops are removed from the land, preventing a buildup of nutrients in the soil.

While we're gaining experience with waste management, we also find that many questions remain to be answered. We need to know more about what happens biologically and chemically when we handle wastes in different ways—in storage pits or basins, in lagoons, or spread on cropland or grassland.

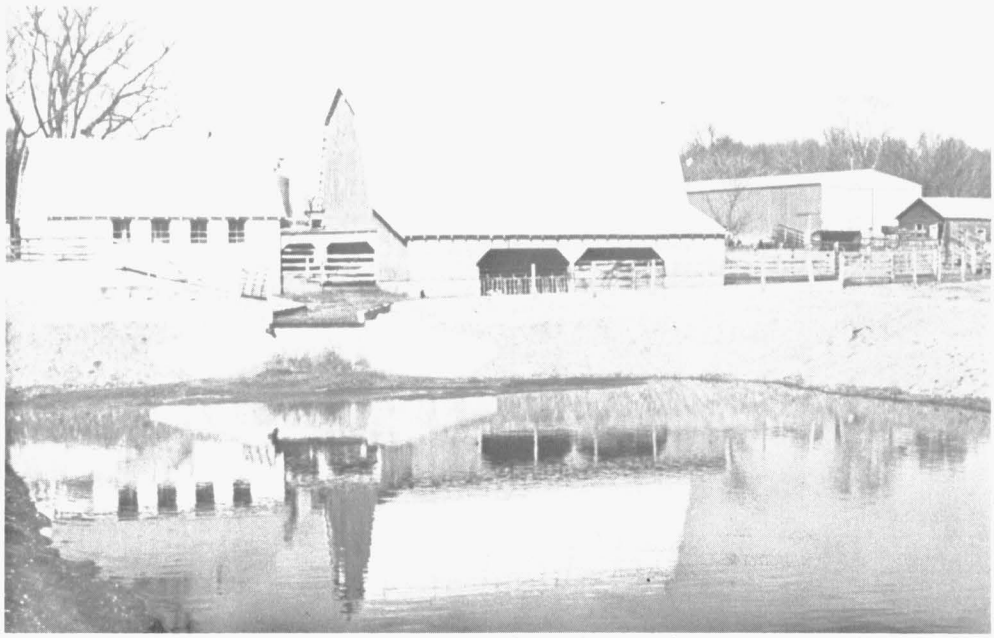
A big step forward in being able to answer these questions was taken when an animal waste laboratory was established at UMC. This lab will act as a hub for animal waste research done by departments such as agricultural engineering, animal husbandry, agronomy, agricultural chemistry, dairy, and poultry. The lab can provide the analytical services needed for both basic research and demonstration type programs.

These services include standard chemical and biological measurements of soil and water samples, and waste materials. Method of analysis will be cross checked periodically with the Environmental Protection Agency to insure uniformity in reporting results.

The lab was made possible by about $40,000 in funds contributed by livestock, dairy, and poultry organizations; private firms; cooperatives, and other groups and individuals. The fund drive was sponsored by the Agricultural Committee of the Missouri Chamber of Commerce.

The funds were matched by special University of Missouri funds and used to equip the lab which is located in the Animal Science Research Center on the UMC campus. Also, the funds will help buy a mobile field unit. This "traveling laboratory" will be equipped to make those analyses which must be done immediately on the site—perhaps a lagoon

Dr. Dennis Sievers, left, and Dr. George Garner check flasks which contain different concentrations of effluent from an oxidation ditch.



Dairy farms face special waste management problems because they must meet milk sanitation requirements. This system in southwest Missouri is working well.

Hog finishing building with lagoon in northeast Missouri is example of the type of waste management systems being used by hog producers.

on a dairy farm, a stream located below a feedlot, or a field that is being irrigated with liquid wastes from a lagoon.

The mobile lab will also be used to transport samples from the field to the UMC lab for more complex analyses.

