Ag Scientists Make NEWS

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UNIVERSITY OF MISSOURI
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COLLEGE OF AGRICULTURE
EXPERIMENT STATION–EXTENSION SERVICE
OFFICE OF THE DEAN AND DIRECTOR

Dear Reader:

An oft repeated saying today is that science is our remaining frontier. This usually conjures up pictures of rockets and space ships. But the frontier of science is much broader than this - and it's all exciting.

Whether a scientist is digging into secrets of plant and animal life or mysteries of space and the atom, he is out in front, treading new paths, leading into the unknown. Those who enter scientific fields become dedicated men who love their work.

On these pages are stories by Clyde Duncan that have appeared in Missouri newspapers on scientists in agriculture.

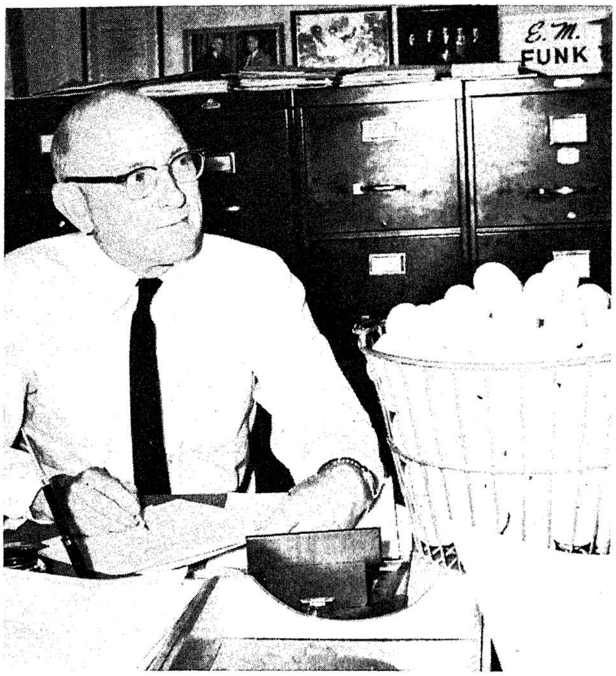
You will find they are warm, friendly men who lead fascinating lives. Any one of their fields makes an enjoyable career.

Very truly yours,

J H Longwell

J. H. Longwell
Dean

His Career Is Chasing Bad Eggs



Often called "the state's leading egg polisher," Dr. Ernest M. Funk, chairman of the Department of Poultry Husbandry at the University of Missouri, is shown above at his desk. Dr. Funk, long one of the nation's leaders in quality egg research, insists the marketing of clean eggs is one of the fundamental steps in his quality egg program.

COLUMBIA — He's not a sociologist, criminologist or penologist, but he's probably caught more "bad eggs" in Missouri, and tried to make good eggs out of them, than all the reformers since the days of Jesse James. He's Dr. E. M. Funk, chairman of the poultry department of the University of Missouri, who has an inborn feeling that a dirty egg is a mark of low quality.

Funk has developed almost a fetish on producing quality eggs as a result of a couple of decades of research, trying to improve Missouri's egg quality. Let a poultryman give some reason why he shouldn't be marketing quality eggs, and one can almost see the hackles rise on Funk's neck.

His enthusiasm for quality eggs is based on solid economics: "There was a time when an egg was just an egg, and no one paid attention to the dirt and filth on it so long as it didn't look as if a quail had laid it." Dr. Funk says. "All that has been changed by modern - day merchandising, and how the demand for good quality eggs is increasing to such an extent that it just doesn't pay any more to market an inferior product."

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Dr. Funk believes that producers who sell eggs on a graded market can average $1.50 to $2 per case more for their product than those who sell ungraded eggs. "This extra premium often increases the annual profit as much as a dollar per layer," he says.

After years of research at the Missouri Experiment Station, Dr. Funk has charted 14 steps which may be taken by any egg producer to get a quality product from his layers:

1. Choose breeding that gives quality.
2. Feed the laying flock well-balanced rations.
3. Produce infertile eggs.
4. Keep the nests clean.
5. Use shavings or any other good absorbent nesting material.
6. Keep the nests dark.
7. Use plenty of nests.
8. Gather eggs frequently—several times daily.
9. Keep the eggs cool.
10. Cool in a wire basket before casing.
11. Hold eggs where humidity is high.
12. Put the small ends of the egg down in the egg case.
13. Market often.
14. Sell on a graded market.

* * *

"With summer here it is very important that these suggestions, which we arrived at not through a hit and miss method, but through years of tedious research, should be adhered to closely to produce a quality egg that will bring a quality price," Dr. Funk says.

In summer months, he points out, dirty eggs become a sort of scourge to the producer, and are graded down on the market in conformity with the Missouri egg law. But every effort should be made to produce and market clean eggs, every month in the year.

"Eggs only slightly dirty may be dry cleaned by scraping and rubbing with abrasive material," Dr. Funk points out. "There are a number of hand buffers on the market that use strips of sandpaper as buffing material, and the sandpaper can be replaced when worn out." Also a cloth buffing wheel, especially made for buffing eggs, can be purchased for use on an electric motor.

Where eggs are extremely dirty they may be cleaned with less labor by washing. "Research at the Missouri Experiment Station shows that eggs properly washed will keep well through market channels," Funk says.

* * *

Here are the rules for egg washing as recommended by the Missouri Experiment Station following considerable research:

1. Use warm water (between 110 degrees and 125 degrees Fahrenheit). Use a thermometer and check temperature to see that it is being maintained. Some egg washers have built-in heating units with thermostats. Never wash eggs in cold water; to do so will cause them to spoil.
2. Use a detergent made especially for washing eggs. Here is the Missouri detergent recommended: tetra sodium pyro-phosphate—40 percent; sodium polyphosphate 10 percent; sodium meta-silicate—45 percent; sodium perbolate—5 percent. The recommended dosage is generally one or two tablespoonsful per gallon of water.
3. Change water frequently. A good rule of thumb is not wash more than five dozen eggs in each gallon of solution.
4. Wash eggs soon after gathering—they will be easier to clean, with less spoilage trouble.
5. Limit the washing time to five to seven minutes.
6. Rinse eggs in warm water after removing from the washer. The best arrangement is to spray water over the eggs. A large can or tub for dipping eggs into warm water can be used. Eggs should be thoroughly dry before casing.

"Do these things religiously," Dr. Funk advises poultrymen, "and you'll be doing for the egg what you do for yourself when you eat a proper diet, and bathe and shave. You not only look better but you feel better, and I just imagine an egg does too."

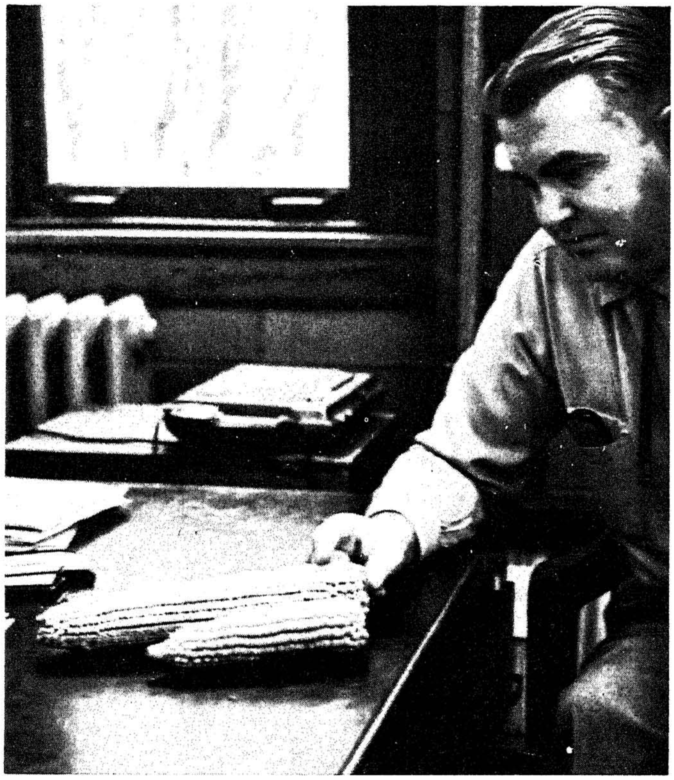
Highway Construction May Cut Corn Surplus

"Land taken out of production for super-highways, housing developments, and for other progressive purposes, is making more work for the corn breeder," says Dr. Marcus S. Zuber, geneticist in the University Field Crops Department.

