History
of the
DEPARTMENT OF
POULTRY HUSBANDRY
by E. M. Funk

SR 85-68
UNIVERSITY OF MISSOURI
AGRICULTURAL EXPERIMENT STATION
DEDICATION

This publication is dedicated to Professor H. L. Kempster, the man who started poultry research, teaching, and extension work at the University of Missouri in 1911. He served as Chairman of the department for 43 years (1911-54) and remained active in poultry work until his death in 1962. He laid the groundwork for the programs that have been developed in the department.
FOREWORD

Department of Poultry Husbandry history at the University of Missouri spans the years from 1911 to the present and is found in many places. Unless someone associated with the department over a considerable part of that span of years was found to organize and record the history immediately it was in danger of being lost. Thus, in 1966 the department called on E. M. Funk to undertake the task. Dr. Funk has been a member of the staff since 1927 (with a 2-year absence at Penn State 1928-30) and he was associated with Professor H. L. Kempster continuously from 1930 to 1962. He was the logical one to write a history of the department.

Professor Kempster had kept copies of most of the departmental correspondence since 1911. This material was examined and pertinent historical information from it has been included in this publication. However, much material had to be omitted because of space. It is hoped that the information included may be of interest to those associated with the poultry industry during the time this history was being made, and to those who may become a part of it in the future.
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History
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DEPARTMENT OF POULTRY HUSBANDRY

by E. M. Funk
FIRST INSTRUCTOR IN POULTRY HUSBANDRY

The records of the Board of Curators of the University of Missouri show that Professor F. H. Stoneburn of Connecticut was employed by the Board as Instructor in Poultry Husbandry for the Winter Short Course (February 14 to March 5, 1910) at a salary of $50 per week plus traveling expenses from Connecticut. Thus Professor Stoneburn became the first instructor in Poultry Husbandry, but his lectures were presented to non-college students.

Professor Kempster wrote in 1939 that in the winter of 1911 (before he was appointed), Professor J. Kerr conducted a short course in Poultry Husbandry at the University of Missouri.

EARLY RESEARCH WORK

Poultry received little attention, the University's records indicate, until a department was established in 1911 where poultry research and teaching were conducted and the people could turn for information. The fact that Professor Kempster answered 800 letters the first year he was at Missouri indicated the demand of the people for information in this field.

Little research with poultry was done before the department was established. However, in 1954 Dean M. F. Miller sent the author an original 1896 plan of an experiment in the Missouri Agricultural Experiment Station (department not indicated) which read as follows:
EXPERIMENT NO. 29
CAPONIZING CHICKENS AND TURKEYS

Object:

Comparison of the growth of caponized and uncaponized chickens and turkeys.

Plan:

Fowls: Select two dozen chicks about 2½ months old, as nearly of the same breed, age, conformation and size and general vigor as possible. Divide these fowls into two lots of twelve fowls each, making the two lots as nearly uniform in live weight as possible, and caponize one lot.

Select one dozen turkeys of about the same age, and divide and caponize as in the case of the chickens.

Mark each fowl with a permanent label, with number, and take the live weight of each immediately before the caponizing is done. Weigh separately at the end of each month until the close of the experiment.

Treat the two lots of each breed alike in all respects, and allow them the run of the chicken yards at the Farm until October 1st, when they should be confined to smaller yards, and then grain-fed to the full limit of their appetites until the close of the State Poultry Show, recording the grain consumed by each lot.

Exhibit all lots at the State Poultry Show, and as soon after its close as possible kill and dress one-half the fowls of each lot and note the weight of the dressed carcass, the vital organs, blood, etc.

The remaining fowls to be fed until the latter part of March 1897, when they should be killed and the data as above gathered.

EARLY EXTENSION

During 1912 eight institute lectures were given and three poultry shows judged. The Department was represented on the Rock Island Cream and Egg Special which made thirty stops. Poultry talks were given at each stop.

A Departmental report of 1912 commented: The large amount of teaching work and the details of organizing a new department have, necessarily, occupied the Department’s attention and as quickly as possible, more time will be devoted to the extension and investigational work.

Before the Cooperative Extension Act was passed (1914), and for some time thereafter, Professor H. L. Kempster held poultry meetings out in the state. That there was much interest in such meetings is indicated by the following reports submitted by Professor Kempster in 1917.
MEETINGS AT AUGUSTA (ST. CHARLES COUNTY)

February 14 a.m. Poultry Houses 100
February 14 p.m. Poultry Feeding 200
February 15 a.m. Raising Chicks 100
February 15 p.m. Marketing 100

MEETINGS IN HOWARD COUNTY

February 18 a.m. Poultry Houses 50
February 18 p.m. Raising Chicks 50
February 19 p.m. Feeding for Eggs 60

ESTABLISHMENT OF THE DEPARTMENT OF POULTRY HUSBANDRY

The demand for a poultry department in the College of Agriculture arose from the fact that the poultry industry had developed into an important segment of the agricultural industry of Missouri by 1900 to 1910 and there was no well organized research or teaching at the college level in the state. The industry had developed a rather strong organization and they were seeking recognition of their industry. The establishment of the Poultry Experiment Station at Mountain Grove grew out of neglect of poultry work by the Missouri College of Agriculture and the Agricultural Experiment Station. The industry worked for an appropriation to establish poultry work at the University but the funds were used to build a horse barn instead. At the next session of the legislature the industry secured an appropriation to establish the Poultry Experiment Station at Mountain Grove. The College of Agriculture then tried to counter the industry's move by establishing the Department of Poultry Husbandry in 1911.

The fact that virtually the only poultry work in the University prior to 1911 had been an occasional lecture appeared to justify the industry's position that the poultry industry was neglected. Missouri was slow in starting poultry research and teaching at the college level. As early as 1902 Kansas State College employed a "Student Assistant in Charge of Poultry." As early as 1905, the Utah State Agricultural Experiment Station published Bulletin 92—"Poultry Experiments" (100 pages) which reported the results of well planned experiments conducted by Professor James Dryden. Iowa State College began poultry teaching and research in 1907.

Dean Mumford Begins Search

In 1911 Dean F. B. Mumford of the Missouri College of Agriculture began correspondence with H. L. Kempster, then on the poultry staff at
Michigan State College, with respect to starting poultry work at the University of Missouri. This correspondence reveals some interesting information about the industry at that time and also something about the salaries of University employees.

June 12, 1911, Dean Mumford wrote Professor Kempster as follows:

Your name has been suggested to me as a possible candidate for the position of Assistant Professor of Poultry Husbandry in this University. We are just beginning our Poultry work here. It is our wish that first class instruction in Poultry Farming shall be organized and that a definite and useful line of experimentation shall be carried on. The Board of control will make such appropriations as are essential to the development of this work. We have a stone Live Stock building now occupied by the Veterinary Department which will be vacated by them September 1. It is our present intention to locate the Poultry department in a portion of this building.

There is great interest in poultry work in Missouri. As you may perhaps know, the value of poultry products sold out of Missouri each year exceeds $40,000,000. It is claimed that Missouri leads all other states in the value of its poultry products.

The minimum salary of an Assistant Professor in this University is $1500. It is our intention to appoint an Assistant Professor in charge of the Department. This means that as soon as the incumbent of that office has proven his ability he will be advanced by gradual steps to a full Professorship in this University and promoted as our resources and the ability of the man require. The maximum salary of Professors in this University is $3300.

If you are interested in this position I shall be glad to have you submit letters from your associates and a statement as to your training and experience.

Kempster's replies are missing from the Poultry Department files, but under date of July 5, Dean Mumford wrote as follows stating that "the position must be filled immediately":

I have your letter of June 19th in reference to the vacant position in the Poultry Department. It is my judgment that there are large opportunities for the development of a high class and successful Poultry Department at this University. Some of the reasons for this belief are that the College of Agriculture is now in a position to secure the help of the Farmers of Missouri. At no time in our history have they shown so much interest and enthusiasm in the development and progress of the work of the departments.

An additional reason is that Missouri is one of the greatest Poultry States in the Union. The value of our Poultry Produce [$40 million] exceeds in value many other of our most important Agricultural products. Some interesting figures as to total values in Missouri are;—Corn 114 millions, wheat 29 millions, hay and forage 37 millions, cotton 3 millions,
potatoes 4 millions, horses and mules 40 millions, meat cattle 25 millions, hogs 6 millions. You will see from these facts that the Poultry Industry is of large significance. We have a very efficient State Poultry Board, interested in the development of the poultry interests of the State. There is opportunity for a good Poultry Instructor and Investigator in Missouri, to make for himself a reputation in Missouri, and throughout the United States. We are prepared to secure efficient equipment for the department, we have a stone Live Stock Building which it is our purpose to use largely for Poultry work.

We enrolled 704 students in the Agricultural classes last year, many of these men desiring Poultry Instruction. During Farmer's Week in 1911, 1300 farmers enrolled, and the Poultry Lectures were crowded throughout the week. We are organizing branch courses throughout the State, and these will demand some Poultry Instruction.

We wish to encourage in every possible way the development of investigational work and this encouragement will be given to the Poultry Department, as it is now given to all Departments...[We] desire to know if you will consider the position of Assistant Professor in Charge of the Poultry Department of the University of Missouri at a salary of $1750.00 a year, your duties to begin September 1st 1911. I will greatly appreciate an answer to this letter at your earliest convenience, as the position must be filled immediately.

July 19, 1911, Dean Mumford wrote Professor Kempster that he was recommending him for the position of Assistant Professor in Poultry Husbandry to begin September 1, 1911, at a salary of $1750 per year, giving more details as follows:

In reply to your letter of July 17th, will say it is my desire to recommend a man for the department of Poultry Husbandry at the July meeting of our Executive Board of Curators. In order to do that I must submit my recommendation to-day. I have decided to recommend you for the position.

I have tried to give you a clear idea of the opportunity for poultry instruction and investigation here, and I believe you will make no mistake in accepting this place. The Poultry Department will be a distinct department, in no way connected with the Department of Animal Husbandry. The building which we are planning to make the headquarters of the Poultry Department...is at least one block from the nearest corner of the proposed poultry yards. The location of the poultry yards is not yet definitely determined. It is my plan to await the arrival of the Poultry Instructor before taking any definite steps in that direction.

You understand that this is a new department, you will have an opportunity to build from the ground up. The success of the work will depend upon your efforts...
August 4, 1911, Dean Mumford wrote that the Executive Board of Curators had elected Kempster "to the position of Assistant Professor in charge of the Department of Poultry Husbandry." J. G. Babb, Secretary of the Board of Curators under date of August 4, 1911, notified Professor Kempster of his appointment as follows:

At the meeting of our Executive Board on the 31st ult., you were appointed assistant Professor of Poultry Husbandry in this University at a salary of $1750, beginning September 1, 1911.

Please let me know as soon as convenient whether you will accept the appointment.

Locating the Poultry Plant

Problems arose with the neighbors in locating the University Poultry Farm in 1911, as they do in 1966 with the modern commercial poultry enterprises.

Professor Kempster had recommended the location which later was accepted and the Board of Curators had approved that location as evidenced by the following notice:

"The Executive Board at its meeting on the 28th inst., approved the location of the Poultry Plant on the field immediately in front of J. N. Fellow's house."

That some problems had arisen was indicated by Dean Mumford's hand written letter to Professor Kempster October 20, 1911, in which he stated:

"Please set your stakes for proposed location of poultry building on the grounds selected but do not begin the actual construction until authorized."

Then, under date of October 26, 1911, Dean Mumford wrote as follows:

"Mr. Babb has just notified me that the Board has ordered that further work on the Poultry Plant be suspended until they give us further notice."

"Therefore, please stop all work on same until further notice."

The difficulties were resolved by the University agreeing to restrict the poultry yards to some distance south of Porter Street.

After the farm was in operation the neighbors learned that they could purchase fresh eggs at the University Poultry Department and all opposition vanished.

Poultry Department Secures Secretarial Service

In 1966 it is difficult to understand the conditions that prevailed in 1911 when the Department of Poultry Husbandry was established. The following letter to Kempster from J. G. Babb, secretary, Board of Cura-
tors, dated July 5, 1912, indicated the dearth of funds available for secretarial help in the College of Agriculture in 1912.

"At the meeting of the Executive Board on the 1st inst., Miss Sara J. Davenport was appointed stenographer for the Departments of Agronomy, Forestry, Poultry Husbandry and Rural Education at a salary of $50.00 a month, Beginning July 1, 1912, one-half to be paid from the Outlying Experiment Fund and the remainder from the General Maintenance Fund. One-half of her time is to be given to the Department of Agronomy and the remainder to be divided between the Departments of Forestry, Poultry Husbandry and Rural Education."

Dean Fears Legislative Investigation of Bathtub Purchase

Funds for poultry work were not only scarce before World War II but much caution was required in their use. October 12, 1916, Professor Kempster requisitioned a bathtub for the Poultry Farm superintendent and family who lived on the Porter Street Poultry Farm. The estimated cost was $13.

Under date of October 14, Dean F. B. Mumford wrote to Kempster:

"I have your requisition of October 12 for a bath tub for the foreman at the Poultry plant. In general, I approve this expenditure but question the expediency of spending money for a bath tub in the Poultry building, which has a remote relation to poultry instruction or investigation. Under other circumstances I might not question this purchase, but when the Poultry department, like every other department in the University, is struggling for funds to conduct the really important work, I am of the opinion that it is wiser not to make this purchase at this time.

"There is another reason: Unquestionably, the State Legislature will make an investigation of the expenditures of the University during the next session of the Legislature and an expenditure of $13 for a bath tub for the foreman of the Poultry Plant would furnish a rare opportunity for some aspiring politician to criticise the University for extravagance."

Evidently this letter stopped the purchase of the bathtub. The requisition and Dean Mumford's letter remain in the files of the Poultry Department.

Securing and Developing Staff

One of the major problems of a research and educational agency is to secure and maintain a staff of well trained personnel. In the early years and throughout most of the period (1911-66) it was necessary for the department to train staff members by providing them with some assistance while they continued their graduate training. A staff can be developed by this process at a minimum of expense. In recent years, with more funds available, it has been possible to employ staff members from other institutions.
Professor Kempster maintained a one-man department from 1911 to 1920 with some student assistants: George Harvey, E. L. Dakan, and E. H. Rucker. In 1921 Professor E. W. Henderson became an instructor in the department. In 1930 he became chairman of the Poultry Department at Iowa State College and E. M. Funk followed him at Missouri. M. A. Seaton served as instructor in 1929-30. In 1934 J. E. Parker joined the staff as instructor working on his doctor's degree. Lester Williams served as instructor, 1939-41, M. R. Irwin was instructor from 1939-43 and Assistant Professor, 1946-47.

### Senior Poultry Resident Staff (1966)

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<tr>
<th>Name</th>
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<th>Years</th>
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<tr>
<td>BIELLIER, H. V.</td>
<td>Instructor</td>
<td>1953</td>
</tr>
<tr>
<td></td>
<td>Assistant Professor</td>
<td>1955</td>
</tr>
<tr>
<td></td>
<td>Associate Professor</td>
<td>1958-</td>
</tr>
<tr>
<td>COTTERILL, O. J.</td>
<td>Assistant Professor</td>
<td>1956</td>
</tr>
<tr>
<td></td>
<td>Associate Professor</td>
<td>1958-</td>
</tr>
<tr>
<td>FUNK, E. M.</td>
<td>Instructor</td>
<td>1927</td>
</tr>
<tr>
<td></td>
<td>Assistant Professor</td>
<td>1930</td>
</tr>
<tr>
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<td>Associate Professor</td>
<td>1935</td>
</tr>
<tr>
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<td>Professor</td>
<td>1951</td>
</tr>
<tr>
<td></td>
<td>Chairman</td>
<td>1954-66</td>
</tr>
<tr>
<td>HOLLEMAN, K.</td>
<td>Professor</td>
<td>1966-</td>
</tr>
<tr>
<td>KINDER, Q. B.</td>
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<td>1966-</td>
</tr>
<tr>
<td></td>
<td>Assistant Professor</td>
<td>1947</td>
</tr>
<tr>
<td></td>
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<td>1951</td>
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<tr>
<td></td>
<td>Professor</td>
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<td>SAVAGE, J. E.</td>
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<td>Chairman</td>
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<td>STEPHENSON, A. B.</td>
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### Poultry Resident Staff (Early years)

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<tr>
<td>FORWARD, JAMES</td>
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<td>Technician</td>
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<tr>
<td>HALL, NOEL</td>
<td>Instructor</td>
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<tr>
<td>HENDERSON, E. W.</td>
<td>Instructor to Assoc. Prof.</td>
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<td>KEMPSTER, H. L.</td>
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<tr>
<td>KRUEGER, W. F.</td>
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<td>IRWIN, M. R.</td>
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<tr>
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<tr>
<td>PARKER, J. E.</td>
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<td>SCHNETZLER, E. E.</td>
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<td>SEATON, M. A.</td>
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<tr>
<td>WILLIAMS, LESTER</td>
<td>Instructor</td>
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</table>
The Poultry Department staff from 1921 to 1930 consisted of Chairman H. L. Kempster, left, and one faculty member, E. W. Henderson, instructor and assistant professor.

Poultry Husbandry staff in 1940 consisted of E. M. Funk, M. R. Irwin, and H. L. Kempster.
Enrollment

The enrollment in poultry courses has varied widely over the years as is indicated by figures compiled by Professor Kempster. The table gives his enrollment figures from the beginning of the department in 1911 until his retirement in 1954. A total of 7,811 students attended two courses in that period. An additional 1,767 attended short courses.

The first course was taught by Professor Kempster in 1912 and that class, consisting of 11 men and two ladies, is pictured on page 11. Early instruction was primarily by lecture but the establishment of a poultry

<table>
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farm (corner of College and Porter) provided birds and eggs for laboratory instruction in judging, grading eggs, incubation, and brooding chicks. Students also had an opportunity to learn poultry management first hand by working on the University Poultry Farm.
TEACHING

Undergraduate Courses

Teaching has always been emphasized in the department. Beginning in 1912, which was the second year after the department was established, the following courses, all taught by "Mr. Kempster," were described in the 1912-13 University of Missouri Catalogue.

1a. Elementary Poultry Raising. A general course dealing with poultry house construction, yarding, fattening, killing, dressing, marketing, and a brief description of the more common breeds. Laboratory consisting of demonstrations in the practices of handling poultry. Two lectures and one laboratory period a week. (3). Mr. Kempster.

2b. Elementary Poultry Raising. A continuation of course 1a. Feeding and general care; common diseases of poultry; incubating, brooding and the handling of farm poultry. Two lectures and one laboratory period a week. (3). Mr. Kempster.

3a. Feeding Practice. Must be preceded or accompanied by courses 1a and 2b. Practice work in fattening poultry for market; feeding for egg production. Record of feed is kept to determine cost of production. (2). Mr. Kempster.

4a. Poultry Judging. Must be preceded or accompanied by course 1a. A study of the history of breeds of poultry, and the application of breeding principles, with special attention to utility judging, and judging according to Standard of Perfection. Two lectures and one laboratory period a week. (3). Mr. Kempster.

5b. Poultry Farm Management. Must be preceded by or accompany courses 1a and 2b. A study of poultry farm methods and practices. Lectures, laboratory and assigned work. (3). Mr. Kempster.

6b. Incubating and Brooding Practice. Must be preceded by or accompany course 2b. Practice work in incubation and brooding. The student hatches and raises chickens, keeping accurate records and submitting detailed reports. Nine weeks, by appointment. (3). Mr. Kempster.

There have been many changes in courses over the years. The 1966-67 University of Missouri Catalog listed the following Poultry Courses offered in the Department of Poultry Husbandry:

101 Poultry Science
201 Poultry Judging
300 Problems
301 Egg Technology
302 Poultry Farm Management
303 Poultry Breeding and Incubation

KINDER
KINDER
STAFF
COTTERILL
KINDER
STEPHENSON
Poultry Correspondence Courses

The department has offered a beginners’ correspondence course in Poultry Production for more than 30 years. This three-hour course has been completed for college credit by several hundred students. Enrollment has varied greatly. At present (January, 1967) there are 23 students enrolled in this course. Several of them live in foreign countries, six in Nigeria, one in Hong Kong, and five or six are U.S. Servicemen.

NON-ACADEMIC PERSONNEL

Secretaries

The first secretary, Miss Sara Davenport, was employed July, 1912, at $50 per month to spend half of her time working for the departments of Forestry, Rural Education, and Poultry Husbandry. The other half of her time was to be spent in working for Agronomy.

Not all of the secretaries’ names could be found in the records but those since the author has been on the staff, beginning in 1927, have been the following: Miss Doris Browning (part-time student), Miss Harriett Rimmer, Miss Natalie Thurmon, Mrs. Wyleta Rice, Mrs. Wanda Mayfield, Mrs. Doris White, Mrs. John L. Wright, Mrs. Russell Smith, Mrs. Sharon Wall and Mrs. Linda Bretches.

Assistants

Professor Kempster listed several assistants who held appointments below the rank of instructor. These people were on board appointment. This does not include student workers.

The first student appointed to assist Professor Kempster was R. V. Mitchell. He was appointed September 1, 1912, and served until he graduated in 1913.
C. A. Webster, a graduate of the Ontario Agricultural College, followed Mitchell as student assistant, serving from September 1, 1913, to August 1914, when he joined the Canadian army.

E. L. Dakan served as an assistant in the department in 1918-19 at a salary of $800 per year. He served for many years as Chairman of the Poultry Department at Ohio State University. He is now retired and lives in Columbus, Ohio.

In more recent years, most of the graduate students have been on appointment as assistants or graduate assistants. They are listed as graduates and their degrees and year of graduation are listed.

Poultry Farm Superintendents, Foremen, and Caretakers.

H. A. (Zeke) Henly was the first caretaker of the newly established University Poultry Farm. He served from January, 1912, to August, 1913.

Wilson Cramer, an undergraduate who later graduated at South Dakota, served as caretaker in 1915-16.

H. L. Peabody served as poultry farm superintendent for many years. He was followed by James Forward and George Rector.

In more recent years and with the addition of the South Poultry Farm and the Rochester Turkey Research Farm, the following men have served as foremen: Norman Holman at the Porter Street Farm from 1960 to date; Claude Howard at the South Farm 1950-1960; and Ralph Poe since 1960.

The foremen at the Rochester Turkey Research Farm have been Ralph Monroe 1957 to 1959, Ronald Paschang 1959-1962, and Edgar Drane since 1962.

Technicians

The classification, Technician, was first used in the department in 1954 when James Forward who handled sales and processed poultry and eggs for sale was designated a technician. In 1960 Norman Holman who supervises the poultry farms was designated a technician.

In 1965 Donald Toalson was employed to serve as technician for the new poultry Physiology building. Leonard Schulte was placed in charge of the chick nutrition building and appointed technician. In 1966 Mrs. Jean Glauert was appointed three-quarters time technician for the egg research laboratory.

POULTRY LADIES’ CLUB

The Poultry Ladies’ Club was organized in 1945. Meetings were held in the home of members.

Those eligible for membership are wives of the Poultry Department staff members, poultry student wives, wives of poultry farm superinten-
dent farmer ladies of the Poultry Department and the Poultry Improvement Association.

Membership dues are one dollar a year for all except the wives of poultry students; theirs are fifty cents a year. The organization met monthly for many years, then the number of meeting times was reduced until, at present, the organization functions mainly to sponsor such special events for the Poultry Department as the annual Christmas dinner and the annual spring barbecue. One year the organization sponsored a "Get Acquainted Get Together" in the early Fall. They also assisted the Department in planning entertainment for the ladies and children who attended the Poultry Science Association Meeting held in Columbia in 1957.

POULTRY GRADUATES

The Poultry Department has enrolled several thousand students but only a relatively small number of these students have majored or specialized in poultry. In 1954, when Professor Kempster retired, he and E. M. Funk compiled a list of those who had specialized in poultry as undergraduates or had completed a graduate program in this area. This list, brought up-to-date, is included in the Appendix.

Many of these students were members of the University of Missouri poultry judging teams who participated in the Midwest (National) Intercollegiate Poultry Judging Contests from 1920 to 1965. Pictures of winning poultry teams that have represented Missouri in the Chicago contest are included in this publication.

Students who majored in poultry and graduated from the Missouri College of Agriculture occupy many responsible positions. Some head departments in universities and in industry. Others are teaching in colleges and in universities. Dr. E. R. Halbrook heads the livestock section of the USAID Agricultural program in Nigeria. One of the more recent (1955) graduates, Ronald Myers has recently been assigned to Western Europe to represent DeKalb. He will be responsible for sales and service of DeKalb Chicks in Continental Europe and Lebanon.

Poultry graduates who have received recognition recently from University organizations include the following:

M. R. Irwin, president of Colonial Poultry Farms, Pleasant Hill, Mo. was recognized in 1965 by Gamma Sigma Delta, the Honor Society, for Distinguished Service to Agriculture. He was named by the Missouri Chapter for his service to the poultry industry and for his leadership in state and national poultry organizations. He is the 1967 second vice-president of the American Poultry and Hatchery Federation.
Dr. E. E. Schnetzler, director of Poultry research for Dekalb Agricultural Assn., Inc., received the College's Citation of Merit in 1967 for outstanding contribution to American agriculture.

Missouri Helps Start National Poultry Judging Contest

The National (Chicago) Intercollegiate Poultry Judging Contest was started in 1920 as the Midwest Intercollegiate Poultry Judging Contest with three colleges participating: Iowa State College, University of Missouri, and Purdue University. Professor H. L. Kempster of Missouri, Professor L. H. Schwartz of Purdue, and Professor Harry Bittenbender of Iowa State took the lead in organizing and conducting the first contest. Teams from their colleges participated and Missouri ranked first. The idea of such a contest originated in the Purdue Poultry Club (Roy Roberts, President). Chicago was selected as the place to hold the contest because
at that time the Chicago Coliseum Poultry Show was one of the great fancy poultry shows of the United States.

The contest consisted of judging four classes (Leghorns, Rocks, Reds, and Wyandottes) for utility or egg production and four classes of each of the above breeds for fancy judging.

The Chicago contest continued annually except during the war years of 1942-45, until 1966 when it was discontinued. Missouri had a team in each contest held from 1920 to 1964.

Winning team at Chicago in 1941 were, left to right, M. R. (Dick) Irwin, coach; Paul Tinsley; Harold Biellier; Clarence Meinert; Noel Hall; and E. M. Funk, coach.

The 1956 trophy winning Missouri team was composed of, left to right, Robert Hastings, Thomas Schubat, George Jury, and Q. B. Kinder, coach.

STUDENT ACTIVITIES

Special Events

One of the early activities of poultry students was the holding of Egg Shows. Students at the University of Missouri sponsored such shows before World War I. The display of eggs in the 1917 show is pictured below.

*Egg show staged by the Poultry Club in 1917.*
During the 1910's, 1920's, and 1930's Farmers Fair, held each spring by students in the College of Agriculture, was a great event. Many floats were prepared for the parade by different student groups. The one built in 1912 (above) by the poultry students depicted the poultry industry of Missouri as a $50,000,000 industry. In 1939, attention was focused on the World's Poultry Congress being held in Cleveland, Ohio, and the students prepared a float to show that poultry leaders from all parts of the world would be meeting in Cleveland.
In more recent years the students have sponsored barbecues in the fall and in the spring. The Poultry Club has issued a number of attractive News Letters which were circulated to the students and to other clubs.

**Field Trips and Field Training**

Teaching in a college of agriculture which serves such a dynamic industry must be related to that industry and the rapid changes occurring in it. Thus, field trips to observe the modern industry are essential in teaching students. Field trips have been used by the Poultry Department since its beginning. Some of these trips have been for only a half day but others involve all-day trips or two or three day trips to near-by states, such as a trip to Northwest Arkansas made during the Easter vacation in 1962.

Students not only learn about industry on field trips, but arrangements are made with industry to hire students during the summer as regular employees. Some have worked on large commercial turkey and chicken farms in California and Illinois. Three students were employed in 1966 by the Ralston Purina turkey processing Plant at California, Mo. Students may register for Field Training and receive college credit by making a study of the operations where they work and preparing a report under the supervision of a departmental staff member.

**Student Employment and Assistance**

Students have been employed by the department since 1911. Several students have earned most, and, in some cases, all of their expenses while enrolled in the College of Agriculture. Some students live on the poultry farm and prepare their own meals. In 1966-67, five students lived at the Porter Street Poultry Farm and worked for the department, earning most of their college expenses.

By working on the farms and in the laboratories, students get experience and training they could not otherwise obtain while going to college. Any young man who has the ability and determination, even

*Poultry graduate students and staff on a field trip to northwest Arkansas in April, 1962.*
though with limited means, can get a college education, even if his means are extremely limited. Scholarships and awards are available, in addition to employment opportunities, for students needing financial help.

**GRADUATE PROGRAM**

The Department of Poultry Husbandry cooperated from its beginning with other departments in training graduate students. However, the department did not develop a Ph.D. program until 1957, when the department requested Dr. Henry Bent, Dean of the Graduate School, to appoint a Committee to consider the department's desire to offer programs of study leading to the Ph.D. degree in Poultry Husbandry. Dean Bent appointed the following committee.

Dr. Homer Dale, Veterinary Physiology; Dr. Ellis Graham, Soils; Dr. Jacob Levitt, Botany; and Dr. A. B. Stephenson and Dr. E. M. Funk, Chairman, Department of Poultry Husbandry. Dean Bent was an ex officio member.

The committee, after considering the faculty, facilities, and proposed courses of study, recommended to the Graduate School that the department be permitted to offer the Ph.D. degree with major or dissertation in poultry breeding, nutrition, poultry products, and physiology.

This step has served as a stimulus to graduate work in the Department.

In 1966, five students completed their Ph.D. degrees in the department and four completed the Masters degree. The doctors' program is now (1967) offered under Dr. A. B. Stephenson (Breeding); Dr. J. E. Savage (Nutrition); Dr. H. V. Biellier (Physiology); Dr. O. J. Cotterill
(Products). The Masters degree is available in these fields plus Management of Chickens and Turkeys under Prof. Q. B. Kinder.

**Graduate Theses on Poultry Problems**

Graduate students at the University of Missouri have worked on many poultry problems while earning their advanced degrees. A list of these students and their theses by department in which their major adviser was located, is included in the Appendix. In most cases, there was cooperation in preparing the thesis between the Department of Poultry Husbandry and the other departments listed.

The Department of Poultry Husbandry has from the beginning had excellent working arrangements with other departments. Cooperative research, mostly non-project type, has been carried on with the departments of Agricultural Chemistry, Dairy Husbandry, Veterinary Microbiology, Home Economics, Agricultural Engineering, Agricultural Economics and Zoology. Evidence of this cooperation is shown in the list of graduate theses on poultry problems prepared in other departments.
Research with poultry or poultry products at the University has stimulated research not only in the Poultry Department but in several other departments. Included have been research projects in the departments of Agricultural Chemistry, Agricultural Economics, Animal Husbandry, Biochemistry, Dairy, Home Economics, Veterinary Bacteriology, and Zoology.

In the early years the research was of the more practical nature, but it has become progressively more basic and more sophisticated. Better trained personnel and improved facilities make possible more fundamental research.

Poultry Research Staff

Since the development of a graduate program leading to the Ph.D. degree in 1957 the research staff has been expanded significantly by the addition of graduate assistants and technicians. The research staff for 1967 consisted of six senior research staff members, 13 graduate assistants, and four technicians.

Research Publications

The Missouri Agricultural Experiment Station has developed three series of publications for reporting research: Station Bulletins, Research Bulletins, and Special Reports. Copies of articles submitted to journals are also numbered and filed at the University Library. The staff of the department has contributed to all of these series (see listing in the appendix).
Porter Street Poultry Farm

Soon after the establishment of the Poultry Department in 1911, an area of 5 acres (increased to 12 acres in 1922) owned by the University, bounded on the North by Porter Street, was assigned to the department for a poultry plant. This area was developed into a research and teaching facility.

Greatly increased enrollment after World War II overcrowded the teaching facilities available to the poultry department. The overcrowded situation was presented to Dean E. A. Trowbridge. He, together with Elmer Ellis, President; Leslie Cowan, Secretary; S. B. Shirky, Associate Dean; and Dale Bowling, Business Manager of the University, secured a surplus building from Camp Crowder which was remodeled into T-14, the Poultry Building. It is located on the Porter Street Poultry Farm at the corner of College and Porter. This building provided teaching facilities, and offices for students and staff.

The South Poultry Farm

In 1944 the University purchased 80 acres of land adjoining the South Swine Farm on the east and assigned this area to the Department of Poultry Husbandry for their research and teaching programs. This area was at first used exclusively for the brooding and rearing of young stock to be used later at the Porter Street Farm. In 1962 a house for 2000 layers was added to this farm for management and housing studies.

Rocheford Turkey Research Farm

Miss Julia Rocheford, long-time Extension Specialist in Home Economics, willed this farm, which had been in her family about 100 years, to the College of Agriculture in 1956 for charitable and educational purposes. Miss Rocheford's will stated:

"My farm in Boone County, Missouri, heretofore described in Item VII, I give, devise and bequeath to the Curators of the University of Missouri, a public corporation of the State of Missouri, and their successors in trust, to have and hold and use for charitable and educational purposes on such terms and conditions as they may see fit. This farm is to be known always as 'The Rocheford Farm.'

"I hope that the University will see fit to use this farm as a place where poor boys seeking to obtain an education in the College of Agriculture may work and earn money in order to pursue their studies in that college. The young men selected to work on the farm and benefit from it shall be selected by my friend Sam B. Shirky, so long as he lives, and thereafter shall be selected by the Dean of the College of Agriculture, so long as it shall exist."

26
The Poultry Husbandry Building, T-14, at College and Porter.

Sign marking the Rocheford Turkey Research Farm northeast of Columbia.
Agricultural Research Park

When the Outer Loop was constructed through the Porter Street Poultry Farm, the State Highway Department compensated the University for the poultry buildings destroyed. These funds, plus other funds, were used to construct a building 36' x 100' for chick nutrition studies and a building 36' x 80' for poultry physiology investigations. The buildings were the first research buildings constructed in the new Agricultural Research Park and have served as valuable facilities for research and training of graduate students.

1911-1938 REVIEW BY H. L. KEMPSTER

The following was prepared for an anniversary bulletin in May, 1938, by H. L. Kempster.

The Poultry Department was organized in 1911. Its early activities consisted largely in the establishment of flocks and laying a foundation for research which was to follow.

In 1915 was designed the square, straw loft, open front, "Missouri Poultry House." This type of building is now standard equipment on thousands of Missouri farms. Similar efficiency of design led to the general acceptance of the Missouri Colony Brooder House. Even after 23 years the Missouri poultry house serves as a standard type and its features are being incorporated into poultry houses both of new construction and those being remodelled.

In 1917 and continuing to date, research with reference to the use of protein concentrates in rations for egg production has occupied an important place in the research program. Earlier results pointed out that the adequate use of protein supplements would double the egg production over similar rations not containing these supplements. Later results demonstrated the possibility of utilizing soybean oil meal in poultry rations provided suitable combinations with minerals were made. Research with baby chick rations involving the use of milk products clearly demonstrated the importance of the use of milk in rations for growing chicks. This research led to the formulation of feeding formulae which have served as a guide for those mixing feed either for sale or for home use.

In 1919 research was centered around the utilization of carotinoid pigments by the fowl. The discovery that the principal yellow pigment utilized by the fowl was xanthophyll made possible an understanding of the problem of the control of yolk color in the production of market eggs by limiting the amount of xanthophyll in the ration. It also explained the bleaching of poultry when crate fed for market. These investigations incidentally
led to the present theory as to why the shanks of yellow skinned hens fade after continued laying.

In 1926 studies were made on the correlation between sexual maturity and egg production in which it was pointed out that rate of maturity was an excellent guide to use in the selection of pullets for the laying flock and of birds to be used for breeders.

Research on the relation of the date of maturity to egg production led to radical changes in recommendations relative to the summer management of pullets. As a result, poultrymen are maturing their pullets at a much earlier date and realizing greater profits because of more liberal fall and early winter egg production.

Since 1930 problems relative to marketing poultry products have received considerable attention. As a result of research in 1932 it was discovered that dried milk products were equally as efficient as liquid buttermilk or condensed buttermilk in securing gains in milk feeding for market.

A study was made of the consumer preferences for egg yolk color and shell color in New York City which showed that price discrimination against eggs which did not have pale yolks or which were brown shelled was not justified. It is believed that this study resulted in descriptive standards more favorable to the mid-west egg.

Work showing the rate at which eggs cool under various environmental conditions attracted national attention and has led to the design of equipment which has caused a considerable reduction in the losses experienced in market eggs due to improper cooling.

Losses from soiled eggs amount to millions of dollars annually. This problem has resulted in an investigation on the factors influencing the production of clean eggs. Under average farm conditions 25 percent of the eggs are dirty or slightly dirty.

Even under favorable production practices dirty eggs constitute over 7 percent of all eggs produced. Price differentials seriously penalize these eggs and the general opinion is that dirty eggs should not be offered the consumer. Until work at the Missouri Agricultural Experiment Station showed that eggs washed in a 1 percent solution of sodium hydroxide held up in cold storage as well as did naturally clean eggs of similar quality the washing of eggs was looked upon with disfavor. With this discovery it is believed that the washing of eggs in a proper cleaning solution will become an established practice of those employed in the merchandising of eggs.

Another phase of research which is receiving considerable attention is a study of the normal growth of chickens under normal conditions. The results of this research will be found in three publications. The first is entitled "The Influence of Temperature on the Growth Rate of the Embryo."