Another need being met by the UMC lab is teaching and training students to work in animal waste management. One graduate student is studying the possibility of combining algae grown in animal wastes with ground newspapers for livestock feed. Another is studying ways to treat animal wastes to get maximum use of the nutrients in them.

A recent UMC graduate who did his student research in this new laboratory is now working full-time in agricultural waste management.

Our Extension specialists working in the field play a key role in helping to refine and improve waste management recommendations. As they work with livestock producers, designing individual systems for each farm, these specialists relay to our researchers the problems and ideas which need further research.

We're probably using "model T" ideas in designing lagoons, according to Robert George, UMC Extension agricultural engineer. George had a major part in developing the waste management guidelines. He is quick to point out the need for additional work on developing new concepts for storing and transporting animal wastes.

For example, George is doing some applied research now on ways to aerate the top two inches of lagoon effluent to better control odors. In fact, the control of odors from animal wastes is becoming much more important. Odors probably trigger as many public complaints as pollution of streams.

Progress is being made. One of our Extension agricultural mechanization specialists working in central Missouri reported that he had been involved in 85 separate animal waste projects in less than a year.

"We're getting some good systems built and they are working," he said •

From the Departments

Plant and Soil Advances

Agronomic science continues its concern with quality and quantity production of foods and feedstuffs. Plant breeding efforts place special emphasis on shorter stiff-strawed wheats, cotton for both woven and nonwoven fabrics, barley for malt under Delta conditions, higher lysine in corn, soybeans for narrow row culture and cyst nematode resistance, and tall fescue with improved palatability and nutritive value as well as better summer and late season production.

Plant genetic efforts seek a further understanding of biochemical pathways of metabolism from known genetic material in corn and Arabidopsis. Studies on the cytogenetics of corn and wheat provide insight necessary for new methods of plant hybridization.

Soils research seeks to describe plant nutrient release more fully, to develop new techniques of analysis of soil, water, and plant for elements that might cause pollution in certain settings. Work continues on tillage practices and no tillage for row crops as well as fertilizer response correlations for all important crops.

The physiology of soybeans, fescue, birdsfoot trefoil, and alfalfa receive special attention. Management practices are conducted for grazing fescue and summer grasses and for row spacing, plant density, and planting date in corn, soybeans, sorghum, and cotton.

Cooperative efforts to improve plants resistance to pests, animal use of forages, and broad aspects of land use relate Agronomy faculty to others in the University.

Faculty in teaching have oriented courses increasingly to environmental quality questions, expanded individualized instruction through audio-tutorial means, and expanded offerings in advanced soils, crop physiology, plant breeding, and international agronomy.

—Edward C. A. Runge, chairman.

Weather a Resource

The success of many management decisions in agriculture, forestry, transportation, construction, and other industries depends on the weather. The climate determines the optimal strategy for the design and operational plan for such activities, while the weather forecast is required in planning operations for the immediate future. Priority for research in atmospheric science has been placed on problems dealing with (1) methods for using the resources from the atmosphere to adopt better management strategies, and (2) atmospheric processes important for more precise or longer range weather forecasts.

Achievements from research concerning the use of the weather resource in management strategies include the design of the need and size of irrigation systems for Missouri's climate. Other investigations deal with problems of the design and construction of buildings and roads. Investigations concerning distribution systems for electrical power using the climatic expectancies are being conducted.

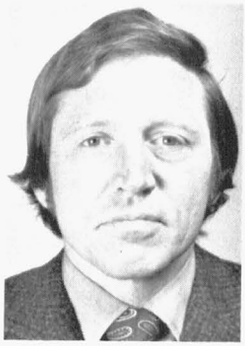
Theoretical studies of atmospheric circulation processes receive emphasis. These investigations include participation in a world-wide program for the study of the interaction between the atmospheric circulation over different portions of the earth. The theory being tested will be applied to the development of techniques for long range weather forecasts. The atmospheric properties associated with the development of thunderstorms and associated severe weather are being studied to provide techniques for improved forecasting of the tornado and other forms of severe weather.

—Wayne L. Decker, chairman.