Zuber explains that today's modern Federal and State highway construction programs, in which thousands of acres are being removed from cultivation may in time eliminate the present-day corn surplus. The corn scientist is beginning to wonder if loss of land on which to grow corn, coupled with great population gains will not actually present a challenge for the corn breeder to keep yields ahead of demand in the very foreseeable future.

H says the present corn surplus has already caused some to suggest that research in connection with it, leading to higher yields, should be curtailed. He feels that in the light of present-day progress however, this is a short-sighted conclusion. As a geneticist Zuber points out that it takes a decade to improve a hybrid through breeding. "Taking a research holiday now could be disastrous later on when food may not be so plentiful," is the way this scientist sums it up.

DR. ZUBER is in hearty agreement with all the present-day planning for new highways. He emphasizes that one would be foolish to speak out against good roads, but when land is taken out of production he reasons that ways must be found to make up the losses occasioned by that soil not being devoted to crops. Improving the yields through a sound program of breeding, such as has produced Missouri's good hybrid corn is one way to do it, and thereby avoid a corn scarcity a decade hence, the geneticist thinks. To emphasize this point Zuber says, "There is bound to be much less land on which to grow corn ten years from now if our building program continues as many think it will."



The average corn yield per acre in Missouri from 1900 to 1940 was only 26 bushels. From 1941 to 1949 it jumped to 35 bushels, and from 1950 to 1958 the average corn yield per acre in Missouri was 41.7 bushels, and much of that increase has been due to hybrids. Dr. Zuber is shown comparing an ear of one of the new hybrids with a "nubbin". Part of the job of the corn breeder, he says is to "eliminate the nubbins."

For emphasis Zuber points out that in the case of the new four-lane highways such as No. 70 running from Columbia to St. Louis, for it alone some 4,000 acres will be taken out of agricultural production. Federal Highway No. 66 from St. Louis to Chicago eliminates another 4,600 acres of the nation's most fertile Illinois land for crop use. Zuber says that these estimates do not include extra land used for overpasses, clover leaves and other necessary traffic modifiers.

"IN THE CASE of the two highways mentioned, if the land used for road right-of-ways produced an average of 50 bushels of corn per acre, the crop loss would amount to 430,000 bushels annually," Zuber figures. He infers that if the picture is projected nationally, and over a long period of time, the number of bushels of corn which would be displaced by highways and housing projects could well be startling.

But with that he has no quarrel, realizing that transportation and housing are both important for the nation's well-being. He realizes at the same time there seems to be no move toward a "cut back" in population trends which forces him to the inevitable conclusion: "Research, both basic and applied, should not now be curtailed in any manner."

He stresses the latter point in these words: "It takes a long time to develop a hybrid in corn breeding. The fruits of the corn research performed in the late 1940's and early 1950's are just now being harvested." He feels too, that breeding for further insect and disease resistance may require even a longer period of time. This will be true, especially, when the selection of resistant progenies are dependent upon natural infestations and epidemics among plants.

"MISSOURI HAS been almost a hundred years getting where she is in corn production," the scientist says. "Men were still struggling back from the Civil War when records on corn production were just beginning to be kept in Missouri in 1866. Lots of virgin land, high in fertility, and ready for the plow was everywhere then, and corn was the mainstay. Each year the acreage devoted to it in this state in these early days was increased. In 1917, the first year of this country's participation in World War I, corn hit a record high with eight million Missouri acres covered with it. Missouri was literally a vast sea of green that summer when soldiers were tramping off to our first big war."

Dr. Zuber says that despite the vast amount of land in corn in 1917, there was actually a limit to the amount it was possible to produce. The genetic yield potential of the open-pollinated varieties used for seed, forty years ago, could not make the fabulous returns per acre as we do today with modern hybrids. It just wasn't in their "family trees" to be heavy producers.

"PROVING THAT POINT on genetic yield potential," Dr. Zuber says, "During the period from 1866 to 1945, for almost 80 years, not once did the average yield of corn in Missouri exceed 40 bushels per acre." He finds by studying the records that it came mighty close to the 40 bushel mark per acre in 1902 when it reached 39 bushels; but "the genetic yield potential just wasn't there," he concludes.

And what a corn year 1902 was, the researcher says now, "Whew," he exclaims, "In that year, a year before the Wrights put their flying machine in the air at Kittyhawk, N. C., and Henry Ford invented his 'flivver,' that was the biggest corn year in this state's history with a total of 294 million bushels of that old-fashioned open-pollinated corn, harvested from 7,500,000 acres." Zuber the corn scientist, chuckles at this huge crop, adding, "Never before have we come even remotely to that 1902 crop, and only in a few years has the crop passed 200 million bushels."

But after 1917 a gradual decline in land devoted to corn set in. The geneticist explains this as resulting probably from an oversupply of the grain, and the low prices for it immediately following World War I. At that time, he thinks, the more modern farmers began retiring marginal land, and soils of less productivity for cultivated crops. The decrease in the amount of corn grown was accelerated by the acreage allotment programs found necessary as a result of the depression of "the thirties."

"MISSOURI had a hard time catching on with hybrids," Zuber recalls. "At first this new kind of corn was not readily accepted by the state's farmers. In 1936 a small acreage of it was first planted in Missouri. Due largely to location the state became a sort of 'dumping ground' for the hybrid seed surplus of northern and eastern corn producing areas. Missouri farmers seemed to believe that any seed bearing the name 'hybrid', would be superior to the locally adapted varieties."

The geneticist points out that it didn't take long, probably two or three years, before farmers began to learn that the local, open-pollinated corn was superior in yield to the "carpet bagger" hybrid seed pouring in from Iowa and Illinois. "So," he claims now, "When good, adapted hybrids could be found on the market some growers in this state were not very eager to plant them."

But, starting in 1940 a rapid change from open-polinated to the new, improved, adapted hybrids began. This University of Missouri breeder of good hybrid corn varieties likes to take a squint at history. What he finds pleases him in regard to hybrid corn. In eight years, or by 1948, some 95 per cent of the state's total from land devoted to corn had been changed over to what some called "this new fangled corn." With increase in acreage came also the tell-tale noticeable increase in yields, with hybrids being largely credited for the increase. The year 1948 became the first one the state's average yield exceeded 40 bushels when it went to 45½ average state wide. "Since 1950," Dr. Zuber points out sort-of-proud like, "The average corn yields in Missouri have been astounding, especially when compared with the previous 85 year period."

DURING THE 10-YEAR decade, 1950-1959, the average corn yield in "Show-Me" land has equalled, or exceeded, 40 bushels per acre a half dozen times, and twice it has gone beyond the 50 bushels.

To what are these phenomenal increase in yield due? Dr. Zuber has the answer. "They are the direct result of corn research during the past three decades. They include the development of high yielding adapted hybrids, improved use of recommended fertilizer applications, and more use of good cultural practices, such as improved seedbed preparation, weed control and harvesting methods."

But that's not all, either. Dr. Zuber stresses another factor: "The more efficient controlling of diseases and insects by resistance bred into the corn plant and proper application of fungicides, and insecticides."

THERE ARE MANY problems still encountered by scientists, seeking to increase the genetic yield potential of hybrid corn, to say 150 to 200 bushels per acre average. Here this scientific corn man, Marcus Zuber, likes to tell about a recent survey he made among corn breeders of the United States. He found that the average corn yield per acre for the 40 years between 1900 and 1940 in this country was but 26 bushels, while in the eight years between 1941 and 1949 it jumped to 35 bushels, or an increase of 34.6 per cent.

From 1950 to 1958 the average corn yield per acre was 41.7 bushels per acre, the scientist found. It represented an increase of 19 per cent over the previous eight year average yield from 1941 to 1949. It also represented a 60.4 per cent increase over the period from 1900 to 1940.

To the layman what do all these figures indicate anyway? To Dr. Zuber they relate a story which runs in this wise: That farmers of the United States have a long way to go before they realize all of the genetic yield potential now present in current-day hybrids. And by that he means the inborn, God-given ability of a corn plant to produce two ears of corn where one grew before. "It's like driving a car at 15 miles per hour when it is capable of seventy," the scientist explains.