The second deals with some production costs with growing chicks which serves as a guide as to feed consumption, fuel and labor require-
ments and the growth that may be expected. The third publication on growth of chickens reveals the fact that chickens hatched early grow much faster when young than do those hatched late. However, retarded growth when young is compensated for by accelerated growth later. This measure has been made possible because of standards of growth that have been established. Eventually chicks hatched at later dates attain the same weight as do those hatched early. From these studies it is concluded that one of the important reasons for fluctuations in the growth curve is the high temperatures during the summer months. The years 1934 to 1936 furnished evidence to support this theory. It was also discovered that chicks of smaller size are influenced less by periods of extreme heat.

Other investigations of economic and practical importance are the feed purchasing power of eggs, made in 1924 and 1933, factors influencing hatchability (1934) and egg weight in the domestic fowl (1934).

Research in progress at the present time (1938) includes also turkey production, the reproduction of wildlife, environmental factors influencing egg production and the influence of certain vitamins on growth and egg production.

New problems are continually facing the poultryman. For example, mortality in adult fowls is increasing at an alarming rate and the problem must be attacked by both the Experiment Station and the poultry breeder. Apparently management practices have not been discovered which will control or lessen losses from certain diseases, particularly range paralysis and leukosis. The development of strains resistant to disease may be the solution of the problem. Losses from everted oviducts and cannibalism are much more common than they were a decade ago.

The problem of selecting suitable rations for poultry will always remain an important one. New feeding formulas adapted to changes in available feed stuffs will continue to be necessary. While science has contributed much in the way of knowledge with reference to poultry nutrition, research will continue to reveal new knowledge just as useful as that which has been developed in the past.

The problem of housing is far from being completely solved. Attempts to measure the influence of the type of housing on production are extremely difficult and the principles of poultry housing still remain uncertain. Poultry Husbandry is a comparatively new field, and while much has been accomplished, additional research is greatly needed.

The Missouri Poultry House

One of the most widely accepted ideas to come from department research in the early years was a plan for the Missouri Poultry House which was announced in January, 1916, at Farmers Week. The essential features of this building were its open front and square (20’ x 20’) construction with a straw loft. It was a very satisfactory house for the Missouri climate.
and it was the proper size for a farm flock of 100 to 150 hens, the number commonly found on Missouri farms in 1916.

This house was well received in Missouri and throughout the mid-west. Thousands of these houses were built in the United States. Later plans were developed for 30' x 30', 24' x 24', and 40' x 40' Missouri type laying houses for larger flocks.

The original Missouri Poultry House is still on the Porter Street Poultry Farm.

1938-1967

The research program of the department has become more technical and has dealt with more fundamental problems since the 1930’s. The personnel is more highly trained and more specialized. The Annual Progress Reports (1911-1966) that follow outline work that has been done since Prof. Kempster’s 1911-1938 review, as well as add detail on work done in his era.
ANNUAL PROGRESS REPORTS

The Director of the Agricultural Experiment Station prepares an annual report of research done each year by each department. Extracts from these reports follow.

Bulletin 111 (February, 1913) Report of the Director for Year Ending June 30, 1912. The first report on research work by the new Poultry Department appeared in this publication, briefly as follows:

The investigational work of this department has been confined to a study of the influence of the age of hens on incubation and the subsequent vigor of chicks. One and two-year old White Leghorn hens were used. As indicated in the summary presented below, the chicks from two-year old hens were larger when hatched and were larger at the end of 10, 20, 30, and 50 days. One experiment would not warrant any generalizations, but this investigation seems to indicate that the eggs from older hens are more desirable for hatching purposes.

<table>
<thead>
<tr>
<th>Pullets</th>
<th>Hens</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of eggs put in Incubator</td>
<td>332</td>
</tr>
<tr>
<td>Weight of eggs per hundred (in lbs.)</td>
<td>12.19</td>
</tr>
<tr>
<td>No. Tested out as infertile</td>
<td>16</td>
</tr>
<tr>
<td>Not hatched</td>
<td>93</td>
</tr>
<tr>
<td>No. of chickens</td>
<td>223</td>
</tr>
<tr>
<td>Percent hatched of all eggs incubated</td>
<td>67.1</td>
</tr>
<tr>
<td>Weight of chickens per hundred when removed from incubator (in lbs.)</td>
<td>7.56</td>
</tr>
<tr>
<td>Weight of chicks per hundred at age of ten days</td>
<td>12.46</td>
</tr>
<tr>
<td>Weight of chicks per hundred at age of twenty days</td>
<td>20.83</td>
</tr>
<tr>
<td>Weight of chicks per hundred at thirty days of age</td>
<td>27.02</td>
</tr>
<tr>
<td>Weight of chicks per hundred at fifty days of age</td>
<td>59.87</td>
</tr>
</tbody>
</table>
Bulletin 117 (February, 1914), Report of the Director for the Year Ending June 30, 1913, lists Press Bulletin No. 19 on *Produce Infertile Eggs*, by H. L. Kempster. The Press Bulletins were news releases, later known as the Farm News Service.

Page 416 lists under *Projects Begun Prior to July 1, 1912, Still Incomplete*, "Sex-linked Inheritance of Characters in Poultry."

There was no report from the Poultry Department under *Project Reports* but the Department of Zoology reported on "A Study of Sex-linked Inheritance in Poultry."

Bulletin 107, *Farm Poultry House Construction*, by H. L. Kempster, discusses the essentials of a poultry house and gives detailed descriptions of several types of houses which supply these essentials.

Bulletin 131 (April, 1915), Report of the Director for Year Ending June 30, 1914, did not contain a report from the Poultry Department, but Zoology reported on "Sex-linked Inheritance."


The Department of Poultry Husbandry reported three addresses at Poultry Meetings, judging 12 poultry shows, and writing 1200 letters.

Bulletin 147 (June, 1917), Report of Director for year ending June 30, 1916. The following projects were reported:

*Mendelian Inheritance in Poultry* (George LeFevre): 1. Inheritance of Spangling in the Silver Spangled Hamburg. 2. Inheritance of Henfeathering in the cocks of the Sebright Bantam.

*The Value of Sour milk and Beef Scrap for Egg Production* (H. L. Kempster): Three pens of 25 White Leghorn hens were used. The hens receiving sour milk averaged 131 eggs each; those receiving beef scrap averaged 107 eggs each; and those receiving neither meat nor milk but in other respects the same ration as the other two pens produced only 55 eggs each.

*The Value of Sour Milk and Beef Scrap in Rations for Growing Chicks, and the Cost of Growing Chicks* (H. L. Kempster): For the first three weeks 100 of the skim milk-fed chicks weighed 21.4 pounds, the same number of the beef scrap chicks weighed 15.1 pounds, and the no meat or milk chicks weighed 9.86 pounds. The percentage of mortality in the no meat or milk pen was 34, the beef scrap pen, 22; and in the sour skim milk,
13.4. It took 2.76 pounds of feed, not including milk, to produce a pound of gain in the sour milk pen; 5.54 pounds of feed to produce a pound of gain in the beef scrap pen; and 15.1 pounds of feed to produce a pound of gain in the no meat or milk pen. Sour milk seems to be indispensable as a feed for growing chicks; if it is not available, beef scrap should be added to the ration.

Value of Sour Milk, Beef Scrap, Cottonseed Meal, Gluten Meal, and Oil Meal in Rations for Egg Production (H. L. Kempster): From this investigation it appears that the protein concentrates of vegetable nature are of little value in rations for egg production. Additional tests in this work will be made.

Bulletin 151 (September, 1917), Report of Director for the Year Ending June 30, 1917, lists Protein Feed for Laying Hens (H. L. Kempster, Missouri Station Circular 82) as a publication giving results of tests to determine the value of beef scrap and sour milk. These experiments indicate that protein supplements of animal origin are more efficient in egg production than protein supplements of vegetable origin.

Bulletin 163 (May, 1919), Report of Director for Year Ending June 30, 1918, reports on the following:

Sex-Linked Inheritance in Poultry (George Lefevre): The inheritance of spangling. This series of experiments has been greatly interfered with by the loss of birds from roup during the past two seasons, making necessary a repetition of a number of the crosses that had previously been made.

Value of Sour Milk, Beef Scrap, Cottonseed Meal, Gluten Meal and Oil Meal in Rations for Egg Production (H. L. Kempster, George Harvey, E. L. Dakan): From the data collected during the year it is seen that the use of a small amount of meat scrap, even as small as three or four percent of the entire ration, greatly increases the efficiency of the ration. There is no evidence that cottonseed meal adds to the efficiency of the ration.

Bulletin 172 (July 1921), Report of Director for the Year Ending June 30, 1919, summarizes the following poultry research projects:

The Relation of Plant Carotinoids to Poultry Production—Relation to Growth, Fecundity and Reproduction (H. L. Kempster, L. S. Palmer): It was concluded that the natural yellow pigment of fowls derived from the xanthophyll of the food, bore no important relation to fecundity and reproduction, at least for one generation.

Physiological Relation Between Fecundity and the Natural Pigmentation of Certain Breeds of Fowls. Cockerels fed on a carotinoid-free ration, when fed xanthophyll, immediately began to show yellow pigmentation of the
visible skin parts. Male birds with yellow shanks, beaks, etc., when given rations devoid of xanthophyll, gradually lost the yellow pigmentation until it finally disappeared.

**Influence of specific feeds and certain pigments on the color of egg yolk and body fat of fowls:** Chickens which had been raised from hatching to maturity on rations devoid of carotinoids were fed certain pigments and feeds and the following observations were noted:

Carotin and the orange-yellow pigment of the annatto seed are without influence on the color of the adipose tissue and visible skin parts of fowls.

Sudan III colors the adipose tissue only of non-laying fowls. It also colors the egg yolk, but is without effect on the visible skin parts of non-laying or laying fowls.

Xanthophyll, fed in the form of yellow corn, has an immediate effect on the color of the adipose tissue and visible skin parts of fowls of the type of the White Leghorn.

**Value of Sour Milk, Beef Scrap, Cottonseed Meal, Gluten Meal and Oil Meal in Rations for Egg Production** (H. L. Kempster).


Reports on the following projects were included:

**Value of Sour Milk, Beef Scrap, Cotton Seed Meal, Gluten Meal and Oil Meal in Rations for Egg Production** (H. L. Kempster). The pen fed a mash containing 8 percent meat scrap produced more than twice as many eggs as did the pens fed no meat scrap.

**Age as a Factor in Poultry Breeding** (H. L. Kempster). The relative hatchability of eggs from White Leghorn hens and pullets was observed. The hens' eggs were 4 percent infertile and the pullets' eggs were 12 percent infertile. On the average, the hens showed an advantage of 4 percent over the pullets in hatchability.

**Experiment in Chick Feeding** (H. L. Kempster). Studies of various supplementary feeds on growth.

**Influence of the Time of Hatching on Future Production** (H. L. Kempster). White Leghorn pullets hatched in February, March, April, and May were observed. Contrary to the general opinion, early hatched birds layed well during the winter. It would also appear from these observations that if a person expects winter layers, Leghorns must be hatched not later than May.

**Winter Egg Production as an Indication of Year's Production** (H. L. Kempster). White Leghorns were grouped in four classes as to produc-
tion. From the data collected, it seems that the number of eggs a hen lays during the winter months, November 1 to February 28, is an excellent index to her total performance for the year.

*Time of Molt as an Indication of Past and Future Egg Production* (H. L. Kempster). The birds which molted early not only made poor egg records their first year but also their second year. Those which molted late made much better records each year.

*Relation of Plant Carotenoids to Growth* (H. L. Kempster). It can not be concluded that the natural yellow pigment of fowls which is derived from the xanthophyll of the food bears no relation to growth.

**Bulletin 189 (October, 1921), Report of Director for the Year Ending June 30, 1921, included reports on the following research projects:**

*Value of Sour Milk, Beef Scrap, Cottonseed Meal, Gluten Meal, and Oil Meal in Rations for Egg Production* (H. L. Kempster). The pen fed no protein concentrate averaged 39 eggs per hen while those fed a slight amount of tankage laid 104. The number of eggs laid varied in direct proportion to the amount of animal food (tankage) in the mash.

*Experiment in Chick Feeding* (H. L. Kempster). Sour milk or fresh buttermilk appears to be an almost indispensible adjunct to rations for growing chicks.

In a third experiment chicks fed whole milk instead of skim milk were compared with a lot fed skim milk and eggs as a supplement to the grain and plain mash. At the end of six weeks both lots were in good condition, the lot fed whole milk weighing 0.38 pounds, the other averaging 0.425 pounds.

*Age as a Factor in Poultry Breeding* (H. L. Kempster). Pullets hatched from hens averaged 12.6 eggs more per bird than did those hatched from pullets, the egg production average being 147 and 134.4 eggs.

*Influence of Time of Hatching on Future Production.* White Leghorn pullets hatched in February, March, April, and May averaged 164, 146, 140 and 129 eggs respectively, from November 1, 1920 to October 31, 1920. More than 200 eggs were laid by 6.25 percent of those hatched in February, 11.7 percent of those hatched in March, and 14.3 percent of those hatched in April. None hatched in May laid over 200. From the standpoint of annual egg production it would appear that early hatching is desirable.

*Effect of Early Laying on Egg Production.* The production of White Leghorn pullets from November 1 to October 31 of the following year showed that those which started to lay in July, August, September, October, November, December, January, and February averaged 174, 162, 160, 151, 154, 150, 130 and 70 eggs, respectively.
Length of period Required to Reach Maturity as an Indication of Future Egg Production. Early maturity appeared to have an important bearing on production.

Bulletin 197 (December, 1922), Report of Director for the Year Ending June 30, 1922, described the following studies:

Effect of Early Laying on Egg Production (H. L. Kempster, Earl W. Henderson). The production of White Leghorn pullets from November 1 to October 31 showed that those which started to lay in September, October, November, December, January, February and March laid 156, 164, 158, 154, 132, 90 and 82 eggs respectively.

Influence of Time of Hatching on Future Production (H. L. Kempster, E. W. Henderson). White Leghorn pullets hatched February, March, April, May, and June averaged 158, 140, 155, 145 and 139 eggs, respectively, from November 1, 1920, to October 31, 1921. The data showed no particular disadvantage in hatching White Leghorn pullets before April 1. If one considers the sale of broilers there is a distinct advantage to hatching early.

Length of Period Required to Reach Maturity As an Indication of Future Egg Production (H. L. Kempster, E. W. Henderson). Of the 230 White Leghorn pullets observed, those which matured in less than 175 days averaged 168 eggs from November 1 to October 31; those maturing in 175 to 199 days averaged 162 eggs; 200 to 249 days, 146 eggs; 250 to 274 days, 125 eggs; 275 to 299 days, 92 eggs; and over 300 days, 93 eggs.

Value of Sour Milk, Beef Scrap, Cottonseed Meal, Gluten Meal and Oil Meal in Rations for Egg Production (H. L. Kempster, Earl W. Henderson). The best records were made with sour skim milk with an egg production of 128 eggs per bird.

Age as a Factor in Poultry Breeding (H. L. Kempster, Earl W. Henderson). Of 129 White Leghorn pullets from hen’s eggs, 11.6 percent died during the first laying season, while the mortality of pullets hatched from eggs produced by pullets was 16.4 percent. The egg production of each group was practically the same, being 148.3 and 149.8, respectively. Winter egg production was 33.5 and 32.3, spring production 75, and summer production 40 to 42. There appeared to be little if any disadvantage in using White Leghorn pullets for breeding purposes if they were fully mature.

Time of Molting as an Index to Past and Future Egg Production (H. L. Kempster and E. W. Henderson). A flock of over 200 White Leghorn
pullets in their first laying season were examined each month. The data indicated that the time at which a bird molted was an excellent guide as to past performance.

The Value of Sour Milk and Beef Scraps in Rations for Growing Chicks and the Cost of Growing Chicks (H. L. Kempster, E. W. Henderson). At the end of eight weeks the chicks fed tankage weighed 0.285 pounds, those fed sour milk, 0.474 pounds, and those fed sour milk and eggs, 0.544 pounds each. The mortality was 12.5 percent for the tankage, 24 percent for the dried buttermilk, 15 percent for the sour skim milk and check pens.

Bulletin 210 (February, 1924), Report of Director for Year Ending June 30, 1923, lists these poultry projects:

Value of Sour Milk, Beef Scrap, Cottonseed Meal, Gluten Meal and Oil Meal in Rations for Egg Production. (H. L. Kempster, E. W. Henderson).

Age as a Factor in Poultry Breeding (H. L. Kempster, E. W. Henderson).

Time of Molt as an Index to Productivity of Hens (H. L. Kempster, E. W. Henderson).

**EGG PRODUCTION AS RELATED TO TIME OF MOULTING**

<table>
<thead>
<tr>
<th>Month Moultered</th>
<th>Total eggs first year</th>
<th>Winter Eggs following year</th>
<th>Total eggs following year</th>
<th>Total eggs for two years</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>122</td>
<td>22.4</td>
<td>103.5</td>
<td>225.5</td>
</tr>
<tr>
<td>August</td>
<td>132</td>
<td>19.8</td>
<td>114.5</td>
<td>246.5</td>
</tr>
<tr>
<td>September</td>
<td>142.4</td>
<td>23.1</td>
<td>122.7</td>
<td>265.1</td>
</tr>
<tr>
<td>October</td>
<td>157.7</td>
<td>28.6</td>
<td>139.</td>
<td>296.7</td>
</tr>
<tr>
<td>November</td>
<td>166.7</td>
<td>19.1</td>
<td>119.</td>
<td>285.7</td>
</tr>
<tr>
<td>After Nov. 1</td>
<td>195</td>
<td>34.5</td>
<td>146.3</td>
<td>341.3</td>
</tr>
</tbody>
</table>

Studies in Regard to Xanthophyll, the Natural Yellow Pigment of the Egg Yolk, Body Fat, and Blood-Serum of the Hen (H. L. Kempster, E. W. Henderson). Chicks fed rations devoid of xanthophyll showed complete absence of yellow coloring in the visible skin parts. The ration in one case contained as high as 30 percent butterfat, which is rich in carotin. This is further proof that chicks are unable to utilize the yellow pigment carotin.

Bulletin 228 (January, 1925), Report of Director, for the Year Ending June 30, 1924, describes these projects:

Time of Molt as an Index to Productivity of Hens (H. L. Kempster).
Data on White Leghorns for 1922-23 indicated that early molters were not only inferior layers the current year but also the following.

*Value of Sour Milk, Beef Scrap, Cottonseed Meal, Gluten Meal and Oil Meal in Rations for Egg Production* (H. L. Kempster, E. W. Henderson).

*Correlation of Sexual Maturity to Annual Egg Production* (H. L. Kempster). Observation of White Leghorn pullets for 1922-23 showed a slight correlation between length of maturity and egg production. The correlation was of such a nature that in general the shorter the length of time between hatching and the date of the first egg the better the egg record.

The average length of time required to mature White Leghorn pullets in 1922 was 232 days; the average egg production was 145. Those maturing in 200 to 224 days made the best record.

*Time of Hatching in Relation to Egg Production* (H. L. Kempster). So far as White Leghorns are concerned there appears to be little disadvantage to hatching even as early as February. Those hatched early made satisfactory egg records as those hatched in May. There appears to be a distinct advantage for April hatching.

**EGG PRODUCTION AS RELATED TO TIME OF HATCHING**

<table>
<thead>
<tr>
<th>Month Hatched</th>
<th>No.</th>
<th>Fall Eggs</th>
<th>Winter eggs</th>
<th>Total, Nov. 1 to Oct. 31, 1923</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>53</td>
<td>16.49</td>
<td>31.6</td>
<td>145.4</td>
</tr>
<tr>
<td>March</td>
<td>55</td>
<td>1.04</td>
<td>35.5</td>
<td>140.5</td>
</tr>
<tr>
<td>April</td>
<td>91</td>
<td>0.34</td>
<td>36.9</td>
<td>148.2</td>
</tr>
<tr>
<td>May</td>
<td>36</td>
<td>---</td>
<td>28.3</td>
<td>139.6</td>
</tr>
<tr>
<td>June</td>
<td>2</td>
<td>---</td>
<td>22.5</td>
<td>107.0</td>
</tr>
</tbody>
</table>

When the extra price received for early broilers is considered, hatching early becomes even more advantageous.

*The Value of Sour Skim Milk and Beef Scrap in Rations for Growing Chicks, and the Cost of Growing Chicks* (E. W. Henderson). Tests were made to determine the effect of freezing and subsequent thawing of milk products of various kinds on the growth and mortality of chicks. The products were fed in liquid state and were the sole source of animal protein. The freezing of milk apparently had no bad effects. There were no apparent differences in the various lots that could be attributed to frozen or unfrozen milk.

*Influence of Time Laying Starts to Future Production* (H. L. Kempster).
EGG PRODUCTION AS RELATED TO THE TIME WHEN LAYING STARTS

<table>
<thead>
<tr>
<th>Month laying started</th>
<th>No.</th>
<th>Eggs before Nov. 1</th>
<th>Winter eggs</th>
<th>Total for year</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>6</td>
<td>30.5</td>
<td>28.1</td>
<td>114.8</td>
</tr>
<tr>
<td>August</td>
<td>12</td>
<td>32.5</td>
<td>25.0</td>
<td>143.5</td>
</tr>
<tr>
<td>September</td>
<td>5</td>
<td>25.4</td>
<td>44.2</td>
<td>185.6</td>
</tr>
<tr>
<td>October</td>
<td>33</td>
<td>6.3</td>
<td>39.0</td>
<td>149.4</td>
</tr>
<tr>
<td>November</td>
<td>72</td>
<td>----</td>
<td>41.3</td>
<td>152.6</td>
</tr>
<tr>
<td>December</td>
<td>58</td>
<td>----</td>
<td>34.7</td>
<td>148.0</td>
</tr>
<tr>
<td>January</td>
<td>45</td>
<td>----</td>
<td>22.8</td>
<td>129.5</td>
</tr>
<tr>
<td>February</td>
<td>6</td>
<td>----</td>
<td>12.0</td>
<td>109.8</td>
</tr>
</tbody>
</table>

Bulletin 236 (January, 1926), Report of Director for the Year Ending June 30, 1925, describes these poultry studies:

Value of Sour Milk, Beef Scrap, Cottonseed Meal, Gluten Meal and Oil Meal in Rations for Egg Production (H. L. Kempster).

EFFECT OF VARIOUS PROTEIN CONCENTRATES ON EGG PRODUCTION

<table>
<thead>
<tr>
<th>Pen No. and Ration</th>
<th>Grain per Hen per Yr. (lbs.)</th>
<th>Mash per Hen per Yr. (lbs.)</th>
<th>Avg. Egg Production</th>
<th>Feed (lbs.) to Produce 1 lb. of Eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cottonseed meal 30%</td>
<td>50</td>
<td>21</td>
<td>67.4</td>
<td>8.35</td>
</tr>
<tr>
<td>2. Cottonseed meal 30% Mineral Mixture 4%</td>
<td>55</td>
<td>15</td>
<td>116.9</td>
<td>4.8</td>
</tr>
<tr>
<td>3. Soybean meal 30%</td>
<td>55</td>
<td>17</td>
<td>69.9</td>
<td>8.27</td>
</tr>
<tr>
<td>4. Soybean meal 30% Mineral Mixture 4%</td>
<td>50</td>
<td>21</td>
<td>121.0</td>
<td>4.73</td>
</tr>
<tr>
<td>5. Tankage 20%</td>
<td>54</td>
<td>20</td>
<td>109.0</td>
<td>5.47</td>
</tr>
<tr>
<td>6. Meat scrap 20%</td>
<td>56</td>
<td>20</td>
<td>107.0</td>
<td>5.67</td>
</tr>
<tr>
<td>7. Fish meal 20%</td>
<td>53</td>
<td>20</td>
<td>110.6</td>
<td>5.15</td>
</tr>
<tr>
<td>8. Dried Buttermilk 30%</td>
<td>56</td>
<td>24</td>
<td>128.5</td>
<td>5.0</td>
</tr>
</tbody>
</table>
**Time of Hatching in Relation to Egg Production** (H. L. Kempster). Data on 1100 White Leghorn hens covering a period of seven years showed that the best hatching date, measured by the number of winter eggs and annual egg yield for the first laying season, was from April to April 15th.

**Relation of Time Laying Starts to Future Production** (H. L. Kempster). Data on 1100 White Leghorn pullets from 1917 to 1923 are presented. The best date to have pullets start laying for winter and annual egg production was approximately November 1.

**Correlation of Sexual Maturity to Annual Egg Production** (H. L. Kempster). Data on 1100 White Leghorn pullets over a period of six years showed that the shorter the time required to mature, the better the production. Quick maturing pullets were superior egg producers.

Bulletin 244 (November, 1926), *Report of Director for the Year Ending June 30, 1926*, describes the following poultry research projects:

**Relation of Time Laying Starts to Future Production** (H. L. Kempster). Early laying pullets laid more eggs during the year, especially during the winter and summer. They laid at a slightly faster rate over a period of two months, and continued laying later the following summer.

**Correlation of Sexual Maturity to Annual Egg Production** (H. L. Kempster). A total of 731 birds was used. From this study it was indicated that the rate of maturity was not inherited by the daughter from the dam.

**Value of Sour Milk, Beef Scrap, Cotton Seed Meal, Gluten Meal, and Oil Meal in Rations for Egg Production** (H. L. Kempster, E. W. Henderson).

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**EFFECT OF VARIOUS PROTEIN CONCENTRATES ON EGG PRODUCTION**
*(For the Year Ending October 31, 1925.)*

<table>
<thead>
<tr>
<th>Pen No. and Ration</th>
<th>Grain per Hen per Yr. (lbs.)</th>
<th>Mash per Hen per Yr. (lbs.)</th>
<th>Avg. Egg Production</th>
<th>Feed (lbs.) to Produce 1 lb. of Eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cottonseed meal 30%</td>
<td>46.2</td>
<td>19.2</td>
<td>67.6</td>
<td>7.78</td>
</tr>
<tr>
<td>2. Cottonseed meal 30% Mineral mixture 4%</td>
<td>45</td>
<td>18</td>
<td>125.1</td>
<td>4.04</td>
</tr>
<tr>
<td>3. Soybean meal 30%</td>
<td>46</td>
<td>19</td>
<td>71.3</td>
<td>7.2</td>
</tr>
<tr>
<td>4. Soybean meal 30% Mineral mixture 4%</td>
<td>55</td>
<td>15</td>
<td>126</td>
<td>4.47</td>
</tr>
</tbody>
</table>
EFFECT OF VARIOUS PROTEIN CONCENTRATES ON EGG PRODUCTION (CONT'D.)

<table>
<thead>
<tr>
<th>Pen No. and Ration</th>
<th>Grain per Hen per Yr. (lbs.)</th>
<th>Mash per Hen per Yr. (lbs.)</th>
<th>Avg. Egg Production</th>
<th>Feed (lbs.) to Produce 1 lb. of Eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Tankage 20%</td>
<td>56</td>
<td>19</td>
<td>122</td>
<td>4.81</td>
</tr>
<tr>
<td>6. Meat Scrap 20%</td>
<td>58</td>
<td>21</td>
<td>124</td>
<td>5.13</td>
</tr>
<tr>
<td>7. Fish meal 20%</td>
<td>49.6</td>
<td>18.7</td>
<td>103</td>
<td>5.25</td>
</tr>
<tr>
<td>8. Dried butter-milk 30%</td>
<td>48</td>
<td>21</td>
<td>131</td>
<td>4.23</td>
</tr>
</tbody>
</table>

HATCHABILITY OF EGGS FROM HENS FED VARIOUS PROTEIN CONCENTRATES

<table>
<thead>
<tr>
<th>Pen No.</th>
<th>Eggs Incubated</th>
<th>No. Hatched</th>
<th>Percentage hatchability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>120</td>
<td>37</td>
<td>30.8</td>
</tr>
<tr>
<td>2</td>
<td>178</td>
<td>95</td>
<td>53.3</td>
</tr>
<tr>
<td>3</td>
<td>116</td>
<td>19</td>
<td>15.4</td>
</tr>
<tr>
<td>4</td>
<td>182</td>
<td>105</td>
<td>57.7</td>
</tr>
<tr>
<td>5</td>
<td>128</td>
<td>78</td>
<td>60.9</td>
</tr>
<tr>
<td>6</td>
<td>132</td>
<td>52</td>
<td>39.4</td>
</tr>
<tr>
<td>7</td>
<td>116</td>
<td>66</td>
<td>53.4</td>
</tr>
<tr>
<td>8</td>
<td>171</td>
<td>116</td>
<td>67.8</td>
</tr>
</tbody>
</table>

The Value of Sour Skim Milk and Beef Scrap in Rations for Growing Chicks and the Cost of Growing Chicks (H. L. Kempster, E. W. Henderson). Comparisons were made of chick-feeding experiments in which yellow and white corn, with and without eggs as a supplement, were compared. Yellow corn proved superior to white. However, the deficiency of the white corn was corrected by using eggs as a supplement. The mortality in the pen receiving white corn alone was extremely high. The chicks receiving the eggs were more thrifty in appearance than those not receiving eggs.

Nutritional Requirements of Poultry (H. L. Kempster). In experiments with White Rock pullets, yellow corn to the extent of 56 percent of the ration proved superior to similar rations containing white corn. The birds fed white corn developed nutritional roup two months after being put on the ration, the production being reduced to zero. The trouble was checked by changing to yellow corn. The egg production was not satisfactory due
to the absence of the vitamin D factor. When this factor was introduced in the form of ultra-violet exposure with a Quartz Mercury vapor lamp, exposure to direct sunlight, or cod liver oil, the production was more satisfactory.

Bulletin 256 (September, 1927), Report of Director for the Year Ending June 30, 1927, summarized these experiments in progress:

Nutritional Requirements of Poultry (H. L. Kempster). Cod liver oil to the extent of 2 percent of the poultry mash was fed to three different lots of hens. In one case the birds were allowed exposure to the limited amount of sunshine available during the winter months. The two other lots were kept behind glass. Three other pens were kept under similar conditions, but no cod liver oil was fed to them. In pens 1 and 2, different males were used. In the other pens the same male was used. The feeding test began December 10 and closed March 31.

THE EFFECTS OF COD LIVER OIL AND SUNSHINE ON EGG PRODUCTION AND FERTILITY OF EGGS

<table>
<thead>
<tr>
<th>Pen</th>
<th>Breed</th>
<th>Supplement</th>
<th>Eggs Dec. 1 to March 31</th>
<th>% Hatch Fertile Eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>White Leghorns</td>
<td>Cod liver oil - sunshine</td>
<td>48.1</td>
<td>81.5</td>
</tr>
<tr>
<td>2</td>
<td>White Leghorns</td>
<td>Sunshine</td>
<td>40.8</td>
<td>80.6</td>
</tr>
<tr>
<td>3</td>
<td>White Rocks</td>
<td>Cod liver oil - no sunshine</td>
<td>51.4</td>
<td>47.0</td>
</tr>
<tr>
<td>4</td>
<td>White Rocks</td>
<td>No sunshine</td>
<td>24.5</td>
<td>33.0</td>
</tr>
<tr>
<td>5</td>
<td>Brown Leghorns</td>
<td>Cod liver oil - no sunshine</td>
<td>49.8</td>
<td>42.0</td>
</tr>
<tr>
<td>6</td>
<td>Brown Leghorns</td>
<td>No sunshine</td>
<td>21.6</td>
<td>7.3</td>
</tr>
</tbody>
</table>

Value of Sour Milk, Beef Scrap, Cotton Seed Meal, Gluten Meal, and Oil Meal in Rations for Egg Production (H. L. Kempster).

EFFECT OF VARIOUS PROTEIN CONCENTRATES ON EGG PRODUCTION

<table>
<thead>
<tr>
<th>Pen No. and Ration</th>
<th>Grain per Hen per Yr. (lbs.)</th>
<th>Mash per Hen per Yr. (lbs.)</th>
<th>Avg. Egg Production</th>
<th>Feed (lbs.) to Produce 1 lb. of Eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cottonseed meal 30%</td>
<td>41.0</td>
<td>17.6</td>
<td>44.9</td>
<td>10.4</td>
</tr>
<tr>
<td>2. Cottonseed meal 30%</td>
<td>51.7</td>
<td>18.5</td>
<td>136.4</td>
<td>4.1</td>
</tr>
<tr>
<td>Mineral Mixture 4%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Soybean meal 30%</td>
<td>42.5</td>
<td>12.1</td>
<td>47.1</td>
<td>9.25</td>
</tr>
<tr>
<td>4. Soybean meal 30%</td>
<td>43.0</td>
<td>16.3</td>
<td>139.0</td>
<td>3.5</td>
</tr>
<tr>
<td>Mineral Mixture 4%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### EFFECT OF VARIOUS PROTEIN CONCENTRATES ON EGG PRODUCTION (CONTD.)

<table>
<thead>
<tr>
<th>Pen No. and Ration</th>
<th>Grain per Hen per Yr. (lbs.)</th>
<th>Mash per Hen per Yr. (lbs.)</th>
<th>Avg. Egg Production</th>
<th>Feed (lbs.) to Produce 1 lb. of Eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Tankage 20%</td>
<td>63.8</td>
<td>25.0</td>
<td>124.9</td>
<td>5.7</td>
</tr>
<tr>
<td>6. Meat scrap 20%</td>
<td>55.0</td>
<td>31.0</td>
<td>143.1</td>
<td>4.7</td>
</tr>
<tr>
<td>7. Fish meal 20%</td>
<td>52.6</td>
<td>20.1</td>
<td>108.4</td>
<td>5.4</td>
</tr>
<tr>
<td>8. Dried buttermilk 30%</td>
<td>51.1</td>
<td>24.1</td>
<td>150.5</td>
<td>4.0</td>
</tr>
</tbody>
</table>

*Age as a Factor in Poultry Breeding* (H. L. Kempster). Heavy winter egg production was not necessarily a detriment to the hatching power of the eggs. Hens possess inherent traits which also play an important part in the production of hatchable eggs.

**Bulletin 272 (May, 1929), Report of Director for the Year Ending June 30, 1928**, included summaries of the following experiments:

*Nutritional Requirements of Poultry* (H. L. Kempster, E. M. Funk).

### EFFECT OF VARIOUS RATIONS ON GROWTH OF CHICKS
*(Weight in Grams)*

<table>
<thead>
<tr>
<th>Supplement</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sunshine</td>
<td>34</td>
<td>49</td>
<td>76</td>
<td>106</td>
<td>148</td>
<td>215</td>
<td>289</td>
<td>372</td>
<td>483</td>
<td>563</td>
</tr>
<tr>
<td>2. Cod Liver oil</td>
<td>35</td>
<td>49</td>
<td>77</td>
<td>107</td>
<td>150</td>
<td>214</td>
<td>278</td>
<td>354</td>
<td>460</td>
<td>517</td>
</tr>
<tr>
<td>3. None</td>
<td>35</td>
<td>48</td>
<td>74</td>
<td>107</td>
<td>145</td>
<td>189</td>
<td>219</td>
<td>254</td>
<td>289</td>
<td>296</td>
</tr>
<tr>
<td>4. Ultra-violet exposure</td>
<td>34</td>
<td>47</td>
<td>74</td>
<td>103</td>
<td>143</td>
<td>210</td>
<td>291</td>
<td>378</td>
<td>445</td>
<td>512</td>
</tr>
<tr>
<td>5. Sunshine</td>
<td>35</td>
<td>50</td>
<td>75</td>
<td>103</td>
<td>148</td>
<td>224</td>
<td>304</td>
<td>389</td>
<td>471</td>
<td>490</td>
</tr>
<tr>
<td>6. Eggs and milk</td>
<td>34</td>
<td>57</td>
<td>90</td>
<td>135</td>
<td>190</td>
<td>266</td>
<td>334</td>
<td>420</td>
<td>480</td>
<td>558</td>
</tr>
</tbody>
</table>

44
**The Effect of Feeding Cod Liver Oil on Egg Production** (H. L. Kempster).

### INFLUENCE OF DIRECT SUNSHINE OR COD LIVER OIL ON EGG PRODUCTION

<table>
<thead>
<tr>
<th>Pen</th>
<th>Breed</th>
<th>Treatment</th>
<th>Winter Eggs Nov. 1- Feb. 29</th>
<th>Eggs Nov. 1- May 31</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wh. Leghorn</td>
<td>Sunshine, Range + Cod Liver Oil</td>
<td>35.3</td>
<td>98.7</td>
</tr>
<tr>
<td>2</td>
<td>Wh. Leghorn</td>
<td>Sunshine, Range</td>
<td>33.0</td>
<td>95.5</td>
</tr>
<tr>
<td>3</td>
<td>Anconas</td>
<td>Cod Liver Oil, Behind Glass</td>
<td>37.8</td>
<td>89.3</td>
</tr>
<tr>
<td>4</td>
<td>Anconas</td>
<td>Behind Glass</td>
<td>36.5</td>
<td>60.8</td>
</tr>
<tr>
<td>5</td>
<td>Br. Leghorn</td>
<td>Cod Liver Oil, Behind Glass + Muslin</td>
<td>29.8</td>
<td>92.6</td>
</tr>
<tr>
<td>6</td>
<td>Br. Leghorn</td>
<td>Glass + Muslin</td>
<td>25.7</td>
<td>62.9</td>
</tr>
</tbody>
</table>

*Value of Cotton Seed Meal, Ground Soybeans, Soybean Meal, Tankage Meat Scrap, and Dried Buttermilk in Rations for Egg Production* (H. L. Kempster). Bone meal seemed to have a slight advantage over rock phosphate, while ground soybeans were not as efficient as soybean meal. Tankage did not give as good results as meat scrap or dried buttermilk.

*The Effect of the Time Pullets Start Laying on their Egg Production* (H. L. Kempster). A study of the records of 264 hens of the general purpose breeds indicated that there was no disadvantage in having them start laying at an early date. There was a slight advantage in having them start to lay before November as compared with those starting in November.

*Weights of Offspring of Hens as Compared with Offspring of Pullets* (H. L. Kempster). From the standpoint of weight of the female offspring from hens as compared to the weight of the female offspring of pullets there was no difference according to weights taken in December.