Remodeling Ag Chem

During the past three years, the Department of Agricultural Chemistry has continued to teach and perform research in the area of biochemistry and analytical biochemistry.

Our research efforts have involved investigations into the effects of trace metals on biochemical structure in mammals, continued research in the conversion of cereal crop residues into useful chemicals, and an analysis of moon rocks, returned by the Apollo expeditions, for life molecules.



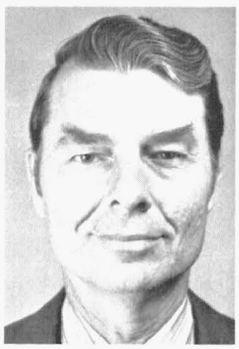
In addition, the Department has added two new staff members with new research and teaching capabilities in the areas of membrane chemistry and plant biochemistry. Undergraduate teaching laboratories have been upgraded by a $120,000 remodeling job and a new course "Agricultural Chemicals and Man", offered through the honors program.

Future plans include a curriculum reorganization at the undergraduate level and a possible merger of graduate programs with the Department of Biochemistry in the School of Medicine.

—Milton S. Feather, chairman.

Tackle Pollution Problems

The research program of the Department of Agricultural Engineering is under continuous review in order to bring the resources of the Department to bear on those problems which are of current concern in Missouri agriculture. One of the most pressing problems of the moment is the management of animal wastes from feedlots and confinement facilities. An intensified program in both research and Extension has been developed to help eliminate pollution of our rivers and streams from these sources.



Though not in the limelight at present, the most serious pollution problem in our state continues to be sediment pollution resulting from soil erosion. Research in this area is directed toward improving water management practices, tillage methods, and terrace systems. An intensive state-wide educational program relating to erosion and sediment pollution control is being launched this year. In a closely related project, the recent emphasis in irrigation research has been on the utilization of limited amounts of water to conserve this valuable resource.

Much of the research in agricultural engineering relates to improved efficiency of production and quality of products. Our animal housing research is aimed at determining optimum environments for production of animals and animal products. Machinery management research enables producers to select and utilize their machinery more efficiently. Pest control studies deal with improved metering and methods for minimizing drift. New and improved methods for utilizing electrical energy for productive agricultural use is being investigated in studies where increased efficiency is the goal. Research on grain drying, forage harvesting, and food engineering is aimed primarily at preserving the quality of the product.

—C.LeRoy Day, chairman.

The College of Agriculture's forage program is geared to Missouri farmers' needs.

More than 16 million acres (40 percent) of Missouri's farmland is pasture. Much of this acreage is producing far below its potential in yield and quality. Furthermore, the number of beef cows that graze these pastures has rapidly increased to over 2 million head.

To meet these needs, the Forage, Breeding, Management and Utilization Program has been developed to combine animal science, agronomy, engineering and economics. The goal: efficient forage systems for Missouri beef cow-calf and other livestock enterprises.

One phase of the effort is aimed at a year-round grazing program. Researchers are selecting varieties best suited for summer production and stockpiling for winter feed.

Particular emphasis is placed on bridging the "summer slump." Under Missouri conditions, tall fescue and orchardgrass normally produce 70 percent of their total forage yield for the season before July. Researchers have introduced pearl millet and warm-season grasses as alternate summer grazing species and are developing management practices for these combinations.

Preliminary research indicates that nearly 90 percent of the grazing growth of Caucasian bluestem and 40 percent of switchgrass is available after early to mid-June. They look promising for filling the forage gap.

Also getting attention are perennial legumes such as alfalfa and birdsfoot trefoil. Researchers are selecting for improved varieties and developing cultural practices that will improve the disease resistance, yield and winter hardiness of these crops.

An improved trefoil variety, Dawn, was released by Missouri researchers in 1965. Another variety is undergoing final tests and will be ready for release soon.

Second in importance to fescue in Missouri is orchardgrass. Studies of this forage are aimed primarily at developing varieties with better resistance to rust and leaf diseases.