SO AT LEAST for the present the development of corn hybrids with higher genetic potential is not nearly so pressing a problem as other factors in limiting the Missouri corn yield. Dr. Zuber says these include ample soil fertility, soil moisture at the right time and right amount, and an ideal climate, freedom from insects and disease, and of course the use of adapted hybrids.

This down-to-earth, understanding scientist working in his laboratories in Curtis Hall on the University of Missouri campus, takes a philosophical look at the future as it relates to him and other plant breeders: "Land being taken out of production for good highways, and for other uses, and a steadily increasing population, leaves us no alternative but to work a little harder to produce an improved hybrid to take up the slack."

"We've got to keep our shirt sleeves rolled up all the time," Zuber keeps telling himself especially at this time of year when "corn plantin' time" is "just around the corner."

Its Soil Yielded Fi

MU's Old Volumes

By CLYDE H. DUNCAN
Associate Agriculture Editor
University of Missouri

One hundred years of watching the results of Sanborn Field are represented in the lives of the two men pictured here. Dr. W. A. Albrecht, as usual with soil auger in hand, with Dr. M. F. Miller, dean emeritus, stand before the gateway of famous Sanborn Field. Miller came to the Missouri campus in 1904, and Albrecht in 1916, as faculty members of the College of Agriculture's soils department. Both at different times served as chairmen of their department. Still quite active and interested in soils research, both continue to marvel at the amount of basic, as well as practical and applied knowledge which continues to come forth each year from the field.

COLUMBIA — Through the years, the little professor — soil auger in hand, students following at a dog trot—had almost worn a path from his classrooms in Waters and Mumford Halls to "Old Sandborn," the eight-acre experimental field within this city's boundaries.

So there appeared to be nothing unusual about Bill Albrecht on this August day, 1945—not in a placid community long accustomed to professors, and where education is common currency. Nevertheless it was an unusual mission that carried the little professor to Sanborn Field.

He came to Plot 23, paused and gave it a cursory survey. He could recite its history with avid facility from 1888, when Dean W. Sanborn had established the land as a "rotation field," through all the years to follow. The plot had never been fertilized in those 57 years, Albrecht knew, and it had been constantly cropped to timothy alone.

Albrecht had a hunch, perhaps a scientific reason, for taking a sample from this particular plot to send to a friend experimenting with a new "wonder drug" then beginning to make the front pages—a drug destined to save the lives of millions in the years of the immediate future. So, from Plot 23, Dr. William A. Albrecht carefully gathered a sample of earth to mail to his old-time colleague and former University of Missouri faculty friend, Dr. Benjamin M. Duggar, a botanist.

* * *

It would be awhile before the story of that day's fortuitous events would be written; but when they were written, they revealed that Albrecht's little test school of Missouri earth was one of the discoveries of the age. It was packed with wonder gold—golden mold from which the first aureomycin was obtained.

And Dr. Duggar extracted that first wondrous healer, perhaps wondering that it should com-

reomycin, Upset Considerable Scientific Dogma

Sanborn Field Has Written in U.S. Agricultural Annals

from common Missouri soil. It's doubtful, though, if it surprised the little professor, for Albrecht in his long years of work with Sanborn field had established for it a peculiar niche in the literature of agriculture. Rebel-like, this tiny field seemed to defy the script.

Dr. Albrecht, as director of research there, had literally unearthed face-reddening facts from this soil. He'd discovered, for example, that in a day when the preachments of crop rotations were sound soil orthodoxy, Sanborn Field had proven orthodoxy wrong in some circumstances—had actually shown that some rotations could be harmful.

Likewise, in a time when it was land gospel that legumes "always leave the soil better than they found it," Sanborn Field experiments had again upset the wagon of orthodoxy by proving that legumes, over-done, could mine the land as barren as a share-cropper could. And again, Sanborn Field had taught soils researchers that fertilizers applied indiscriminately could be almost as bad as no fertilizers applied at all.

* * *

Albrecht knew all these things—all and many more. To him, Sanborn Field was capable of producing more surprises than a clown at a circus—scientific surprises at that.

Indubitably, that is what prompted him to comment as he did when the soil sample that produced the first aureomycin—the selfsame Sanborn sample— was presented in special ceremonies to the Smithsonian Institution. For on that day, Oct. 15, 1958, Dr. Albrecht said it was doubtful if any other plot of land, comparable in size, on the face of the earth has produced as much genuine knowledge for humanity's use in combating physical suffering and hunger "as have the hallowed acres of Sanborn Field."

Dr. Albrecht no longer daily tramps the soil of Sanborn Field. Today he is a professor emeritus, busier with writing and lecturing now that he is no longer confined by his old campus routine. In his place is one of his former students, another fully steeped in the traditions and history of Sanborn Field, Dr. George Smith.

Smith is convinced that Sanborn Field has furnished information that has helped shape the soil fertility and management program not only of Missouri but of most states.

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"Basic information that this old field supplies can be obtained at no other place in the United States," Smith insists, "and it is of just as much value to the city man as it is to the farmer." Summing it up, Smith contends "It could be argued that Sanborn Field has greater potential value to mankind than any other similar tract in the world."

Smith, in reviewing the first work of Sanborn Field, says that farm manure was the main soil rteatment then. One plot has been continuously in wheat since 1888 and has received chemical fertilizer since its start. As the original treatment then. One plot has been new practices available, some treatments were changed.

"These management practices have pointed to the potential for rejuvenating worn out soils," Smith declares. "There are still 14 plots that have been kept with no change since studies began on them, 72 years ago."

One of the more recent contributions to modern science made by this famous field is in the studies of soil in relation to radioactive fallout. These materials fall in rain and are carried into the soil: can be absorbed by plants, later concentrated in animal products which, if eaten by human beings, can result in very harmful effects. There is a strong feeling that even cancer may result.

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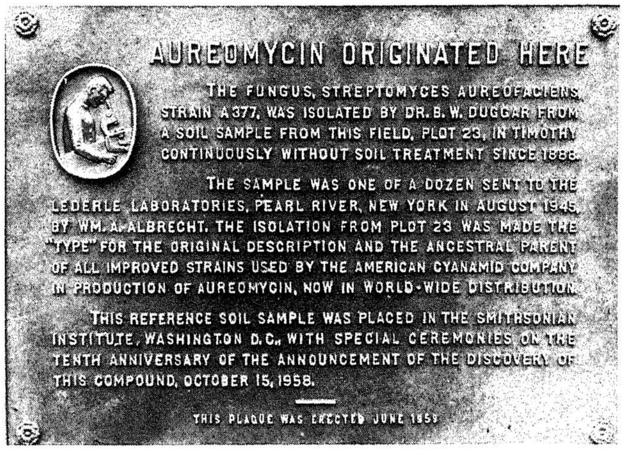
Soil samples have been collected at regular intervals from all plots in Sanborn Field since 1888 and have been kept for future study. By comparing soil samples collected before first atomic explosion with those since, it is possible to determine the amount of increase that has occurred in the soil.



"Aureomycin Originated Here," proudly proclaims this plaque at the entranceway to 72-year-old Sanborn Field. The story of that historic find follows. The plaque was erected with special public ceremonies one day last June.

"By studying the composition of plants grown on these variously managed soils, information is being obtained on the possible influence of land management on accumulation of these radioactive materials in food crops," Smith concludes.

He says that detailed studies of these plots can show the amount of movement of these radioactive elements that has occurred, the influence of soil erosion, and the depth of penetration that has resulted from leaching. Thus, by using the old and present samples as a basis, future fallout and accumulations can be measured.

Smith feels strongly that the Sanborn Field plots can better serve in this way than some others that are now being established by the Atomic Energy Commission at a great expenditure of funds, and can do it at considerably less cost.

* * *

Dr. Smith points out that many of the foremost scientists in this and foreign countries have been students at the University of Missouri, and have studied the serious accumulated results from this interesting field. Smith feels that when their influence on students at other institutions is truly evaluated, or at least considered, the far-reaching effect of this one very small experimental field on the over-all knowledge of soils and food production can only faintly begin to be realized.

Dr. Sanborn, who in 1888 founded the field which today bears his name, perhaps least of all, ever dreamed that these few acres would cause his name to be heralded in the nation's agriculture many years to come.

On taking leave of the state after seven tempestuous years, Sanborn probably felt that he would be best remembered for a two-hour speech before the Missouri Legislature in which he defended his stewardship as dean of the newly established agricultural college of his adopted state of Missouri, and director of its new agricultural experiment station. His forensic efforts climaxed in a near-riot. This from a firebrand speech by a man described by Colman's Rural World of that day as "the patient, plodding and hard-working dean."