*Using Artificial Lights to Stimulate Winter Egg Production* (H. L. Kempster, R. R. Parks).

*Bulletin 285 (April, 1930), Report of Director for the Year Ending June 30, 1929,* lists the following poultry studies:

*The Relation of Time of Hatching to Egg Production* (E. W. Henderson). The performance of 225 White Leghorn pullets indicated that there was no disadvantage in hatching at an early date. Pullets hatched in February laid the largest number of eggs before November 1, for the winter period November 1 to February 28, and for the 12-month period from November
1 to October 31. A large part of the February-hatched birds and one-fourth of the March-hatched birds were housed in a different type of poultry house, which may have influenced results. However, the fact remains that early hatched pullets made very creditable records.

The Use of Artificial Light to Stimulate Winter Egg Production (H. L. Kempster and R. R. Parks).

EFFECT OF ARTIFICIAL LIGHTS ON EGG PRODUCTION

<table>
<thead>
<tr>
<th>Average Number of Eggs Per Hen</th>
</tr>
</thead>
<tbody>
<tr>
<td>------</td>
</tr>
<tr>
<td>No light</td>
</tr>
<tr>
<td>Lighted</td>
</tr>
</tbody>
</table>

The Feed Purchasing Power of Eggs Produced by One Hen (H. L. Kempster).

The Use of Eggs as a Supplement in Chick Rations (H. L. Kempster). The mortality of chicks fed ration supplemented with boiled eggs produced in winter (when hens had little sunshine) had 14 percent mortality. Those fed spring eggs (when sunshine for hens was abundant) had 8 percent mortality. No symptoms of rickets appeared. Therefore, eggs kept in storage apparently retained their antirachitic properties. Eggs successfully prevented leg weakness in baby chicks when exposure to direct sunlight was impossible. The difference in the results was too slight, however, to state that eggs laid in spring were superior to those produced in winter.

Value of Dried Buttermilk, Meat Scrap, Cotton Seed Meal, Soybean Meal, and Ground Soybeans in Rations for Egg Production (H. L. Kempster). Dried buttermilk proved the most effective protein supplement in rations for laying hens. The protein concentrates used were cottonseed meal or soybean meal supplemented with either bone meal or rock phosphate, and ground soybean supplemented with bone meal, tankage, meat scrap, and dried buttermilk. White Leghorn pullets were used.

The hens fed cottonseed meal were slightly more productive than those fed soybean meal. Rock phosphate was as satisfactory a mineral supplement in the proportions used as bone meal. Ground soybeans were not satisfactory as a protein supplement even though bone meal was added. Hens fed meat scrap laid more eggs than those fed tankage. Dried buttermilk rations resulted in much better egg production.
Samples of eggs from each lot were placed in storage and examined January 1. The eggs from the hens fed dried buttermilk or soybean meal showed extraordinarily fine quality while a high percentage of the eggs from the hens fed cottonseed meal showed discolored yolks, some of them being olive green in color. There was no objectional odor to the eggs even though the yolks were discolored. The eggs laid by the hens fed dried milk were larger than those produced by the other hens.

_Nutritional Requirements of Poultry_ (E. W. Henderson). Dried skim milk proved superior to commercial meat scrap in rations for baby chicks.

_The Relation of the Date of Sexual Maturity to Egg Production_ (H. L. Kempster). Early laying pullets made equal, if not better, egg records than those which started laying at a later date. In a group of over 200 White Leghorn pullets it was observed that pullets which started laying in August and September made slightly better winter and annual egg records than did those which started laying in November. Early laying pullets apparently were not handicapped to the extent commonly supposed.

_The Use of Dried Skim Milk in Rations for Poultry Fattening_ (H. L. Kempster, E. E. Schnetzler). Dried skim milk proved equal to semi-solid buttermilk in rations for crate feeding poultry.

_Bulletin 300 (April, 1931), Report of Director for the Year Ending June 30, 1930_, lists the following poultry studies.

_The Value of Cotton Seed Meal, Soybean Meal, Dried Skim Milk, and Dried Buttermilk in Rations for Egg Production_ (H. L. Kempster). Dried skim milk was equal to dried buttermilk in rations for laying hens. Soybean meal was utilized to good advantage in rations for egg production. The use of cottonseed meal was limited because of yolk discoloration when the eggs were kept in storage.

_The Feed Purchasing Power of the Eggs Laid by One Hen_ (H. L. Kempster). The relationship between feed and egg prices was more favorable to poultrymen in 1929 than during the two previous years. The feed purchasing power of eggs in 1929 was nearly 13 percent higher than for the previous year.

_Normal Growth of Chicks_ (H. L. Kempster, E. E. Schnetzler). Rhode Island Reds and White Rocks hatched in February were consistently larger at a given age than those hatched later. There was little difference in the growth rate of the pullets hatched in March and April.

_Wheat as a Supplement to Yellow Corn in Rations for Egg Production_ (H. L. Kempster). Egg production per hen increased as the percentage of
wheat and wheat products increased up to the point where the ratio between corn and wheat was equal.

**Bulletin 310 (April, 1932), Report of Director for the Year Ending June 30, 1931**, summarizes the following poultry studies:

*The Relation Between Feed and Egg Prices in 1930* (H. L. Kempster). The relation between feed and egg prices in 1930 was less favorable than for the two previous years.

*Protein Concentrates in Chick Rations* (H. L. Kempster, E. M. Funk). Satisfactory results in growth of White Leghorn chicks were obtained with rations using various combinations of dried buttermilk, meat scrap, cottonseed meal and soybean meal. The basal ration consisted of yellow corn meal, corn gluten meal, ground wheat, steamed bone meal, alfalfa meal, yeast and salt (40-10-22-5-2½-2-5).


*Will Chicks Balance Their Own Rations?* (H. L. Kempster, E. M. Funk). Chicks allowed free choice of various feed stuffs selected those essential for growth. The chicks had access to yellow corn meal, wheat bran, wheat shorts, dried buttermilk, dried skim milk, meat scrap, alfalfa leaf meal, bone meal, and salt. Cod-liver oil was given in the drinking water. The chicks were brooded with free choice of food until eight weeks of age. Twice daily the position of the feed troughs was changed. Following are the proportions of the various feed stuffs consumed in the rations selected by the chicks:

<table>
<thead>
<tr>
<th>Feed Stuff</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow corn meal</td>
<td>39.4%</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>11.1%</td>
</tr>
<tr>
<td>Wheat shorts</td>
<td>29.3%</td>
</tr>
<tr>
<td>Dried buttermilk</td>
<td>6.1%</td>
</tr>
<tr>
<td>Dried skim milk</td>
<td>4.8%</td>
</tr>
<tr>
<td>Meat scrap</td>
<td>5.4%</td>
</tr>
<tr>
<td>Alfalfa leaf meal</td>
<td>0.9%</td>
</tr>
<tr>
<td>Bone meal</td>
<td>3.0%</td>
</tr>
<tr>
<td>Salt</td>
<td>0.2%</td>
</tr>
</tbody>
</table>


*Dried Skim Milk in Rations for Baby Chicks* (H. L. Kempster, E. M. Funk). Growth in White Rock chicks was in proportion to the amount of skim milk used until the amount was over 30 percent. The basal ration consisted of yellow corn meal, bran, shorts, bone meal, and salt (50-15-15-4-1).

Influence of Time of Hatching on Rate of Growth (H. L. Kempster, E. M. Funk).

Influence of Age of Breeding Stock on Rate of Growth on White Leghorns, White Rocks and Rhode Island Reds (H. L. Kempster, E. M. Funk). Pullet progeny from adult hens of the White Leghorn, White Rock, and Rhode Island Red breeds were compared with pullet progeny from mature pullets of the same breeds in their first laying season. There was no significant difference in the weights of either group. Evidently a pullet sufficiently matured to lay a good sized egg was satisfactory for breeding purposes.

Bulletin 328 (July, 1933), Report of Director for Year Ending June 30, 1932, listed the following research projects:


The Relation of Date of Sexual Maturity to Egg Production (H. L. Kempster). White Rock and Rhode Island Red Pullets that were brought into laying early produced more eggs than similar birds that did not start laying until a later date. They produced a liberal supply of fall eggs and also produced as many winter eggs as those starting later. There was no tendency for early laying to cause a fall or winter molt.

Artificial Lights and Winter Egg Production (H. L. Kempster, E. M. Funk). Burning lights all night with White Rock pullets increased winter egg production 13.5 eggs per bird. However, during March and April these same pullets laid fewer eggs so that the total production from November 1 to June 30 was the same as for the unlighted pens. There was practically no difference in feed consumption during the winter months, but the birds under lights were a half-pound lighter in weight on March 1, which probably accounted for the lower egg production during March and April.

Feed Purchasing Power of Eggs Laid by a Hen (H. L. Kempster). The relationship between feed and egg prices for 1931 was more favorable for the poultryman than in 1930. Feed prices declined 35 percent and egg prices 33 percent. The eggs produced by an average hen would buy eight pounds more feed in 1931 than in 1930.

Commercial Fattening of Poultry (H. L. Kempster, E. M. Funk, C. G. Bryan). Most satisfactory gains were obtained with Leghorn broilers, Rhode Island Red roasters, and Leghorn hens. The lowest loss in dressing
was secured with Plymouth Rock broilers, roasters, and hens. The ration containing 10 percent dried skim milk produced the most satisfactory gains. The ration did not influence the feed consumption materially. Small birds made more rapid gains than large ones. Condensed buttermilk produced the highest quality birds. A simple basal ration containing 70 pounds of yellow corn meal, 20 pounds of wheat middlings, and one pound of salt properly supplemented with milk products produced as satisfactory gains as more complex basal rations.

Meat Scrap and Milk in Rations for Baby Chicks (H. L. Kempster, E. M. Funk). A ration containing 10 percent dried skim milk and five percent meat scrap proved as satisfactory as either dried skim milk or dried buttermilk as the sole source of animal protein. Pullets fed combinations of meat scrap and milk were heavier at the age of eight weeks than those fed milk alone. However, at the ages of 16 and 20 weeks these pullets were the smallest.

Time of Hatching in Relation to Egg Production (H. L. Kempster). February and early March hatched pullets of the general purpose breeds produced from two to three dozen more eggs up to July 1 of their first laying year than did pullets hatched in early April. The early hatched chicks made more rapid growth, and experienced lower mortality, and a larger percentage of them were retained as layers.

Influence of Position in the Egg Cycle on Size of Eggs (E. M. Funk). The term “cycle” designates the eggs laid on consecutive days. The first egg laid in two, three, or four egg cycles was the largest egg laid during the cycle. Eggs laid during the remainder of the cycle decreased in weight as the cycle advanced.

The Relation of Egg Production to Hatchability (E. M. Funk). Correlation studies of the egg production and hatchability records of 609 hens showed that there was no significant relationship between winter (November to February), spring (March to June), or annual (November to October) egg production and hatchability of eggs.

Effect of Breed and Age upon Hatchability of Hens’ Eggs (E. M. Funk). A higher percentage of chicks was produced from Leghorn eggs than from White Plymouth Rock or Rhode Island Red eggs. There was a higher degree of fertility and hatchability in eggs from this breed. Fertile eggs laid by White Plymouth Rock pullets hatched better than those laid by hens of the same breed.

Bulletin 340 (September, 1934), Report of Director for the Year Ending June 30, 1933, summarized these poultry research projects:

Influence of Cod Liver Oil, Alfalfa Leaf Meal and Yellow Corn Upon Production, Hatchability, and Quality of Eggs (H. L. Kempster, E. M. Funk).
Cod liver oil in a ration deficient in Vitamin A for laying hens increased the egg production eight percent. When 10 percent alfalfa leaf meal was added in place of an equal amount of bran to a ration containing 65 percent corn, there was an increase in egg production of 6.7 percent.

The Use of Artificial Lights to Stimulate Winter Egg Production (E. M. Funk, H. L. Kempster). The use of all night lights with White Leghorn hens doubled egg production during the period from October 9 to January 1. During the next two months the lighted pen averaged 52 eggs, compared to 37 for the unlighted pen. During the spring months the unlighted pen laid the greatest number of eggs so that for the period ending May 31 the unlighted pen had laid 87 eggs, compared to 83 for the pen where lights were used. A 30-watt light was used in a pen 12 by 14 feet in size. The use of all night lights did not increase annual egg production, but it materially increased production during the fall and early winter when higher egg prices prevail. There was no significant difference in the size of eggs laid.

The Relation of the Date of Sexual Maturity to Egg Production (H. L. Kempster). White Leghorn pullets which started laying in September laid more eggs during the winter and spring periods than did those starting to lay in August or after November 1.

The Feed Purchasing Power of the Eggs Laid by a Hen (H. L. Kempster). An unusually favorable relationship between the farm prices of eggs and feed prevailed during 1932. The average price of a mixture of corn, oats, and wheat (5-3-3) was 58 cents as compared with 98 cents for 1931. The average price of eggs per dozen was 10.8 cents, compared to 14.1 cents the previous year.

The Effect of Cross-breeding Upon Hatchability of Hens' Eggs (E. M. Funk). Barred Rock pullets were mated with two Barred Rock cockerels. When the last regular settings were made from this flock, the two Barred Rock cockerels were replaced by two Rhode Island Red males. On April 21, 202 eggs from this crossbred mating were set. Replacing the Barred Rock males with Rhode Island Red males did not influence fertility. However, there was a significant increase in hatchability. This improvement in hatching was due to an increase in the viability of the embryo, particularly during the period following the eighteenth day of incubation.

Relation of Shell Texture to Hatchability (E. M. Funk).

The Effect of a Freezing Temperature Upon Hatchability (E. M. Funk). Eggs were held in a household refrigerator at 32°F. from 6 to 48 hours hatched as well as those held at temperatures of 45°F. to 60°F. in a basement. Eggs held 96 hours or longer at 32°F. decreased in hatchability until none hatched after 168 hours.
The Effect of Age Upon Hatchability (E. M. Funk). Eggs were held for two weeks in a basement where the temperature varied from 45° to 62°F. without decreasing their hatchability. Eggs held longer than two weeks decreased in hatchability. No chicks could be produced from eggs held over four weeks. Hatchability of fertile eggs and fertility both decreased with the age of the egg.

The Effect of the Time (Hour) of Laying Upon the Hatchability of Eggs (E. M. Funk). Eggs laid in the afternoon hatched slightly better than eggs laid in the morning. However, the difference was too small to be of practical importance.


Nutritional Requirements of Poultry (H. L. Kempster, E. M. Funk).

The Value of Sour Milk and Beef Scrap in Rations for Egg Production (H. L. Kempster). Dried skim milk in rations did not increase egg production, compared with meat scrap, except where an equal quantity of dried skim milk was substituted for one-fourth of the meat scrap.

Bulletin 358 (December, 1935), Report of Director for Year Ending June 30, 1934, summarized the following studies:

Time of Hatching in Relation to Egg Production (H. L. Kempster).

Effect of Various Sources of Vitamin D on Growth of Chicks (H. L. Kempster, E. M. Funk). When chicks are not allowed exposure to direct sunlight or ultra-violet light vitamin D supplements are necessary. Sardine oil has been found to be a very satisfactory vitamin D supplement; normal growth was obtained with rations containing one-half of one percent of it. Concentrated cod liver oils promoted satisfactory growth when fed as one-eighth and one-sixteenth of one percent of the ration. Highly concentrated oils have not been recommended for home-mixed rations because of the difficulty in getting an even distribution of the oil in the mash.

The Feed Purchasing Power of Eggs Laid by a Hen (H. L. Kempster).

Seasonal Variation in Hatching (E. M. Funk). A study of the hatching records of commercial chick hatcheries in Missouri showed a definite seasonal variation in hatching results. Most satisfactory hatches were obtained during the months of March, April, and May, and the poorest in July and August. High temperatures during the summer months were detrimental to hatchability. In some cases the percentage hatch of all eggs was 20 percent less during July and August than it was during the spring and fall months. Sudden changes in temperature caused a decrease of from five to 10 percent in hatching results four or five weeks following the change in
temperature. When the temperature is low enough to freeze severely the comb and wattles of the breeding stock, the estimate of future hatches four or five weeks later should be reduced from five to 10 percent.

The Relation of Egg Size and Hatchability (E. M. Funk). Marketing agencies demand large sized eggs. However, an analysis of the relationship between hatchability and large sized eggs in the Station flocks has shown a tendency for birds that lay large eggs to produce eggs which do not hatch as well as those produced by hens that lay small or medium sized eggs.

The Effects of Age Upon Length of Incubation Period (E. M. Funk). Old eggs required more time for incubation than did fresh eggs. Apparently, age weakened the embryo so that more time was required for the development of the chick.

Effect of Pre-Incubation on the Length of the Incubation Period (E. M. Funk). Normal incubation temperatures were found to have a cumulative effect on the development of chick embryos, even though the period of incubation was interrupted during the early stages. Eggs were held at 101°F. for several hours before they were cooled after laying. This decreased the regular incubation period approximately the same number of hours. This explains why some chicks often hatch several hours before the majority of the chicks in a hatch emerge from the shell.

Effect of Pre-Incubation on Hatchability (E. M. Funk). Pre-incubation of eggs for as long as 14 hours at 101°F. before cooling after laying did not decrease the percentage hatch of all eggs set, but eggs held at this temperature for 18 hours or longer did not hatch as well as those which were not pre-incubated.

Effect of Length of the Incubation Period on Mortality (E. M. Funk). Chicks which were slow in hatching were apparently low in vitality and more likely to die than chicks which hatched early. The last chicks hatched (10% of the total) in the Station flock showed, at 8 weeks of age, a mortality of 24 percent. The other 90 percent of the chicks suffered a loss of only 8.7 percent for the same period. This substantiates the opinion of poultrymen that late hatched chicks are less desirable.

Influence of Time of Hatch on Rate of Growth (H. L. Kempster, E. M. Funk).


Bulletin 370 (November, 1936), Report of Director for the Year Ending June 30, 1935, contains summaries of the following research projects:
Temperature Changes in Eggs (E. M. Funk). The most important factors influencing the rate at which the temperature of the inside of an egg changed were the difference in temperatures between the egg and the air surrounding the egg, the rate of air movement at the surface of the egg, and the insulation around the egg or its container.

Relation of Length of Incubation Period to Livability of Chicks (E. M. Funk). A complete record has been kept of the length of the incubation period of each chick hatched on the University Poultry Farm. An analysis of the mortality which occurred during the first eight weeks showed that the last 10% of the chicks to hatch in each hatch has a considerable higher mortality than the first 90% of the chicks which hatched.

Grit in All Mash Chick Ration (H. L. Kempster, E. M. Funk). The value of grit as a supplement to the Missouri all mash chick ration has been tested. The use of grit did not increase the growth rate of the chicks raised to 12 weeks of age.

Nutritional Requirements of Poultry (H. L. Kempster, E. M. Funk).

Growth of Turkeys in Confinement (E. M. Funk). The growing of turkeys in complete confinement has presented new feeding problems. Turkeys closely confined and having access to small wire runways frequently develop "slipped tendons" or crooked hock joints. During the 1934 season Bronze turkeys were raised in complete confinement.

The Rate of Growth of Chicks Under Normal Conditions (H. L. Kempster, E. M. Funk).

The Influence of Time of Hatch on Growth (H. L. Kempster, E. M. Funk).

The Feed Purchasing Power of the Eggs Laid by a Hen (H. L. Kempster).

Bulletin 387 (July, 1937), Report of Director for Year Ending June 30, 1936, included summaries of the following poultry studies:

Nutritional Requirements of Poultry (H. L. Kempster, E. M. Funk).

The Rate of Growth of Chicks Under Normal Conditions (H. L. Kempster, E. M. Funk). The data substantiated earlier observations that abnormally high temperatures resulted in retarded growth, although this was not as marked as in 1934 due to the lower temperatures that prevailed up to July 1, 1936. At 40 weeks of age the Leghorn pullets weighed 3.5 pounds; the White Rocks, 5.0 pounds; and the Rhode Island Reds, 5.5 pounds.

At 40 weeks of age there was no significant difference in the weights of pullets that were progeny from hens in their first year of production.
and weights of pullets from hens in their second year of production or older.

The Feed Purchasing Power of the Eggs Laid by a Hen (H. L. Kempster). A more favorable relationship between feed and egg prices prevailed in 1935 than in 1934. The eggs from a 122-egg hen would purchase 135 pounds of feed or an increase of 19 pounds over the previous year. Feed prices declined from 147 percent of the 1910-14 price average in January to 94 percent in November. The price of eggs in January was 95 percent of the 1910-14 average, but rose to 148 percent in July.

Temperatures of Eggs Incubated Naturally (E. M. Funk). Thermocouples were used to record the temperature of the tops and bottoms of eggs being incubated by hens. The thermocouples were arranged to record the temperature between the shell and shell membrane. Within 30 minutes after the hen began sitting, the top of the egg was above 90°F. Since the embryo is located near the top of the egg, embryonic development begins soon after the hen begins sitting.

Seven hours after the eggs were placed under the hen the difference between the temperature of the top and bottom of an egg located in the center of an excelsior nest was 10°F. Less than three hours was required for the top of the egg to reach a temperature of 100°F.

The Relation of the Size of the Egg Clutch to Hatchability (E. M. Funk). An analysis of hatching and egg production records showed that those birds which laid every other day or less often produced eggs with relatively poor hatching power. The position of the egg in the clutch was not a factor affecting hatchability. However, those birds that laid three egg clutches produced eggs which hatched better than the birds that laid single egg clutches.

Relation of Candling Appearance to Hatching Results (E. M. Funk). To determine the relationship of yolk movement and hatchability 1136 eggs were candled the day they were set to note movement of contents. Eighty-seven percent of the fertile eggs showing slow movement hatched compared with 72 percent of those showing rapid movement, indicating superior hatching eggs could be selected by candling.

Factors Influencing the Production and Keeping Qualities of Eggs (E. M. Funk). The management of the flock as affecting clean eggs has been studied. Shavings, straw, and oat hulls proved satisfactory materials for litter in laying houses. The percentage of clean eggs produced in each of these pens did not differ significantly. For nesting materials, excelsior, oat hulls, shavings, straw, sugar cane pulp, and sawdust were used with satisfactory results.
Consumer Preference for Eggs with Different Amounts of Thick White (E. M. Funk). Two hundred fifty-two people were asked to indicate their preference for egg with different amounts of thick white. These eggs were freshly broken out of the shell. A decided preference for eggs with a large amount of thick white was shown.

Egg Weight Relationships (E. M. Funk). The problem of determining an approximate mean annual egg weight for birds being trapnested has become more important as an increasing number of poultry breeders demand information on the size of eggs laid by their breeding stock. A common method is to weigh the eggs laid on three successive days of each month and the average of those weights is assumed to represent the mean annual egg weight.

A more simple method of approximating the mean annual egg weight was worked out by an analysis of all eggs laid by 48 White Plymouth Rock pullets from October, 1932, to July, 1933. If ten eggs laid in February were above the mean annual size a very close and satisfactory approximation could be secured.

Factors Causing "Slipped Tendons" in Turkeys (E. M. Funk). Turkeys raised in complete confinement with only a wire sun porch for range are apparently more susceptible to "slipped tendons" than are turkeys raised on range. A ration consisting of yellow corn meal, 42 pounds; wheat bran, 15 pounds; wheat shorts, 10 pounds; alfalfa leaf meal, 5 pounds; meat scrap, 10 pounds; soybean oil meal, 10 pounds; dried milk, 5 pounds; salt 1 pound; and cod liver oil, 2 pounds fed to 36 turkeys produced only one case of slipped tendons.

A ration consisting of a similar mixture in which 10 pounds of cottonseed meal was substituted for 10 pounds of soybean oil meal fed to 45 turkeys produced three cases of slipped tendons. The other 42 birds had normal leg development but the males at the end of 28 weeks averaged 14.1 pounds, compared to 18.4 pounds for the males receiving the soybean oil meal.
Bulletin 413 (January, 1940), Research in Agriculture for Year Ending June 30, 1937, contained summaries of the following poultry projects:

Time of Hatching in Relation to Egg Production (H. L. Kempster). Chicks were hatched each week from February 2 to April 25. The February hatched pullets produced a few less eggs during the winter period, but this was compensated by more liberal production during the early fall months.

Growth of Chicks Under Normal Conditions (H. L. Kempster). During 1936 there were two periods of extremely high temperatures. The average maximum temperature for the week ending July 18 was 106; for the week ending August 22, 104. The percentage of normal growth declined to 70 for July 11, rose to 94 on August 1, and declined to 85 during the middle of August. As the temperature declined in September, the percentage of growth rose to slightly above normal.

The Feed Purchasing Power of the Eggs Laid by a Hen (H. L. Kempster). Slightly less favorable relationships between feed and egg prices prevailed in 1936 than in 1935. The eggs from a 122-egg hen would purchase 131 pounds of feed, compared to 135 the previous year.

Nutritional Requirement of Poultry (H. L. Kempster, Bertha Bisbey). Factors Influencing the Production and Keeping Quality of Eggs (E. M. Funk). The proportion of dirty eggs gathered was reduced 50 percent by gathering the eggs four times per day instead of only at the end of the day.

The percentage of dirty eggs was decreased when open nests were kept dark. Shavings, oat hulls, sawdust, and excelsior were the most effective materials to use for nests for producing clean eggs. Keeping the birds in the laying houses increased the percentage of clean eggs. Some breeds produced very few dirty eggs, other breeds produced a fairly large number. The percentage of dirty eggs from trap nests was higher in the morning than in the afternoon. More than 99 percent of all eggs were clean before they came in contact with the nest.

The Effect of Environment on Egg Production (H. L. Kempster, J. C. Wooley). (In cooperation with the Department of Agricultural Engineering). White leghorn pullets housed in the Missouri 20' x 20' straw loft poultry house have laid a few more eggs per hen than similar pullets housed in a two-story 20' x 20' experimental poultry house designed by the Department of Agricultural Engineering. The differences may be attributed to ventilation problems, or to the greater ease with which the pullets in the one story house could be exposed to sunshine.
The Effect of All-Night Lights on Egg Production in Turkeys (E. M. Funk). Tests gave the following results.

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<thead>
<tr>
<th>Week</th>
<th>All-Night Lights</th>
<th>No-Night Lights</th>
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<tbody>
<tr>
<td></td>
<td>Percentage</td>
<td>Production</td>
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<td></td>
<td>Production</td>
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<tr>
<td>February 14-20</td>
<td>27</td>
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<td>February 21-27</td>
<td>69</td>
<td>14</td>
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<td>February 28 - March 6</td>
<td>79</td>
<td>30</td>
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<td>March 7-13</td>
<td>80</td>
<td>43</td>
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<td>March 14-20</td>
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<td>61</td>
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<td>March 21-27</td>
<td>56</td>
<td>43</td>
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<td>March 28- April 3</td>
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<td>53</td>
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<tr>
<td>April 4-10</td>
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<td>56</td>
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<tr>
<td>April 11-17</td>
<td>57</td>
<td>59</td>
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<tr>
<td>April 18-24</td>
<td>59</td>
<td>49</td>
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The Size and Shape of Turkey Eggs (E. M. Funk). Seven hundred and sixty-eight turkey eggs, laid during the spring of 1937 by 20 Bronze pullets, were weighed to the nearest gram and measured to the nearest millimeter. Measurements gave an average weight of 84.5 grams, with a standard deviation of 6.8 grams; an average width of 48.6 millimeters, with a standard deviation of 1.5 millimeters; and an average length of 66.6 millimeters, with a standard deviation of 2.3 millimeters.

The Relation of Yolk Movement and Hatchability (E. M. Funk). Eggs which showed rapid yolk movement when they were rotated before an electric egg candler did not hatch as well as eggs which showed slow movement.

The Effect of Washing Eggs on Hatchability (E. M. Funk). It has been reported that washing dirty eggs is detrimental to hatching results. This investigation has indicated that eggs soiled with poultry droppings may hatch as well as clean eggs, and that eggs which have been washed hatch equally as well as clean eggs. Washing eggs with hydrant water and also with one percent lye water did not reduce the percentage of hatch.

Bulletin 438 (November, 1941), Investigations of Agricultural Problems for the Year Ending June 30, 1938, reported these poultry research projects:
Normal Growth of Chickens (H. L. Kempster). Records on the growth of New Hampshire pullets indicated that this breed possessed the ability to accumulate weight rapidly when young. For the production of market chickens, such as broilers, the use of a breed which grows rapidly at a young age is highly desirable.

The Rate of Growth of Rhode Island Red Pullets Infected with Paralysis or Leukemia (H. L. Kempster). Rhode Island pullets that developed paralysis or leukemia grew at the same rate as did birds not affected by these diseases. This confirmed earlier observations with reference to White Leghorns.

Nutrition Requirements of Turkeys (E. M. Funk). The occurrence of slipped tendons in turkeys was greater when additional bone meal was added to the ration and when corn gluten meal was substituted for soybean oil meal.

Growth data also showed that soybean oil meal was superior to the corn gluten meal or cottonseed meal as a protein supplement for turkeys when used in conjunction with meat scrap and dried milk.

Factors Influencing the Hatchability of Hen’s Eggs (E. M. Funk). The shell breaking strength, percentage of thick white and the height of thick white, the yolk color and the percentage of yolk, have been studied in relation to the hatchability of hen’s eggs. Measurements made during the hatching season with fresh laid eggs indicated that these characters were not related to the hatchability of eggs.

Artificial Propagation of Game Birds (E. M. Funk). Production of 12 quail from April through September ranged from eight to 95 eggs. The wide variability in egg production indicated the possibility of breeding quail which possess the ability to lay a large number of eggs. Feed con-

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<th>Hen</th>
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<td>15</td>
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<td>Total</td>
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<td>35</td>
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<td>28</td>
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EGGS LAID BY QUAIL BY MONTHS
sumption of quail and chukar patridges varied with production, being approximately 50 percent greater when the females were laying eggs.

The Effect of Feather Mites on Egg Production (H. L. Kempster). A severe outbreak of feather mites in November in a 20' x 20' Missouri poultry house caused egg production to drop from 53 percent to 2.3 percent. The birds were treated by dusting with sulphur; by February production averaged 54 percent.

Nutritional Requirements of Poultry (H. L. Kempster). The use of ground barley as a substitute for yellow corn meal resulted in slower growth and an excessive mortality among baby chicks. Post mortem examination showed that the hulls of the barley were causing compaction in the intestines.

The Feed Purchasing Power of Eggs Laid by a Hen (H. L. Kempster). The year 1937 showed the most unfavorable relationship between egg and feed prices that has prevailed since 1910 and possibly for a much longer period.

Bulletin 444 (April, 1942), Agricultural Investigations for the Year Ending June 30, 1939, reported on the following poultry projects:

The Influence of Environment on Winter Egg Production (H. L. Kempster). (In cooperation with the Department of Agricultural Engineering). White Leghorn pullets housed in the 20' x 20' Missouri straw loft poultry house consistently laid more eggs during the period from October 23 to February 19 than did those confined to a two story 20' x 20' poultry house.

The average percentage production was 44 percent in the Missouri straw loft poultry house from September 4 to February 12th, compared to 35 percent production in the two-story poultry house. The combination of straw loft and open front evidently afforded conditions more conducive to egg production.

The Feed Purchasing Power of the Eggs Laid by a Hen (H. L. Kempster). The relationship between feed and egg prices for 1938 was the most favorable since 1933.

The Normal Growth of Chickens Under Normal Conditions (H. L. Kempster). A period of growth below normal usually is followed by a compensating increase in the growth rate.

The Influence of Date of Hatch on Growth of Chickens (H. L. Kempster). An appreciable difference in the weight of pullets depending upon the date of hatch appears, ordinarily, at the age of 20 weeks.
The Periodic Gains of Chickens (H. L. Kempster). During 1938 additional information on the growth rate of Rhode Island Reds, White Leghorns, New Hampshires, and White Wyandottes was obtained.

The Influence of Incidence of Paralysis on the Early Growth Rate of Rhode Island Reds (H. L. Kempster). Earlier work with White Leghorns indicated that the incidence of paralysis did not influence the early growth rate. A similar study was made of Rhode Island Reds and the growth rate of pullets which later showed symptoms of paralysis corresponded to the normal growth curve for the breed.

The Relation of Fowl Weight at Eight Weeks and Length of Life (H. L. Kempster). All Single Comb White Leghorn females hatched in 1936 have been studied in order to determine the relation of fowl weight at eight weeks to length of life. There appeared a slight tendency for birds that were average in weight at eight weeks to live longer than birds which were either lighter or heavier than the average.

Artificial Propagation of Game Birds (E. M. Funk). The fertility and hatchability of quail eggs produced under artificial conditions vary greatly. The percentage of fertility varied from 48.5 to 96.5 and averaged 76.5 for the 1938 season. The birds were mated artificially and fertility might have been higher if the birds had been given the opportunity to choose mates as they do in nature. The hatchability of the fertile eggs also varied greatly, ranging from 41.3 to 94.7 percent. This greater difference in hatchability suggests the possibility of breeding for this character.

Increasing the Egg Production of Chukar Partridges by Artificial Lighting (E. M. Funk). The stimulating effect of artificial lighting on egg production in the domestic fowl and the turkey has been known for some time. Two groups of Chukar partridges of apparently similar quality were fed the same ration, and were kept under the same environmental conditions except that one group was exposed to all night light, while the other group was kept under natural lighting conditions. The use of all night lights not only stimulated early egg production but apparently increased the total egg production. These birds varied greatly in productive ability. Therefore, there is a possibility of selection for egg production.

A comparison of Soybean Oil Meal and Corn Gluten Meal as Protein Supplements for Turkeys (E. M. Funk). In 1938 two groups of turkeys were fed rations similar in all respects except that 10 percent of one ration was soybean oil meal and 10 percent of the other ration was corn gluten meal. More than 50 percent of the turkeys fed the ration containing the corn gluten meal developed slipped tendons. Very few of the birds survived, and those that did survive had almost solid white plumage instead of the
normal bronze color pattern. The turkeys receiving the rations containing soybean oil meal were normal in all appearances.

The Effects of Feeding Dehydrated Green Feeds on Hatching Eggs (E. M. Funk). A product prepared by adding specially dehydrated green feed to condensed buttermilk has been compared with ordinary condensed buttermilk as a supplement to a ration containing five percent alfalfa leaf meal and five percent dried buttermilk to determine the effect upon the hatchability of hens' eggs. The results obtained showed no significant difference in the fertility of the eggs. However, there was a significant difference in the hatchability of the eggs.

Seasonal Variation in Fertility in Poultry (E. M. Funk). Fertility records, using the same breeding stock, showed that approximately 90 percent of the eggs produced during spring months were fertile. Fertility was highest during this period. Fertility during the summer was 20 percent lower.

Effect of Washing Eggs on Hatchability (E. M. Funk). Investigations to determine the effect of washing eggs on hatchability have been continued. The hatchability of eggs coated with egg material was only 34.2 percent of the fertile eggs set. However, when eggs which had been coated with liquid egg were washed with water the hatchability was 94.3 percent. This was approximately the same hatching results as when clean eggs were used. Eggs coated with liquid egg, when washed with one percent NaOH solution, had a hatchability of 72.1 percent. The difference in hatchability between eggs washed with water and those washed with the one percent NaOH solution indicated that the hatchability of badly soiled eggs may be greatly improved by proper washing.

The Relation of Size of Clutch and Position of the Egg in the Clutch to Hatching Results (E. M. Funk). Eggs laid in multiple egg clutches were more fertile and possessed higher hatchability than eggs laid in single egg clutches. The position of the egg within a given egg clutch apparently was not related to fertility or hatchability.

Effect of Pre-Storage Treatment of Eggs on their Keeping Quality in Cold Storage (E. M. Funk). Results obtained in 1938 substantiated previous findings: (1) dirty eggs washed in tap water may keep very poorly in storage and (2) the use of a lye water solution helps in reducing spoilage. These results also suggest: (1) that eggs can be cooled in ice water containing 1 percent NaOH solution and (2) that the temperature of the water used in cleaning eggs may be an important factor influencing the keeping quality of eggs.

Time of Hatching in Relation to Egg Production (H. L. Kempster).
Bulletin 457 (December, 1942), Agricultural Experiment Station Serves the People (Director's report for year ending June 30, 1940), reports on the following poultry projects:

**Time of Hatching in Relation to Egg Production** (H. L. Kempster). A study of the production records of White Leghorn pullets hatched in February, March, and April revealed little if any advantage in favor of hatching in one month as compared to another.

**The Feed Purchasing Power of the Eggs Laid by a Hen** (H. L. Kempster).

**Effect of Washing Eggs on Keeping Quality** (E. M. Funk). Dirty eggs were cleaned by washing with warm and cold tap water and with a one percent lye water solution. The results again showed that soiled shell eggs washed with lye water kept well in storage and that washing greatly increased their value. The results also indicated that the temperature of the water was an important factor in cleaning eggs. The use of warm water was an important factor in cleaning.

**Effect of Washing Eggs on Hatchability** (E. M. Funk). Further investigations indicated that the hatchability of soiled eggs could be increased greatly by cleaning them with either warm water or a one percent lye water solution.

**Protein Supplements for Turkeys** (E. M. Funk). Soybean oil meal was superior to either cottonseed meal or corn gluten meal for stimulating the growth of turkeys. Turkeys raised on a ration containing soybean oil meal graded higher both as live and as dressed birds than did those raised on a ration containing corn gluten meal. Bronze turkeys fed rations containing soybean oil meal had feathers which were pigmented normally, while similar stock fed rations containing cottonseed or corn gluten meal had feathers which contained an abnormal amount of white.

**Artificial Propagation of Game Birds** (E. M. Funk). Quail exposed to artificial lights were stimulated into earlier egg production than those exposed to daylight only. An increased total egg production resulted.