Work with bermudagrass is aimed toward developing winter hardy, high yield varieties. Winter grains are also being studied for forage production potential.

the college of agriculture's Forage Program

By measuring photosynthetic rate, researchers are learning more about the effects of temperature and drought stress on fescue. Plants with higher photosynthetic rates should have the ability to produce greater amounts of forage and improve the quality.

Here are some other highlights of Missouri forage research:

—Seeding legumes into established fescue sods extends their grazing time over the summer. Best yields come from fescue-legume mixtures.

—Fescue grows best with spilt applications of nitrogen, half topdressed in March and the rest in July.

—Alfalfa and birdsfoot trefoil can be successfully established in spring if farmers apply herbicides.

—Pest management looks like the best bet for controlling alfalfa weevil. Management includes using a combination of pesticides, resistant varieties, and imported parasites which are natural enemies of the weevil.

—Well managed forage can eliminate the need for protein in beef cows' winter ration.

Applications of nitrogen on fall growth increased dry matter yield of the forage—from 17 to 24 pounds per acre for each pound of nitrogen applied. In recent tests, neither digestibility nor percent crude protein were greatly influenced by nitrogen fertilizer. So, the nitrogen increased the amount of stockpiled fescue available for grazing.

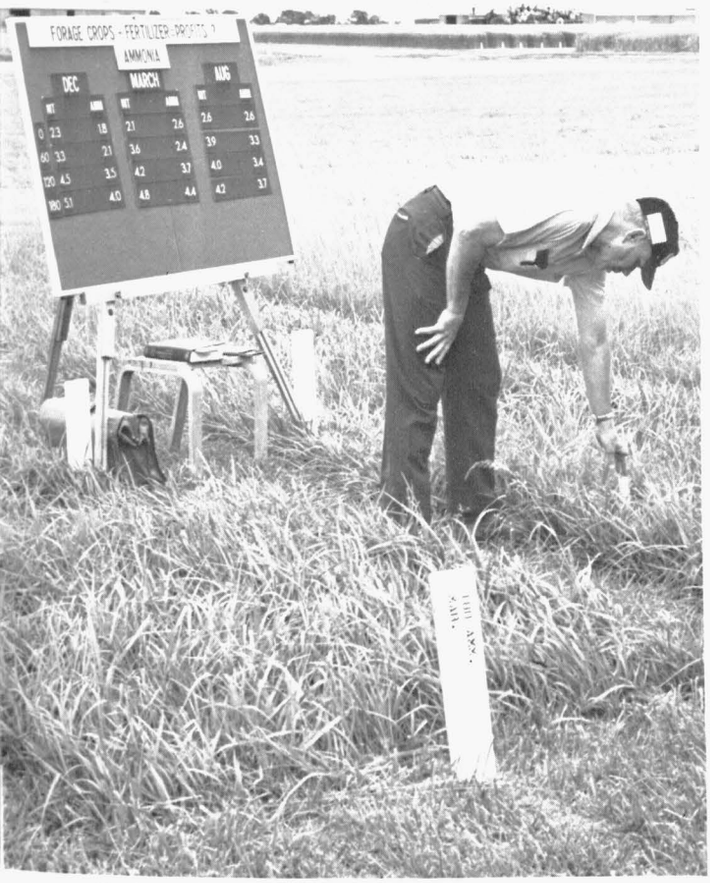
—Forage protein is as valuable for milk production as other plant protein. Research shows that animals will eat more forage, even during warm weather, if the crop has received proper fertilizer treatment.

The University of Missouri has established one of the first proving grounds for forage systems research. Known as the UMC forage systems research center, it is located at the College's Cornett Farm, an 1100-acre site leased at Linneus. Other sites for forage testing include the Southwest Center at Mt. Vernon, the North Missouri Center at Spickard, and the Bradford Farm at Columbia.

A major thrust at these research centers includes the development of a system for year-round forage for cow-calf operations. Spring calving and fall-calving cow herds are carried year long on tall fescue-ladino clover pastures.