Professor With Yule Spirit Promotes

By CLYDE H. DUNCAN
Associate Agricultural Editor
University of Missouri

COLUMBIA — If it is possible to have the Christmas Spirit the year around there is a quiet, soft-spoken professor on the University of Missouri campus here who qualifies, hands down.

Florida-born and reared, Brooks Polk, associate professor in the institution's nationally recognized School of Forestry, left the sunshine of the South a decade ago, traveled North and became virtually an apostle for improved Christmas trees, and with the peculiar notion he could persuade an entire state. He stuck around to contribute a ton of information on how to take the drabness out of Missouri Christmases.

FOR BROOKS POLK the true Christmas spirit starts with the tree. Few people had thought of that angle of the holiday season, this student of Christmas thinks, because it is "so simple."

He adds with a sly smile, "I found that we were spending so much time gift wrapping that we didn't have time for the tree, and the tree, like Santa Claus, is one of the truest symbols of the Yuletide. Take away the tree, and you take away the main element that distinguishes this day from others."

Helping Missourians grow finer and more marketable Christmas trees was something that offered Polk a challenge because of the tree's economic improtance to the state. Thousands of dollars were being spent on trees ten years ago which were shipped in from other states as far away as Montana, and some from the provinces of Canada.

Fortuntely, Polk was put in charge of the Christmas tree research soon after coming to the University, and as a result today — a decade later — there are enough people growing good quality Christmas trees in Missouri so that they have their own association, hold an annual meeting, and swap ideas on how to improve their product, and how to market it more efficiently.

"Although complete records have not been kept," estimates at varying intervals over the last quarter century are adequate to reveal an industry that has been making unusual gains," Polk says.

"In 1930 an estimated eight million Christmas trees were sold in American cities.

The numer gradually grew until by 1955 more than thirty million Christmas trees were marketed in this country, and today the figure is closer to forty million trees."

Polk feels that there has through the years been a continued infusion of the Christmas tree tradition. He explains: "Whereas, the activities of old St. Nicholas, himself, were once related to the family hearth, his visits of nowadays are more likely to pivot around the family Christmas tree."

CHRIS KRAMER studies a Scotch pine of good quality produced at the Weldon Spring Experimental Farm. This species is now being grown commercially by Missouri landowners.

"**MOREOVER,**" he adds, "it seems at times that adults will crowd Santa off the scene as they exchange gifts that have been accumulated on and under the same tree."

He finds too that more and more the Christmas evergreen is becoming a hub from which radiate the season's glad tidings in the home as well as in churches, lodges and places of business.

There's still another factor which accounts for more Christmas trees being bought through commercial channels. Professor Polk sums it up: "Those who still venture into the country, axe in hand, for their tree are less certain in these modern days that they have a God-given right to make such a raid."

"They are unable to reconcile a hand that steals along with a heart that tries to live the spirit of Christ at Christmas-time."

In this prosperous industry, which is well on its way to an annual business of 100 million dollars, where does Missouri state stand? It is Professor Polk's opinion that although some people still settle for a locally grown eastern redeedar or shortleaf pine for Christmas trees, most Missourians depend upon out-of-state production.

The majority of trees sold annually in Missouri come from such far away places as Idaho, Montana, the Lake States, New England and southern Canada. Just a glance at the record tells an impressive story.

Shipments of Montana trees into this state increased from 228,000 in 1953 to 323,000 in 1954. In 1955, a total of 326,125 Canadian Christmas trees were shipped to Missouri buyers and the figure has been that many or more every year since.

Polk is of the opinion that Missouri will eventually produce its own trees. He has arrived at that conclusion because heavy cutting in the northern and western coniferous forests has depleted the best natural Christmas trees stands.

PRODUCTION LEVELS have been maintained or increased only at the expense of tree quality. "Yet people are demanding better trees," Polk says. "This has been clearly demonstrated by marketing tests in the course of which premiums trees sold more quickly, even when offered at twice the price of average-quality trees."

PROFESSOR BROOKS POLK, who h ing Missouri's annual Christmas tr research, does not confi s readir letins. Here he is shown ding a p Tales for Reading Aloud."

s Christmas Tree Industry In Missouri

There has been a natural and strong trend towards the development of Christmas tree farms in some parts of the state. On lands given to such use growers seek to improve quality in their stands through good management practices.

"Excellent crops of Scotch pine Christmas trees have been produced by the University of Missouri School of Forestry on abandoned old fields, and eroding slopes." Professor Polk says. "This suggests a means of supplementary income for the owners of such lands, especially if well located close to local markets."

Research now under way is designed not only to stay abreast of the growing Christmas tree industry, but also to develop new materials and techniques that will insure improved yields, and larger profits, in the years ahead.

Polk points out that examples of experimentation now in progress are a continuance of species adaptability tests, comparisons of geo-

DOUGLAS FIR has given good results on well-aerated soils but has failed on heavy, plastic soils with poor internal drainage. The species is still in an experimental stage of development for Missouri use.

graphical races within a species, and work in controlled pollination within and between species.

"In order to keep abreast of new developments the interested landowner should maintain a good contact with forestry personnel of the Missouri Agricultural Experiment Station," Professor Polk says.

"In both production and marketing the prospects are unusually bright today for the growth who is seriously interested in producing good Christmas trees."

THIS CHRISTMAS TREE researcher has some suggestions especially for the beginning grower. Trees must be protected from fire and livestock. This problem should be carefully weighed in the selection of a planting site.

The Scotch pine right now seems to stand highest in public acceptance for Christmas tree use. Plantation yield and consumer popularity seem to be on its side. Jack pine needs more research before its true place in the Missouri Christmas tree picture will be fully known.

Both do best on well-draintd soils and in full sunlight. Polk urges the Christmas tree grower to avoid low, wet places, and do not plant in the shade of other trees.

The planting site should be full and deep plowed. Planting is best done in early spring before new root growth and bud swelling starts.

The roots of the seedlings should be kept moist. If planting is to be delayed beyond several days, "heel-in" by spreading roots along one side of a V-shaped trench, and firming soil over them. Never allow the roots to dry.

"Plant Christmas trees to obtain a good spread and depth of root system with the root collar at or slightly below ground level," Professor Polk urges. "Use 5x5 foot spacing, or adjust this to suit machinery that is available for between-the-row cultivation."

Polk recommends a light to moderate herbaceous cover during the period of seedling establishment. A grass sod or rank weeds, however will result in poor seedling survival.

Pines do not require high fertility levels for good establishment, growth and color. In fact, fertilization, especially nitrogen, during the period of seedling establishment is usually harmful in that it causes a rankness of weed growth.

CHRISTMAS TREE plantations should be checked annually and cleaned of any invading trees and shrubs. High yields in Christmas tree plantations can be realized only through annual pruning.

The only serious insect pest is the pine tip moth which attacks all of the two and three needle pines. It is difficult to control, but best results have been obtained with a one percent DDT emulsion. Deer can do serious damage by winter browsing of the seedling and by rubbing the larger trees with their antlers. The planting of Christmas trees on deer range is not advisable.

"By and large," Professor Polk concludes, "The growing of Christmas trees is no more of a problem than the growing of any other farm crop, and much easier than most of them."

He adds quickly, "And look at the fun one has working on a project in partnership with of all people, old St. Nick himself because you do have to have his Christmas spirit to really do much good growing trees or anything else."

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Crickets Assist In Lab Exp

AG EXPERIMENT STATION FORWARDS RESEARCH IN STUDIES OF ORTHOPTERA

By Clyde H. Duncan
Associate Agricultural Editor
University of Missouri

COLUMBIA, MO. — The cricket that gets in your clothes, and may even take a few bites from your favorite pair of pants, or dress, is the same "Cricket on the Hearth" about which Dickens wrote his drama in three acts.

Today, not on the hearth but in the laboratory, it is providing the entomologists of the Missouri Agricultural Experiment Station with information which will help in the control of its more destructive "cousins." Grasshoppers for instance.

Dr. Philip C. Stone, chairman of the University of Missouri's department of entomology, goes on the theory that "it takes a thief to catch a thief." Thus, to find out more about grasshoppers, roaches, katydids, and others of the order of insects known as orthoptera, of which also the cricket is a member, a study of one of their member's eating habits will help track down the outlaws of the clan.