In the flock mating trial with Chukar partridges, the best results were obtained when one male was mated to four females. Maintaining the breeding birds on the ground resulted in a higher percentage of fertile eggs and also a greater percentage hatchability than for birds maintained on wire floors.

High temperature has a particularly depressing effect on egg size in chickens but not in quail or Chukar partridges. Chicken eggs have a tendency to become smaller from February to September. However, quail and Chukar partridge eggs increased in size during this same period.
A Comparison of Growth Rate and Feed Consumption of New Hampshire Cockerels and Capons (H. L. Kempster). Three hundred New Hampshire chicks were hatched April 13, 1939. At eight weeks of age, the cockerels were divided into two groups of 63 birds each. One group was caponized. The other group was used as a control group to compare growth and feed consumption. No significant difference was found in growth and feed consumption between cockerels and capons up to twenty weeks of age.

Rate of Growth of Chicks Under Normal Conditions (H. L. Kempster). Growth data from 1939 revealed that many different growth curves may be secured under “normal conditions.” This emphasized the necessity of control lots in all comparative tests. Environmental conditions greatly influence the growth rate. The hatching date to some extent influences the type of growth curve obtained.

Winter Egg Production in Missouri Type Poultry House (H. L. Kempster).

The Influence of Vitamin A on Egg Production (H. L. Kempster). The egg production of White Leghorn hens fed various amounts of vitamin A in the form of yellow corn, alfalfa leaf meal, and cod liver oil varied in proportion to the amounts of these vitamin A feeds in the ration. The basal ration contained: 65 percent yellow corn; 2 percent dried skim milk; 10 percent meat scrap; and 23 percent ground wheat, bran, and shorts.

Corn and Milo in Poultry Rations (H. L. Kempster). Whole milo in the scratch and ground milo in the mash can be substituted for yellow corn, provided adequate alfalfa leaf meal is used in the ration to satisfy the vitamin A requirement.

The Use of Milk Products in Poultry Rations (H. L. Kempster). Supplementing a regular laying ration with a condensed buttermilk product containing dried cereal grass resulted in an increase in egg production of 8.5 eggs per bird over a similar ration supplemented with condensed buttermilk. From September 4 to April 16, the hens fed the condensed buttermilk product containing the dried cereal grass laid 86.9 eggs per hen, compared to 78.4 for those fed the condensed buttermilk supplement. The condensed milk products were fed at the rate of approximately one-fourth pound per hen per day.

Soybean Oil Meal in Rations for Young Chicks (H. L. Kempster). Efforts have been directed toward developing a broiler ration which will produce rapid growth and economical gains.

Bulletin 477 (April, 1944), Report of Director for the Year Ending June 30, 1941, summarizes the following poultry studies:
Protein Supplements for Young Chicks (H. L. Kempster). The results of this study suggest that combinations of proteins from several sources are more satisfactory than proteins from only two sources.

Feed Purchasing Power of Eggs Laid by Hen (H. L. Kempster).

Time of Hatching in Relation to Egg Production (H. L. Kempster). Apparently there is a wide latitude in the selection of a hatching date for White Leghorn pullets as far as subsequent egg production is concerned, according to investigations carried out by H. L. Kempster.

Bulletin 490 (July, 1945), Report of Director for the two years ending June 30, 1943, describes the following poultry research projects:

Cleaning Soiled Shell Eggs (E. M. Funk). Losses in the eggs washed with a one percent lye water solution and stored for 8 months were negligible, averaging less than one percent. The eggs cleaned by washing with water at relatively high temperatures kept remarkably well, the loss being less than two percent.

Stabilizing Quality in Shell Eggs (E. M. Funk). The quality in shell eggs was stabilized by applying heat so that it penetrated the entire egg. When fertile eggs were treated by this process embryonic development was immediately and permanently arrested. The albumen was stabilized by this process so that the normal break-down of thick albumen was greatly retarded. Eggs treated by this process kept their commercial grade much longer than untreated eggs. Yolk blemishes and stuck yolks were minimized. Cooking tests showed that treated eggs were definitely superior to untreated eggs. The author concluded that this process might be of value in preventing loss of quality and spoilage in eggs.

Effect of Time of Hatching White Leghorn Chicks on Egg Production (H. L. Kempster).

The Normal Growth of Chickens (H. L. Kempster). The results of this study have demonstrated the importance of selecting rapid growing strains for broiler production and the desirability of early hatching when economy of production is the goal.

Nutritional Requirements of Turkeys (E. M. Funk). During 1942 a strain of U.S.D.A. White Turkeys developed at Beltsville were used to ascertain their adaptability to Missouri conditions. They were found to be very efficient producers of meat. The economy of gains made by male and female Bronze turkeys was measured and it was found that the male turkeys utilized their feed more efficiently than the females.

Protein Supplement in Poultry Rations (H. L. Kempster). Preliminary results indicate that lespedeza seed may be substituted for soybean oil
meal to the extent of 13 percent of the total chick ration. Sticky droppings developed when greater amounts than this were fed.

No significant difference in egg production resulted from feeding laying mashess in which \( \frac{1}{4}, \frac{1}{2}, \frac{3}{4} \), and all of the meat scrap was replaced by soybean oil meal. Egg production from September 27 to April 30 ranged from 58 eggs per hen in the "all meat scrap pen" to 71.6 eggs for the pen in which \( \frac{3}{4} \) of the meat scrap was replaced by soybean oil meal.

*The Feed Purchasing Power of Eggs* (H. L. Kempster). From an income over feed cost standpoint the production of eggs was the most profitable since 1921, being 4 cents per hen higher than in 1929.

*The Comparative Value of Certain Grains in Rations for Egg Production* (H. L. Kempster). Egg production per hen ranged from 123 eggs for the hens fed corn or corn and barley to 102 for the pen in which oats replaced half the corn. A slight advantage in favor of wheat as a supplement to corn was experienced. Barley ranked second, followed by oats. The difference in egg production for the various groups was not significant.

**Bulletin 491 (August, 1945), Report of Director for the Year Ending June 30, 1944**, includes summaries of the following poultry studies:

*Thermo-stabilization of Eggs Reduces Spoilage in Storage* (E. M. Funk). The work on this project during the past year has been, in the main, the making of practical applications of the thermo-stabilization of shell eggs within the industry. The process reduced spoilage in shell eggs going into storage materially and thermo-stabilizing current receipt shell eggs before they were broken reduced the bacterial count of the liquid egg, as sampled from the churn, by 95 percent. The results may suggest a practical method for reducing bacterial contamination of frozen and dried eggs.

*Vegetable Protein Concentrates in Rations for Egg Production.* (H. L. Kempster). There has been an acute shortage of animal protein concentrates. The extent to which vegetable protein concentrates could be used in mashess for laying hens was investigated. Vegetable protein concentrates such as soybean oil meal could be used extensively to provide adequate protein in rations for laying hens, it was concluded.

*Soybean Oil Meal in Rations for Young Chicks* (H. L. Kempster and Noel Hall).

*The Feed Purchasing Power of the Eggs Laid by a Hen* (H. L. Kempster). According to H. L. Kempster, the year 1943 was one of the most profitable for poultry raisers from the standpoint of cash income over feed cost.

*Closed Flock Breeding of Poultry* (H. L. Kempster). After five years of closed flock breeding there appeared to be no decline in hatchability or
liveability. The number of chicks required to produce a pullet remained unchanged. The rate of growth has been maintained and the variability in size of pullets was no greater than in the original stock. The investigator could find no appreciable objection to closed flock breeding.

*Nutritional Requirements of Turkeys* (E. M. Funk). The author has been accumulating data on the level of protein in mashes for turkeys. Upon analysis, he found a very definite waste of protein when concentrated mashes were used containing 27 to 40 percent protein.

**Bulletin 510 (October, 1947), Report of Director for the Year Ending June 30, 1945,** describes the following poultry studies:

*Effect of Temperature, Humidity, and Cleanliness of Shell on the Keeping Quality of Shell Eggs* (E. M. Funk). Temperature of the water was an important factor in cleaning soiled shell eggs by washing. During the normal storage season soiled eggs may be cleaned by washing them in warm water (130°F to 140°F) with very little loss resulting when they are stored. However, the tests indicated that during summer weather (June) it might not be possible to store cleaned shell eggs without heavy losses.

Eggs processed in hot oil (30 seconds at 150°F) kept better than eggs processed in cold oil and not a single mold spot was found in 1007 eggs examined. This tends to disprove the theory that hot oil processing results in mold spots.

*Prevention of Spoilage in Eggs by Controlling Their Bacterial Count* (E. M. Funk, Ferne Bowman). Investigators found that the water glass method was the only known practical method for preserving eggs from spring to fall under Missouri conditions without refrigeration. This method does not retain egg quality as well as refrigeration.

*The Feed Purchasing Power of the Eggs Laid by a Hen* (H. L. Kempster). The feed purchasing power of eggs during 1944 was slightly below normal and an appreciable reduction in poultry numbers occurred. The year was much less profitable than was 1943, due to higher feed prices and lower egg prices.

*The Use of Vegetable Protein Concentrates and Crystalline Riboflavin in Practical Rations for Growing Chicks* (H. L. Kempster, Noel M. Hall). Various sources of riboflavin were studied to determine which could be conveniently and economically incorporated into practical chick starter rations. One conclusion was that practical rations for chicks could be designed which depended upon soybean oil meal as the sole source of supplementary protein.
Determining the Influence of Pasteurized Treatments on the Keeping Quality of Eggs (E. M. Funk). Flash pasteurization of shell eggs in water (170°F. for 10 seconds or 200°F. for 5 seconds) was effective during the normal storage season in reducing spoilage in shell eggs washed in cold water. However, this process failed to reduce spoilage when eggs produced in June were used. When the bacterial contamination was confined to the shell, flash pasteurization appeared effective but was ineffective when the organisms penetrated the eggs.

Time of Hatching in Relation to Egg Production (H. L. Kempster). From the standpoint of egg production, April did not appear too late to hatch Leghorns and New Hampshires, two breeds that reach sexual maturity at a younger age than Rocks, Wyandottes, and Rhode Island Reds.

The Effect of Environment on Laying Hens (H. L. Kempster and J. C. Wooley). Production of White Leghorn pullets housed in the standard Missouri poultry house and in a modified one, equipped with a baffle to prevent direct drafts on the birds, was not significantly different.

Bulletin 520 (December, 1948), Report for the Year Ending June 30, 1946, contains summaries of the following projects:

The Effect of Temperature, Humidity, and Cleanliness of Shell on the Keeping Quality of Shell Eggs (E. M. Funk). In this project, storage losses of shell eggs which were clean, soiled, soiled and washed in tap water, machine washed and irradiated, and washed at high temperatures (5 minutes at 140°F.) were studied. The average percentage losses in nine repeated tests were: clean, 0.3; soiled, 5.1; soiled and washed in tap water, 19.9; and washed at high temperature, 2.4 percent.

It is necessary, when cleaning soiled eggs for storage during warm weather when contamination is greatest, to use temperature which penetrates the egg contents and destroys the organisms which cause spoilage.

Time of Hatching in Relation to Egg Production (H. L. Kempster). These data show that early hatched chickens have an advantage over those hatched in April, especially under conditions which prevailed at the time of this experiment.

Prevention of Spoilage in Eggs by Controlling Their Bacterial Content—Testing the Value of Thermo-Stabilization (E. M. Funk). The results show that eggs may be thermo-stabilized while being washed. The keeping quality of such eggs is thereby greatly improved. In fact, the losses were reduced to the average for commercially clean eggs held in storage for the same length of time.
The Use of Protein Concentrates and Crystalline Riboflavin in Practical Rations for Growing Chicks (H. L. Kempster and Noel M. Hall). Soybean oil meal supplemented with crystalline riboflavin produced as satisfactory growth as did rations using riboflavin carriers, such as dried milk, dried whey, yeast, or dehydrated alfalfa leaf meal.

The test showed that soybean oil meal could be used as the only protein supplement in a ration for growing chicks. Alfalfa, milk, whey, yeast, or crystalline riboflavin can be used as a source of riboflavin.

Prevention of Spoilage in Eggs by Controlling Their Bacterial Count—Determining the Influence of Pasteurizing Treatments on the Keeping Quality and Palatability of Shell and Dried Eggs (E. M. Funk). This experiment tested the keeping quality of cleaned soiled shell eggs, flash pasteurized by two methods: (a) in water for 10 seconds at 160°F, and (b) in oil 35 seconds at 160°F. These two methods did not coagulate the albumen of the egg contents.

Flash pasteurization was not effective in preventing spoilage in shell eggs which had been soiled and cleaned by washing before pasteurizing. The losses in 18 different lots ranged from 2.3 percent to 31.8 percent. Average loss for the water pasteurization eggs was 6.0 percent and average for the oil pasteurization was 13.0 percent. These losses are comparable to 19.9 percent in the lots soiled and washed but not pasteurized.

Losses were excessive and show that flash pasteurization cannot be used effectively with such eggs. However, flash pasteurization did reduce spoilage.

Research to Determine if Pre-Mixed Concentrates Retain Their Vitamin Potency (H. L. Kempster). A mixture of soybean oil meal, 15 pounds; alfalfa, 10 pounds; meat scrap, 10 pounds; cod liver oil (400 D), 91 grams; salt, 1/2 pound; and manganese sulfate, five grams was mixed October 25, 1944, and stored in the attic of the feed house. At the same time, ingredients were sacked and stored separately. On April 28 the pre-mixed concentrate was added to corn and mill feeds in the proportions used in the Missouri chick starter formula. The control ration consisted of the same formula and of the same ingredients which had not been pre-mixed.

The ration was fed to New Hampshire chicks for a period of six weeks. The chicks fed the pre-mixed concentrate averaged 477 grams compared to 482 grams for the control group. No mortality occurred.

Bulletin 524 (April, 1949), Report of Director for the Year Ending June 30, 1947, describes the following studies:

Keeping Quality of Eggs (E. M. Funk). The process of thermo-stabilization provides the industry with a better means of preserving the quality
of shell eggs than any other method developed to date. This process has
the following features:
1. The thick white of an egg is stabilized and such eggs retain their
fresh appearance longer than untreated eggs.
2. Fertile eggs are devitalized and, therefore, react as infertile eggs.
This prevents spoilage from embryonic development which might occur
at high temperatures.
3. Eggs are protected against spoilage in storage as a result of a pas-
teurizing effect of this process.

A process was also developed for cleaning soiled shell eggs by the
use of a one percent lye (NaOH) solution. It reduced losses during an
eight months storage period to less than one percent, a negligible amount
equivalent to the normal loss in clean eggs. Another process developed
for cleaning eggs was to wash them in water held at 130°F to 140°F.
This process also reduced spoilage to a minimum and approximately to
the loss which occurs in clean eggs.

Prevention of Spoilage in Eggs by their Bacterial Content (E. M. Funk).
During the year Missouri cooperated with Swift and Company in their
work of introducing thermo-stabilized eggs to the egg trade. Swift and
Company distributed 400 to 600 cases of thermo-stabilized eggs weekly in
Miami, Florida, and a similar quantity bi-monthly in Honolulu. The pro-
cess of thermo-stabilization practically eliminated spoilage which would
otherwise have been heavy.

The Use of Vegetable Protein Concentrates and Crystalline Riboflavin in
Practical Rations for Growing Chicks (H. L. Kempster).

The Effect of Using Moldy Corn in Chick Rations (M. R. Irwin and H.
L. Kempster). No mortality occurred and no ill effects were observed in
the groups receiving moldy corn.

Chicken Scrap as a Protein Supplement in Chick Rations (M. R. Irwin). 
In this experiment, rations in which chicken scrap replaced meat scrap
were fed to Barred Plymouth Rock chicks. The chicken scrap ration proved
somewhat superior when gain in weight to eight weeks of age was used
as a measure of the value. Fifty percent of the chicks in one trial devel-
oped pерисis on the ration containing 20 percent chicken scrap. The chick-
en scrap analyzed 54.69 percent protein. Vitamin assay gave the following
values: niacin, 24.85 mgm. per lb.; thiamine, 114 mcг. per lb.; riboflavin,
5925 mcг. per lb.

Twelve Years of Poultry Record Keeping In Missouri (Ted Joule, H. L.
Kempster and E. B. Winner). This study was an analysis of 1584 poultry
record keeping flocks covering the period 1934 to 1945. The labor income
per hen rose from $0.72 in 1940 to $3.08 in 1948 and averaged $1.19 for the 12 year period. Egg production was an important factor in determining labor income. Flocks which averaged less than 150 eggs per hen experienced a labor income of $0.33 to $0.85, compared to $1.30 to $1.89 for flocks that averaged over 150 eggs.

Bulletin 528 (September, 1949), Report of Director for the Year Ending June 30, 1948, includes summaries of the following poultry projects:

**Thermo-Stabilization of Shell Eggs** (E. M. Funk and Harold Biellier). Storage experiments started in May, 1947, were completed in December, 1947, showing that the process of thermo-stabilization was effective in reducing spoilage in shell eggs. Shell eggs stabilized commercially by Swift & Company at Beatrice, Nebr., have been observed over a period of 6 weeks at room temperature.

About 300 cases per day of these eggs were stabilized by this process and placed in commercial channels in southern markets. The eggs retailed for as much as 10 cents per dozen above other eggs and gave excellent satisfaction. If these favorable results continue the mid-west will be able to place a high quality table egg throughout the year in the southern cities.

**The Use of Vegetable Protein Concentrates and Crystalline Riboflavin in Practical Rations for Growing Chicks** (H. L. Kempster and Q. B. Kinder). Practical chick starter rations were designed without using appreciable amounts of animal protein concentrates. Crystalline riboflavin is an adequate source of riboflavin and is a less expensive source of this vitamin than many of the feeds high in riboflavin that are generally used. It is possible to reduce the cost of a chick starter ration from $10.00 to $15.00 a ton by judicious use of ingredients in the ration. A ration of cereal grains using soybean oil meal as the sole source of supplementary protein and supplemented with crystalline riboflavin has proved satisfactory.

**Relation of Date of Hatch to Egg Production** (H. L. Kempster). Poultry profits are greatly influenced by the rate of lay during the fall months. Chicks must be hatched early if high fall egg production is to be obtained.

**The Use of Laying Concentrates for Egg Production** (H. L. Kempster and Q. B. Kinder). As a means of saving on labor and of using a greater proportion of home raised grains in poultry rations there is a trend toward a method of feeding in which a high protein concentrate supplemented with free choice of grains is employed.
The Effect of Environment on Laying Hens (H. L. Kempster and J. C. Wooley). Apparently, under Missouri conditions the open front straw loft type of poultry house meets the necessary requirements.

Bulletin 535 (December, 1949), Report of Director for the Year Ending June 30, 1949, includes summaries of the following poultry studies:

Thermo-Stabilization of Shell Eggs (E. M. Funk, James Forward, and Martha Lorah). Tests were designed to determine the relation of the rate of cooling after stabilizing to the occurrence of spoiled eggs in shell eggs recently stabilized. These preliminary results showed that eggs cooled soon after stabilization kept much better than those which remained warm for 24 to 48 hours after stabilizing. Thus, if stabilized eggs were cooled soon after processing occasional spoiled eggs were prevented.

Again it was demonstrated that soiled eggs cannot be cleaned so they will keep well in storage without using enough heat to pasteurize them for most of the organisms that cause spoilage in storage.

Rations for Growing Chicks (Quinton B. Kinder and Harvey Strothman). Rations were designed with low fiber and high energy content to meet demand of broiler growers. Lowering the fiber content, chiefly through the omission of alfalfa leaf meal, necessitated the inclusion of crystalline riboflavin to supplement the need for this vitamin. Apparently crystalline riboflavin fulfilled this need and the ration produced faster growth.

Effect of Washing Soiled Eggs on Hatchability (E. M. Funk and James F. Forward). Soiled hatching eggs were washed without injury to hatchability. During the 28-week period, January 21st to August 3rd, 6.3% of 19,296 hatching eggs were classified as soiled. These 1215 eggs were cleaned by washing. The 18,081 clean, unwashed eggs hatched 69.9% of the eggs set, compared to 69.1% for the soiled and washed eggs. This small difference in hatch was not considered significant.

Systems of Breeding for Performance in Poultry (G. E. Dickerson, H. L. Kempster, Q. B. Kinder, W. F. Krueger and Jack Hill). This is a new cooperative experiment of the Department of Poultry and Animal Husbandry in cooperation with the Regional Poultry Breeding Project, including the United States Department of Agriculture and the state agricultural experiment stations of the North Central Region.

The experiment was essentially a comparison of different methods of breeding for performance characters in poultry: (1) Intra-flock selection with minimum inbreeding; and (2) Recurrent selection for maximum performance in cross combination of strains. During 1948-49, foundation stock was reared, breeding and laying houses were built, and chicks were hatched from the first year’s matings.
Time of Hatching in Relation to Egg Production (H. L. Kempster). It was found that White Leghorns hatched in March and April proved to be slightly superior in egg production to those hatched in February. The pullets hatched in February laid an average of 179 eggs during the season while those hatched in March averaged 190 eggs and the April pullets, 204 eggs.

The best hatching date for Production-bred Rhode Island Reds proved to be February or the first half of March. The February Production-bred pullets averaged 213 eggs for the season while the March pullets averaged 198 and the April pullets averaged only 168 eggs.

Bulletin 556 (June, 1951), Report of Director for the Year Ending June 30, 1950, contains reports on the following poultry projects:

Maintaining Quality in Fresh Eggs (E. M. Funk, Martha Lorah, and James E. Forward). These tests were to determine the cause of stuck yolks and spoilage in stabilized eggs stored at 55°F. and short-held. In general, the eggs of better quality at time of treatment kept best in storage. The treated eggs which were immediately cooled after treatment kept better than did those cased immediately after treatment or those held at 100°F. for 24 hours after treatment. Washed eggs possessed inferior keeping qualities and the soiled eggs of better quality kept longer after washing than did the eggs of lower grade.

It appeared from these tests that eggs for stabilizing should be of good grade and that the warm eggs should be cooled following stabilizing before casing.

Rations for Growing Chicks (Quinton B. Kinder and Frank Murray, Jr.). Rations containing animal protein that contains $B_{12}$ or the Animal Protein Factor showed greater efficiency in feed per pound of gain than rations that were deficient in these growth factors.

Systems for Breeding for Performance in Poultry (G. E. Dickerson, H. L. Kempster, Q. B. Kinder, W. F. Krueger, Frank Murray, Jr., Bertha Jean Shaffer, and Claude Howard). This experiment of the poultry and animal husbandry departments was in cooperation with the Regional Poultry Breeding Project, including the United States Department of Agriculture and the experiment stations of the North Central Region.

The objective is to develop more effective methods of breeding for maximum performance in poultry. The methods being tested are (1) Intra-flock selection with minimum inbreeding; and (2) recurrent selection for maximum performance in strains. In addition, a control flock of outcrosses and crossbreds was maintained.
Approximately 300 pullets have been used in the outcross and crossbred part of the experiment.

A new 40-pen breeding house (20’ x 126’) for 480 birds was completed and is in use. Also, a new laying house (104’ x 24’) with 4 pens, 24’ x 24’, was completed and now houses 800 crossbred pullets. Nine new range shelters also were constructed for rearing the spring hatch.

Bulletin 584 (July, 1952), Report of Director for the Year Ending June 30, 1951, includes reports on the following studies:

Systems of Breeding for Performance Characters in Poultry (G. E. Dickerson, H. L. Kempster, Q. B. Kinder, W. F. Krueger, Natalee Thurmond, Claude P. Howard). The breeding systems compared in this project were: (1) Intra-flock selection with minimum inbreeding, (2) recurrent selection for crosses between specific strains, and (3) outcrossing and cross breeding, using a new sample of males from representative purebred flocks each year. The performance characters in which improvement was sought included fertility, hatchability, viability of young stock through the first laying year, rate of growth, meat conformation, egg production and egg quality.

Cross breeding consistently improved viability from hatching to 22 weeks of age compared with parent breeds. This advantage was three to eight percent in Leghorn-New Hampshire Crosses, eight percent in Leghorn-White Rocks, and 10 to 16 percent in Leghorn-Rhode Island Reds—regardless of the breed used as the male parent.

Cross breeding also increased the rate of growth over the parental records by six to 10 percent up to eight weeks and by three to 6 percent up to 22 weeks. Crossbreds also matured earlier in Leghorn-Rock and Leghorn-Hampshire crosses. Hen-day egg production was above parental mean by four to five percent for Leghorn-Red and Leghorn-Hampshire crosses, but two percent below parent breeds for Leghorn-Rock crosses.

Feed Purchasing Power of Eggs (H. L. Kempster).

The Use of Synthetic and Natural Sources of "Animal Protein Factor" in Practical Chick Rations (Q. B. Kinder). B₁₂ alone gave a 6% increase in rate of growth and about 5% increase in feed efficiency over all-vegetable protein (soybean oil meal) ration. B₁₂ plus an antibiotic (aureomycin) fed at full recommended levels (10 mg. of B₁₂ a ton and 10 grams antibiotic per ton) increased growth rate an average of 17 percent over basal ration and gave a gain of 11 percent in feed efficiency.

Study of the Thyroxine Secretion Rate of Turkey Poults (Harold V. Biel-lier and C. W. Turner). By assays made at three, six and ten weeks, it was found that the daily rate of secretion by the thyroid gland, expressed
as micrograms of D, L-thyroxine per 100 gm body weight, was 2.31, 1.93, and 1.52 for the male and 2.55, 2.30 and 1.67 for the female. These results substantiated previous reports that the females of several species studied have a greater thyroxine secretion rate than the males.

*Maintaining Quality in Shell Eggs by Thermostabilization* (E. M. Funk, James Forward, and Martha Lorah).

*The Effect of Humidity Prior to and During Incubation on the Hatchability of Chicken Eggs* (E. M. Funk and James Forward). Completed this year after three years of investigation, this study showed that high humidity gives the best hatch, and that humidity is more important during incubation than it is prior to incubation.

**THE EFFECT OF INCUBATION HUMIDITY ON THE HATCHABILITY OF EGGS**

<table>
<thead>
<tr>
<th>Percentage Relative Humidity</th>
<th>No. Eggs</th>
<th>Percentage</th>
<th>Hatch all eggs</th>
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<tr>
<td>58</td>
<td>12,621</td>
<td>8.22</td>
<td>10.02</td>
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<tr>
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<tr>
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**Bulletin 621 (April, 1954), Report of Director for the Year Ending June 30, 1952**, includes reports on the following poultry projects:

*Rations for Growing Chicks* (Q. B. Kinder). It was found that addition of vitamin B₁₂ plus antibiotic (either aureomycin or terramycin) at a level of 10 grams per ton resulted in 10 percent increase in growth rate.

Station rations were as good as, and in eight of nine cases slightly superior to, the commercial rations with which they were compared on growth rate and in all cases proved superior in feed efficiency. The improved feed efficiency varied from two percent to 10 percent, depending on the ration considered. The procaine penicillin ration at two grams per ton gave equally good results when compared with like rations containing 10 grams per ton of aureomycin.

Reducing protein level of 20 percent chick mashes after eight weeks of age and weights of two to 2.2 pounds by supplementing 10 percent more yellow corn meal in place of 10 percent soybean meal proved a sound and economical practice.

The all-vegetable protein ration, when supplemented with vitamin B₁₂ and antibiotic (aureomycin), showed substantially cheaper per pound gain than other rations containing fish meal and meat scrap.
Cleaning and Preserving Eggs (E. M. Funk, James Forward, Martha Lorah). In this project various means for cleaning and preserving shell eggs in storage were studied. It was found that eggs washed in tap water containing Klenex, at 50 to 60 degrees F., suffered heavy losses of 9.1 to 54.4 percent compared to losses of 0 to 1.6 percent in a similar lot of eggs washed in cold water and later submerged in water for three minutes at 145 degrees F. or five minutes at 140 degrees F. Eggs washed within six hours after soiling suffered as much or more spoilage than eggs washed 48 hours and 96 hours after soiling. On eggs washed 6; 48; and 96 hours after soiling the thermostabilization process reduced the storage spoilage to less than 1 percent.

Poultry Breeding Systems (G. E. Dickerson, H. L. Kempster, Q. B. Kinder, W. F. Krueger). Results from this project indicated that older females were consistently lower in fertility (by 4 to 12 percent) and had poorer hatch of fertile eggs than pullet breeders in three of the four breeds studied. Pullet and older breeders differed little in viability of progeny up to 12 weeks of age or in body weight or scores at 12 and 22 weeks of age. Progeny from pullet breeders were equal or superior to progeny from older hens in sexual maturity, hen-day egg production, and viability. The advantage for pullet breeders was largest in the Leghorn flock where older females were used most extensively. Apparently selection of pullet breeders based on part-year family performance worked as well as or better than selection of yearling or older hens on the basis of full-year family and part-year or full-year progeny test.

Feed Purchasing Power of Eggs (H. L. Kempster).

Care of Hatching Eggs Prior to Incubation (E. M. Funk, James F. Forward). Data obtained in this experiment justify the use of high humidity for holding hatching eggs. The hatchability of eggs which showed a high rate of evaporation (poor shell quality) was maintained best by high humidity.

Bulletin 643 (January, 1955), Report of Director for the Year Ending June 30, 1953, contained reports on the following poultry projects:

Value of $B_{12}$ and Antibiotics in the Replacement of Animal Protein in Chick Rations (Q. B. Kinder). Small increases in rate of gain and feed efficiency were obtained by including fish meal at a five percent level in rations containing vitamin $B_{12}$ over all-vegetable protein (soybean meal) rations. This improvement of about three percent was small but was consistent between replications within tests and between different tests.

Reducing the salt in the ration from one percent to 0.5 percent did not affect growth rate or feed efficiency but it did result in 7 to 10 percent less moisture in the droppings.
**Care of Hatching Eggs Prior to Incubation** (E. M. Funk, J. F. Forward). It was found that soiled turkey eggs could be cleaned without appreciably reducing hatchability. There was some evidence, though not conclusive, that dipping hatching eggs in a germicidal solution improved hatchability. This investigation will need to be continued.

**Care of Hatching Eggs During Incubation**—Highly significant increases in the hatchability of incubated eggs was obtained by substituting multiple plane turning for the single plane turning or two-position incubation commonly practiced. Eggs of low, medium, and high hatchability all benefited from incubating in more than two positions and normally from four to six positions.

The principal benefit from multiple plane turning was a reduction in embryonic malpositions during the latter stages of incubation, such as head between thighs, feet over head, and beak turned away from the air cell. Chicks incubated in four to six positions hatched several hours earlier than those incubated in two positions.

**Thermo-Stabilization of Shell Eggs** (E. M. Funk, James Forward, Martha Lorah). Heating the egg sufficiently to pasteurize the eggs against organisms which caused spoilage in storage gave effective protection against spoilage for at least 6 months.

**The Feed Purchasing Power of Eggs** (H. L. Kempster). The relationship between feed and egg prices for 1952 was the most unfavorable of any year for the 1910-1953 period.

**Closed-Flock Breeding Systems for Poultry** (W. F. Krueger, Q. B. Kinder, H. L. Kempster). Data from 1952 studies indicated that yearling breeders were somewhat poorer in fertility than pullet breeders in the Leghorn, Hampshire, and Rhode Island Red breed strains that were tested. Leghorn, Rhode Island Red, and White Rock pullets showed a definite advantage over yearlings in hatch of fertile eggs, ranging from 4.3 to 13.9 percent. Eggs from yearling breeders hatched better in the Hampshire breed. No consistent trends could be noted in liveability of chicks up to 22 weeks of age.

Eggs from dams mated to the young cockerels were two to 10 percent more fertile than eggs from dams that were bred to yearling males.

**Recurrent Selection for Maximum Performance in Strain Crosses** (W. F. Krueger, Q. B. Kinder, H. L. Kempster). During the three years of this experiment, fertility has been consistently poorer in test-cross than in intra-flock matings. Use of less vigorous, inbred birds in test-cross matings may be partially responsible.

Hatchability has averaged about the same for test-cross and intra-flock matings. Viability has averaged two to three percent higher for the test
crosses from zero to eight weeks and two to six percent higher on range from eight to 22 weeks. Viability from hatching to housing has averaged four to eight percent advantage for test crosses.

In weight at 22 weeks of age, the test crosses show a two to five percent advantage over intra-flock matings. Fleshing scores averaged three to four percent higher in test crosses at 12 and 22 weeks of age.

Test cross progeny laid their first eggs 4 to 8 days earlier than intra-flock progeny. Leghorn males consistently demonstrated sex-linked superiority in inheritance of early sexual maturity over heavy breed males.

Hen day egg production from 154 to 300 days averaged six to 10 percent higher for test crosses. Viability from 154 to 456 days averaged zero to three percent less for test crosses.

Farm Care of Market Eggs (E. M. Funk, J. F. Forward).

Bulletin 663 (October, 1955), Report of Director for the Year Ending June 30, 1954, contains reports on the following studies:

Protein Level Effect on Egg Production, Egg and Body Weight (Q. B. Kinder, T. W. Day). Eight hundred White Leghorn and crossbred pullets were used in four replications. There was no difference in egg weight, body weight, or mortality rate on the two types of rations. Egg production favored the 20 percent protein mash with hand fed grain by 2.3 percent or 6.35 eggs over the 10 months period.

Relation of Refrigeration etc., on the Farm Quality of Shell Eggs (E. M. Funk and James Forward).

Value of B12 and Antibiotics in Chick Rations (Q. B. Kinder, Mike Kelly). The addition of extra B vitamins (niacin, choline and pantothenic acid) to chick rations had little effect on growth rate or feed efficiency with the type of rations used.

Cleaning Soiled Hatching Eggs (E. M. Funk, James Forward). Investigation of the cleaning of soiled turkey hatching eggs was continued in 1953. Hatchability records on turkey eggs produced and incubated by Fitch and Hedrick, Columbia, Mo., were obtained for 6,535 clean eggs and 1,134 soiled eggs cleaned by washing the day laid in quaternary ammonium solution (800 ppm). The percentage of hatch of all eggs set was 74.0 for clean eggs and 70.2 for washed eggs.

Care of Hatching Eggs During Incubation (E. M. Funk, James Forward). These studies indicate that turning hatching eggs during incubation 45° or 40° give increased hatches over turning 30°. Multiple plane turning has been found to improve hatching results, especially if the eggs are
only turned 30°. Our investigations show that eggs must be turned 40° or 45° or 30° plus extra tilting in another plane for best hatching. These results will point the way to better incubators. Some machines turn eggs only 30°.

*Preventing Losses in Storage Eggs* (E. M. Funk, James Forward, Martha Lorah). Spoilage in shell eggs held in cold storage was effectively minimized by using sufficient heat to pasteurize the contents of such eggs. Surface cleaning was not effective. Green whites were practically eliminated by immersing shell eggs for 15 minutes in water held at 130°F, or 5 minutes at 140°F. These heat treatments were also effective in preventing sour eggs, musty eggs, and other rots. A method was also developed for removing stains from white shell eggs by dipping them in warm water containing 0.5 percent perborate (a substance contained in dentifrices).

*Study of Thyroxine Secretion Rate of Growing Turkeys* (H. V. Biellier). This study was devoted to the determination of thyroxine secretion rate of growing turkeys by the use of $^{131}$I, a radioactive isotope. The secretion rate was estimated to be 56.2 micrograms of D, L-thyroxine per poult daily or 1.35 micrograms per 100 grams body weight for the Broad Breasted Bronze poult at three months of age. Results show that certain modifications of technique are necessary before adoption as a standard assay method.

*Feed Purchasing Power of Eggs Layed by a Hen.* (H. L. Kempster).

*Intra-flock Selection with Minimum Inbreeding.* (Q. B. Kinder, A. B. Stephenson, H. L. Kempster, W. F. Krueger). A general comparison of the test-crosses with the mean of the parental intra-flock breeds shows consistent differences in some traits but not in others. Age at sexual maturity is a week or more earlier for the test-crosses. The progeny of Leghorn males start to lay from 1 to 2 weeks earlier than their reciprocal crosses. Viability from 8 to 22 weeks is consistently better from the test-crosses by about 4 percent. Egg production from 154 through 300 days was about 7 percent higher for the test-crosses, due to earlier sexual maturity. The intra-flock birds, over a 4 year period, have produced eggs with approximately 9 percent higher fertility.


**Bulletin 664 (December, 1955), Report of Director for the Year Ending June 30, 1955,** includes summaries of the following poultry research projects:

Value of $B_{12}$ and Antibiotics in the Replacement of Animal Protein in Chick Rations (Q. B. Kinder, H. L. Kempster, J. E. Savage and Dale Ross). These series of rations demonstrate an overall increase in growth rate on broiler strain birds of over 30 percent due to the combined factors of decreasing the alfalfa meal, increasing the energy level, and use of antibiotics and fish meal. This degree of response was similar at four weeks in Leghorn cross chicks but was reduced to only 14 percent at eight weeks.

Testing Performance of Strains and Crosses of Poultry (Q. B. Kinder, E. M. Funk, A. B. Stephenson, N. Hall and T. W. Day). This project was initiated in the spring of 1954 with the introduction of six egg strains of purebreds from leading breeders.

Care of Hatching Eggs (E. M. Funk, H. L. Kempster, James Forward, T. W. Day). It appears that turning eggs 60° or 75° increases the percentage of hatch slightly above hatches obtained when eggs are turned 30° or 45°. We have secured additional evidence this year that confirms earlier results indicating that turning eggs 45° increases hatchability over results when eggs are turned 30°. We have also obtained additional evidence that multiple plane turning of eggs during incubation increases the hatch above that obtained when eggs are turned in one plane.