Another research effort is the development of equipment for more efficient forage handling. For example, agricultural engineers are developing machinery that will separate alfalfa leaves from stems and dry the harvested leaves.•

A Team Effort



Earl Kroth, associate professor of agronomy, prepares for a field day demonstration on forage crops.

In addition to continued work with variety development, researchers are also working to improve trefoil in vigor of spring growth and regrowth. Howell Wheaton, professor of agronomy, gives a field day explanation.

Some new forage research is concerned with studying insect control. Researchers like Jim Huggans, associate professor of entomology, are attempting to predict alfalfa weevil infestations by evaluating dormant populations.

From the Departments

Teachers for Vo Ag

The Department of Agricultural Education has as its primary goal the preparation of qualified teachers of agriculture to meet the needs of the state. There are 229 local vocational agriculture programs and 293 teachers employed at locations covering the entire state.

There is a range of opportunities concerning the type of teaching position one may prepare for. Vocational agriculture programs include preparation for the farm occupations (production agriculture), and preparation for the off-farm agricultural occupations (ornamental horticulture, forestry, agricultural mechanics, agricultural products, agricultural supplies and services, agricultural resources, and professional agricultural occupations). A teacher may specialize during his professional preparation in any of these areas.

Graduate students who earn their masters and doctoral degrees are also finding ready employment in expanding vocational programs which include colleges and universities, junior colleges, area vocational schools, state departments of education, U.S. Office of Education, and selected centers for vocational education (Ohio State and North Carolina State University). Salaries ranged from $14,000 to $20,000 per year during 1972 depending upon experience and qualifications.
—Gene M. Love, chairman.

Aid With Scarce Resources

An applied social science, agricultural economics deals with the central problem of allocating scarce resources among competing demands. Enhancing human potential and focusing attention on the legitimate concerns of society through programs of instruction and research are the goals of the Department of Agricultural Economics.

Our primary areas of emphasis are commercial agriculture, natural resource development, rural community development, and human-resource development.

Researchers, Extension specialists, and classroom teachers are devoting attention to the economic organization of agriculture, a subject of vital importance. The keen public interest in environmental quality is served through programs of Extension education and research, often of an inter-disciplinary nature.

Recognition of commodity systems is inherent in the efforts and accomplishments of researchers and Extension specialists in their work with specific agricultural commodities. A consumer marketing program using mass media has attracted national attention.

Farm operators and owners are served through programs designed to improve decision-making in farm operations and ownership. A successful mail-in farm record program utilizes the best in computer technology. An effective pilot program designed to meet the special needs of operators of small farms is underway. Business firms are served through programs designed to improve the management skills used by businesses associated with agriculture. A combination of Extension teaching and research is effective in this effort.

In addition to the usual bulletins and special reports, the Department publishes newsletters for those with special interests.
—Charles L. Cramer, chairman.

Battle Plant Enemies

The Department of Plant Pathology has as its mission one of research, teaching, and service. Since the Department's beginning in 1967 it has concentrated its research efforts into four carefully selected areas, based upon our competence, manpower, and agricultural needs.

These areas include: 1) soybean pathology—including electron microscopy of the host-pathogen interaction and the pathogen itself; (3) phytobacteriology, including studies on the causes and controls (chemical and genetic) of diseases of plants caused by bacteria; and 4) the use and fate of pesticides, including the efficacy and persistence of plant disease controlling chemicals. Each of these areas has distinguished itself and is now recognized at the national, as well as the international, level.

The Department has recently purchased a high resolution electron microscope and a scanning electron microscope.

The electron microscope facility represents one of our major areas of service and one which promotes a degree of research integration by allied disciplines that otherwise would be unattainable.

The teaching mission of the Department has been largely confined to graduate education. We offer both MS and PhD degrees. The PhD program is unique and innovative in that we provide graduate training not only in the diseases of plants but, in cooperation with the Departments of Veterinary and Medical Pathology, we provide our students an opportunity to study basic disease phenomena at the cellular and subcellular levels regardless of the biological model chosen.