"The grasshoppers and roaches may not think this is exactly 'cricket' but we do," smiles Dr. Stone, knowing full well he has dropped a full grown pun. "so today we operate what you might call a cricket factory in our laboratories. Each year we hatch a quarter of a million of the house variety of these interesting insects, and of those that survive — and most of them do — we have for each of them an interesting job."

The man who has recruited an otherwise insignificant insect for top secret duty in the battles agaist our natural food destroyers claims that the work with crickets already is opening up fantastic areas of possibilities. The cricket research embodies investigations along the lines of new techniques in producing crickets in large numbers. Scientists have long sought the perfect laboratory insect for their studies. Cockroaches in the past have had to do for laboratory work, but as Dr. Stone explains, "they are messy and smelly while crickets are not."

STATISTICAL STUDIES

Good statistical studies can be obtained quickly in using crickets while in the case of larger insects, or animals, used for laboratory studies the time consumed is much longer. Time is an important factor in any science study. This insect will help to overcome this. "The cricket will show growth and weight difference at 30 days, and at most we can get all the information we need in 60 days," Dr. Stone says.

By understanding the cricket's behavior, as regards to abundance and scarcity of food, may enable the world of the future to be able to avoid the insect plaguers which seem to come with clock-like regularity every number of years The Pharaohs were bothered in no less that way than we are in this modern day.

By knowing these things, Dr. Stone thinks the experiment station scientist has valuable information on how to handcuff other members of the orthoptera order, such as grasshoppers, as a good practical example. It can be in Missouri the real Jesse James of the insect world come the corn roasting ear stage for example.

"By knowing all about the cricket nutrition-wise, exactly what he will eat, and why, it is possible then to plan some real savory dishes for the outlaws of the clan, such as maybe a little baby chick starter feed loaded with toxaphene arsenic or something else which will wind him up as a dead grasshopper." the entomologist says.

SILVERFISH USED

The silverfish was first used for this work. It was discarded because its life cycle was too long. Too much time was taken up in rearing broods, and making the investigations. The black cricket, the fellow you search for on your lawn, around rotted logs and stumps, just before you start fishing, was also discarded after several trials.

In the case of the black cricket the majority of the nymphs required 90 days to mature. This might have been all right but a small percentage needed a year or more to mature which was too long. This would result in much lost motion in the studies.

"Then we experimented with the house cricket," Dr. Stone says. "We found that it can pass through the nymphall stage from 30 to 40 days at 90 degrees Farenheit, and have up to 25 offspring. Now we knew we had it, the real answer to our problem. What's more we had found it right under noses. Where to get enough house crickets to start a breeding program, that came next."

"We started with three females," the friend of the cricket says. "They gave us a beginning, and we went on from there. From those three crickets have come several million descendants." Dr. Stone soon found that besides having a real genuine ally in his department's studies of insect nutrition that it had in the cricket an interesting personality and make more pleasant laboratory work companions than cockroaches. They are also more refined and less messy.

Being a member of the orthoptera order the house cricket besides being possessed with that famous chirp that through the centuries has made poetry, and which the cricket incidentally manufactures by rubbing his two front wings together, he has in addition biting mouth parts. He also has some idiosyncrasies, doesn't like the sunlight: but on the other hand nematodes like the cricket and use it for a host.

MOUTH IMPORTANT

To the entomologist the biting mouth parts are important. They distinguish him from the insect which will suck its meals from plants. The cricket, like the grasshopper and other of its relatives of the order of orthoptera, will bite off and chew its food. Crickets will eat just about anything — dried plant foods, synthetic foods, even to their own brothers and sisters.

In studying the crickets' nutrition needs, the knowledge gained helps in preparing the sort of food they will eat. his knowledge later can be put to use in poison warfare against grasshoppers and roaches. Beisdes having biting mouth parts, crickets like their "cousins" in the orthoptera order, have narrow, hard forewings that cover folded lace-like hind wings that run lengthwise.

Dr. Stone, and his fellow entomologists, soon after the first cultures were started, found out that basically crickets prefer the simple life. They require cages having only food, water, and moist sand into which they may lay their eggs.

The first cages experimented with were battery jars six inches in diameter, and eight inches high. They contained two inches of moist sand, a finely ground chicken mash for food, and a cheesecloth plugged No. 6 dram vial with drinking water. The top of the jar, covered with two layers of cheese cloth, was held in place with a rubber band.

The entomologist explains that when fed certain grasses low in sodium and distilled water the crickets' growth is not as rapid as when ordinary Columbia tap water is used. This may be explained by the fact that in the tap water they get an adequate amount of sodium without which they will mature very slowly, causing them to look like pygmies.

THE FIRST TESTS

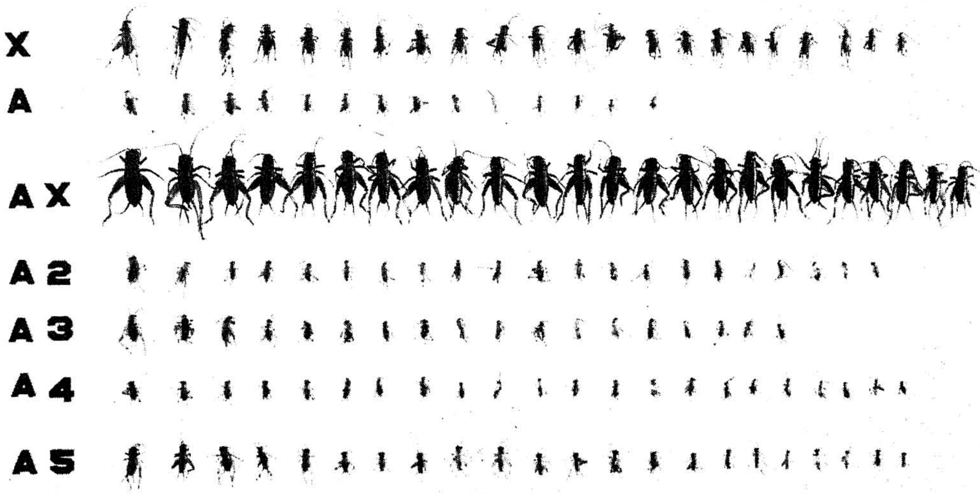
Dr. Stone says that at first, day-old test crickets, living at a 9[illegible]-degree Fahrenheit tempe[illegible]e, were collected daily from many battery jar cages with the aid of an aspirator. This is an apparatus which moves them by suction, by which they are transferred to test jars. Later a large stock culture of adults is maintained, and the eggs are all laid in moist sand contained in a finger bowl that is embedded in the sand to the level of the floor of the culture.

Although the concentration of eggs in an oviposition jar, a large glass jar especailly for the laying act, was an improvement in eliminating many daily collections of young from so many different jars, it did not prove to be entirely successful.

The head of the entomology department says that the removal of the oviposition jar each day from the sand floor of the cage killed many crickets. The moist sand in the egg jar became contaminated with the food, and the dung of the crickets. It was also difficult to maintain the moisture in the open type finger bowl oviposition jar during the hatching of the eggs.

Another factor which works against the experiments is that cricket eggs cannot withstand excessive drying. This is controlled, by what Dr. Stone calls "a weeping vial." It is a water-filled [illegible]-

eriments For Insect Control



RESULTS OF RESEARCH—The above photograph tells the research workers considerable about the various diets on which the crickets have been fed. Size, weight and survival of crickets after 30 days on various diets are carefully tabulated studied, and recorded for future research by the University of Missouri entomologists.

pered test tube, inserted into moist sand in a finger bowl. Since it has a minute hole near its base, the moisture level can be held for several days. Thus, less time has to be spent caring for the oviposition jars.

In time these breeders of crickets come to use four - sided quart glass mason jars for the laying and the depositing of the eggs. Each is filled two-thirds full of white silica sand, tilted to one side, and then about 200 cc. of water is introduced to moisten the sand. This is enough water to wet the sand, and keep it moist during incubation, but not enough to leave excess free water on the surface of the sand, possibly drowning the newly hatched crickets.

AFTER HATCHING

After the crickets are hatched the light and heat from a 60-watt light bulb drives them from the jars to the rearing cages containing food and drinking water. Thus these thousands of tiny insects are handled and are provided with food and drinking water as soon as they are able to walk.