Thyroxine Secretion Rate of Growing Turkeys (H. V. Biellier and H. L. Kempster). Experimental work during the past year has been directed at developing and testing a new technique for measuring the thyroid secretion of an individual animal. This technique employs radioiodine, $I^{31}$, as a tracer element of thyroxine secreted into the bloodstream. A dose of 100 uc of $I^{31}$ per kilo of body weight, injected intra-abdominal, has given satisfactory count rates as a tracer in counted whole blood samples of chickens at various ages.

Feed Purchasing Power of Eggs (H. L. Kempster).

Effect of Protein Level on Egg Production (Q. B. Kinder, D. E. Sonage and Thomas Day). Under the conditions existing in this experiment, where grains were hand fed, the 20 percent protein mash was slightly but significantly superior to the 24 percent mash.

Factors that Influence Quality of Shell Eggs (E. M. Funk and James Forward). The results obtained indicate that market eggs held in a basement retained their quality as measured by price as well as eggs held in a refrigerated cooler except when unusually high temperatures prevailed.

Systems for Breeding for Poultry Performance (Q. B. Kinder, A. B. Stephenson and H. L. Kempster). The objective of this experiment is to compare rates of improvement by different methods of breeding for factors related
to egg production. At present, an intra-flock and a recurrent selection breeding program are being used.

The intra-flock method of breeding differs from the closed flock system in that outside blood is sometimes introduced and inbreeding is kept to a minimum.

Systems of Flock Replacement (Q. B. Kinder, Claude Howard, and Thomas Day). Since this project was not started until November of 1954, no experimental results are available.

Bulletin 676 (October, 1956), Report of Director for the Year Ending June 30, 1956, includes summaries of the following poultry projects:

Minimizing Quality Losses in Shell Eggs and Dressed Poultry (E.M. Funk, R. F. Grotts, Glenn Froning). Results obtained indicate that soiled eggs may be cleaned so they will keep well in storage. Other results indicated that hens in cages might produce slightly larger eggs than their sisters on the floor. Otherwise there appeared to be no difference in the quality of eggs laid by hens in cages and by those kept on the floor.

A polyethylene emulsion was more effective in preventing evaporation and mold development than oil processing. The interior quality of such eggs was also superior to the controls or oil processed eggs.

Rations for Growing Chicks (J. E. Savage). The addition of fat improved feed efficiency slightly; added methionine also produced a slight increase in feed efficiency and the combination of fat and methionine was more effective than either alone. Apparently, the basal ration was on the border line with respect to content of sulfur amino acids required by the chick, and additional methionine had to be supplied to efficiently utilize the additional fat.

Testing the Performance of Different Strains and Crosses of Poultry (Q. B. Kinder and A. B. Stephenson). Part year performance records on the test crosses indicate:

1. Earlier sexual maturity in test crosses as compared to purebreds. No difference in test crosses as compared to commercial crosses and hybrids.
2. Test crosses using a Leghorn on the male side were earlier in sexual maturity than the reciprocal mating.
3. Mortality was higher in test crosses using Leghorn males on heavy breed hens than reciprocal matings.
4. Selected strain crosses and selected crosses appear to perform equal to commercial hybrids and superior to untested commercial crosses.
5. Selected purebreds appear to compete closely with the better test crosses and hybrids.
Care of Hatching Eggs (E. M. Funk, Bobby R. Jones). Results obtained this year indicate that eggs held at 50°F hatch better than eggs held at 60°F or 70°F.

Results with turning eggs during incubation verified previous experiments which showed that turning eggs through 90°, 120°, and 150° increased the percentage of hatch above that obtained when eggs were turned through 60°. There was also more evidence that eggs turned in more than one plane at greater angles improved hatching results.

Thyroxine Secretion Rate of Growing Turkeys (H. V. Biellier, E. M. Funk). Crystalline testosterone (male hormone) was included in regular ration at levels of 10, 20, 40, and 80 grams per ton and fed from six to 16 weeks of age. The higher levels were effective in stimulating rate of gain in both males and females. Treated birds of both sexes developed extensive head furnishings, head coloring, and beards. Females developed male-like characteristics but fighting and mating did not occur. The male poult that received 80 grams of testosterone per ton of feed gained 8.4 percent more than the controls and females gained 9.5 percent more.

Effect of Protein Level on Egg Production, Egg and Body Weights (Q. B. Kinder, Mike Kelly, Jimmie Savage). These conclusions were reached:

1. Raising the average protein intake level from 15.25 percent to 17.3 percent in total ration by increasing the protein in the mash portion resulted in slightly but significantly lower egg production. (Significant at a 5 percent level).

2. Variation of protein level in this experiment had no effect on egg weight, body weight, or adult mortality.

3. Feed efficiency was slightly better on the 20 percent protein mash and hand fed grain. Part of this could be due to difference in production and energy level of ration.

4. Data suggest that energy level of ration needs to be considered along with protein level. The energy level of the 24 percent laying mash was six percent lower than that of the 20 percent mash.

Factors Affecting the Quality of Shell Eggs (E. M. Funk, James Forward). Results show the steps necessary to produce and market quality eggs are: Produce infertile eggs, keep nests clean, use shavings or absorbent nesting material, use plenty of nests, gather frequently, keep eggs cool, cool in wire basket before casing, hold where humidity is high, case small end down, market often, and sell on graded market.

Systems of Breeding for Poultry Performance (E. M. Funk, Q. B. Kinder, A. B. Stephenson).
Systems of Flock Replacement (Q. B. Kinder). Feed per pullet housed under a self-feeding program resulted in identical feed consumption of 17.6 pounds for both range and confinement. The confined birds ate 59 percent mash, 33 percent corn, and 8 percent oats, compared to 50.6 percent mash, 36.3 percent corn, and 13.1 percent oats for the range-reared birds, indicating a slightly lower protein requirement for the range-reared birds. Feed efficiency favored the confined birds slightly due to slightly heavier housing weight.

Rations for Laying Hens (J. E. Savage, Mike Kelly).

Nutritional Requirement of the Chick (J. E. Savage).

Bulletin 695 (November, 1957), Report of Director for the Year Ending June 30, 1957, includes summaries of the following poultry studies:

Minimizing Quality Losses in Shell Eggs and Dressed Poultry in Market Channels. (E. M. Funk, O. J. Kahlenberg, Fred A. Gardner, Glenn Froning). With layers (sisters) in cages and on the floor in the same pen, the eggs produced by the hens in cages were slightly larger (58.6 gr. vs. 57.2 gr.), and had better albumen quality (76.3 vs. 72.7 Haugh Units), higher thick albumen (6.0 mm. vs. 5.5 mm.), and thicker shells (.0152 in. vs. .0145 in.). However, the incidence of all blood and meat spots was higher in eggs produced in cages (7.7 percent vs. 5.2 percent) and the rate of egg production was lower in caged layers by about five percent.

Factors Affecting Feed Efficiency in Broilers (E. M. Funk, J. E. Savage). The conclusions drawn from this trial were:

1. Growth and feed efficiency on the relatively simple corn-soy diet supplemented with three percent of fish meal and 2.5 percent of dehydrated alfalfa meal was equal to that on the modified ANRC type ration which contained fish solubles, dried whey, and additional vitamins.

2. Three percent of fish meal was replaced by three percent of condensed fish solubles with no difference in growth or feed efficiency.

3. Addition of three percent of dried whey, five percent of distillers dried solubles, and a combination of three percent dried whey and five percent distillers solubles to the ration containing three percent of fish meal did not improve growth or feed efficiency.

Testing the Performance of Different Strains and Crosses of Poultry (E. M. Funk, Q. B. Kinder, A. B. Stephenson). It was found that (a) careful testing should be practiced before offering any cross for sale, particularly a White Leghorn x heavy breed; (b) experiments should be made to determine how much of the difference in the crosses was due to genetic effects and how much due to maternal effects with special reference to leu-
cosis; and (c) many commercial crosses have not been tested before offering for sale.

**Care of Hatching Eggs** (E. M. Funk, Bobby Jones, James Forward). Eggs incubated in an upright position (small end down) hatched relatively more chicks than eggs held in a horizontal position; 73.4 percent to 76.7 percent as compared to 70.4 percent to 72.5 percent.

Turning eggs through 90° to 150° improved hatchability, compared to 60° turning. Turning through 90° gave the best results.

There appeared to be no advantage in cooling hatching eggs soon after they were laid. Our data indicated that eggs held at room temperature might hatch slightly better than those placed in the cooler the day laid. However, we were unable to improve hatchability by pre-incubating chicken eggs.

The present practice of incubating eggs with small end down and turning such eggs through 90° (45° each way from the upright vertical position) appears to be the best position and turning practice.

**Determination of Thyroxine Secretion Rate of Growing Turkeys** (E. M. Funk, H. V. Biellier). The first trial of 1956 consisted of testing the effect of continuous feeding of dienestrol diacetate, a synthetic estrogen, to turkey poults from six to twenty weeks of age. The variety of Thompson’s Large Broad White was used and 250 day-old poults were purchased January 5, 1956.

**Factors Affecting Quality of Shell Eggs on the Market.** There was no significant difference in the interior quality (Haugh Units) of eggs laid each hour throughout the day. There was no difference in interior quality of eggs within a clutch (eggs laid on consecutive days).

Holding eggs in a sealed container (Cry-o-vac bags) minimized loss in albumen quality. This was likely due to retaining carbon dioxide within the eggs.

The albumen quality of eggs laid by layers at the end of the first and the second year of production was approximately the same. Eggs cooled soon after laying retained their quality unusually well.

**Systems of Breeding for Poultry Performance** (E. M. Funk, Q. B. Kinder, A. B. Stephenson, Bobby Jones). In general, the intra-flock Leghorns showed a higher fertility and hatchability than the test crosses. If any differences existed between the intra-flock Leghorns and test crosses in viability, eight week weight, or 22 week weight they were very small.

By January the test crosses were averaging about one-half pound heavier than the Leghorns. The test crosses were also laying eggs which averaged about one ounce per dozen heavier. This difference in egg size
is probably associated with differences in body size and not to specific inheritance of egg size related to methods of breeding. The mean difference between the intraflock Leghorns and the test crosses in age at sexual maturity is very small. Leghorn male x heavy females apparently gives an earlier sexual maturity than the straight intraflock Leghorns. The test crosses involving heavy males and Leghorn females gave somewhat slower sexual maturity. The apparent advantage of earlier sexual maturity with the Leghorn male is somewhat offset by higher mortality. Where the male parent was a Leghorn reciprocal of the same matings gave 92 percent livability.

The percentage fertility of practically all of the test crosses is less than that of the intra-flock Leghorns. The test crosses in general also appear to be inferior to the intra-flock Leghorns in hatchability. The differences in viability during the brooder and range period were small but rather consistently in favor of the intra-flock Leghorns. Weights at eight and 22 weeks of age were rather consistently heavier for the test crosses with two exceptions.

Egg production in the intra-flock Leghorns has increased about 10 percent during eight years. This rate of improvement is equal to or slightly better than that of the recurrent selection.

System of Flock Replacement (E. M. Funk, Q. B. Kinder). Egg production on a hen day basis was 230.0, 219.4, and 206.6 eggs for the February, June, and September hatches, respectively, from 24 to 76 weeks of age. Due to the management and use of artificial lights there was little difference in the age to sexual maturity. Egg size averaged higher for the February hatch. The June and September hatches did not reach maximum egg size before summer hot weather, and consequently laid smaller eggs a longer period of time. They did not improve in egg size until cool weather. Feed efficiency per dozen eggs varied inversely with the rate of production as would be expected except for the June hatch which was second high in egg production but the best in feed efficiency. Difference in egg size could be a factor. Overall feed efficiency was good with an average of 4.56 pounds per dozen eggs.

The use of three hatches per year tended to even out seasonal variations in production with only October falling below 50 percent production on a hen day basis. This offers some good possibilities for the producer of graded eggs for direct sale to consumer or retailer in that it gives a more even flow of eggs of various grade sizes than do conventional single brood systems.

Rations for Laying Hens (E. M. Funk, Q. B. Kinder, J. E. Savage). Chicks hatched from hens receiving a corn-soy ration grew as well as those
hatched from hens fed the corn-soy ration plus fish solubles, dried whey, or dried distillers solubles when all chicks received a corn-soy type chick diet. This was also true when chicks were fed a corn-soy diet supplemented with a combination of the supplements in the hen diets. All groups that received the supplemented chick diet grew at a significantly faster rate compared to the unsupplemented chick diet.

**Nutritional Requirement of the Chick** (E. M. Funk, J. E. Savage). Maximum growth was attained at total cystine plus methionine levels of 0.9, 1.2, and 1.3 percent of 20, 30, and 40 percent protein diets. It is evident that the amino acid requirement increases as the protein content of the diet increases, but not in direct proportion.

**Factors Affecting Chicken Reproduction** (E. M. Funk, H. V. Biellier).

**Thyroxine, Androgens and Estrogens in Chickens and Pouls** (H. V. Biellier).

**Bulletin 728 (June, 1959), Report of Director for the Year Ending June 30, 1958,** describes the following poultry studies:

**Nutritional Requirements of the Chick** (J. E. Savage, E. M. Funk). When the broiler strain chicks were fed a practical type diet that was calculated to contain sub-optimal levels of 1.25 percent of arginine and 1.0 percent of glycine, additional supplements of these amino acids did not improve growth.

When the basal ration was further modified to contain only 0.95 percent of arginine and 0.65 percent of glycine, then both arginine and glycine supplements improved growth. Creatine was not as effective as either of the amino acids as a growth stimulant.

A limited number of observations indicated that the zinc content of practical broiler rations may be on the border line with respect to the amount of zinc required by the chick. In three out of four battery trials zinc supplements slightly improved the growth of broiler strain chicks. This observation is of considerable significance in view of the reports that much of the unrecognized growth factor activity of certain crude supplements is found in their mineral or ash fraction.

**Rations for Laying Hens** (J. E. Savage, E. M. Funk, R. M. O’Neal). The average egg production of hens that received the 800 calorie ration for the October-June period was 62.7 percent with 5.53 pounds of feed required per dozen eggs. The egg production of similar hens that received the 900 calorie ration during this period was 61.1 percent and 5.33 pounds of feed were required per dozen eggs. The increase in energy content improved the feed efficiency but did not improve egg production.
It appears that the laying hen has a rather wide tolerance for feed energy levels and can maintain equal production rates on diets that differ by as much as 100 calories per pound or more. Feed required per dozen eggs is a function of energy level and decreases as the energy level increases.

In studies with the free choice system of concentrate and grain feeding it was found that egg production on a 32 percent protein concentrate with corn and oats fed free choice was equal to the production of hens that received a 20 percent mash and limited amounts of hand fed grains.

The addition of trace minerals, "unidentified factors," and vitamins E and K to the rations of broiler strain hens did not improve either egg production or hatchability. An antibiotic supplement improved both egg production and hatchability.

No maternal transfer of either "unidentified growth factors" or improved chick growth due to the presence of an antibiotic in the hen's diet could be demonstrated.

*Factors Affecting Growth and Feed Efficiency in Broilers* (J. E. Savage, E. M. Funk). The basal diets used for the trace mineral and unidentified growth factor studies were corn-soy diets fortified with the necessary vitamins, minerals, methionine, and a coccidiostat. It is apparent that molybdenum did not improve either growth or feed efficiency. The zinc supplement improved growth and feed efficiency slightly but this difference was not significant. The mixture of unidentified growth factors produced a significant increase in chick growth rate.


*Testing the Performance of Different Strains and Crosses of Poultry* (Q. B. Kinder, A. B. Stephenson, E. M. Funk). Hybrids continued to show uniformly good performance. Selected crosses between heavy breeds and White Leghorns appeared to offer more possibility in improved performance than strain cross Leghorns or crosses of two heavy breeds.

*Care of Hatching Eggs* (E. M. Funk and James Forward). This year's tests were designed to determine the value of adding CO$_2$ to the atmosphere surrounding hatching eggs after laying and before incubating. In other tests the eggs were held in Cry-O-Vac bags either in cases or baskets.

Increasing CO$_2$ in the air surrounding hatching eggs before incubation may be beneficial, but in one test, where apparently an excess of CO$_2$ was used, hatchability was depressed significantly. It is doubtful if a practical application of adding CO$_2$ to the atmosphere surrounding hatching eggs can be made.
An attempt was made to contain the CO₂ released by the eggs by holding them in Cry-O-Vac bags, both in baskets and in cases. Hatchability was increased slightly in eggs held 1-7 days and 8-14 days when they were held in bags in cases. Apparently there was a greater CO₂ concentration surrounding eggs held in baskets than in cases.

_Determination of Thyroxine Secretion Rate of Growing Turkeys_ (H. V. Biellier, E. M. Funk). The feeding of “protamone” at the levels used in this trial showed no benefit in growth rate of poults from seven to 16 weeks of age. All birds were placed on a finishing ration from 16 to 20 weeks of age to promote fat finish. They were marketed at the end of the period.

_Breeding Chickens for Egg Production by Recurrent Selection and Intrasflock Selection Methods_ (A. B. Stephenson, Q. B. Kinder, E. M. Funk, Bobby Jones, Maynard Yoes). Recurrent selection is basically a top cross. An inbred male line is mated to a non-inbred or segregating female line. These parental lines may be of the same or different breeds and their progeny are referred to as test crosses.

Over this six-year period, 1951-1955, a comparison of the test crosses with the intrasflock Leghorns as a control has shown about 10 percent lower fertility. This condition is probably partially due to the use of inbreds as the male parent. Inbred birds are not usually very vigorous. Hatchability of fertile eggs has been the same for both groups although there has been considerable yearly variation.

Over this same six-year period egg weights have been consistently heavier for the crosses by about three percent. Age at first egg has shown considerable variation and averaged two percent later for the crosses.

An earlier age at first egg usually has been observed in crosses where the Leghorn was the male parent. The crosses with the Leghorn as the male parent usually result in higher laying house mortality than the reciprocal cross. Production from first egg over the last three-year period has averaged four percent more for the crosses.

Recurrent selection as a breeding method, with the stock hatched from 1950-55, has given some improvement, if one assumes no environmental change. However, the rate of improvement with recurrent selection has been less than with family and individual selection in the Leghorn line which was considered as a control.

_Systems of Flock Replacement_ (Q. B. Kinder, E. M. Funk). The second year’s work on this project was in agreement with the first year study which indicated faster growth rate, earlier sexual maturity and higher feed efficiency in confinement reared pullets. There was no difference in the
percentage of pullets suitable for housing. Subsequent egg production favored the range reared birds by + 1.9 percent from housing and + 3.5 percent from sexual maturity. There was no difference in adult mortality, body weight or egg weight.

The use of three hatches per year with brooding, growing, and laying facilities in the same building did not adversely affect livability of the birds or egg production. Seasonal effects of date of hatch appeared to influence egg production and culling rate with the February hatch showing the best performance. Date of hatch has a marked influence on egg size pattern in relation to age of bird. The use of three broods per year tended to smooth out yearly production and produce a more uniform flow of various size grades of eggs; however, production was below average from August through November.

Keeping yearling hens in laying shelters an additional 3-4 months:

Moving 76.5 percent of the original number of hens to laying shelters after 11 months of production in regular laying houses resulted in an average of 55.1 percent hen day production for the additional 140 day period when accompanied by once per month culling.

Average number of birds for the test period was 79.1 percent of number moved to shelters. Eggs graded 84.8 percent large and extra large. Feed per dozen eggs was 6.0 pounds. Income over feed cost was estimated at $1.25 per bird moved to shelters for the 140 day period.

*Photoperiodicity and Age on Chicken Reproduction* (H. V. Biellier, E. M. Funk). The duration of the total amount of light and darkness making up a test day had a direct effect upon time of oviposition. Days of less than 24 hours had the effect of shortening the egg clutch and increasing the number of days skipped in egg production between clutches.

Day lengths from 25 to 32 hours caused the oviposition to occur in the period of darkness. All day lengths of 25 hours duration or greater increased the clutch length and maintained a higher percentage of hens in egg production. The results showed that the optimum day length to maintain maximum egg production was somewhere between 24 and 27 hours for the breeding and ability to lay of the hens used in this trial.

*Thyroid Activity of Chicken Laying Hens as Affected by Age, Season Level of Production, Ambient Temperature, and Light* (H. V. Biellier and E. M. Funk). This project was submitted in June of 1957. Work was begun in preparation of housing facilities, equipment, and experiment birds. Thyroid rate determinations are to be collected during the spring laying season.

*Factors Affecting the Flavor of Poultry* (O. J. Kahlenberg, E. M. Funk, and W. C. Hurley). As a part of the general plan of studying the factors
affecting flavor, inorganic constituents were analyzed in the chill water from both eviscerated fowl and broilers when chilled in distilled water at 34°F. for periods varying from one to 24 hours.

The inorganic constituents for the fowl, in terms of milligrams per gram of eviscerated bird, increased from one to 24 hours as follows: sodium 0.080 to 0.1508 and chlorine 0.1118 to 0.2689; for the broilers, sodium 0.0365 to 0.2307, potassium 0.1569 to 0.7483, calcium 0.0087 to 0.0234, phosphorus 0.0379 to 0.1978, and chlorine 0.1205 to 0.5942.

Methods of Processing Poultry and Commercial Precooked Frozen and Canned Products (O. J. Kahlenberg and E. M. Funk). Preliminary results on a limited number of birds indicate that the most tender meat was obtained when birds were cooked by “boiling” in tap water alone, and when they were cooked by either “simmering” or “pressure cooking” in 0.75 percent potassium chloride solutions.

Bulletin 747 (April, 1960), Report of Director for the Year Ending June 30, 1959, describes the following poultry studies:

Thyroid Activity of Chicken Laying Hens as Affected by Age, Season, and Level of Production (Harold V. Biellier and E. M. Funk). The daily thyroid hormone secretion rate of S.C. White Leghorn laying hens ranged from 15.98 to 33.23 micrograms of L-thyroxine. The amount of L-thyroxine required per 100 grams body weight to equal the thyroid hormone secretion rate of S.C. White Leghorn hens ranged from 0.8 to 1.2 micrograms daily.

The amount of L-thyroxine required per 100 grams body weight to equal the thyroid hormone secretion rate of White Plymouth Rock hens ranged from 0.6 to 1.0 micrograms daily.

Relationship of Egg Composition to the Preservation and Utilization of Shell Eggs, and Egg Products (O. J. Cotterill, E. M. Funk, F. A. Gardner, F. E. Cunningham, J. Colburn.) The effects of several chemical additives on various physical properties and on the performance of egg white in angel cakes has been observed. These observations include: surface tension, viscosity, pH, optical density, electrophoretic patterns, beating characteristics, and angle cake volume and texture. Anionic surface active agents tend to increase cake volume but produce a cake with poorer texture. Cationic and nonionic detergents usually do not increase cake volume. Additives such as triethylcitrate and acetoin tend to increase whip time and improve texture. Viscosity of egg white appears to be unimportant insofar as cake function is concerned.

Photoperiodicity and Age on Chicken Reproduction (H. V. Biellier, E. M. Funk). The time of oviposition was restricted to the daylight hours on the 24-hour day. As day-length was decreased more eggs were laid during
the dark period. Increasing the day-length from 24 to 27 hours also increased the percent of ovipositions occurring in the dark period.

Day-lengths greater than 24 hours progressively advanced the time of oviposition to an earlier hour of the day. On days shorter than 24 hours oviposition occurred at a later time of the day. Results indicate use of longer days (24-26 hours) for laying hens can increase the annual egg production by permitting sustained lay.


Performance Testing of purebreds, strain-crosses, crosses and hybrids for egg production (Q. B. Kinder, A. B. Stephenson, E. M. Funk). On the basis of performance index the hybrids with an index of 108 were eight percent above the average of all birds tested. The six strains of purebred White Leghorns tested were highly variable, with an average index of only 96 although three strains were 100 or above. Twenty strain-cross combinations of White Leghorns averaged an index of 101, with some combinations going as high as 114. This indicates that strain crosses do give about five percent boost over purebreds on an average with specific crosses capable of eight-ten percent improvement. Considerable testing and retesting is necessary to identify such nicks. Breed crossing of Rhode Island Red, New Hampshire and California Gray on White Leghorn females gave an average index of 106, or six percent above average, which was superior to strain crosses and almost as good as hybrids. The reciprocal cross using White Leghorn males on heavy breed females gave relatively poor performance, largely due to high adult mortality. Specific crosses of the latter may succeed, but considerable testing should be done before they are offered commercially. Crossing purebred White Leghorns on commercial hybrids gave results intermediate to the two parents. This work indicated that with a moderate amount of testing, certain breed and strain crosses can be produced that can effectively compete with the best commercial egg strain birds now offered.

Breeding Chickens for Egg Production by Recurrent Selection and Intra-flock Selection Methods (A. B. Stephenson, Q. B. Kinder, E. M. Funk, Bobby Jones). The averages of four test crosses (recurrent selection populations) were about five percent lower in fertility, one percent lower in hatchability, and one percent lower in brooding, rearing, and adult viability when compared to the purebred (intraflock) used as control population. The test crosses were slightly heavier at eight weeks and 22 weeks of age and in January. Both populations had about the same egg size and age of first egg.
In this experiment major emphasis in selection has been on rate of production. Rate of production as measured from first egg was about the same for both breeding methods. When rate was measured on a hen-day basis from housing, two of the test crosses were equal to the control and the other two test crosses were about three percent higher.

Systems of Flock Replacement (Q. B. Kinder and E. M. Funk). Laying house performance consistently favored the range-reared birds with from 0.9 to 3.0 percent higher rate of egg production (66.7 percent average for range-reared compared to 64.2 percent for confinement-reared). Egg weight slightly favored the range-reared birds, chiefly due to later sexual maturity. Very little difference was shown in adult mortality. General conclusions give the range-reared birds a slight advantage in performance. Labor efficiency was better with confinement-rearing and where two broods are produced per year in confinement, the capital investments are better utilized.


Rations for Laying Hens (J. E. Savage, R. M. O'Neal, E. M. Funk) Both all-mash groups were slightly superior in feed efficiency, as measured by feed required per dozen eggs, when compared with the grain-fed groups. The medium energy ration was as efficient as the higher energy ration in this trial but this may be partly due to the increased body weights of the high energy fed group. Birds on the higher energy ration averaged about one-half pound heavier than the birds on the medium energy ration throughout most of the year.

Birds maintained in floor pens produced about 4.5 percent more eggs than their full sisters kept in individual cages and fed the same 16 percent protein all-mash ration. The higher production of birds kept in floor pens is in agreement with a previous study conducted during 1957.

Raising the protein level of the mash to 18 percent did not increase the production of another group of full sisters kept in cages in the same room. The caged birds laid larger eggs and were heavier in body weight. The group of birds which received the 18 percent protein ration gained more in body weight and laid slightly larger eggs than their sisters on the 16 percent protein ration.

Birds maintained on a low zinc purified diet laid eggs with slightly thinner shells and their rate of egg production was about five percent less than birds on the same diet supplemented with zinc.

The continuous treatment of the pullets with 110 grams of an antibiotic per ton of total ration resulted in a significant improvement in egg production during the first 140 days of a 280 day experiment, an improvement in feed efficiency and highly significant greater body weights in
February and June. The continuous treatment had little or no effect on mortality, egg size, interior egg quality, or shell thickness. The intermittent treatment of the pullets with 110 grams of an antibiotic per ton of total ration resulted in a slight improvement in egg production and feed efficiency, and had little or no effect on body weight, mortality, egg size, interior egg quality or shell thickness. Late in the experimental period when no response was being observed in the antibiotic treated groups, changing the antibiotic treatment from aureomycin to a mixture of penicillin and streptomycin fed at the same rates as the aureomycin resulted in no improvement in egg production.

Factors Affecting the Flavor of Poultry (O. J. Kahlenberg, E. M. Funk, J. Forward). Results of this study show that a new “quick-chill” continuous commercial processing method of cooling carcasses in 30 minutes did not adversely affect flavor or tenderness in freshly ice-packed whole broilers. This technological improvement in processing should save time, labor, and floor space, and eliminate the conventional chill tanks and reduce the cost of processing. The ultimate purpose of this type of research is for optimum quality improvement and retention of flavor in all poultry products.

Turkey Feed Practices (H. V. Biellier, E. M. Funk). Three systems of feeding growing turkeys reared in confinement were tested in 1958. Four hundred Broad Breasted Bronze poult s were separated by sex and tested from 10 to 24 weeks of age on duplicated feeding systems. The feeding of a 24.7 percent protein growing mash fed free-choice with either corn and oats or milo and oats produced satisfactory gains and feed efficiencies as good as a 20.2 percent protein all-mash fed alone. The use of standing milo grain as a forage crop for 981 Bronze turkey poult s showed a considerable saving in pounds of feed required to produce a pound of gain. A 24.7 percent grower mash was fed and was restricted to promote consumption of milo. The feed efficiency was 2.18 (does not include milo or other feed eaten on range) compared to 7.43 for birds that were full-fed and grown in confinement.

The maximum utilization of grain sorghums harvested on range by growing turkeys offers a great reduction in the feed cost required to produce market turkeys.

Bulletin 770 (July, 1961), Report of Director for the Year Ending June 1960, contains summaries of the following poultry studies:

Relationship of Egg Composition to the Preservation and Utilization of Shell Eggs and Egg Products (O. J. Cotterill, E. M. Funk, F. E. Cunningham, J. T. Colburn, Walter Seideman, and Beverly Kluge). The yield of
white, yolk, and whole egg liquid and solids was observed as a function of egg size and age of bird. Obtaining smaller eggs from older birds tends to maximize yield of egg yolk with respect to white. Egg white yield can be maximized by obtaining larger eggs from younger birds.

Season was not significant in its effect on the functional properties of egg white as determined by angel cake volume. The age of the bird had no effect on the functional capacity of egg white in angel cakes when the albumen was blended to the same viscosity.

Lipase did not improve the functional properties of yolk contaminated egg white. It was thought that lipase would hydrolyze yolk glycerides to less harmful components. The addition of sodium oleate to normal egg white and to the yolk contaminated white increased angel cake volume but the addition of lipase to the sodium oleate treated white did not produce a further supplemental effect. Lipase treatment of egg white from aged eggs did not restore original angel cake making properties.

**Breeding Chickens for Egg Production by Recurrent Selection and Intra-flock Selection Methods** (A. B. Stephenson, Q. B. Kinder, E. M. Funk, Bobby Jones). The mean rate of all three-way crosses was six percent lower than the mean of their two-way cross dams. This decline was thought to be due to the loss of specific combining ability. Differences in rate of production among the progeny of male lines mated to the same female line were significant for several rates of production and age at first egg. Differences among the progenies in egg weight were significant when classified by the dam line but not when classified by the sire line.

**Systems of Flock Replacement, Feeding, and Laying House Management** (Q. B. Kinder, E. M. Funk, J. E. Savage and Elmer L. Nichols). Floor space allowance study indicated very little reduced production or feed efficiency when floor space was reduced from 3 to 1½ square feet with yearling hens in laying shelters. Part-year test with pullets showed a reduction from 73.5 to 69.1 percent in production when floor space was reduced from 3 to 1½ square feet. Feed efficiencies remained about the same.

Restriction of feed to 70 percent of normal intake on pullets from eight to 24 weeks resulted in 21.4 percent less gain in weight and 28 days later sexual maturity than full-feeding. Feed restriction by addition of soybean hulls gave intermediate results.

Comparison of four systems of feeding laying hens showed no difference in egg production. The systems of feeding compared were 16 percent protein, all mash, 16 percent protein commercial crumbles, 20 percent protein mash and hand-fed grains and a 32 percent protein mash plus self-fed corn and oats.
Rations for Laying Hens (J. E. Savage, E. L. Nichols, E. M. Funk). All-mash, mash-grain, and concentrate-grain feeding programs were tested with egg-strain and broiler-strain hens. No differences in production or feed efficiency due to the system of feeding were observed in the egg-strain White Leghorns. Production averaged between 71 and 72 percent for the 308-day test for all three systems.

Production of the broiler-strain White Rocks averaged 53 percent on the all-mash ration, which was about four percent higher than production on the other two rations. Feed efficiency values were also improved on the all-mash ration.

Egg weights showed a tendency to be increased in the rations where corn and oats were fed free choice with the concentrate and this was correlated to some extent with the higher body weights which developed on the concentrate and grain type rations.

Equal hatchability of fertile eggs was observed with the all-mash and concentrate plus free choice grain system.

Reproductive studies were also conducted with purified type diets. It was found that when a purified ration low in zinc was supplemented with .02 percent zinc carbonate less feed was required per dozen eggs, hatchability was increased, shell thickness was improved, and egg weight was increased. The zinc supplement did not improve rate of production. Egg production on both of the purified diets was from four to five percent less than that of comparable birds which received a practical control ration. Further studies are planned to identify the nature of the factors which are deficient in the supposedly complete purified diet.

Nutritional Requirement of the Chick (J. E. Savage, Dale A. Ross, E. M. Funk). Amino Acid Requirements. Purified diets were used to study the requirement of broiler-type chicks for the amino acid arginine. Contrary to reports published some years ago that heavy breed chicks required less arginine than White Leghorns, it was found in the current studies that the fast feathering, rapidly growing meat-type birds presently being used for broiler production required at least as much arginine as a fast feathering egg-strain bird such as the White Leghorn.

Photoperiodicity and Age on Chicken Reproduction (H. V. Biellier and E. M. Funk). The utilization of a 23-hour day-length for chicken breeder hens proved to be a satisfactory means of identifying hens having a short interval between ovipositions. Six pullets of a population of 48 progeny produced from dams which were selected in 1958 demonstrated the ability to lay eggs at intervals less than 24 hours apart. These hens confirm the hypothesis that hens do exist which are capable of producing eggs at a rate greater than one per 24-hour day. These superior breeder birds have
not been identified in the past due to the blocking action of the normal 24-hour diurnal cycle.

The restriction of light to 6 hours per day during the growing period of pullets proved satisfactory if begun before the pullets reach 14 weeks of age and continued to 21 weeks of age. Pullets restricted at 18 weeks of age for a period of three weeks were delayed in sexual maturity and showed lower annual egg production. The effect of light as a stimulus to egg production persists for at least four weeks on laying hens subjected to unfavorable lighting conditions.

Laying hens which received a 15 minute increase in the lighted period per week during the laying season showed a 3.5 percent higher egg production than those which received a constant 14 hours of light. The day-length of 26 hours was more favorable for egg production than the 24 hour day when maintained throughout a complete laying year. Use of longer days (24-26 hours) for laying hens can increase annual egg production by permitting sustained ovulation and ovipositions. Through the use of day-lengths longer than 24 hours, controlled egg production at a uniform rate can be obtained as a means of lessening experimental variation due to egg production.

**Thyroid Activity of Chicken Laying Hens** (H. V. Biellier, Armando Rosales, and E. M. Funk). The daily thyroid hormone secretion rate of S.C. White Leghorn hens showed individual variation throughout the laying period. The level of secretion varied from 0.4 to 1.6 micrograms L-thyroxine per 100 grams body weight.

**Factors Affecting the Flavor of Poultry** (O. J. Kahlenberg and E. M. Funk). Statistical treatment of the palatability scores showed that the cooked dark meat was significantly more flavorful, juicier, and more tender than the cooked light meat from the same bird.

These studies indicated that ingredients in the broiler ration are not the primary factor in influencing these traits.

**Methods of Processing Poultry for Commercial Precooked Frozen and Canned Products** (O. J. Kahlenberg and E. M. Funk). Comparisons have been made on various cooking procedures with and without salts on 130 old fowl for cooking losses, degree of tenderness in the breast meat, and retention of fat and moisture in the cooked thigh meat. The salts incorporated in the water were two levels each of potassium chloride, sodium chloride, and sodium tripolyphosphate. The cooking procedures were boiling, simmering, and pressure cooking. Studies were also made on 78 fowl cooked in various types of plastic bags.

Cooking old fowl with the salts studied had no advantage over cooking in water with respect to cooking losses, tenderness of breast meat, and
the amount of fat and moisture in the thigh meat. Pressure cooking treatment gave significantly lower Kramer shear force values (more tender meat) than did either boiling or simmering. No significant differences in shear force values were obtained by either boiling or simmering. The amount of fat in thigh meat was significantly lower in pressure cooked than in boiled or simmered birds. Only 1 out of 5 plastic materials studied remained intact after boiling, simmering, or pressure cooking fowl in them. Cooking losses were found to be significantly lower when birds were simmered in mylar-polyester tubes compared with birds simmered in tap water alone.

**Turkey Feeding Practices** (H. V. Biellier and E. M. Funk). The use of standing milo grain as a forage crop showed considerable reduction in the cost of feed required to produce market turkeys. Broad Breasted Bronze poults were ranged on milo range from 12 to 24 weeks of age and fed a 25 percent grower mash, then compared to those receiving the grower mash, yellow corn, and oats fed free-choice. Total cash cost, including cost of seeding milo, was $2.49 per male bird compared to $2.94 for birds full-fed and ranged on grass and legume sod. For females, the milo range cut total feed costs 21 cents per bird. Their cost was $1.72, compared to $1.93 for sod-ranged birds. Feed cost per pound of gain for birds on milo range was 8.9 cents for males and 9.7 cents for females.

In another test where toms and hens ranged on milo together, feed cost per pound of gain to market was 10.4 cents. These birds received a 36 percent protein supplement in pellet form. Pellets were fed on the ground, a practice which worked well except in rainy weather.

**Bulletin 788** (July, 1962), Report of Director for the Year Ending June 30, 1961. The director’s report for 1961 listed for each project, the project personnel, objectives, and publications and did not summarize results of investigations.