Finally, we continually seek to extend our information to the rural and urban communities through our Extension activities. Most recently we have led the nation in establishing a corn disease monitoring system designed to provide adequate warnings of impending plant disease epidemics. *—Robert Goodman, chairman.*

Environmental Concerns

The School of Forestry, Fisheries and Wildlife has been affected by the recently developing interest in the natural environment. Undergraduate enrollment has jumped significantly —46 percent in three years—in large part as a result of environmental concerns. Students indicate a strong orientation to the forest as environment as well as a source of wood, water, and range. Wildlife continues to have its historical amenity values for people.

In its research and graduate education program, the School is increasing its emphasis upon interdisciplinary effort in the relationships of forests to fish and wildlife, in the full range of ecology of the central hardwoods and in integrated management and planning for forests and related lands and waters.

With the rapid changes taking place in professional activity and related public policies, substantial Extension effort is directed toward programs of continuing professional education emphasizing interrelationships, new management concepts, and areas of public environmental concern.

As the School looks ahead, following the recent consolidation of Forestry with the Fisheries and Wildlife units, closer working relationships with a variety of groups, both on and off campus, will occur. Such relationships can only strengthen efforts to increase human benefits from the natural resources of Missouri.
—Donald P. Duncan, director •

extension and agriculture combine to promote

JOINT RESEARCH

What do you do when you need a flock of 250,000 laying hens for short-term research? Buy them? And, if you buy the flock, what about housing and other facilities?

Buying such research facilities is both expensive and impractical. Still, today's poultry operations demand research answers associated with large-scale operations with layers, broilers, and turkeys.

One answer to the problem is to seek cooperation from commercial poultrymen and use their operations for research. To do this requires a staff member with special interests and capabilities—a person with both research and extension interests.

Such a person needs the research background to correctly identify research needs and how to service such needs. He also needs the capabilities of an extension specialist to locate commercial poultrymen who are interested and willing to cooperate on research problems.

Dr. Joe Vandepopuliere in the Department of Poultry Husbandry is a recent faculty appointee that has these capabilities. He had 15 years commercial poultry research experience prior to joining the College faculty in 1972.

Vandepopuliere is a joint appointee between the research and extension staffs in the College of Agriculture. In the short time he has been at UMC Vandepopuliere has worked, for example, with large-scale producers in setting up research projects on utilization of eggshell waste from breaking plants as an ingredient in laying flock rations; manure disposal from laying flocks of 250,000 and more hens; and the use of hard wood (as contrasted to soft wood) shavings as a litter for starting turkey poults.

It would have been impossible to conduct such research on the College's poultry farms.

Vandepopuliere is an example of a recent trend to appoint faculty members with both research and extension responsibilities. Both Richard J. Aldrich and Schell H. Bodenhamer, associate deans of the College for research and extension respectively, feel that such joint appointments can often increase the efficiency and enthusiasm of staff members.

In recent years such joint appointments have increased from virtually zero to the current high of more than 20. There are faculty in agricultural chemistry, agronomy, dairy husbandry, agricultural economics, entomology, food science and nutrition, horticulture, plant pathology, poultry husbandry, and rural sociology with joint appointments. Such appointments also exist in the Schools of Forestry and Home Economics.

According to Aldrich and Bodenhamer the joint extension-research appointments have several advantages:

- Joint appointments provide an opportunity to tie research and extension programs more closely together.
- Combining research and extension staffs provides a larger pool of personnel and permits hiring highly specialized staff.
- An increase in the types of expertise are made available for the benefit of the users of research.
- Makes researchers and extension specialists perform like a team—communication is strengthened between the two.
- Joint appointments help keep a large number of the faculty knowledgeable, interested, and contributing to both the research and extension programs of the College.
- Provides the opportunity for highly trained, highly specialized extension staff members to be involved in research.

Bodenhamer points out that as new—and younger—specialized extension staff members join the faculty they often have a desire to be involved in a continuing research program. A joint appointment allows this to happen.

And, Aldrich says joint appointments often make research programs more responsive to the problems faced by farm operators for applied management research. •