What do crickets eat when being grown in a quarter of a million quantity each year? Cerophyl, a dark green, fine granular commercial product that makes use of a combination of cereals, blades and stems, harvested when hand-high and carefully dehydrated, is a general purpose food for the young cricket. Other foods, such a chick starters and finely ground dog foods, are added after the first few days.

Dr. Stone explains that the floors of all cages and test jars where crickets are being grown and studied, are made up of white silica sand. This is used for several different reasons. Sand makes it easy and safe to pick up, or scoop up, young crickets in a vial after being anesthetized with carbon dioxide as all of them are before handling.

"Young crickets are often harmed when picked up by forceps, or an aspirator,' Dr. Stone explains. "The white silica sand floor of cultures also absorbs excess moisture. When sand is sprinkled daily over the floor of the culture, it helps to keep it clean and dry."

SMALL PERCENTAGE

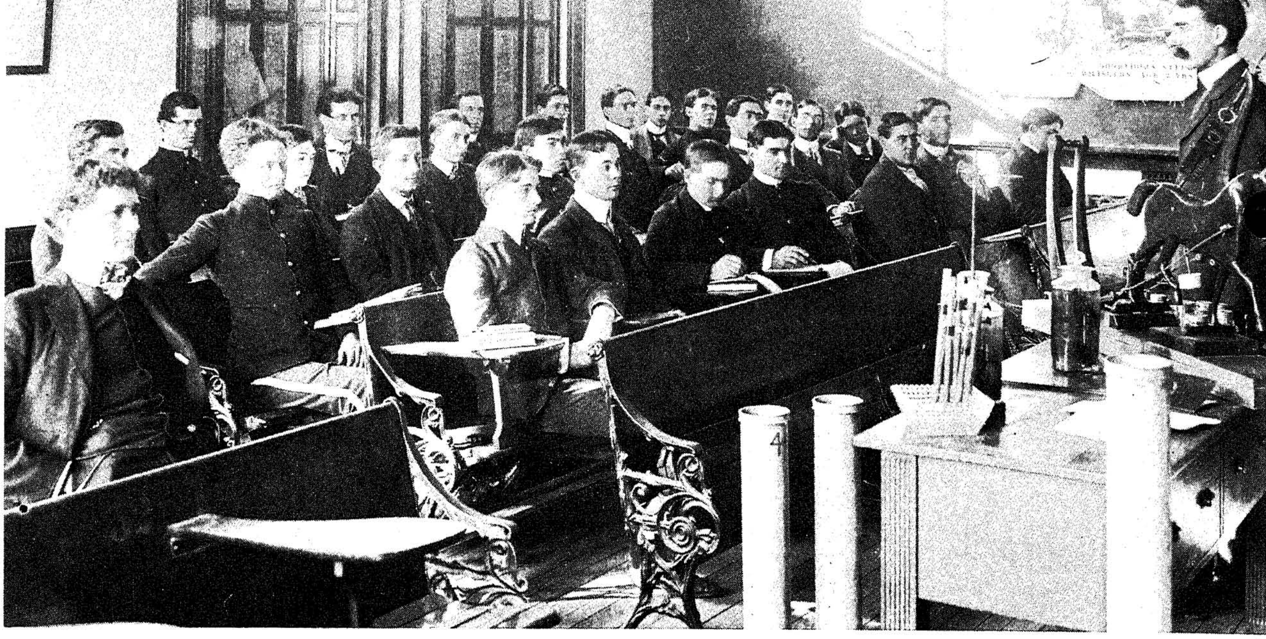
Although a quarter of a million of the house crickets are hatched each year, it is obvious that only a small percentage of them can be used for the insect nutrition studies presently underway at the Missouri Agricultural Experiment Station. What then becomes of the others? Fish bait, no, although they do make excellent lures for bluegill.

The department sticks strictly to its job of studying crickets as a means of knowing what they need nutritionally as a means of being able to control their more lawless relatives, notably the grasshopper and the cockroach, and to develop laboratory techniques which will shorten the time in scientific studies.

The surplus crickets are used in the classes of the beginning students in entomology, who, like Dr. Stone and his associates, soon find them to be the most interesting of insects, and can easily fall into th classification of pets. In fact, the entomologist explains, many children today, keep a cricket in a cage to look at, and to study, and, of course, to hear its odd sound on late damp days and on long winter evenings. In that way, they gain a first-hand beginner's knowledge of the wonder world of insects. They learn to enjoy insects. They find out very soon that the expression "only dead bugs are good bugs" is incorrect.

Other of the crickets not needed in the nutritional studies are used in classes in toxicology, physiology, morphology, biochemistry and in the rearing of ant lions, wheel bugs, praying mantids, scorpions, tarantulas, a poisonous spider, mites, tropical fishes chameleons bats, lizards, monkeys and in applying basic breeding stock for others interested in growing crickets.

Dr. Stone works closely with other departments such as field crops, biochemistry, soils, horticulture, animal husbandry, agricultural chemistry, and others in reaching conclusions. "There's always a place for a cricket and it need not be under your rug or on your hearth," says the man who has a feeling for crickets akin to one's love for a dog.



There have been many changes in agricultural teaching and research in the 60 years since the picture above was taken of F. B. Mumford, dean of the Missouri College of Agriculture, teaching a class in agriculture in 1900 in Switzler Hall. During the six decades from celluloid collars, tight jackets, and vests to the present day, the state's College of Agriculture and its partner in research, the Missouri Agricultural Experiment Station, have kept abreast of the times studying and solving problems affecting the rural and urban life of Missouri. Back then when the above picture was "snapped", the classroom problem being discussed might well have been "deep vs. shallow cultivation," but whatever it was, the subject was timely.

* * *

Animal, Soil, Human Health

By CLYDE H. DUNCAN
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COLUMBIA — The Texas cowman's forefinger dug at a tick in the steer's flank. His eyes became close - lidded as he studied the hard, flat insect. He fingered it in his leathery left palm. "Disease carrier! Cattle killer" His words cracked like a bull whip.

He crushed the blood - sucker. There was the tell - tale red clot. He cursed his fate. "Blood of my cattle. Lucky to make it up the trail to Abilene with only a handful of old crusty, mossy-horns left." With one hand he pushed the wide - brimmed, tall-crowned Stetson farther on his head. The forefinger of the other hand troweled sweat and dust from a trail wrinkled forehead. Two words, words that depicted the bankrupting of plainsmen, were spat from his sun - cracked lips:

"Texas fever!"

The disease became noticeable a hundred years ago in the great trail movements, Texas to the stock - raising sections of the West. The carrier of the disease, researchers found just as cattlemen predicted, was the tick, a villain, with four pairs of legs, one pair more than common insects.

So this pest, indirectly a $40 million - a - year cattle killer, suddenly topped America's "most wanted" insect list. The entomologists, the G-Men of the insect world closed in. He definitely, they knew, was a carrier of Texas fever.

* * *

Tick studies that helped lay the groundwork for handcuffing the disease were soon started in 1906 by the Missouri Agricultural Experiment Station. They included the habits and distribution of the tick.

It was soon found that the pest is very sensitive to light; he travels always away from it. On a grassy pasture the distance, he will move is but a few inches from the point where dropped from the infested cattle host — four feet, at the most, is the extent of his travel on his own power. It was found, too, that ticks lose their power of transmitting the disease when grown upon mules or horses. Small studies now, you say, but they contributed heavily in early plannings on tick control and eventually total eradication.

When finally the nation became "tick free" and the controversial vats emptied of their arsenical dips, Dr. W. M. MacKellar, then principal veterinarian of the Bureau of Animal Industry, summed up the vast effort in one sentence. "The fight to eliminate the cattle fever tick from the United States is probably the most extensive and sustained campaign ever made against any of man's parasitic enemies."

Missouri's part, in the Texas fever campaign, is according to script as always when the country's food supply is endangered.

* * *

The Missouri Agricultural Experiment Station is the research arm of the land - grant college program. The Hatch Act produced it in 1887. Physically the station consists of scientists in many fields. They have their laboratories in Columbia, and their fields and feedlots in various parts of the state where they can best study specific problems. The researchers also teach classes in the Missouri college of agriculture in addition to their research.

The experiment station started out to serve farmers primarily, but today it serves not only rural people but all residents of Missouri. A look at some of the station's accomplishments in its 70-year life leaves one amazed at the mass of knowledge and wisdom so acquired. There was its part in helping eradicate pleuropneumonia, a form of cattle disease complicated by pleurisy. Came backleg in calves, most infectious, and fatal, young animal disease known.