**Bulletin 811** (September, 1963), Report of Director for the Year Ending June 30, 1962, lists the following poultry studies:

**Producing Turkeys on Forage** (H. V. Biellier, E. M. Funk). This year forage feeding trials were conducted on 837 Broad Breasted Bronze poults grown for 14 weeks on the regular starter and grower rations. At this age they were moved into the milo fields and the daily amount of 28 percent protein concentrate fed was restricted in order to encourage the poults to consume the standing milo. After a four week restricted feeding training period the poults were divided into four groups: Group A, restricted pellet concentrate on milo range; Group B, free choice pelleted concentrate on
milo range; Group C, free choice mash concentrate on milo range; and Group D, free choice pelleted concentrate and whole yellow corn on sod range. The feed cost per pound of gain for these groups from zero to 24 weeks of age was respectively, nine, 12.5, 12, and 12 cents; from 24 to 28 weeks, for toms, it was seven, 22, 10, and 17 cents. A hatch of 409 toms was reared successfully on milo range with concentrate restricted mechanically in drinking water.

Breeding Chickens for Egg Production (A. B. Stephenson, E. M. Funk, Q. B. Kinder). This year's work represented the third generation of selection in the recurrent selection and segregating types of breeding. Differences among types were not significant in either fertility or hatchability except for the inbred lines. Fertility values within the crosses and within inbreds were not significantly different. The crosses as a type had only half as many families with blood spots as the other types. Within the crosses the Rhode Island Red progeny had seven times as many blood spots as the progeny from White Leghorn or White Plymouth Rock males. Meat spots were significantly more frequent in the Rhode Island Red progeny. Broodiness was more frequent among the crossbred progeny of the Rhode Island males. The differences in annual egg production within the crosses were not significant.

Flock Replacement, Feeding, and Laying House Management (Q. B. Kinder, E. M. Funk, A. B. Stephenson). At present values it would not be profitable to keep layers for a second year unless the pullets' replacement cost exceeded $2.00.

Floor Space: Birds that have been in production for 10 months were moved to laying shelters. They were given 1 ½, 2 ¼, and 3 square feet of floor space (earth). They laid at rates of 54.8, 59.6, and 58.6 percent, respectively. A similar crowding experiment with pullets gave six percent fewer eggs when the pullets were housed at 1 ½ square feet per bird than when given three square feet.

Feeding Systems: Rations with 945 and 878 calories per pound did not show a significant effect on production.

The Nutritional Requirement of the Chick for Amino Acids and Unrecognized Growth Factors. (J. E. Savage, E. M. Funk, A. B. Stephenson, D. A. Ross, D. Bird, J. Yohe). Chicks fed high levels of iodinated casein showed growth depression and increased mortality. Addition of liver fractions to the diet partially counteracted the detrimental effects. The addition of L-thyroxine produced symptoms similar to iodinated casein, and liver was effective in reducing these toxic symptoms. Chicks and poults consuming copper deficient diets showed growth depression and developed leg deformities, subcutaneous hemorrhage, and defects in major blood vessels.
A high mortality, due to massive internal hemorrhage, occurred in chicks fed the deficient diets but this symptom was not observed in the poults. The poults showed a marked lack of pigmentation. Copper supplements increased growth, no hemorrhage or mortality occurred, and incidence of leg abnormalities was reduced greatly. In broiler feeding trials 0.8 percent dietary calcium was found to support gains equal to those obtained with 1.3 percent calcium. Maximum growth and feed efficiency was obtained with a ration composed of 50 percent protein soybean oil meal and 3 percent fish meal as the major protein ingredient source but various other ingredient combinations were shown to give almost equal results. This work will be continued, especially the work with copper and manganese.

*Unidentified Factors in Diets for Hens and Their Effect on Progeny* (J. E. Savage, E. M. Funk, A. B. Stephenson, D. A. Ross). Eggs from hens reared on purified diets and fed purified diets in reproduction studies showed low hatchability. Dietary supplements of corn, casein, alfalfa, whey, liver, corn distillers solubles, and corn fermentation solubles increased hatchability but did not improve egg production, egg weights, or body weight. Casein and corn also improved feed efficiency. In three growth trials with chicks from hens fed the various supplements no evidence was obtained that the factors responsible for the increased hatchability were transferred to the egg and influenced growth of the progeny.

*The Effect of Light on Poultry* (H. V. Biellier, E. M. Funk, A. B. Stephenson). The effect of varying day lengths on the time of oviposition in poultry is of primary importance in developing higher annual egg production.

The restriction of artificial light to six hours per day on growing pullets from eight, 10, 12, and 14 weeks until housed at 18 weeks of age was not effective in conditioning them for early sexual maturity under progressive light stimulus. Eight hours of artificial light with increased intensity of one foot-candle per week was not satisfactory for laying hens. Hatchability studies on 58 hens classified into three groups as to average intervals between ovipositions of 24.0, 25.0, and 26.7 hours, respectively, were compared to records of control hens. Light cycles of dark plus light totaling 23, 25, and 27 hours, along with intravenous injections of 3 units of mammalian oxytocin, forced ovipositions at time desired. Hatchability, blastoderm diameter and shell thickness measured as deviation from controls increased when interval between ovipositions was increased in three hatches. The utilization of reduced day-length (23 hours) in the selection of breeding hens has developed over 10% which lay at intervals less than 24 hours apart. Genetic family selection of strains with long and short sequence lengths will be continued.
Thyroid Activity in Laying Hens (H. V. Biellier, E. M. Funk, A. Rosales, A. B. Stephenson, P. C. Harrison). Meat-type strains and a laying strain were utilized to determine the thyroid hormone secretion rate throughout the laying period, July to June. The level of daily thyroid secretion rate varied from 0.4 to 1.2 micrograms of L-thyroxine per 100 grams body weight. In a separate trial it was demonstrated that a minimum of 48 hours was required for each individual in vivo thyroid count to stabilize, following either low or high levels of injected thyroxine.

Quality of Eggs in Market Channels (O. J. Cotterill, F. Cunningham, E. M. Funk, M. Sebring, W. E. Seideman, A. B. Stephenson). This year observations have been made on several factors affecting the filming and coagulative properties of egg white and whole eggs. Special attention has been given to methods of improving the foaming properties of yolk-contaminated white. Pancreatic lipase as well as heat treatment improved angel cake volume. Higher temperatures and shorter holding periods have been studied. Centrifuging yolk-contaminated white improved functional performance and concentrated the yolk lipid in the precipitate. Contamination of egg white with small amounts of yolk decreased the amount of protein insolubilized air-liquid interface of the foam. Heating yolk-free egg white at high pH levels electrophoretically immobilized the lysozyme fraction, while heating at lower pH immobilized the conalbumin fraction. Insolubilization, coagulation, and color of whole egg varied greatly according to the pH of the system. High pH levels (10 to 12) increased the electrophoretic mobility of ovomucoid and decreased the mobility of both conalbumin and lysozyme. Egg white gelatin occurred at about 12.5. These studies will be continued during the coming year.

Bulletin 826 (March, 1964), Report of Director for the Year Ending June 30, 1963, lists the following poultry studies:

A Study of Egg Composition in Relation to Quality and Utilization of Eggs in Market Channels (17 and NCM-7) (O. Cotterill, E. M. Funk, F. E. Cunningham, M. Hill, W. Seideman, M. Sebring, and A. B. Stephenson). Heat treating yolk-contaminated liquid egg white for short periods (130°F - 15 min.) improved functional performance as well as holding at 100°F for 20 hours. This improvement was not apparent after spray drying. Changes in certain physical and functional performance characteristics caused by the addition of yolk to egg whites supports the view that the harmful effects result from a yolk lipid egg white protein complex.

Breeding Chickens for Egg Production by Recurrent Selection and Intra-flock Selection Methods (164 and NC-47) (A. B. Stephenson, E. M. Funk,
D. Andrews and M. Yoes). This project has progressed to the third generation of the revised recurrent selection procedure for increased egg numbers and trends are now indicated in these data. The crosses of the recurrent selection population had a lower fertility and higher hatchability than birds bred by conventional family and individual selection for overall performance. There were no apparent differences in livability or age at first egg which were related to method of breeding. Within the crosses, the progeny of American class males matured slightly earlier than the progeny of the Leghorn males.

Systems of Flock Replacement, Feeding, and Laying House Management (244) (A. B. Stephenson and E. M. Funk). Layers fed a medium high energy ration (945 calories per pound) laid at a rate of 67.8 percent, which was 2.7 percent higher than that of birds fed a medium energy ration (878 calories per pound).

Unidentified Factors for Hens and Their Effect on the Progeny (255) (J. E. Savage, E. M. Funk, G. Radmall, J. Schulze, and A. B. Stephenson). Work in this and other laboratories has shown copper to be an essential nutrient in early chick and poult growth but little information is available on the role of this element in the reproductive processes of poultry. During this past year laying hens were fed a copper-deficient diet with the following results: Egg production was depressed only slightly; body weight, egg weight, and shell thickness (as measured by specific gravity) were not affected; only a very slight anemia developed; and blood plasma copper levels and the copper content of the egg were markedly lower. Hatchability was also markedly depressed in the lower-copper group.

Hatchability was not improved in a limited number of eggs injected with copper salts. Blood plasma and egg copper levels of hens fed a copper-supplemented diet were similar to those of hens fed practical diets and hatchability was improved dramatically. When the experimental diets were reversed, rapid copper depletion occurred. In previous studies with zinc-deficient hens’ diets, characteristic abnormalities were seen in developing embryos, but with the current copper-deficient hen diets embryo deaths occurred primarily in the early blood stage and no abnormalities were observed.

The Nutritional Requirement of the Chick for Amino Acids and Unrecognized Growth Factors (277) (J. E. Savage, D. W. Bird, E. M. Funk, G. Radmall, J. Schulze and J. M. Yohe). The availability of zinc in chick diets was decreased markedly when phytic acid was added to the diet. In the presence of phytic acid, an increase in calcium levels caused a significant decrease in four-week chick weights, but this detrimental effect was
overcome if a zinc supplement was also added. The free form of phytic acid was as effective in decreasing the availability of zinc as a protein-phytic acid complex. Balance trials showed that when phytic acid was present in the diet, both fecal and urinary zinc excretion were increased and the chick went into negative zinc balance. Apparently the phytic acid chelated zinc within the chick's body and when the phytic acid was excreted, zinc was carried along with it. The zinc content of the diet also affected the amount of copper required. Increased levels of zinc added to low-copper chick diets increased the degree of anemia, increased mortality with much of the mortality being due to internal hemorrhage, and increased the incidence of subcutaneous hemorrhage and bone abnormalities.

Turkey poults fed the same diets showed similar symptoms but to a lesser degree and no mortality from internal hemorrhage occurred. Dietary copper supplements largely alleviated the deficiency symptoms in both chicks and poults.

*The Effect of Light and Thyroid Gland Activity on Ovulation and Oviposition in the Domestic Fowl* (292) (H. V. Biellier, A. A. Rosales, J. E. Savage, P. C. Harrison, A. B. Stephenson, and E. M. Funk). The restriction of artificial light to six hours per day on 11 week old S.C.W. Leghorn pullets and the shift to long light periods at 16 weeks of age were effective in obtaining early sexual maturity (24 weeks). The group maintained on restricted light from 11 to 21 weeks of age showed five percent lower annual egg production than the stimulated and natural-light groups.

Forty-eight S.C.W. Leghorn hens with inherent short, medium, and long intervals between ovipositions were induced to lay at average intervals of 23.96, 25.44, and 27.47 hours. Hatchability, shell thickness, blastoderm diameters, and egg weight increased with interval between ovipositions.

A group of 48 S.C.W. Leghorn hens were submitted to light cycles of 23, 25, and 27 hours. Hatchability, shell thickness, and blastoderm size increase with increase in the length of the light cycle. It was concluded that short intervals between ovipositions were detrimental to hatchability of hens having the inherent or genetic characteristic of intense "lay.

The utilization of reduced day-length (23 hours) in the selection of chicken breeding hens has developed more than 10 percent that lay at intervals less than 24 hours apart.

*Evaluation of Systems of Feeding and Use of Forage on Range for Growing Turkeys* (344) (H. V. Biellier, D. D. Jackson, A. B. Stephenson, and E. M. Funk). Grain sorghum forage feeding trials were conducted on two age groups of Broad Breasted Bronze poult hatched May 19 and June 2, 1962. At 16 weeks of age, 500 males and 500 females were moved into milo fields
and were fed 33 percent protein mash concentrate free choice in bulk feeders. One hundred males and 100 females were full-fed on grass range as controls. The tom turkeys were unable to make efficient gains and consumed excessive amounts of the concentrate. The females made efficient gains on free choice mash concentrate and milo forage, showing less than half the cost per pound of gain shown by the controls. Four groups reared on milo forage and hand fed 28 percent protein pelleted concentrate on a restricted schedule demonstrated feed costs of less than 10 cents per pound gain.

Grain sorghums may be used as a forage crop by growing turkeys to offset a considerable portion of the feed cost to producers. Savings of over 50 cents per bird have been demonstrated. Five varieties of grain sorghum were shown to be satisfactory as forage for turkeys. Turkeys foraged two varieties of soybeans satisfactorily. Raw soybeans were unsatisfactory for pouls from 16 to 24 weeks of age.

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A Study of Egg Composition in Relation to Quality and Utilization of Eggs in Market Channels (NCM-7) (Owen J. Cotterill, E. M. Funk and A.B. Stephenson). This project concerns chemical, microbiological, physical, and functional studies of egg products. Some results of fractionation, dehydration, and pasteurization investigations are included.

The ion-exchange (CMC) chromatographic separation of yolk proteins yielded five major fractions. This new method of yolk fractionation detects changes in the protein systems caused by freezing, drying, diluting, centrifuging, and pasteurizing. Pattern differences were also found in egg yolk from various ages and species of birds. The yolk fractions are being identified by chemical analyses.

Spray-drying egg white at pH levels below 6.5 damages the conalbumin fraction and alters its iron-complexing and heat coagulating properties. Lysozyme is damaged by spray-drying egg white above pH 9.0. The conalbumin and lysozyme fractions are more stable and remain more functionally active when egg white is spray-dried at pH 8.5 and possibly account for the improved performance in this region.

Liquid egg pasteurization requirements vary with the product pH. Isotherms illustrating the time required to destroy Staphylococcus aureus and Salmonella oranienburg (food poisoning organisms) in liquid whole egg at various pH levels have been determined. These organisms have maximum resistance to heat in whole egg near pH 5.0. This product can be more effectively pasteurized at higher pH levels. The current recommended
pasteurization conditions (140°F for 3 1/2 to 4 min.) are inadequate for \textit{Staphylococcus aureus} destruction in liquid whole eggs.

\textit{Breeding Chickens By Recurrent Selection and By Family and Individual Selection for Greater Number of Eggs and By Family and Individual Selection For General Desirability} (NC-47) (A. B. Stephenson, E. M. Funk, and Q. B. Kinder). The report is on the fifth generation of the revised recurrent selection project. Fertility and hatchability were lower for the inbreds. Only 30 percent of the eggs set from the R3 line produced chicks. Livability was not noticeably related to type of breeding except for the inbreds. Broodiness was quite rare in the pure Leghorns but four percent of the crosses went broody at least once.

Selection was on the basis of high egg production from first egg to 34 weeks. Other traits were observed as correlated responses. Some trends are becoming apparent over the five year period. The intralock has been consistently above the average of all non-inbreds in egg production. The crosses have had about average production and the family and control population about one and three percent lower index values for production from first egg to 64 weeks production. Within the crosses the R3 x Lc cross has the highest production of any group with an index of 106.

Egg size was largest for the control population and smallest for the R3 x Lc cross which had the highest egg production.

The progeny of an inbred American Class sire weigh about 15 percent more than that of a Leghorn both at housing and in January. No differences were observed between egg quality and type of breeding.

\textit{Systems of Flock Replacement, Feeding and Laying House Management} (Q. B. Kinder, E. M. Funk, and A. B. Stephenson). The second year of a study, comparing productive performance of laying hens in (1) insulated forced draft houses, (2) straw loft open front houses, and (3) non-insulated open front houses, resulted in an almost complete reversal of the first year study which favored the insulated forced-draft house. Second year performance gave production of 67.0 percent, 70.0 percent, and 70.0 percent and feed efficiencies of 4.81, 4.72, and 4.70 for the three types of housing over a 52-week production period. Egg weight, body weight, and livability also favored the open type ventilation with little or no insulation. (There were no significant differences between the straw loft and non-insulated types of housing.) This study raises serious question of the economy of expensive systems of insulation and ventilation for layers under Missouri conditions. Study needs to be continued.

A study of growing out replacements pullets with and without coccidiostats in the ration during the eight-week brooding in built-up litter indicated no differences in mortality or gain by birds the first eight weeks.
Cessation of treatment at eight weeks resulted in greater losses of treated birds from eight-22 weeks on range. Effect of this management during growing period on subsequent production will be determined. (It is quite possible that management systems that do not use coccidiostats in rations for replacement pullets can be determined.)

Unidentified Factors for Hens, and Their Effect on the Progeny (J. E. Savage, E. M. Funk and A. B. Stephenson). Graded levels of copper were added to the diets of birds which had been fed a copper deficient diet for 10 weeks. Based on egg production and hatchability, the copper requirement of the laying hen was in excess of 2.0 ppm. Satisfactory hatchability was not obtained by the injection of copper salts into deficient eggs.

Hatchability, egg production, and egg weights were significantly lower in hens fed a purified diet than in hens fed a practical diet. Substitution of ground corn for the carbohydrate fraction and a part of the protein of the purified diet gave results comparable to those obtained with the practical ration. Two groups of chicks were hatched from each maternal dietary group at intervals throughout the year and reared to four weeks of age on either a basal diet or a similar diet containing UGF sources. No evidence of a carry-over effect from maternal diet was obtained.

The Nutritional Requirement of the Chick for Amino Acids and Unrecognized Growth Factors (J. E. Savage, E. M. Funk, and A. B. Stephenson). A copper deficient diet reduced the percentage of elastin in chick aorta, thereby affecting its structural integrity. Excess zinc accentuated the deficiency. Determination of tissue elastin by a method which involves use of the enzyme elastase, was not as satisfactory as chemical extraction. In a study of the relationship of diet and age to cardio-vascular tissue damage it was found that elastin increased with age in birds receiving adequate diets but was depressed in birds receiving deficient diets.

Excess cations markedly improved growth of chicks fed diets containing an imbalanced source of protein. In low arginine diets, excess sodium or potassium improved growth and appeared to spare arginine. Growth improvement appears to be related to changes in acid-base balance state since an equivalent level of cations as the neutral salt was ineffective.

Studies were continued on an unidentified factor in liver which reduces the toxicity of excess thyro-active supplements. Chicks fed iodinated casein showed an increase in weight of heart. Their metabolic rate was elevated, and their mortality was high. Liver supplements reduced mortality and had only a slight effect on metabolic rate. Heart weight was reduced as compared to the thyroid supplemented group but not when compared to the control level.
In three of four trials where supplemented diets were adjusted for protein, energy, and sulfur amino acids, the addition of fish meal did not significantly improve either growth rate or feed efficiency.

The Effect of Light and Thyroid Gland Activity on Ovulation and Oviposition in the Domestic Fowl (H. V. Biellier, E. M. Funk and A. B. Stephenson). White Leghorn pullets placed in a specially constructed light control shelter at 9, 11, 13, 15, and 17 weeks of age were maintained on six hours of light daily until housed at 19 weeks of age. Those maintained on short day-lengths of 6 hours of light from 13 to 19 weeks of age were stimulated to enter production by a 15-minute increase in day-length. Birds accustomed to natural light and day-length were not stimulated to reproductive activity equal to that of birds subjected to 14 hours of light or continuous artificial light by the same treatment.

The optimum age for light restriction appeared to be 14 weeks of age for birds housed under increasing day-length, beginning with short day-length. This was in agreement with previous studies conducted at this station. The pullets responded similarly to increasing day-length when restricted to six hours of light at any age up to 14 weeks, with those restricted at 9, 11, and 13 weeks maturing at 25, 27, and 27 weeks, respectively. Increasing day-length did not serve the same stimulating purpose; those restricted to six hours of light at 15, 17, and 19 weeks matured at 29, 30, and 36 weeks, respectively. Under laying house light treatments of 14 hours per day of continuous light, or continuous with increasing intensity, rearing period light treatment was of little consequence. All birds on these laying period light treatments attained 50 percent production between 25 and 26 weeks of age. Continuous light of increasing intensity of 0.5 foot candles per week did not result in increased annual egg production over other light treatments.

The use of a 24-hour automatic oviposition recorder will be continued to obtain genetic selection of strains of Leghorn hens with short sequence lengths. The effect of cycling daily high and low ambient temperatures compared to constant temperatures will be determined on laying hens by measuring thyroid gland activity and egg production.

The Evaluation of Forage Produced on Range for Growing Turkeys (H. V. Biellier, E. M. Funk, and A. B. Stephenson). Systems of feeding designed to utilize standing corn forage and grain with growing turkeys were tested in 1964. Broad Breasted Bronze males selected from three separate hatches were placed on range planted to corn at 12, 14, and 16 weeks of age. Body weight gains and rate of mortality of toms which grazed field-grown corn with daily restriction of protein concentrate were equal to those receiving a complete mash ration on orchard grass sod (26.6 to 26.7 pounds at 24
weeks of age). Male turkeys did not graze standing corn satisfactorily. It was found necessary to use a field chopper to cut the immature ears of corn and blow the chopped feed back on the ground to maintain a large intake of grain and prevent wastage. Dwarf corn with ears approximately 18 inches above ground was not grazed successfully by male turkeys unless chopped. Forage corn with open shuck and AES 704 required chopping also.

Male turkeys grown on a pasture forage of a hybrid of sudan and sorghum did not gain as well as those on orchard grass forage.

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A Study of Egg Composition in Relation to Quality and Utilization of Eggs in Market Channels (NCM-7) (Owen Cotterill, Walter Seideman, Merlin Nichols, Max Norris, Herschel Ball, E. M. Funk, A. B. Stephenson [Poultry Department] Ruth Baldwin [School of Home Economics]).

High temperature (130, 140, 160, 180°F) aging (up to 60 days) of white solids prepared from yolk-free and 0.03 percent yolk-contaminated liquid, adjusted to pH 5.0, 6.5, 8.5, and 9.5 before spray drying (1) improved foaming ability of the reconstituted yolk contaminated powder; (2) reduced solubility and angel cake volume at 160 and 180°F storage; and (3) increased NH₃ evolution, and gave some conalbumin damage, and poorer functional performance at higher pH levels. Higher temperatures than normally used to destroy Salmonella in egg white solids show promise.

Centrifugation of liquid whole egg will partially overcome the heat damage caused by pasteurization at 140°F for three minutes. Maximum sponge cake volume was obtained at pH 8.0-9.5. Centrifugation of the non-pasteurized samples at pH levels between 5.5-10.0 improved functional performance of the supernatant. Also, percent solids and percent protein were decreased in the supernatant. This fractionation process could become commercial practice.

Egg products should be heat-pasteurized at the highest pH that permits satisfactory performance. High product pH permits the use of lower pasteurizing temperature and lessens the incidence of debilitated cells, and negates the growth of Salmonella. Equivalent pasteurizing temperatures were established for three egg white conditions, using 3½ to 4 minute heating time: (1) pH 7.0 + AI = 140°F, (2) pH 8.7 = 136°F, (3) pH 9.3 = 133°F. While conalbumin stabilization at pH 7.0 with AI permits higher heat treatments without coagulation, this advantage is off-set by greater heat resistance of Salmonella at pH 7.0, compared to the more natural pH levels of pH 8.7 to 9.3.
Breeding Chickens by Recurrent Selection and by Family and Individual Selection for Greater Number of Eggs and by Family and Individual Selection for General Desirability (NC-47) (A. B. Stephenson (leader), Q. B. Kinder, E. M. Funk and Terry Kinney). The fertility figures for inbred males with segregating and inbred females were 12 and 19 percent below the mean of all non-inbreds. Differences in livability do not seem to be related to types of breeding. Broodiness was more prevalent among the progeny of the White Rocks and Rhode Island-Reds than it was in the Leghorn progeny.

Production of the R3 male’s progeny has averaged six percent above the non-inbred mean for the duration of this experiment. However, the egg size has decreased six percent. Although selection has not changed the net egg mass, it is probable the smaller eggs have more yolk solids. The data for the past year showed albumen height in the eggs of the R3 progeny to be about as high as in the other crosses.

Unidentified Factors for Hens, and Their Effect on the Progeny (J. E. Savage (leader), D. W. Bird and J. R. Gardner). The copper requirement of the laying hen was studied by the addition of graded levels of supplemental copper to a low-copper purified diet. Egg production, hatchability, and copper content of eggs were used as measures of response. Although the requirement for egg production appears to be no more than two ppm of additional copper, this level is inadequate for normal hatchability. Maximum egg storage and hatchability appear to be reached with no more than eight ppm of additional copper.

The effect of unidentified nutrient supplements on avian reproduction was studied in laying hens fed a soy protein-glucose purified diet. Egg production and hatchability were improved by supplements of dehydrated alfalfa meal, corn, and casein. When starch replaced glucose, egg production was improved but no increase in hatchability occurred.

Bone ash, liver weights, hemoglobin, and fertility did not appear to be related to the nutrient activity in the supplements which produced improvements in egg production or hatchability. Carry-over of growth promoting activity to chicks was insignificant.

Systems of Flock Replacement, Feeding and Laying House Management (Q. B. Kinder, A. B. Stephenson and Albert Bentley). Third year of a study comparing the productive performance of laying hens in (1) insulated forced ventilated, (2) straw-loft open front, and (3) non-insulated open front houses resulted in slightly better performance in types 2 and 3. Third year egg production for a 40-week period was 68.8 percent, 70.0 percent and 71.8 percent and feed efficiencies were 4.66, 4.60, and 4.62 for the three types of housing, respectively. Egg size and body weight of birds
were slightly higher in the open type houses. There was no difference in mortality rate. This study indicates that expensive systems of insulation and ventilation are not necessary for satisfactory performance of layers in this area. This is the second year of the three-year study that types 2 and 3 were slightly superior.

A study of the effect of nitrate in the drinking water of layers at a level of 300 ppm. indicates that conversion of nitrate in the water of birds on rations with no added vitamin A or iodine may reduce the production in the early part of the laying year. First trial indicated a reduced production of 5.1 percent (70.5 percent compared to 65.4 percent) through 24 weeks of production. The second trial, for a 16 week period with four replications on each treatment, resulted in a difference of only 1.2 percent (69.8 percent compared to 68.6 percent). Where vitamin A or iodine was added to the ration there was little if any effect on production with 300 ppm. nitrate in the drinking water. High levels of nitrite in drinking water produced eggs with 1-2 ppm. of nitrite in the egg albumen.

Hatch 277, The Nutritional Requirement of the Chick for Amino Acids and Unrecognized Growth Factors (J. E. Savage, D. W. Bird and Jerry Cherry). In previous studies, chicks fed copper-deficient diets were retarded in growth, developed anemia and bone abnormalities, and had a high mortality rate due to massive internal hemorrhage. Histological and biochemical studies showed the internal hemorrhage was associated with defective cardiovascular tissue.

Additional studies were conducted during the past year with embryos from hens maintained on variable levels of dietary copper. Most of the embryos from hens fed diets extremely low in copper failed to develop normally. Histological studies of the copper-deficient embryos showed a characteristic lack of organization and differentiation in mesodermal tissue.

In other work, studies were continued with the liver fractions which reduce the toxicity of excess dietary thyroactive compounds.

Metabolic rate, as measured by oxygen consumption, showed a progressive decrease up to 12 hours after withdrawal of the dietary thyroactive supplement. Chicks which received both liver residue and the thyroactive supplement appeared to have a lower metabolic rate, but this difference did not appear to be wholly responsible for the beneficial effects of the liver supplement.

Hatch 344, The Evaluation of Forage Produced on Range for Growing Turkeys (Harold Biellier, Preston Hill, E. M. Funk and A. B. Stephenson). Systems of feeding designed to utilize standing grain sorghums by growing male turkeys were tested in 1965. Concentrate mashes of two different protein levels, 28 and 38 percent, were tested against a control ration fed
as a complete feed. Broad Breasted Bronze males selected from two separate hatches were placed on standing milo range at 15 and 17 weeks of age. Each hatch consisted of approximately 600 birds which were randomized between the three experimental groups on a total of six ranges. Free-choice feeding of concentrate mashes in bulk feeders was satisfactory in restricting protein intake and increasing consumption of standing milo grain. Considerable labor saving was realized over the hand-fed, daily restriction system of pellet feeding reported earlier, without loss of forced grain intake by the males.

Performance of 285 Bronze males on sorghum-sudangrass forage and 90 on orchard grass pasture indicates that further study is needed to show the actual feed savings and digestibility of the hybrid forage. The males on the hybrid forage weighed 1.1 pounds less at 24 weeks of age and consumed 0.53 pounds more feed per pound of gain than those on orchard grass.

The Effect of Light and Thyroid Activity on Ovulation and Oviposition in the Domestic Fowl (Harold Biellier, P. C. Harrison, E. M. Funk, and A. B. Stephenson). Leghorn pullets placed in restricted light control quarters at 11 weeks of age were compared to those receiving natural light while being reared on range. One-half of the restricted group received a maximum of eight hours light daily from 11 to 21 weeks of age and the other half were restricted to eight hours from 11 to 16 weeks and returned to natural light from 16 to 21 weeks of age. At 21 weeks of age birds from each of the rearing treatments were randomized into the four separate light chambers which received the following lighting programs during the laying year: 14 hours of light per day; eight hours to be increased 15 minutes per week; 12 hours per day; and 12 hours with increasing intensity of 0.5 foot-candle per week.

In all light treatments the birds restricted and then returned to natural light attained sexual maturity at 25 and 26 weeks respectively, and an increase in production equal to those reared on natural light, whereas, those restricted to housing at 11 weeks reached 50 percent production at 28 weeks of age. No difference was observed between egg weights or Haugh unit scores when the birds were maintained on 14 hours of light or on 12 hours of light per day. However, those on increasing day-length had a significantly higher average egg weight and Haugh unit score. Egg shell thickness, feed per dozen eggs, and rate of mortality showed no difference due to the treatments described.

Progress Reports Prepared for 1966 by the Poultry Research Staff

Improving Acceptability, Stability, and Utilization of Poultry Products (Owen Cotterill, Hershel Ball, Max Norris, Jean Glauert, Rehana Shafi
and Stanley Steinhoff). The precipitate fraction obtained by centrifuging liquid whole egg has better emulsifying properties than the original mixture. Precipitates prepared from low pH liquids formed more stable emulsions than high pH samples as indicated by performance in mayonnaise and photomicrographs of the oil globules.

Preliminary observations were made on various methods to improve heat damaged egg white. Low temperature storage, H₂O₂ treatment, and enzymatic hydrolysis show promise. Under some conditions, moderately heat denatured egg white proteins appear reversible.

Minimum pasteurization temperatures to kill salmonella were established for egg products. Salted (10%) whole egg and yolk products required pasteurization for 3.5 to 4.0 minutes at temperatures above 66 to 68°C to kill all cells from a 10⁶ inoculum of salmonella. Sugared (10%) whole egg and yolk products require about 59 and 63°C. Adjusting egg white to pH 9.0 and holding at 46°C for 24 hours produced salmonella negative samples, while most inoculated cells survived low temperature storage.

A technique was developed to determine the pasteurization temperature where inoculum size may not be a biasing factor. When the survival curves from various inoculum levels are graphed, rather than being parallel, these lines intersect at a common point. This point was termed the “Death Point Temperature.”

These data have been useful in establishing minimum pasteurization requirements for egg products.

_Breeding Chickens by Recurrent Selection and by Family and Individual Selection for Greater Number of Eggs and by Family and Individual Selection for General Desirability (NC-47) (A. B. Stephenson, Q. B. Kinder and E. M. Funk) (Terry B. Kenny, Jr.—Regional Lab.)._ This report is based on data from the seventh generation of the revised Recurrent Selection project. The R3 inbred line was extremely low in fertility and livability this generation and is in danger of becoming extinct. In general this generation did not show any marked changes from the previous generations.

A comparison of the progeny from dams of the random control population with that of dams of the same base population after seven generations of selection indicated a genetic change had occurred. Selection for increased egg numbers from first egg to 34 weeks of age increased the rate of egg production 0.6 percent per year. This gain in egg numbers was associated with a decrease in egg size of almost two percent per generation. Other correlated responses over the 7 generations showed a total change of four days earlier sexual maturity, two percent higher production from 34 to 64 weeks of age, three percent fewer birds with produc-
tion rates of less than 15 percent and one percent more birds going broody. The changes in livability, body weight, and egg quality were small.

*Systems of Flock Replacement, Feeding, and Laying House Management* (Q. B. Kinder and A. B. Stephenson). The fourth year of a study of productive performance of laying hens in (1) insulated force ventilated, (2) straw-loft open front and (3) non-insulated open front housing indicates that expensive systems of insulation and ventilation are unnecessary for satisfactory performance of floor type layers in Central Missouri from August to June. Changing floor density from two square feet per bird had little effect on egg production, feed efficiency or mortality rate. Preliminary studies indicate no genetic-environment interaction due to type of housing.

Under a system of growing replacement pullets on old built-up litter and using a coccidiostat to 14 weeks of age, the treatment variable of weekly moistening the litter in alternate pens resulted in no difference in mortality rate. Percentage of pullets suitable for housing was an excellent 95.5 percent for the period of seven to 144 days of age for the combined treatments.

*Unidentified Factors for Hens, and their Effect on the Progeny* (J. E. Savage, D. W. Bird, and D. M. Hughes). Hens fed a low copper, normal zinc diet for a 20-week experimental period showed a slight decrease in rate of egg production. The copper content of eggs, plasma, and liver decreased and hatchability dropped markedly during the first two weeks of the experiment.

The effect of a low copper, high zinc diet was similar except that the production of hens fed the high zinc diet was lower and hatchability declined more rapidly.

Studies with graded levels of copper in two semi-purified diets containing different zinc levels indicated that at least four ppm of additional copper were required to maintain hatchability in hens fed the high zinc diet, while two ppm may have been adequate for those fed the normal zinc diet. The requirement for hatchability was at least two times that required for egg production.

Hens fed soy protein diets with either glucose, starch, sucrose, or corn as the carbohydrate source showed no significant differences in egg production. Hatchability was higher in the diets containing starch and corn than in those containing glucose or sucrose as the carbohydrate source.

*The Nutritional Requirement of the Chick for Amino Acid and Unrecognized Growth Factors* (J. E. Savage, D. W. Bird, and J. A. Cherry). Previous studies of copper deficiency in avian species showed that growing birds were anemic, retarded in growth, and developed tissue abnormalities.
High mortality associated with the presence of defective cardiovascular tissue was observed. Since the deficiency symptoms were more pronounced in the younger birds, studies during the year were extended to developing embryos from hens fed variable levels of copper.

Embryos examined after 72 and 96 hours of incubation time showed that a retardation in development was present, also a high incidence of anemia and hemorrhage was noted.

Anomalies observed in histological studies of the copper deficient embryos included defects in spinal cord development, aortic abnormalities and a general lack of organization and development in the heart region.

The Effect of Light and Thyroid Gland Activity on Ovulation and Oviposition in the Domestic Fowl (Harold Biellier, Paul Ballard, A. B. Stephenson and J. E. Savage). Laying hens were subjected to six abrupt changes in environmental temperature to determine the effect on physiological variations in rate function. Changes in temperature were: 21 to 5, 35 to 5, 35 to 21, 21 to 35, 5 to 35, and 5 to 21°C. Six physiological parameters were measured: pulse rate, blood pressure, respiratory rate, body temperature, oxygen consumption, and thyroid release rate. The general pattern of response was a rapid initial change in rate function, which was followed by a plateau generally at a different functional rate than at previous temperature. A decrease in blood pressure was indicated at both high and low temperatures. There was a rapid increase in pulse rate when the birds were transferred from 35 to 21 to 5°C. Pulse rate showed the opposite responses when birds were transferred from 5 to 21 to 35°C. Respiratory rate response was inversely related to pulse rate in birds exposed to a decrease or increase in temperature. Change in body temperature best reflected the general response pattern to an increase or decrease of temperature. Plateauing of body temperature best reflected the time of acclimation as thermal equilibrium was attained. Rapid change in egg shell thickness indicated an acid-base imbalance of the blood which may represent a "cause-effect" relationship between respiratory rate and pulse rate. Prior to shift to high temperature the mean specific gravity was 1.0725 and a day following exposure it was 1.0608. On the day following return to 21°C, the mean specific gravity was 1.0733. Thyroid I\textsuperscript{131} release rate was not a sensitive indicator of effects of abrupt changes of environmental temperature.

The Evaluation of Forage Produced on Range for Growing Turkeys (Harold Biellier, Preston Hill, Stanley Kenney and A. B. Stephenson). Two concentrate mashes consisting of 28 and 38 percent protein were tested against a control ration fed as a complete feed in three separate trials with over 1000 turkey males. Free-choice feeding of concentrate mashes in bulk
feeders on range and in confinement was satisfactory in restricting protein intake and increasing consumption of milo grain. The satisfactory replication permits the termination of eight years study in development of a turkey range-forage rearing program which will offer great savings in the cost of growing turkeys. The over-all benefits of range-grown forage to the turkey industry and suggested implementation of program are to be presented in two publications. Two levels of NaCl, five and eight percent, in protein concentrates were effective in reducing consumption of concentrate and increasing consumption of milo grain without serious effect on growth rate of males from 17 to 25 weeks of age.
shown at dedication for the poultry buildings financed by an $18,000 Missouri Poultry Improvement Assn. grant in 1952 are, left to right: Berley Winton, former Missouri extension specialist and now director of the Regional Poultry Disease Laboratory, East Lansing, Mich.; Dr. Funk; S. B. Shirk, assoc. dean of the College of Agriculture; Dr. Elmer Ellis, president of the University; and Franklin Gamble and Charles Dixon, Missouri Poultry Improvement Assn.

INDUSTRY COOPERATION

The Department of Poultry Husbandry has had excellent cooperation from the poultry industry of Missouri. We shall list the donors and their gifts but space permits details about only one gift; that of the Missouri Poultry Improvement Association.

Since the founding of the Missouri Poultry Improvement Association in 1928 there has been a very close working relationship between the Association and the Department of Poultry Husbandry. From the beginning of the organization members of the poultry staff have served as secretary of the MPIA. Prof. E. W. Henderson served as secretary in 1926-27, and E. M. Funk from 1935 until 1964 when the Dean of the College of Agriculture asked all secretaries to relinquish such offices. Funk was then named advisor to the association.

The close cooperation between the Association and the University resulted in the association making a grant of $18,000 to the Poultry Department in 1950 for research work. The department was then badly in need of facilities. They used these funds very sparingly and, under the supervision of Prof. Kinder, constructed the following buildings: a laying house 24' x 180' for progeny testing of breeding stock, a house for research in poultry nutrition 30' x 96', a house 24' x 72' for management, and a broiler house 24' x 72'. The remaining funds were used to remodel the interior of T-14, the building used for offices and laboratories. The Association offices were located in T-14 which the association understood would be their permanent headquarters.
DONORS

We apologize if any firms have been omitted from the following list and would welcome any corrections.
American Dry Milk Institute (1932) $1,300 for studying the value of dried skim milk in poultry rations.
American Iron and Steel Institute, Pittsburgh, Pennsylvania (1962) $1,500 for the construction of a confinement shelter for turkeys.
American Poultry and Hatchery Federation, Kansas City, Mo. (1948-1956) $18,000 to study factors influencing hatchability.
American Poultry and Hatchery Federation, Kansas City, Mo. (1963-65) $3,000 to support research on artificial insemination.
Dekalb Agricultural Association, Inc., Dekalb, Illinois (1954) $200 to print a booklet: “Graduates in Poultry Husbandry, University of Missouri, College of Agriculture”.
Dow Chemical Company, Midland, Michigan (1963) $1,500 of insulation (styrofoam) for use in the Poultry Physiology Building.
Franz, Chester, St. Louis, Mo. (1953) gave the Poultry Department laboratory equipment used in an egg breaking plant. Estimated value $1,200.
Gordon Johnson Company, Kansas City, Mo. (1950) $2,500 to be used for poultry research for the right of the company to manufacture machines to thermostabilize shell eggs.
Gordon Johnson Company, Kansas City, Mo. (1956) $500 for support of a senior student interested in poultry processing.
Gordon Johnson Company, Kansas City, Mo. (1957) $2,000 to support poultry meat research.
Harrold, Mr. and Mrs. James, Montreal, Mo. (1961) $2,000 to support management studies with laying hens. The $2,000 was presented to the Harrollds by the Ford Motor Company, Dearborn, Michigan as the 1961 National Egg Efficiency Award.
Henderson Produce Company, Monroe City, Mo. (1961) $300 for the construction of spray dryer for egg research.
William S. Horvath, St. Louis, Mo. (1961) $200 for construction of a spray dryer for egg research.
Missouri Turkey Federation, Columbia, Mo. (1957) $1,200 to support turkey research at the Rocheford Turkey Research Farm.

Monark Egg Corporation, Kansas City, Mo. (1961) $200 for construction of a spray dryer for egg research.

National Dairy Products Corporation (Kraft), Chicago, Illinois (1957) $6,250 in support of the chemical modification of egg white proteins.

National Turkey Federation, Mount Morris, Illinois (1958) $500 to support research in artificial insemination in turkeys.

Neel, Lyman, Hales and Hunter Company, Chicago, Ill. (1945) $2,500 to the College of Agriculture Foundation to support a graduate student working on a poultry problem.

Refrigeration Research Foundation, Denver, Colorado (1962) $900 to study the freezing rate of turkeys, using liquid carbon dioxide.

F. M. Stamper Company, St. Louis, Mo. (1961) $1,000 for construction of a spray dryer for egg research.

Sucrest Corporation, New York (1965) $300 to support student activities in the Department of Poultry Husbandry.

U. S. Public Health Service, Bethesda, Maryland (1963-66) $31,812 for research on egg product pasteurization efficiency.

Other firms that have supported research in the department are:

- American Cyanamid Company
- Armour and Company
- Bohannon, Lloyd
- Calcium Carbonate Company
- Corn Products Company
- Distiller Feed Research Council
- E. I. duPont deNemours & Company, Inc.
- General Mills
- Hoffman-Taff, Inc.
- Hovde, Ralph
- I. D. Russell Company Laboratories
- Merck and Company
- Monsanto Chemical Company
- Nopco Chemical Company
- Dr. Salsbury's Laboratories
- Sears Roebuck Foundation (See Sears Poultry Improvement Project)
- Swift and Company
- Wiley, Gene
SCHOLARSHIPS
AND
AWARDS

The department in cooperation with industry members over the years has developed a program of scholarships and awards to encourage better scholarship and to assist students who need financial assistance.

Greenlee Award

The Greenlee Award ($50 annually since 1951) is made possible by contributions by Mr. A. D. Greenlee of the Greenlee Egg Products Company, St. Louis. Mr. Greenlee graduated in Chemistry at the University of Pennsylvania in 1909 and was associated with the U.S. Bureau of Chemistry from 1907 to 1918. He organized the Greenlee Egg Products Company in 1919. The award is for a junior student interested in poultry who ranks high in scholarship and leadership.

Recipients of the Greenlee Award

1951 CHESTER FRANZ, JR., St. Louis. B.S. 1952
Operated a large commercial egg farm in Florida successfully for several years and now is in the brokerage business in Florida.

1952 GLENN FRONING, Grays Summit. B.S. 1953, M.S. 1957 (Poultry Products). After receiving his Ph.D. degree in poultry products technology from the University of Minnesota, he served on the faculty at Rutgers and the University of Connecticut. Now at the University of Nebraska.


After serving with the U. S. Navy for 4 years, now operates Stout's Feed and Supply Co., Inc., Richland, Mo.; primarily in turkey hatching and production.

1956 ROBERT HASTINGS, Moberly. B.S. 1957.
Superintendent of poultry plant operations with the F. M. Stamper Company, Macon, Missouri.


1960 WILLIAM CLOUD, Appleton City. B.S. 1963. In turkey production (plans to raise 100,000 turkeys in 1966) at Green Ridge, Missouri.


1964 STANLEY STEINHOFF, St. Charles. B.S. 1966. Graduate student in poultry technology at the University of Missouri.

1965 JOHN FIDLER, Stockton. Senior in poultry nutrition at University of Mo.

1966 GARY HARGUS, Marionville. Poultry student at University of Nebraska majoring in poultry products technology.

All degrees in poultry department at University of Missouri, Columbia, unless otherwise listed.

**Ralston Purina Fellowships**

The Ralston Purina Company, St. Louis, Missouri provides three graduate fellowships in the field of poultry husbandry available to students in the United States and Canada. These fellowships have been liberal; in 1966 they were $3200 per year to each student awarded a fellowship. Graduate students working in the Poultry Department at the University of Missouri have been fortunate in receiving these fellowships. Robert O'Neal received this fellowship in 1958 and Donal Bird was the recipient of three of these fellowships (1963, 1964, and 1965).

**NIH Fellowships**

Paul C. Harrison working in poultry physiology received the following fellowships awarded by the National Institute of Health:

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$14,000
Missouri Poultry Council Scholarships

The Missouri Poultry Council, when active, provided $150 annually as a scholarship for a poultry student. In 1953 Ora Messick, Cedar County, received this scholarship.

A fine supporter of Extension programs over the years, the Mo. Poultry Council provided financial support for the Jr. Chicken of Tomorrow Contest, 4-H Poultry Judging Team trips to Chicago, the 4-H Junior Fact Finding Delegation, the University of Missouri Poultry Judging Team, plus other youth activities.

They also supported various poultry and egg promotional programs in the state. Examples are the State Fair Chicken Barbecue and Contest, Eggtober Campaigns, etc.

Other support came in the form of an Annual Poultry Council Scholarship of $150, assisting with Egg Day programs and providing luncheons, poultry eggs and supplies for TV demonstrations and other Extension educational programs.

The Council supported the addition of an Extension Poultry Marketing Specialist by providing part of his salary for several years. Many educational films and publications were purchased by the Council and distributed widely for use in Missouri.

Kempster Scholarship Fund

In 1954 when Professor Kempster retired as Chairman of the Poultry Department at age 70, the F. M. Stamper Company Mill, Moberly, established an annual scholarship of $200 in his honor for a deserving poultry student to be selected by the staff of the Department of Poultry Husbandry.

This scholarship arose when E. M. Funk conferred with Mr. Howard H. Stamper, President of F. M. Stamper Company, about soliciting funds from the poultry industry to establish an endowment fund in honor of Professor Kempster. Mr. Stamper suggested that the F.M. Stamper Company Mill, which Professor Kempster had advised on their early formulas, would be pleased to provide an annual scholarship of $200. This they have continued to do each year to date (1954-1966).

Kempster Endowment Fund

When Professor Kempster passed away in 1962 his former students and colleagues in the poultry department established a committee to receive funds for an endowment fund as a permanent memorial to him. The fund which now (1966) is $3700 is invested by the University and the income is available for student aid under the poultry achievement awards program.
Poultry Achievement Awards

The Poultry Department has developed a series of poultry achievement awards to encourage better scholarship and to assist students financially.

Poultry undergraduate awards payable $50 to $100 per semester are available for students working in the Poultry Department who maintain a scholastic average of 2.5 or better on a minimum schedule of 12 hours (exclusive of military and physical education), and work at least 40 hours per month for which they are paid the going student wage ($1.00 to $1.50 per hour). Students recommended by the poultry staff may receive these awards for the first semester enrolled and thereafter as long as they meet the above conditions.

The Kempster Scholarship provided by the F.M. Stamper Company Mill, Moberly, Missouri supplies $200 annually for these awards.

The Kempster Memorial Fund provides the income from a permanent fund of $3700.

Armour and Company, Chicago, Illinois contributes $250 annually to these awards. The Ernest M. and Flo Dickey Funk Scholarship Fund initiated in 1965 provides the income from a $5,000 endowment fund for students who qualify for the poultry achievement awards.
Industry Support of Poultry Extension

When the need for extra supporting funds for poultry extension has been presented to poultry industry leaders, they have responded to that need.

The Board of Directors of the Missouri Turkey Federation, being interested in increasing the consumer use of turkey products, made grants to the Agricultural Extension Service to support the work of Ted Joule and Tom Day in poultry marketing extension work.

MPIA Supported Trips for 4-H Members

For several years the Missouri Poultry Improvement Association provided the expenses of 4-H Club Members of the Missouri Poultry Judging Teams participating in the Chicago contests.

St. Louis Exchange Sponsors Trips

The expenses of four 4-H Club members selected to attend the Junior Poultry Fact Finding Conference held in Kansas City each February have for several years been paid by the St. Louis Butter, Egg and Poultry Exchange. This has made it possible to encourage youth to find a career in the poultry industry.

Springfield Chamber of Commerce Supports Youth Tours

Beginning in 1965 the Agricultural Committee of the Springfield Chamber of Commerce has cooperated with the poultry Extension specialists in holding youth tours for FFA and 4-H Club members in the Springfield area to show them the poultry industry of that area and thereby interest them in a career in this industry. A bus load of about 25 students makes the tour each year.

OPEN HOUSE FOR FACULTY

In 1949 and again in 1961 the Department of Poultry Husbandry held "open house" for the faculty of the College of Agriculture. The programs for the two occasions indicate a shift to more basic research. The 1949 program featured topics such as: The Use of Hormones, H. V. Biellier; Maintaining Egg Quality by Stabilizing and Pasteurizing Shell Eggs, E. M. Funk; Nutrition and High Producing Stock, J. E. Savage.

The 1961 program featured topics such as: The Hen on an IBM; Radio-Active Eggs and Poultry; Little Feeds for Big Chicks (Trace elements in poultry nutrition); and Hens That Lay During the Night and Sleep During the Day.
GENERAL COMMENTS

Prior to the Smith-Lever Act

Before the Cooperative Extension Service was established in 1914, the Missouri College of Agriculture cooperated with other agencies in carrying information to the farmers of the state.

One of the popular means of distributing information was the demonstration train sent out by Missouri's railroads. These trains carried displays for people to see, and staff members from the College of Agriculture went along to present talks on subjects of interest to farmers.

Professor H. L. Kempster represented the Poultry Department on several of these trains, lecturing on poultry. Hundreds of people gathered at each stop to see the exhibits and to listen to the lectures.

Extension During World War I

Professor Kempster wrote the following account of Extension work during World War I.

Following declaration of war in 1917, attention to poultry keeping was emphasized. Fortunately for the University, Mr. T. S. Townsley reported for duty as poultry extension specialist April 1, 1917. Congress passed an emergency food production measure which set aside $148,000 for increasing poultry production. This fund was to be spent under the direction of Bureau of Animal Industry in cooperation with the colleges of agriculture. Missouri was allocated two poultry specialists; R. L. Mason, who later became poultry extension specialist at the University of West Virginia, and H. E. Cosby, who later was in charge of poultry work at Oregon State College. Considering the number of men needed for this program, Missouri was fortunate in securing two very high class men. Mason was the better qualified, a graduate from Connecticut, a very sincere, serious, polite person. Mr. Cosby had more practical experience but was not as well trained. His lack of training was compensated for by his wide experience and congenial disposition. Both were cooperative and took their jobs seriously.
Mr. Townsley was project leader. Mr. Cosby was assigned to Missouri, south of the river, while Mason confined his activities to the north half of the state. It was planned by the Bureau to locate one of the extension specialists at Springfield but the Bureau was prevailed upon to have both with headquarters at Columbia. The country was subdivided into districts and George W. Hackett was finally put in charge of this district with headquarters at Kansas City. There was much confusion as to what policy should be followed. Councils of Defense were organized with local units and a state chairman. By December work was well under way. The relationship between feed and egg prices became unfavorable. Emphasis was placed on prevention of loss in handling eggs, with rooster days, infertile egg campaigns, and candling of eggs on purchase. People were urged to adopt good management practices purely from a patriotic standpoint. The University was reluctant to urge expansion of the poultry enterprise but could wax enthusiastic over more efficient poultry practices. Emphasis was placed on back-lot poultry keeping as a means of utilizing waste.

Following the declaration of war, active organization of the state to produce more food was accomplished. The organization was state-wide including state, county, and even school district chairmen. Immediately, there was an expansion of the county agents. By May 22, 1917, 60 counties had organized Farm Bureaus and the University had more than 30 men in the field to organize farm bureaus.

The extent of the work was dependent upon adequate financial assistance from Federal sources. Lists of desirable practices were made and the farmer asked to check those he would do. Through the Agricultural Editor’s office, press articles were distributed and given wide publicity.

Poultry Extension Through Mass Media

The poultry extension specialists have made wide use of printed material and news releases to educate producers and consumers.

Extension Circulars have been published from 1916 to the present to disseminate current information to the public. A small folder series has also been published by Extension for many years and in 1962 the MU Guide series was added. The Guides are short, two to four page leaflets, punched and indexed for reference notebooks. A list of Extension publications issued on poultry appears in the Appendix.

The poultry extension specialists also prepare a monthly publication, “News and Views,” that is distributed to a list of interested producers and contribute articles to the Missouri Turkey Federation News and the Missouri Poultry and Egg News.

The Poultry staff has from the beginning supplied information for farm and poultry magazines. Professor Kempster wrote a monthly poultry
column for the Missouri Farmer from 1917 to 1934. E. M. Funk wrote a weekly column, "From Day to Day with Poultry" for the weekly Kansas City Star from February 26, 1941, to December 27, 1944. The staff has also used radio and T. V. to distribute poultry information.

**Movies**

Elmer Winner, Poultry Extension Specialist, in cooperation with the Missouri Poultry Improvement Association, produced an excellent color sound movie, "Missouri Chicks," depicting methods used by MPIA members in producing quality chicks. Professional services were obtained and paid for by the Missouri Poultry Improvement Association. The cost was approximately $3000.

Another movie produced by Mr. Winner was "Profitable Poultry Production." This movie was used to show producers the latest methods in poultry raising.

The poultry Extension specialists also produced a short (10 minute) movie on poultry house remodeling. The Missouri Poultry Council, in cooperation with the Missouri Agricultural Extension Service, produced an excellent movie on consumer education, "Poultry Products on Parade."

These movies all served a useful purpose in educating producers and consumers and they were widely used by the poultry extension specialists throughout Missouri. They were also used in University classes.

Mr. Winner, who produced these movies, later became Agricultural Editor of the Missouri College of Agriculture, head of the Division of Information Service for the Federal Extension Service, Washington, D.C., Director of U.S. Trade Center in London, England, and in 1966 was named Agricultural Attache′ to Pakistan.

**Public Service**

The staff of the Department of Poultry Husbandry has been responsive to the public interest since the department was founded in 1911. They have attempted to serve the poultry industry in any way they could to improve the industry. By personal contact, correspondence, and by working with industry and through trade and scientific organizations they have served the public interest.

**Correspondence**

When Professor Kempster came to Missouri in 1911, ninety percent or more of Missouri's 277,000 farmers kept chickens, and the Cooperative
Extension Service had not been established. When farmers learned of a poultry department in 1911-12, 800 of them wrote for information. This demand increased until as many as 3000 letters were written annually. After the Cooperative Extension Service was established, the Specialists and County Agents answered many of these queries and correspondence in the department declined, but several hundred letters still are written each year. Thus, correspondence with the public has always been important in the Poultry Department.

Misunderstandings sometimes arise in correspondence. A Missouri farmer in 1952 wrote the Poultry Department asking for advice on handling hybrid chickens, stating, "I have bought 225 Pullet Hybrid Chicks and 25 day-old Hybrid Roosters to use for breeding stock."

Professor Kempster replied in part as follows: "Hybrid Chickens are not used for breeding. This is true for hybrid corn. Farmers purchase hybrid corn seed, but go back each year to purchase seed from the breeders."

The farmer, somewhat disappointed, replied as follows: "I am sorry for my selection of hybrid chickens. They are developing pretty good on regular chicken feed, but I called to find the price of Hybrid corn feed and it is $16 a hundred pounds, and then has to be chopped to chick size. If they have to be fed Hybrid corn, I will switch them to broiler feed and sell them for fryers."

**Poultry Improvement Work**

The Poultry Department has assisted poultry improvement programs since certified poultry breeding began in Missouri in 1920. This program developed as a part of the poultry extension program. The certification of poultry breeding stock was first done by extension personnel. Stock qualified for certification by meeting the following requirements:

1. Keep complete record of the production, income, and expenses for one year in advance of certification.
2. Mail monthly records to Missouri Agricultural Extension Service.
3. Secure an average production of 25 eggs per hen from the entire flock between November 1 and March 1.
4. Join Certified Breeders’ Association after the flock has qualified.
5. Have the flock examined and individuals banded with a sealed leg band by a Poultry Specialist representing the Certified Poultry Breeders’ Association.
6. Mate only Certified hens to approved standard bred, vigorous, pedigreed male birds, the dams of which must have a trapnest record of 200 or more eggs in one year.
This system of poultry breeding was very popular in the 1920's and did much to improve egg production and profits, as shown by the following records for 1927-28.

<table>
<thead>
<tr>
<th></th>
<th>Certified</th>
<th>Non-Certified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hens per farm</td>
<td>283</td>
<td>206</td>
</tr>
<tr>
<td>Income over feed cost</td>
<td>882.75</td>
<td>498.00</td>
</tr>
<tr>
<td>per farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs per hen</td>
<td>163</td>
<td>149</td>
</tr>
<tr>
<td>Labor income per hen</td>
<td>2.67</td>
<td>1.94</td>
</tr>
</tbody>
</table>

In 1924 the Certified Poultry Breeders Association was organized with H. L. Shradar as secretary-treasurer. In 1925 this association relieved extension personnel of the certification work and the association employed part-time inspectors to certify birds entered in this program.

Demonstration farm flock records were started November 1, 1917, with 30 cooperators. The following year more than 100 flock owners kept records and reported to the Extension Service. T. S. Townsley, poultry extension specialist, reported in 1920 that 20,000 flocks were culled as a result of the culling demonstrations held by the Extension Service; he estimated that 760,000 unprofitable layers were sent to market at a saving of $456,000 to the flock owners who culled their flocks.

**Missouri Poultry Improvement Association**

The Missouri Poultry Improvement Association was organized and incorporated in 1928. In the early years the Missouri Poultry Improvement Association was only concerned with the Certified and Record of Performance Poultry breeding work. In 1928 the Missouri Record of Performance Breeders organized and became a part of the Missouri Poultry Improvement Association. During those early years the hatchery work in flock selection was carried out under the supervision of the Missouri Accredited Hatchery Board, which was affiliated with the Missouri Accredited Hatcheries Association, Inc. This board was composed of representatives of the State Department of Agriculture, the State Poultry Experiment Station, the College of Agriculture and three representatives from hatchery associations.

When the National Poultry Improvement Plan became effective in 1935, Missouri participated the first year with only one hatchery (Edwards Hatchery, Springfield). There was some dissension among Missouri hatcherymen as to participation in the NPIP, but this was resolved and Missouri soon became one of the leading states in this program.
E. M. Funk served as Secretary of the MPIA from 1935 to 1961 and took an active part in poultry improvement work, with both chickens and turkeys. He was succeeded by Miss Harriett Rimmer. Prof. Kempster served as an ex-officio member of the MPIA board of directors until he retired in 1954.

**Sears Poultry Improvement Project**

The control of pullorum disease in chicks continued to be a serious problem for the poultry industry of Missouri up until about 1950. Since then pullorum has been reduced almost to the point of eradication. In 1946 and 1947 the Department of Poultry Husbandry developed a program of controlling this disease by establishing pullorum clean flocks to supply hatching eggs to Missouri hatcheries. Sears Roebuck and Company financed the project with a $10,000 grant.

The Missouri Poultry Council, the Missouri Poultry Improvement Association, and the Extension Service cooperated in this project. The

*These baby chicks hatched by the Department of Poultry Husbandry are shown being shipped to key flock owners who cooperated in the 1946-47 pullorum control program.*
hatching eggs were purchased from well-known poultry breeders in New England who had maintained pullorum clean breeding flocks for several years. These hatching eggs were shipped to the Department of Poultry Husbandry where they were hatched. The chicks were then shipped to selected flock owners who were selling hatching eggs to Missouri hatcheries.

Since the heavy breeds in Missouri had more pullorum infection than the Leghorns, the breeds selected were Barred Plymouth Rocks, Rhode Island Reds, White Plymouth Rocks, and New Hampshires. Stock was selected that had good egg records. The breeders were: Barred Rocks—T. J. Frizzell, Charleston; N. H. Rhode Island Reds—D. I. Goodenough, Torrington, Conn., Donald Crooks, N. Brookfield, Mass., and Mt. Fair Farm, Watertown, Conn.; White Plymouth Rocks—E. R. Rutter, Derry, N. H.; A. C. Lawton, Foxboro, Mass.; New Hampshires—H. S. Twitchell, Exeter, N. H.

More than 10,000 eggs were incubated each year (1946 and 1947).

**Missouri Broiler Tests—1954 and 1955**

These tests were held at the University of Missouri in response to requests from the broiler industry of the state. The University chick brooding facilities were used during the summer and fall months when they would not otherwise have been in use. Two hundred and forty eggs were selected at random by a disinterested party from three days collection of eggs. The eggs were hatched by the Poultry Department. An entry consisted of 100 chicks at one week of age. The detailed results of these tests were printed in Missouri Agriculture Experiment Station Bulletins 639 and 665.

After two years, interest waned and the tests were discontinued.

**Participation in the 1939 World’s Poultry Congress**

The Department of Poultry Husbandry had a very active part in the Seventh World’s Poultry Congress held in Cleveland, Ohio, July 28 to August 7, 1939. This was one of the largest conventions and expositions held in the United States to that time. More than 700,000 people attended the 10-day Congress. Mark Egan, head of the Cleveland Convention and Visitors Bureau, stated, “This is the biggest convention Cleveland has ever had.” He rated the 1936 American Legion Convention second with an attendance of 200,000. Forty-four nations and 48 states of the U.S. were represented, most of them with exhibits.

The Missouri legislature appropriated $5000 for the Missouri Exhibit. Prof. Kempster secured the cooperation of industry leaders and legislators
in getting this appropriation. Governor Lloyd Stark signed the appropriation bill the day before the Congress opened. The industry had gone ahead and prepared the exhibit, having faith that the appropriation would be forthcoming. The Missouri exhibits (see pictures) were planned by A. D. Greenlee, representing industry, E. M. Funk, representing the University, and Ad-Craft Advertising Agency of St. Louis.

Charles E. Rhode and D. D. Moyer, poultry extension specialists for Missouri, assisted industry leaders through the Missouri Poultry Industry Council (organized in 1938) in raising funds to send youth to the Congress. They raised $9,163 which was used in helping defray the expenses of 75 youth delegates to the Congress.

Missouri was represented at the Congress by more than 500 people who registered at the Missouri booth. All but 10 counties in the state were represented. The University sent a poultry judging team that tied with Oklahoma for the highest (Superior) team rating. The members of the Missouri team were Billy Kerr, Lester Williams, James Hamilton, and William McDonald. The team was trained by E. M. Funk and M. R. Irwin.

The Poultry Science Association of the U.S. and Canada held their annual meeting in 1939 at the World’s Poultry Congress in Cleveland. The president of the Association that year was Berley Winton (former Missouri extension specialist) and H. L. Kempster was secretary-treasurer.

**Participation in Overseas Aid**

Professor Q. B. Kinder spent two years (1962-64) in Assam, India on a USAID program conducted by the University of Missouri. While
there he established and built a very complete and practical poultry research plant at Jorhat, Assam. He trained many Indian students and workers in better poultry management practices. He also visited the University of Missouri project at Bhubaneswar, Orissa, and assisted in planning the poultry plant which was later built there.

In 1965 E. M. Funk was named a member of a Study Team sent to India by Dean Elmer Kiehl to evaluate the University's USAID program and to make recommendations for its improvement.

In 1963 E. M. Funk spent three months at the Universidad Populaire in Guatemala City where he gave a series of lectures under the auspices of the Organization of American States on modern poultry husbandry for the commercial poultry men of Guatemala.

The lectures were attended by 200 poultrymen. They were translated into Spanish and distributed to other poultrymen. They were also reproduced in the magazine “Industria Avicola” which circulates throughout Latin America and Spain.

**Hatching Eggs to India**

In 1962, Prof. Kinder, while stationed in Assam, India, requested two cases (720) of hatching eggs from University of Missouri purebred White Leghorns so that he might introduce this laying strain into India. The department shipped the eggs by air express. A number of eggs were broken in transit but from 480 eggs set, 408 chicks were hatched and grown out. A breeding flock of 180 females was established. The following year more than 2000 chicks were hatched from this introduction. This stock has produced well under Indian conditions and has been widely disseminated to
government poultry farms in India. When the writer visited India in 1965 he saw some excellent flocks of these white Leghorns on the government farms, especially those at Gauhati.

First Air Mail from Hawaii Contained a Letter to Professor Kempster from H. L. Chung, Class of 1917

December 5, 1935, the China Clipper carried the first air mail from Hawaii to the mainland of the United States. H. L. Chung, Honolulu, member of the class of 1917 and an admirer of Professor Kempster, sent him the following greetings on this first flight:

My dear Professor Kempster:

I am sending you the greetings of the season much earlier than usual—all because of an unusual method of dispatching it to you.

The China Clipper is leaving here on its first return trip to the mainland—having gone to Manila from California since November 22—and is carrying the first official airmail from here. Hence it gives me the honor to send you this greeting, in this fashion. You are the only person, either in U.S. or China to receive an airmail from me.

With Aloha

H. L. Chung
817 10th Ave.
Honolulu

Missouri Presidents of Poultry Science Association

The first MU poultry graduate to serve as president of the Poultry Science Association was H. L. Shreader, poultry extension specialist for the U. S. Department of Agriculture. He was president of the Association in 1929-30. Other Missourians who served as president were Berly Winton, 1938-39; H. L. Kempster, 1940-41; and E. M. Funk, 1951-52.

The National Collegiate Poultry Club

The National Collegiate Poultry Club was organized at the World's Poultry Congress in 1939 by the representatives of several states where student poultry clubs were active.

The preamble of the constitution stated:

The object of this National Collegiate Poultry Club will be to bring a mutual understanding and a closer relationship between the separate Poultry Clubs located in the Agricultural Colleges throughout the United States. This club has as its primary purpose the pro-
motion of a finer fellowship, and a greater knowledge among those of us who enjoy the privilege of working with poultry and in the various fields of the Poultry Industry. It shall ever be the charge of this Club to sponsor and promote worthwhile activities such as National Collegiate Poultry Judging Contests when and if possible, as well as to hold National Conferences periodically with the thought to bind us ever together in closer bond of Union.

The national club served to stimulate activities in the state clubs, but the war years interfered with student enrollment and many state clubs became inactive. The organization encouraged the publication of student poultry newsletters by local (state) clubs. The national club became inactive and, to date (1967), has not been revived.

**Annual Poultry Science Meeting, 1957**

One of the major joint efforts of the Department of Poultry Husbandry and other departments and divisions of the University was holding the 1957 Annual Poultry Science Meeting at the University of Missouri with guests from 45 states and seven foreign countries. The attendance of nearly 1100 broke the 46-year attendance record to that date. Such an undertaking required and received the cooperation of the entire University. Though air conditioned facilities for dining and meetings were available, sleeping quarters were not. Fortunately, cool weather pre-
vailed through the week and people who brought fans as insurance against
a hot dormitory room had to use blankets at night.

It was no small job to provide entertainment for 1100 guests, wives,
and children. Fortunately, theRalston Purina Company of St. Louis agreed
to entertain 500 of the group with a tour, one afternoon and evening, in-
cluding dinner and a show at their Research Farm, Gray Summit, Mo. The
other half of the crowd visited the University and attended a chicken bar-
becue at Hulen's Lake in Columbia.

Receives Thanks for Job Well Done

The following extract from a letter from T. B. Avery, president of
the Poultry Science Association, to E. M. Funk was typical of 54 letters
received by the Poultry Department after the Missouri meeting:

It is a little difficult for me to know just how to express to you my personal
feeling for the splendid job you and all of your staff did to make the recent Poul-
try Science Association Meeting the success that it was. It certainly showed splen-
did organization and a lot of careful planning.

No doubt you heard many fine comments, but I wish that you could have
also heard some of the many fine compliments that I heard commending you and
your staff. I think without a question that it was the smoothest running meeting
that I have had the privilege to attend and I feel that all the credit should go to
your people.
Professor Kempster's Portrait Presented

Since Professor Kempster had recently been elected by the American Poultry Historical Society (APHS) to the Poultry Hall of Fame, it was deemed appropriate to unveil his portrait and present it during the 1957 Annual Poultry Science Meeting. The portrait, which was painted by Ned Etheridge, was presented by John H. Longwell, Dean of the Missouri College of Agriculture. It was accepted by Professor Loyal F. Payne of Kansas State College, who was then president of the American Poultry Historical Society.

The Poultry Hall of Fame was started in 1954 as a means of recognizing people who make outstanding contributions to the poultry industry as teachers, research workers, investigators, and personnel in industry. Those elected to date have been:

1953  Lyman B. Kilbourne  Charles W. Wampler, Sr.  James E. Rice  W. R. Graham  Seth S. Barker
1956  Hubert D. Goodale  Harry L. Kempster  Morley A. Jull  Allen G. Phillips
1959  Fred R. Beaudette  Mary E. Pennington  James G. Halpin
1962  W. A. Billings  Andrew Christie  O. B. Kent  Howard C. Pierce
1965  Dr. George F. Ghostley  Mrs. Kathryn B. Niles  Carl A. Swanson  William Dewey Termohlen  Prof. R. B. Thompson

State FFA Poultry Judging Contests

The Department of Poultry Husbandry has cooperated with the Department of Agricultural Education and the State Department of Education and Vocational Agriculture Division in holding annual state FFA poultry judging contests at Columbia since the contests were inaugurated in 1918. As many as 60 teams (180 students) participated some years. In recent years the contest has been limited to 40 teams. Several thousand young men have entered these poultry judging contests and thereby become better acquainted with the University. Many of them later came to the College of Agriculture and graduated with B.S., M.S., and Ph.D. degrees.

In recent years Professor Quinton Kinder has not only handled the state contest but he has assisted the teachers in holding district poultry judging contests by providing graded eggs and placed classes of birds so the teachers could set up and manage their own district contests.
Staff Recognition and Awards

The work of staff members has been recognized within the University and outside by national and international organizations.

The greatest honor to come to a staff member was the election of Professor Kempster in 1956 to the Poultry Hall of Fame. This selection was made by 50 leaders of the poultry industry of the United States and Canada. Professor Kempster also received the teaching award of the Poultry Science Association in 1951 and was named a Fellow of that association in 1938.

Professor Kempster served as Secretary of the Poultry Science Association in 1938-39 and was President in 1940-41. The Poultry Industry of Missouri sent him to the World’s Poultry Congress held in London, England, in 1930. He was elected President of Sigma Xi, an honor indicative of the esteem in which he was held by his colleagues. He was highly respected by industry and was named as honorary member of the Missouri Turkey Federation.

Berley Winton, former poultry extension specialist, served as President of the Poultry Science Association in 1938-39.

Professor Walter Russell, project leader and poultry extension specialist received the Pfizer Extension Award of the Poultry Science Association in 1964. This award carried a $1,000 cash stipend.

Dr. Owen Cotterill in 1962 was presented the Award of Merit by the Missouri Chapter of Gamma Sigma Delta for his contribution to research and teaching in the egg products field.

E. M. Funk was recipient of the Christie Award of the Poultry and Egg National Board in 1950 (See pic). This award of $500 later became the PENB Award of $1000. It was awarded to Funk for egg research that promoted consumer demand, mainly for the process of thermostabilization. He received the Poultry Science Association Teaching Award in 1947 and the Research Award in 1942. He held the following offices in the Poultry Science Association: member of the Board of Directors, secretary (1944-49), vice-president (1950), and president (1951). The World’s Poultry Science Association named Funk to the Council (governing body) of that association in 1948 at the Denmark meeting. He was reelected in 1956 and 1962.

The American Poultry and Hatchery Federation named Funk a member of their first Research Committee. That Committee, with Dr. L. J. Taylor of the University of California as author, produced the book *Fertility and Hatchability of Chicken and Turkey Eggs* in 1949, published by John Wiley and Sons, Inc. Funk was named the first director of research
Poultry students and alumni present portrait of Prof. Kempster to the Poultry Department, 1949.

Dr. H. M. Scott, Ill., and Dr. Funk being named fellows of Poultry Science Assn., 1957.
(non-salaried position) and served as director from 1951-59. Under his direction, APHF developed a research program whereby research grants were made to Land-Grant Institutions to encourage them to do research on problems related to the poultry industry and also train graduate students for future work in this area. The research program of APHF has become one of its major projects.

E. M. Funk was elected a Fellow of the Association in 1957 in recognition of his service to the Association and to the poultry industry.

**Recognition for War-Time Service**

Getting wholesome food to the armed services in war time constitutes a major problem. When E. M. Funk announced in 1942 the process of thermostabilization for maintaining quality of shell eggs the U. S. Army became interested and sent Maj. James M. Gwin to the University to investigate the process. Maj. Gwin suggested that studies be made under field conditions in the Mojave Desert near Needles, California, where the 5th Army Corps was training men under desert conditions. Arrangements were made to compare shell eggs treated by this new process with untreated eggs and others treated by other processes.

Maj. Gwin arranged for Sgt. Marlow Olsen, Dr. George Stewart of Iowa State College, Funk and himself to make the field tests.

The results showed that thermostabilized shell eggs held under desert conditions maintained their quality much better than untreated eggs. The

*Field testing thermostabilized eggs at Needles, Calif., are, left to right, Dr. George Stewart, Iowa State College; Sgt. Marlow Olson, U. S. Army; Maj. James M. Gwin, U. S. Army; and Prof. Funk, University of Missouri.*
Quartermaster Corps, in their Research and Development Laboratory in Chicago, conducted many tests which confirmed the field tests. In 1967 the armed services are still purchasing thermostabilized eggs for overseas use.

The U.S. State Department appointed Funk an adviser to the official delegation to the World’s Poultry Congress held in Copenhagen in 1948, and the ones in Mexico City in 1958 and Sydney, Australia, in 1962. Funk also served as chairman of the Committee for U.S. scientific papers for the Congresses held in Edinburgh in 1954 and Mexico City in 1958.

Missourian Contributes to Numerous Textbooks

The need for textbooks in the poultry field became rather urgent in the late 1930’s, and book publishers began surveying the field for potential sales and possible authors. The J. B. Lippincott Company approached Dr. A. R. Winter of Ohio State University and E. M. Funk of the University of Missouri, asking them to prepare a general text for the first college course in poultry. They prepared the text, Poultry Science and Practice, and the first edition came out in 1941. Four revised editions followed up until 1960 (5th edition). This book became a “best seller” and remained so until it became outdated about 1966. More than 150,000 copies of the book were sold.

After World War II there was a great influx of college students, including many who were interested in hatchery management. No up-to-date text was available for courses in this area so Funk contacted John Wiley and Sons and suggested that he and M. R. Irwin prepare such a text. Irwin, former member of the University of Missouri poultry staff, was then president of the Colonial Poultry Farms, Inc., Pleasant Hill, Mo.

This book, Hatchery Operation and Management (1955 edition), though the only one in its field, was not reprinted or revised because there was only a limited demand for such a specialized book.