In France, a vaccine had been discovered, blackleg's only known antidote. The Missouri Experiment Station became the first in this country to make it, immediately reducing heavy losses from this plague.

The saga of smallpox vaccine for human immunization against awful outbreaks of that malady reads like fiction. The Missouri station produced and distributed the first smallpox vaccine made west of Boston.

* * *

It was the first to establish a laboratory, putting to scientific and practical test anti - hog - cholera serum. The Experiment Station produced the serum until commercial interests took over the industry in 1930.

Then came brucellosis, so named from its discoverer, Sir David Bruce, Scot physician. He determined that the disease was the source of undulant fever. Victims suffered with enlarged spleens and pained joints. Milk from infected cows carried the disease bacteria. The Missouri station, one of the first in America, carried on basic research in the prevention and control of brucellosis. Today the names of Paquin, Connaway, and Durant, who pioneered in studying this disease on the staff of the Missouri station, are renowned partly as a result.

"The old studies," as the present - day researchers at the station refer to them, almost in the tone of benediction, included such findings as those of Dr. Paul Schweitzer. They made notable use of chemical analysis.

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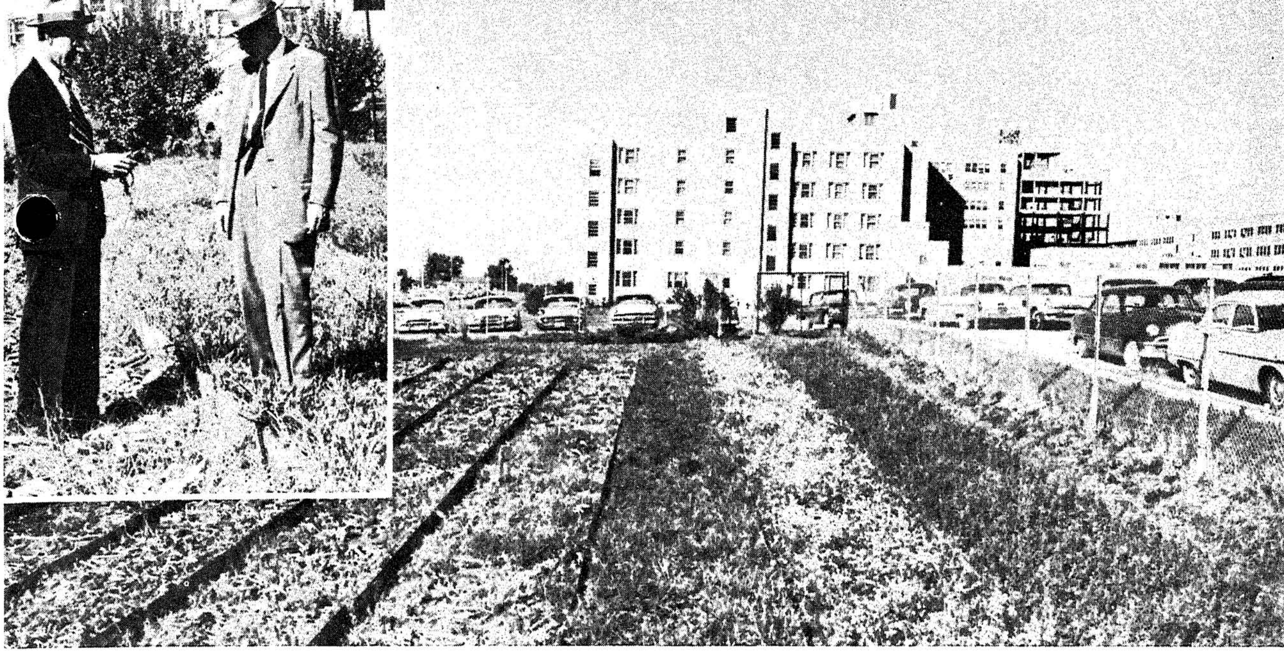
Noteworthy among the findings then was that "superior tillage methods, with the chemical and physical processes thus brought about in the soil, constitute the key to the maintenance of fertility." They found also "That adequate root development will lay the foundation of a good crop." Our great body of agricultural knowledge today goes back to



First plots in the United States for studying runoff and erosion from cropped land are shown above. Started by M. F. Miller and F. L. Duley in 1917 the results from the plots provided the foundation for the soil conservation movement. The design of the experiment was used as a pattern for future experiments by the USDA erosion in studies. Since 1941 the plots have been used to study reclamation of eroded land with Dr. C. M. Woodruff of the University of Missouri's soils department in charge. The inset picture shows Dr. Woodruff in conversation with Dr. Miller, who with Duley, originated the erosion study and is now dean emeritus of the college of agriculture.

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--All Chaff to Ag Research

such precepts.

"Ensilage better than corn fodder?" farmers questioned 30 years ago. They turned to their state experiment station. Came the answer: "There is a loss in nutrients after fodder goes into the silo; but the loss is compensated by an increase in palatability." Sugar corn fodder for dairy cows, field corn fodder for steers led in the feeding trials then.

Waters, Trowbridge, and Hogan made contributions in the field of nutrition which made the experiment station, and the men, internationally known. Their studies have become guides for present day scientists throughout the civilized world.

Begun by Waters, and carried out later by others, was the famous "use of food" experiment. They found out the composition of the flesh of animals fed on different planes of nutrition. The "retarded growth" experiment, started in 1914, studied the effect of slow growth in a young animal upon its condition when mature, and at the end of a later feeding - out period.

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Research in fundamental problems of animal nutrition were largely the work of Hogan. The nutrients — including vitamins, amino acids, and minerals — essential for a complete life cycle were determined.

Weaver's hog breeding and feeding research; Brody's energy metobaolism studies; and McKenzie's animal reproduction investigations, forerunner of today's knowledge in artificial breeding are but a few in the long list of the station's credits in research which have contributed to the scientific knowledge of the age.

Eckles' research helped to move the Missouri station into the very forefront in dairy science. The valued knowledge of nutrients required for milk production; importance of silage in dairy feeding; causes of growth in dairy cattle, and the development of "normal" standards, were a few of Eckles' accomplishments.

These were to be added to in recent years by Ragsdale and his associates, including Turner. The latter's work in endocrinology, a study of the endocrines, such as thyroid, adrenal, and pituitary glands is monumental.

Here was opened the door showing the internal gland secretions to be the determiners of efficiency in milk secretion. Highly practical this has proven for the man who milks cows. In that same area was the work of Eckles and Palmer in studying pigments of milk - carotin in the milk fat, and lactochrome in the whey. Then was laid the foundation for later research which has shown that carotin is the provitamin A and lactochrome is vitamin G, often termed lactoflavin or riboflavin.

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The rest periods in plants, in the days of World War I, interested Howard and his conclusions were significant as basic research. Then came the work of Miller, the slender, keen - eyed future dean, who found much of signficance in the relation of soil colloids to soil properties.

Then there were his and Duley's studies on the effect of a varying moisture supply on the development of the corn plant. In all this mountainous mass of data, there was always a keynote of practicability showing through, new knowledge gained which could be applied and used in Missouri's field and feedlot.

There's Murneek's work at the Missouri station which was of genuine value to the fruit growers. It included, among other studies, the physiological mechanization of reproduction in horticultural crops. There was his famous hormone studies in which he investigated their influence on apples, and other orchard crops.

It will take years yet to fully evaluate work in genetics. One of his studies, the transmission of characters in field crops, would be enough for an average lifetime. This genius of his age found time for much more, however, until now it would require volumes to record all his findings and observations.

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There's the old story of three score and 10 years of constant cropping, as carried on at Sanborn Field, that research land inside the Columbia city limits. It was started by Sanborn and carried on in later years by Albrecht, Smith, and others. There's the work of Miller again on water runoff and soil loss. It is the study which became the keystone of the national program of the Soil Conservation Service.

Doane and Johnson in agricultural economics, through their studies in farm management, launched a quarter of a century of balanced farming on thousands of Missouri acres. These are only a few of the many experiments which, since the station's founding, have caused men, capable of evaluation, to remark, "A dollar buys more in genuine research at the Missouri Agricultural Experiment Station than anywhere else on earth."

Its problems today differ from yesterday only in that they are the problems of a new day. The studies of dwarfism in cattle, foulbrood in honeybees, and nematodes in many crops are only a few found in some 225 separate and distinct pieces of research now being catalogued and carried on.

To what end is all of this being done? To solve fully the problem of the man who today will pick the tick from the steer's flank, and will curse his losses, or as a former director of the station, F. B. Mumford, once said, "To establish in Missouri a permnent and prosperous agriculture, and a contented and efficient people."

The amount of water under a corn field in central Missouri is being measured by this equipment, manned by a soil scientist of the Missouri Agricultural Experiment Station. Radioactive material is being lowered into the soil from the apparatus on the right. This material sends out neutrons which are intercepted by the hydrogen in the water of the soil and returned. The box in the foreground is an electronic device which counts the number of returning neutrons. From this count a rapid measurement of the amount of water in the soil may be obtained. In this research the Missouri Experiment Station shows how radioactive materials and electronic equipment may be put to peacetime use to gain knowledge with which to assist the farmer engaged in irrigation.

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Not Yet, but M.U. Research Promises It

Measure October's Crop Yield in June

By CLYDE H. DUNCAN
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University of Missouri

COLUMBIA — How many bushels of corn or wheat, bales of cotton, or tons of hay farmers produce per acre in the future may be directly tied in with the peaceful use of radioactive materials, and electronic equipment now in use in today's agricultural research. Such is the opinion of Wayne L. Decker and John F. Gerber, scientists of the Missouri Agricultural Experiment Station.

Decker and Gerber last summer engaged in a study to determine the rate water is used by plants, under levels of high production. They made use of a field of ordinary corn at one of the outlying farms of the Missouri Experiment Station near McCredie.

What difference does it make at what rate a corn plant uses water? Decker explains: "As a result of this study agronomists and horticulturists will be able to determine the condition of their crops before symptoms of water stress are noted. The danger point, so far as plant thirst goes, will be noted much sooner than in the past when information on water used by a crop cover could only be obtained in a much slower way." Decker says now it will be possible for farmers to have knowledge regarding the level of soil water without going through a more laborious process.

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Perhaps one of the brightest spots of this interesting study is the help it will give to the producer who irrigates. The irrigator will be able to learn the most suitable time for applying water, thus adding efficiency by eliminating guesswork.

Decker says this new research will also make it possible to generalize about water conditions over wide areas of the state. It will also provide important information about the biological processes involved in the transfer of moisture from the soil, through the plant, and into the atmosphere, and help provide the means whereby the plants will use water most effectively.

In explaining the research, Decker says that there are two methods for determining the amount of water used by a high producing plant: the direct method, making use of direct measurement of water in the soil; and the indirect method, or estimating through measurement of certain factors in the environment.

The direct method was the one used at McCredie — with a curious box-like apparatus, on a 10-acre plot of corn. Certain radio active material was lowered into the soil, emitting radiant energy to break down the nucleui of atoms.

* * *

"When thus broken," Decker explains, "the material sends neutrons out into the soil." Neutrons are the fundamental particles of an atom. Neutrons are uncharged, and have about the same mass as protons, one of the basic particles of the nuclei of all atoms.

As these neutrons move into the soil, the hydrogen atom, a part of each molecule of soil water, intercepts the neutrons and returns them to a detector. By comparing the number of returning neutrons to a standard, the amount of water in the soil can be determined.

While an excellent way of measuring moisture present, this is also expensive. "Neither does it give any information about the biological, or physical factors, involved in the movement of water from the soil to the air," Decker points out. But it is a real beginning in the right direction, he thinks.

Weather — whether a sunny or a cloudy day — determines the amount of moisture used by a plant. This is the basis for using the indirect method for estimating amounts of water used by plants.

There are two theories relative to indirect methods, Decker says. The first involves the fact that heat is used when water is evaporated from plant surfaces. By measuring the amount of heat transferred from the crop cover to the sky, and from the sky and sun to the cover crop, scientists obtain an estimate of the energy which may be used for heating the soil, warming the air, and evaporating water from the plant.

It is also possible to estimate the amount of heat transferred to the soil and to the air. This leaves the amount used in evaporation. Thus, Decker says, the rate of water loss by evaporation, and the amount given off through expiration may be obtained."

* * *

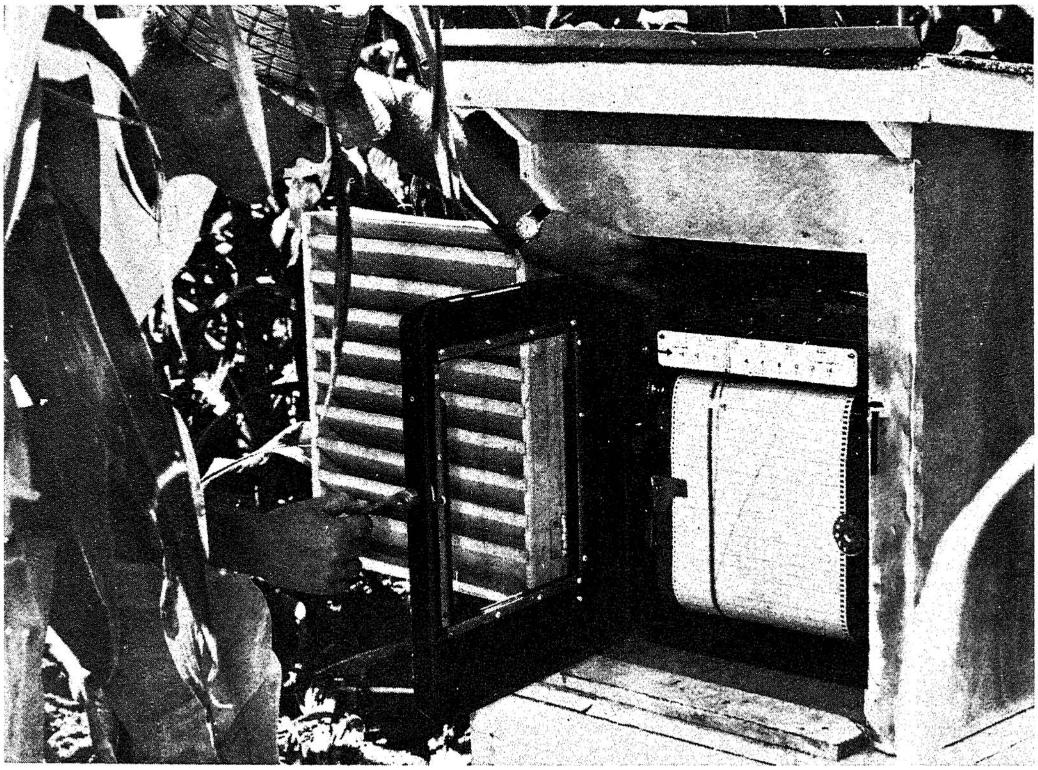
Another indirect method of estimating water used by plants makes use of the relationship between temperature, humidity and wind movement in the water used by vegetation. These relationships are now being checked, as part of the study, to determine the most useful.

The past summer's research results indicate that a rapidly transpiring corn plot will transfer between .15 and .33 inch o water to the surrounding air eacl day.

This indicates that not onl large amounts of water are tran ferred to the atmosphere froi the soil, but that also there is a great variation in the amount thus moved daily. It is Professor Decker's opinion that this variation indicates the importance of the weather condition in determining the amount of water used by plants.

During the past summer the research has shown that in general the air near the ground supplies energy to the crop cover which is used in evaporation. An interesting fact brought out by Professor Decker is that only during periods of cool weather is heat transferred to the atmosphere from the corn field as heat instead of being used in evaporation.

This study may lead into very fruitful fields. It may be possible in the future to estimate to a barrelful the exact amount of moisture needed in the soil on June 30 to produce 150 bushels per acre of corn in October. You say that is a job for the "weathermen." Well, Decker and Gerber at heart are really "weathermen" and as such they had the cooperation in their study of the Agricultural Research Service of the U. S. Department of Agriculture; the Agricultural Engineering Department of the University of Missouri, and the U. S. Weather Bureau from whose funds a grant was provided to help the research along.



RECORDS ENERGY — This equipment is recording the amount of energy gained or lost by a corn field of the Missouri Agricultural Experiment Station near McCredie during a hot day last summer. It is also recording the amount of energy entering or leaving the soil under the corn field. From these measurements estimates of water usd by the corn plants may be obtained. This information will be helpful in period of drouths, and will assist in planning irrigation needs.