The first Research Committee of the American Poultry and Hatchery Federation, of which E. M. Funk was a member, named as their first project the production of a book which would serve as a review of literature on hatchability of eggs, so that a sound research program could be launched under the auspices of APHF. Dr. L. W. Taylor of the University of California (Berkeley) was engaged to edit the publication, Fertility and Hatchability of Chicken and Turkey Eggs. He enlisted the services of nine specialists to prepare different sections of the book. E. M. Funk prepared the chapter on the “Care of Hatching Eggs Before Incubation.” This book was published in 1949 and though it was an excellent book and served a
useful purpose, only one edition was published (1949). APHF underwrote the publication of this book by purchasing the first 2000 copies.

To improve the teaching of the first course in poultry production a laboratory manual was needed. None was available. E. M. Funk, M. R. Irwin, Q. B. Kinder, and other staff members collaborated in writing the *Poultry Laboratory Manual* in 1947 and the first edition came out in 1948. It has been kept in print up to the present. Several other colleges have used it. The University Book Store published the manual and at first paid royalties which were turned over to the department for student activities. In recent years the manual has been produced at cost and no royalties have been paid. From 1948 through 1966, a total of 6689 copies were printed.

Funk also served as chairman of a Committee on Careers established by the Poultry Science Association which prepared a booklet on careers entitled "Find Your Career in the Poultry Industry." This booklet was published by Interstate Printers and Publishers, Inc., Danville, Illinois. They sold 53,500 copies of this booklet.

### Professor Kempster Honored When Retired

One of the outstanding events in the Poultry Department's history was staged when Professor Kempster retired in 1954. He retired at age 70 in May, 1954, after 43 years of service to the University of Missouri. He was honored by more than 300 of his friends who gathered in the Student Union. The theme of the program was *Prof. Was There* and events from Prof.'s life were depicted by a slide show staged by Elmer Winner, Agricultural Editor, and former poultry extension specialist.

M. F. Miller, dean emeritus of the College of Agriculture was toastmaster for the occasion and A. A. Jeffrey, a fondly remembered former Agricultural Editor, gave the invocation. President F. A. Middlebush gave the address. "Stars" included in Elmer Winner's story of Prof. Kempster's life were: H. L. Shrader, '14; M. A. Seaton, '22; D. D. Moyer; John Dickey, '41; Mike Kelly, '55; E. M. Funk, '27; and J. G. Halpin, Professor Emeritus of Poultry Husbandry, University of Wisconsin.

A. D. Greenlee, President, Greenlee Products Co., St. Louis, presented the letters of appreciation to Prof. Kempster, and Howard Stamper, president, F. M. Stamper Company, Moberly, presented the H. L. Kempster Scholarship to the University of Missouri. J. H. Longwell, dean of the College of Agriculture, gave the acceptance response.

The sentiments of Prof.'s co-workers and former students were expressed by E. M. Funk:
"I have had the pleasure and experience of working longer in the department with Prof. than anyone else. I have observed in him the elements of greatness; loyalty to family, friends, university, state and nation, unparalleled unselfish devotion to duty, a friend, and counselor of men, always placing human welfare and need above all else; a man of great patience and tolerance.

"Those of us who have been his students and have worked with him have learned much from him, but we could have profited more if we had followed his footsteps and examples more closely . . ."

In relating anecdotes of work under Prof. Kempster, Funk said:

"If we wrote or ordered something he did not approve, he merely filed it in his desk and nothing was said about it. Prof. never thought much of caponizing and practically everyone who came into the department wrote a bulletin on caponizing to have it filed in his desk. However, Dick Irwin succeeded in breaking into print on caponizing. We learn something new about him every day.

"Prof. Was There characterizes his life and devotion to duty at the University of Missouri. From 8 to 5 every day and Sunday if need be for 43 years Prof. was there."

University President Elmer Ellis expressed the opinion of those present when he said this was the best program of its kind he had ever seen.
1917-1939 REVIEW BY H. L. KEMPSTER

Poultry Extension Work in Missouri

Professor Kempster and C. E. Rohde, poultry Extension specialist in Missouri (1936-44), wrote a History of Missouri Poultry Extension work for 1917 through 1939. The author considers this to be the best information available on poultry extension during those early years. It is reproduced here without change, except that subheadings have been written to make the text more readable.

In 1917, as in 1939, poultry raising was widely practiced on the vast majority of farms in Missouri. Prices received by producers, in terms of feed costs, were very favorable, as compared to similar relationships existing in the late thirties and at the present time. However, net returns per bird were smaller for the average poultry keeper, because of low egg production. Smaller supplies of poultry products, strong consumer demand, and a different price level all tended to create a very favorable feed-egg ratio. Higher production costs, incident to less efficient production, neutralized these favorable factors for the vast majority of producers.

Low levels of egg production were due to a common lack of information on feeding, management, and housing essentials and to almost a complete absence of production bred laying stock. Much information on nutrition and other problems which has become common knowledge was yet to be discovered.

Poultry disease problems apparently were less acute, although deficiency diseases were perhaps more common.

Commercialization of poultry raising was in its infancy. The development of large commercial flocks, large commercial hatcheries, and feed manufacturing industry occurred at a tremendously rapid rate during the 1920’s and continued during the generally less satisfactory business years of the 1930’s.

The larger portion of chicks were hatched on farms under hens or with small home incubators. Poultry raising consisted almost entirely of farm flock enterprises, largely conducted by homemakers and exhibition breeders.
Agricultural Extension Service educational activity beginning in 1917 was, therefore, concerned with the teaching of fundamental production practices that would provide the means of increasing the efficiency and the amount of production. This was necessary to increase profits from poultry raising and to provide larger food supplies for general consumption, as well as for the purpose of supplying farm families with an important portion of more adequate and healthful diets.

Food Program 1917-18

The particular problem of larger food supplies was rendered acute because of the World War. This fact is emphasized by the employment of T. S. Townsley,* in April, 1917, as the first Extension poultry specialist. This appointment was quickly followed by those of Ralph Mason, on October 16, 1917, Herbert Cosby, on June 30, 1918, and W. L. R. Perry, October 14, 1918. The latter three appointments were made on an emergency basis. Salaries and expenses were paid entirely by the Federal Government.

Beginning in 1917 and continuing in 1918, emergency food production was emphasized by the three poultry specialists working with county Extension agents and home economics agents and local leaders in both agent and non-agent counties.

Through meetings and various other publicity media, backyard poultry keeping was encouraged, and particular emphasis was placed upon protein feeding for egg production, early hatching (by May 1), culling, proper housing, and reduction of summer egg losses through infertile egg production.

Demonstration Farm Flocks

These efforts of a more spectacular nature were effective, but the foundation of almost all future effort was laid with the establishment of the first demonstration farm flocks by T. S. Townsley in 1918. These demonstrations established proof of the value of poultry raising as a source of income and as local examples providing readily available teaching material to emphasize any particular practice or group of practices involved in the production program.

Twenty-four of these demonstrations were established in 13 counties in 1918. These cooperators obtained an average of 101 eggs per hen and made an average return of $2.38 per hen, above feed costs.

Demonstration flocks continued as a prominent part of the program, and by 1920 there were 138 such record keepers in the state and this particular type of program was widely copied in many sections of the United States. The results were publicized extensively in newspapers and poultry publications. Superiority of these cooperators as poultry keepers, and the
need for breeding improvement, were emphasized by the low levels of egg production that prevailed. The average Missouri hen laid 56 eggs in 1920, compared with 114 eggs per hen obtained by the cooperators, who received an income over feed costs of $3.42 per hen. The growth of record keeping activities, which reached the peak of interest in 1936, is shown in Figure 1 of the Appendix.*

Other educational activities conducted during these early years included attempts to improve egg quality through “Swat the Rooster” campaigns, and egg candling schools for dealers, both of which were only nominally successful.

Culling Work

Emphasis continued on proper feeding, housing, and other management phases, but the outstanding successful effort was that of poultry culling. This work was done through demonstrations conducted by specialists and county extension workers. As demand for this work increased, successful efforts followed, in 1924 and subsequent years, in the training of local leaders to do this work in their respective communities. It is significant that home economics agents played an important role in these early programs. As late as 1932 county agents were doing a considerable amount of culling work. One question asked on state supplements to annual statistical reports was intended to determine the number of hens culled by the agents. By 1926, interest in culling work reached the saturation point. From that date to the present, interest in this activity has become less acute. This may be attributable in part to the results achieved in training poultry raisers. It is important to note, however, that rapid commercial hatchery development during this period and in subsequent years resulted in much of this work being taken over, none too effectively, by hatchery operators and their employees.

This development has tended to result in once or twice a year culling, as opposed to the more profitable program of frequent culling during the summer and fall months.

Certified Breeding

Certified breeding work was begun in 1920. This Agricultural Extension Service activity has had a profound influence on breeding improvements achieved by the entire industry in the state, as well as in more distant areas.

Its basis lay in demonstration record keeping flock work, which represented the cooperators having the best flocks. Flocks became eligible for certification when a winter (November-February) average of 25 eggs per hen was obtained. These flocks were then inspected and culled by poultry specialists. The approved hens and males were banded and the male off-
pring were used as breeding males to head other flocks over the state. These males, known as "certified males," required the approval of an inspector, usually the poultry specialist. As approved and banded breeding stock they found ready sale, particularly to the hatcherymen.

Certification work led to organization of the Missouri Poultry Improvement Association in 1923, and a rapid increase in the number of certified breeders offering hatching eggs, baby chicks, and breeding stock of superior quality to the buying public. In 1920, the first year, there were 59 such flocks in 25 counties. This number increased to 91 flocks in 40 counties in 1921, and 290 flocks in 1925.

Certified breeders paid the expense of the certification work on a partial basis, because up until 1927 much of the inspection work was done by poultry specialists. However, in that year this work was placed on a self-sustaining basis, with a sufficient volume of participation and fees to permit the hiring of inspectors to entirely relieve specialists of this responsibility.

By 1925, participation of home economics agents in poultry educational work became practically unknown. This change in attitude of home economics agents and a restriction of their subject matter field is subject to debate.

The first organized cooperation with the hatcheries of the state occurred in 1923, with a three-day culling school. With interruptions, these schools have continued and the scope of subject matter has enlarged to include consideration of testing to control pullorum disease or bacillary white diarrhea, as it was called in 1924, and many other production and hatchery management problems. These schools led to the development of the accredited hatchery program in 1925. The subsequent decline in certified breeding work was supplanted by individual hatchery breeding programs or the sale of an entire certified breeder's output, on an individual basis, to hatchery outlets.

Certified breeding work is continuing at the present time as a part of the National Poultry Improvement Plan, which is sponsored in Missouri by the Missouri Poultry Improvement Association. Developments in breeding, however, now require that these certified flocks be headed by Record of Performance (R.O.P.) male birds. Practically all of the flock selection work is done by qualified inspectors, approved by the Improvement Association, as employees of hatcheries participating in the National Poultry Improvement Plan.

A further step in breeding improvement was brought about by the Agricultural Extension Service with the organization of the Missouri R.O.P. Breeders Association in 1928. The members of this association have become the principal sources of improved breeding stock for the hatcheries and commercial poultrymen of the state.
Proof of the progress made in raising the productive ability of the chickens of the state through the utilization of this stock by hatcheries and the dissemination of these blood lines to chick buyers is given by census figures and record keeping cooperative results. According to the 1920 census, the average production per hen was 56 eggs. By 1925 it had risen to 98 eggs and by 1938 was 103 eggs per hen. Record keepers in 1920 averaged 114 eggs per hen. In 1925 this rose to 132 eggs and in 1939 the average was 154 eggs per hen.

Not all of this improvement can be attributed to breeding alone. During all of these years efforts have been continued, utilizing a wide variety of teaching media, to increase producer knowledge on all phases of production. In addition to culling, these efforts have involved poultry house remodeling demonstrations, construction demonstrations of new buildings and equipment, sanitation and disease control, feeding and management demonstrations and meeting discussions. A summary of the progress made in construction and equipment improvement is included as figure three in the appendix.

As poultry numbers increased, the need for a program of parasite and disease control became increasingly obvious as a means of reducing losses in young birds and adult stock mortality, attributable to earlier parasitic infestation and infection.

**Grow Healthy Pullet Program**

The *Grow Healthy Pullet Program* was organized in 1927 with the establishment of 77 demonstrations, having as their basis the application of six essentials in proper pullet development. These essentials were: (1) Hatch by Mid-April; (2) Brood on clean ground; (3) Brood each hatch separately; (4) Feed a complete ration; (5) Separate cockerels and pullets at 8 weeks; and (6) Maintain roomy, sanitary summer quarters.

This program, from meager 1927 beginnings, grew by leaps and bounds and was perhaps more spectacularly successful than any poultry program initiated by the Agricultural Extension Service. It was widely copied in other states. Appendix Table 4 shows the growth and interest in this phase of poultry production.

Measures of success in pullet rearing were determined by the number of chicks raised to six weeks of age and by the laying performance of adult birds raised according to this plan.

Interest in this program was great for a number of reasons. These include: (a) an increasing rate of adult mortality; (b) a specific one, two, three program was involved, and cleverly illustrated and publicized; (c) poultry raising was more than usually profitable; and last, but not least; (d) the rapid whole blood test for pullorum disease was being rapidly adopted by hatcheries and the general level of chick livability to three weeks of age was raised appreciably.
Depression and Drought

This program, with modifications, is still being followed. It has served as the basis for additional progress on improved housing, feeding, and management problems, which continued until 1932 and 1933 when low prices almost eliminated possibilities for making progress.

These unfavorable years were followed by the drought of 1934. Liquidation of flocks followed. Slight recovery was made in 1934, only to be followed by more drastic reductions during the 1936 drought and the most unfavorable feed-egg ratio ever to exist during the year of 1937.

During this period, the one extension poultry specialist devoted only part-time to poultry work. In 1933 Berley Winton collaborated in a study of New York consumer preference for egg. In 1934, half the year was spent assisting to administer the early Agricultural Adjustment Administration programs with wheat, corn, and hogs, and in activities relating to the hatchery code under the N.R.A.

These important extraneous activities, combined with an enlarged extension staff, untrained in extension methods and interested primarily in emergency programs, plus the demoralized economic condition of Midwestern poultry raising, left a situation since 1936 which has not been conducive to the attainment of the type of progress that was recorded prior to 1932.

Quality Egg Program

During all of these years of industry development, efforts to improve egg quality and secure consistently profitable quality outlets at premium prices met with only mediocre success.

This is attributable to a number of very pertinent factors listed as follows:

1. Extremely ruinous competition, which results in the narrowest of handling margins experienced by the 15,000 licensed dealers. This number of dealers equals one for every 12 poultry raisers. Margins are so small (2.7% gross, according to 1935 and 1939 surveys) as to preclude the profitable rendering of essential marketing services with the small volume handled per dealer.

2. Small flock size, which makes increased returns attainable from premium outlets of little interest to the rank and file producers.

3. The practice of many buyers of using eggs as a "loss leader" to secure other types of business.

The basis for a successful quality egg program was developed in 1935 and its execution begun in cooperation with the Producers Produce Company of Springfield. This program involved ice refrigeration equipment installation in local buying stations where operators advance the current receipt price. Producers at a later date receive premiums, based on graded returns obtained from eastern markers. This program operates only during
the summer and fall months when a sufficient price differential exists for high quality eggs.

This program has operated at a number of points in 20 counties since 1935. The number of participating producers has been disappointing and limited to approximately 50 percent of producers having 175 or more hens on June 1 each year. Net premium returns during the years 1935-1938 totaled $27,644.

The same general plan is being used to expand outlets for quality producers in various other communities over the state. This plan involves concentration by local hatcherymen, after the hatching season, and sale on federal grades in St. Louis. Net returns per case equaled or exceeded those obtained by shipments to eastern markets in the other program.

Miscellaneous other activities in the Extension program include:
1. Turkey production and marketing work, which began in 1937.
2. Introduction, in 1930, of chicken pox vaccine, as a means of controlling this important source of loss in South Missouri.
3. Educational Programs with dealers and hatcherymen of the State in attempts to serve them, improve practices, and create industry consciousness.

Conclusion: In studying the history and course of 23 years of poultry extension educational activity, two possible shortcomings in the light of present needs, appear. It is wholly possible that these shortcomings were entirely unavoidable. Pointing them out is not done with critical intent, but merely as a means of presenting current problems.

The first shortcoming is an apparent lack of consistent effort to develop a state-wide all-industry organization and representative leadership through which the programs of the past and future might be more effectively projected.

The other shortcoming, perhaps less valid on a practical basis, deals with educational efforts that tended to emphasize phases of the problem of obtaining satisfactory poultry returns. The focusing of attention, for example, on growing healthy pullets tended to leave out of consideration many of the other factors having pertinent bearing on the final result to be attained.

During the period covered by this historical appraisal, the poultry industry grew incredibly through the "Roaring Twenties," spurred on by technological advances and satisfactory returns. Progress continued through the "Depressing Thirties," but at a retarded rate. This progress continuously favored the upper 15 or 20 percent of producers and during the periods of satisfactory prices enlarged the incomes of the majority of producers.

Various unfortunate factors, including the depression and drought, have reduced incomes for the relatively more efficient producers from $2.50 or more per bird to $1.50 or less. This lower figure, when considered in the light of price level changes, is a relatively satisfactory return for the
upper 15 to 20 percent of producers. On the other end of the scale, the remaining great majority of "average" producers are perhaps little advanced from the net earning position occupied in 1920 when annual egg production averaged 56 eggs per bird, compared to 103 eggs in 1938.

It is essential not to overlook the important contributions to income obtained by the average producers during this period of industry growth. These undoubtedly were far greater than would otherwise have been possible without these effective, well-founded educational efforts.

The extension program of tomorrow must be designed to hold the ground gained for the leading 15 to 20 percent of producers. Of equal importance is the need to again establish the faith of the majority of less efficient producers who have tended to lose interest during the "Depressing Thirties." This requires ingenuity and patience because morale is low as compared to 1917-18. In addition, due to smaller net margins, success depends upon an understanding of the whole program of poultry production rather than phases of it, as was true 20 years earlier.

Under these conditions, solutions to marketing problems, industry leadership and consciousness are of extreme importance. These developments must accompany continued educational efforts on all phases of production and marketing and producer consideration of the whole problem, rather than phases of it.

This industry organization and leadership is doubly important if a successful competitive position is to be maintained in light of increased sectional competition, and the more popular subsidized emergency educational programs now in the field.
SUMMARY OF 1940 TO 1966 POULTRY EXTENSION ACTIVITIES

1940

C. E. Rohde and D. D. Moyer, extension poultry specialists, reported savings of over one-half million dollars in 1940 by poultry producers who followed the recommendations of the extension service as follows: $214,926 from rearing better pullets; $176,000 by mixing recommended rations; $91,000 in increased inventory flock values; $27,700 from control of chicken pox; $21,000 from reduced chick losses, and $23,000 from improved marketing practices.

They reported that 739 farmers built 823 range shelters; also, that 1252 farm poultry houses were remodeled and 748 new Missouri type laying houses were built in 91 counties. According to Rohde and Moyer, 3671 producers used individually pedigreed males in their breeding flocks.

The specialists held 241 meetings attended by 8,690 persons; county agents and leaders held 720 poultry meetings attended by 12,074 persons. Poultry work was conducted in 969 communities in 99 counties. They also reported that 1274 poultry news stories prepared by the Extension Service were printed by Missouri newspapers.

1941

Rohde and Moyer state that in 1941 the Lend-Lease program and higher prices stimulated Missouri poultry producers to increase their production. Low prices during the depression before World War II had resulted in the deterioration of housing and equipment. Missouri producers responded to higher prices in 1941 by constructing new range shelters on 1239 farms located in 86 counties. They also built 2028 portable (10’ x 12’) brooder houses. In 93 counties poultry laying houses were remodeled on 2172 farms and new laying houses were constructed on 2316 farms. Thin section concrete floors were laid in 620 houses.

Poultry producers invested approximately $1,000,000 in new housing and equipment. The increased income from the adoption of new practices was estimated at more than $2,000,000.

A total of 25,504 persons attended 1267 poultry meetings held in the state in 1941 by the extension service.
### 1941 Goals and Results

<table>
<thead>
<tr>
<th>Persons to hatch early</th>
<th>Goals</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>50,000</td>
<td>51,407</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Persons to rear under sanitary conditions</th>
<th>Goals</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000</td>
<td>12,487</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Persons to use range shelters</th>
<th>Goals</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,500</td>
<td>2,964</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Persons to vaccinate pullets for pox</th>
<th>Goals</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,500</td>
<td>846</td>
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</table>

<table>
<thead>
<tr>
<th>Laying houses</th>
<th>Goals</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,000</td>
<td>2,258</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Persons to feed as recommended</th>
<th>Goals</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>30,000</td>
<td>33,050</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Persons to use improved breeding practices</th>
<th>Goals</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,000</td>
<td>6,706</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Producers selling quality eggs on a graded basis</th>
<th>Goals</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,000</td>
<td>4,200</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of hatcherymen actively supporting extension program</th>
<th>Goals</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>104</td>
<td></td>
</tr>
</tbody>
</table>

### 1942

C. E. Rohde comments in a 1942 report that the emergency war situation called for increased food supplies, including poultry and eggs. It was estimated that Missouri farmers produced 360,000,000 more eggs and 3,700,000 more pounds of poultry meat in 1942 than they did in 1941. The size of the laying flock for 1943 was increased by one million layers.

Though there was a scarcity of building supplies, Missouri farmers managed to expend $1134 million for poultry buildings and equipment and increase the number of layers on Missouri farms to 24,000,000.

It was estimated that practices adopted by poultry raisers that were recommended by the extension service increased their income by $3,300,000 in 1942.

### 1943

The war stimulated Missouri poultry raisers into producing 30 million dozen more eggs in 1943 than in 1942 and also six million more pounds of poultry meat, according to C. E. Rohde’s 1943 report.

He estimated that new laying houses were built on 4461 farms, poultry houses were remodeled on 4530 farms, and thin-section concrete floors were poured in 1777 laying houses.

A radio short course program was developed and conducted over KMBC, Kansas City. This was a 15 minute program from 12:30 to 12:45 each Saturday from January 2 to March 13, 1943. The estimated listening audience was 5000. Copies of each broadcast were mailed each week to 3600 poultry raisers who enrolled for this short course.

The conservation of feed as a part of the war effort emphasized the use of clean pastures and better feeding and watering equipment. The ex-
tension service secured the cooperation of feed dealers and lumberyard dealers in this program.

1944

C. E. Rohde and E. B. Winner revealed in their 1944 report that egg production in Missouri exceeded three billion eggs for the year, which was an all-time high for the state. Extra income to poultry producers in the state from following extension recommendations was estimated to be as follows:

<table>
<thead>
<tr>
<th>Practice</th>
<th>Pulets @</th>
<th>Income</th>
<th>Feed cost</th>
<th>Ret. over feed/hen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean range for growing pullets</td>
<td>1,226,802</td>
<td>$50¢</td>
<td>$273,284</td>
<td>$572,429</td>
</tr>
<tr>
<td>Pox vaccinations</td>
<td>1,093,138</td>
<td>$25¢</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved brooding</td>
<td></td>
<td></td>
<td>$273,284</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>$1,459,114</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Star Poultry Raisers**

This was the second year for the Missouri Farm Flock Improvement Contest sponsored by the Kansas City Chamber of Commerce and the Kansas City Weekly Star. One hundred twenty-five flock owners in 20 counties entered the contest. The five Star Poultry Raisers selected and their records were as follows:

<table>
<thead>
<tr>
<th>Name and address</th>
<th>No. Hens</th>
<th>Eggs/ Hen</th>
<th>Income per Hen</th>
<th>Feed cost per Hen</th>
<th>Ret. over feed/hen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mrs. Ira Jones, Mt. Vernon</td>
<td>148</td>
<td>203</td>
<td>7.77</td>
<td>2.42</td>
<td>5.35</td>
</tr>
<tr>
<td>Mr. &amp; Mrs. Paul Pippitt, Cleveland</td>
<td>449</td>
<td>185</td>
<td>10.61</td>
<td>5.57</td>
<td>5.04</td>
</tr>
<tr>
<td>Mr. &amp; Mrs. K. L. Schwartz, Hartville</td>
<td>225</td>
<td>195</td>
<td>5.72</td>
<td>2.56</td>
<td>3.16</td>
</tr>
<tr>
<td>Fred Cervinka, Farmington</td>
<td>864</td>
<td>177</td>
<td>5.45</td>
<td>1.96</td>
<td>3.49</td>
</tr>
<tr>
<td>Mr. &amp; Mrs. C. G. Sherman, Urbana</td>
<td>133</td>
<td>198</td>
<td>5.70</td>
<td>2.65</td>
<td>3.05</td>
</tr>
</tbody>
</table>

**Comparison of Different Types of Flocks**

<table>
<thead>
<tr>
<th>Eggs Per Hen</th>
<th>Returns Above Feed Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Five Star Poultry Raisers</td>
<td>189</td>
</tr>
<tr>
<td>County Contest Winners</td>
<td>183</td>
</tr>
<tr>
<td>Farm Flock Record Keepers</td>
<td>168</td>
</tr>
<tr>
<td>Average Missouri Flock</td>
<td>144</td>
</tr>
</tbody>
</table>
1945

E. B. Winner, poultry specialist, reported this was a most profitable year for Missouri poultry raisers. A summary of Missouri poultry records for commercial flocks (500 or more layers) showed that these flocks had an income over feed costs per hen of $3.74, which was a record exceeded only by 1919, another war year.

**COMMERCIAL FLOCK RECORDS**

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Flocks</th>
<th>Av. No. hens/farm</th>
<th>Av. No. eggs/hen</th>
<th>Income over feed cost/ farm</th>
<th>Income over feed cost/ hen</th>
<th>Income over feed cost/ hen</th>
</tr>
</thead>
<tbody>
<tr>
<td>1930</td>
<td>47</td>
<td>548</td>
<td>163</td>
<td>$2418.13</td>
<td>$1141.67</td>
<td>$2176.47</td>
</tr>
<tr>
<td>1931</td>
<td>49</td>
<td>533</td>
<td>165</td>
<td>1652.45</td>
<td>809.78</td>
<td>852.67</td>
</tr>
<tr>
<td>1932</td>
<td>46</td>
<td>603</td>
<td>163</td>
<td>1337.04</td>
<td>614.42</td>
<td>722.62</td>
</tr>
<tr>
<td>1933</td>
<td>42</td>
<td>579</td>
<td>150</td>
<td>1192.42</td>
<td>591.52</td>
<td>600.90</td>
</tr>
<tr>
<td>1934</td>
<td>44</td>
<td>554</td>
<td>140</td>
<td>1225.76</td>
<td>703.93</td>
<td>521.82</td>
</tr>
<tr>
<td>1935</td>
<td>30</td>
<td>561</td>
<td>155</td>
<td>2012.31</td>
<td>1098.82</td>
<td>914.49</td>
</tr>
<tr>
<td>1936</td>
<td>43</td>
<td>546</td>
<td>138</td>
<td>1528.22</td>
<td>895.06</td>
<td>633.16</td>
</tr>
<tr>
<td>1937</td>
<td>31</td>
<td>542</td>
<td>163</td>
<td>1853.60</td>
<td>1242.75</td>
<td>610.85</td>
</tr>
<tr>
<td>1938</td>
<td>19</td>
<td>518</td>
<td>181</td>
<td>1802.67</td>
<td>852.97</td>
<td>949.70</td>
</tr>
<tr>
<td>1939</td>
<td>18</td>
<td>534</td>
<td>174</td>
<td>1571.25</td>
<td>782.37</td>
<td>788.88</td>
</tr>
<tr>
<td>1940</td>
<td>11</td>
<td>621</td>
<td>174</td>
<td>1941.77</td>
<td>1088.90</td>
<td>852.87</td>
</tr>
<tr>
<td>1941</td>
<td>9</td>
<td>612</td>
<td>170</td>
<td>2273.36</td>
<td>1109.89</td>
<td>1163.47</td>
</tr>
<tr>
<td>1942</td>
<td>9</td>
<td>591</td>
<td>166</td>
<td>2829.60</td>
<td>1226.43</td>
<td>1603.17</td>
</tr>
<tr>
<td>1943</td>
<td>7</td>
<td>643</td>
<td>150</td>
<td>3380.28</td>
<td>1519.74</td>
<td>1860.55</td>
</tr>
<tr>
<td>1944</td>
<td>8</td>
<td>672</td>
<td>174</td>
<td>3927.57</td>
<td>1948.79</td>
<td>1978.78</td>
</tr>
<tr>
<td>1945</td>
<td>12</td>
<td>658</td>
<td>180</td>
<td>4452.10</td>
<td>2004.76</td>
<td>2447.32</td>
</tr>
</tbody>
</table>

Considerable emphasis was placed on turkey production this year. Production in Missouri had increased from 245,000 market turkeys in 1930 to 1,838,000 in 1945. The extension service emphasized efficient production and labor saving methods. Major attention was given to sanitation, feeding, use of pasture, improved breeding, and testing for pullorum disease under the National Poultry Improvement Plan. A turkey short course held at the University of Missouri was attended by 120 people.

The 30 minute color, sound movie "Profitable Poultry Production" was completed and shown to 13,767 people during the year.
1946

Poultry specialists E. B. Winner and Norman Clizer reported that the highest feed costs per hen ($3.92 per bird) since records were started in 1918 began to have an effect on producers. The number of layers declined 4.4 percent. In June, feed costs per dozen eggs exceeded the sale price for such eggs. However, farmers built 1316 new laying houses, remodeled 764 houses and poured thin section concrete floors in 779 laying houses.

This year the poultry extension specialists devoted much time to setting up demonstration flocks which were partially financed by a grant of $10,000 from the Sears Roebuck Foundation. Eighteen demonstrations were established in 12 counties. In this plan young farmers, especially veterans, were supplied 500 pullorum clean pullet chicks and 100 cockerel chicks, all of production breeding.

Poultry Improvement Days were held in 12 counties which were attended by 2000 poultry producers.

Polk County lead the state in turkey production, starting 85,500 poulets.

1947

E. B. Winner and Norman Clizer reported that high feed prices and uncertain market demands reduced chicks hatched in Missouri in 1947 by eight percent. Missouri poultry raisers, however, continued to improve their facilities by building 1703 new laying houses, remodeling 1017 houses and pouring 1156 thin-section concrete floors.

Twenty-seven Eastern Chick Demonstrations were established in 1947 through a cooperative project between the Poultry Department, Agricultural Extension Service, and Sears and Roebuck Foundation. In this plan, young farmers, especially veterans, received 500 pullorum clean, production bred chicks, upon agreement to follow recommendations of the College of Agriculture relative to poultry production. The chicks were paid for the following year at the rate of one case of eggs for each 100 chicks received. The eggs in turn were used to set up another project, thereby being a practically self-perpetuating plan. This project was intended to further the use of clean, high production stock on Missouri farms. The 12 weeks summary showed an 8.2 percent mortality in the 15,290 chicks started, and a 31 cents per chick cost (outside original estimated cost).

Thirty counties held Poultry Improvement Days that attracted over 7,140 poultry producers. The meetings were all-day affairs. The programs included a discussion of exhibits, round-table discussion by leading poultry
producers, and demonstrations on culling by hatcherymen. The color movie, “Profitable Poultry Production,” filmed last year on Missouri farms, was a part of every program. Some 89 planning meetings were held with industry representatives many months before these events, to insure their success.

A new sound movie (12 minutes) “Poultry House Remodeling” was completed in June, 1947, and was shown to 6451 persons from June until December 1.

1948

Built-up litter, which was recommended by the poultry extension specialists, was reported as being used by 10,888 Missouri producers, for an increase of 19 percent over 1947. There was also a 21 percent increase in the use of droppings pits, now used by 12,795 producers.

Number of chickens raised in Missouri declined 20 percent, compared to a decline of 15 percent for the nation as a whole. Despite the decline in chickens raised and the shortage of materials, Missouri poultry raisers constructed 1177 new brooder houses, 1152 sun porches, 1388 range shelters, 3029 range feeders, 1076 water fountains, and 266 combination brooding and rearing shelters.

Records on 21 flocks established under the Sears project showed that they averaged 318 hens per flock and they returned an average of $915.99 per farm above feed costs, or more than twice the original $10,000 Sears grant.

Poultry Improvement Days were encouraged and 49 such all-day meetings were attended by 12,188 persons.

The marketing of eggs on a quality basis was promoted and reports from county agents showed that 3884 producers sold 129,318 cases of eggs on a graded basis, thereby increasing their income $245,704.20.

A survey made in Dallas County showed that the average flock had 97 hens and its caretaker spent 74 minutes per flock per day in caring for it while carrying feed an average of 89 feet and water 108 feet.

During 1948, the poultry extension specialists emphasized (1) flock demonstrations, (2) industry cooperation in getting practices adopted, and (3) marketing eggs on a graded basis.

1949

Poultry Improvement Days proved highly effective in extension teaching during this period. Specialists E. B. Winner and Ted Joule gave this account of the program:
"Top attention and interest-getter in the Poultry Extension program continues to be the county-wide Poultry Improvement Days. And of even more importance, reports from county agents and industry men indicate that this teaching method is effective in getting more profitable poultry methods into operations in the counties where the events are being held. Not only do those attending have a chance to hear reports from fellow producers, discussions by poultry specialists, various trade representatives, county agents and others, but they also have a chance to see exhibits that help clarify points being made. A poultry movie and various types of demonstrations add to the effectiveness of these programs.

"These events have been held for only the past five years. This year, these county-wide events were held in 49 counties with an attendance of 9,790 people. Although these poultry days are only a part of the Poultry Extension program, they undoubtedly have been a major factor in securing an egg production today of some 10 to 12 eggs per hen, per year, higher than five years ago. They have, undoubtedly, contributed to the producers' desire to secure more fall eggs—with the rate of lay during the fall months now being 6 to 7 percent higher than five years ago. Undoubtedly, the trend towards more economical size flocks—that is, 300 to 400 birds or more—stems from the discussions at these days. Then the ever increasing trend towards more use of labor-saving methods certainly has received a part of its boost through these events.

"The exhibits are many and varied—but all aimed at the goal of more efficient production and marketing, and labor saving. Good laying house equipment, including dropping pits, feeders, waterers, nests, and legume hayracks, are displayed. A floor plan for a 24' x 52' laying house is usually laid out and the above equipment displayed within the building layout. Important range equipment that producers see includes range shelters, barrel waterers, and range feeders. Likewise, chick brooding equipment is exhibited in much the same manner as the laying house equipment.

"The need for improving quality is illustrated through a graded egg and poultry meat display. An exhibit of a sand box egg cooler that can be easily constructed on most any farm, gives producers information and ideas on methods that will aid in producing a quality product. This phase of the program has been pushed particularly in the counties where graded egg outlets are available, or could be made available rather readily.

"These days are put on through cooperative action on the part of the poultry industry in the various counties. The county agent calls on hatcheryman, produce dealers, hardware men, lumber dealers, farm exchanges and feed dealers, as well as vocational agriculture teachers, farmers home administration supervisors, and other farm and civic groups to help plan and put these on."
1950

The annual farm income from poultry products exceeded $100 million; 75 percent of Missouri farmers sell poultry products; according to the 1950 report of Specialists Winner and Joule.

Quality egg marketing outlets had increased 32 percent during the previous two years and were available in 74 counties. The average premium over current receipt prices received by producers was 4 to 6 cents per dozen.

Two hundred and ninety-one producers kept complete records on their poultry flocks and 141 flock owners entered the Missouri Flock Improvement Contest sponsored by the Kansas City Chamber of Commerce, the Weekly Kansas City Star, and the Extension Service.

Even though the return over feed cost ($2.04 per hen) as reported by the flock record keepers for 1950 was the lowest since 1941, the confidence of the people in poultry as a source of income is reflected in the work done on poultry buildings this year. According to county agents' reports, 585 Multi-Unit houses, 378 20 x 20 brooder houses, and 1815 range shelters were built. A total of 254 farmers converted their 20 x 20 laying houses over to brooder houses, 482 installed automatic waterers and 877 built feed rooms into their laying houses. Many types of water systems were used, cisterns built under the laying houses, hydraulic rams installed in springs, regular pressure systems and farm ponds.

Labor saving conveniences are being stressed through the extension program and programs conducted by the poultry industry. Agents report 15,349 farm families are now using built-up litter, about a 40 percent increase over 1949. Agents also said 1897 are using same litter more than one year.

County-wide poultry days head the poultry educational program of the Extension Service in many Missouri counties. During the past year 64 counties held poultry days, with 9882 local people attending. The responsibility in arranging for and setting up exhibits is carried by the local people with the agents’ cooperation. All types of businesses, civic groups, schools, extension clubs, 4-H agency representatives, churches, and others have worked and continue to work to bring to the people of their county a program on production and consumption of poultry products that will provide an increased income and a higher quality product.

1951

Poultry specialists E. B. Winner, Ted Joule, and Schell Bodenhamer reported that an outstanding feature of 1951 activities was a well organized poultry industry tour by 24 food and farm editors of press and radio and
home economists. The Sears Roebuck Foundation financed the transportation, meals, and lodging for this two-day tour.

Pre-tour activities the evening of October 23 included the assembling of Kansas City, St. Louis, and other people at the Missouri Hotel in Jefferson City for an evening turkey dinner. Plans for the two-day tour were outlined to the group following the dinner. A folder was handed out giving information about Missouri as a producer of eggs and highlights about the state’s poultry industry.

Three poultry farms near Jefferson City were visited. After lunch at Eldon, the group visited the Waite Brothers Turkey Farm and a broiler operation on the Jim Crum farm.

At this point the group divided, with one group starting on their way back to Kansas City and the other going toward St. Louis. The two groups saw similar operations as they traveled back towards the two cities.

The St. Louis group went to Warrenton to stay overnight. Early the next morning they visited the Mildred Brothers Hatchery, at Warrenton, then proceeded to St. Louis and visited the Producers Produce processing plant, the C-S Marketing Company, and a Kroger store.

The Kansas City group visited the Bagby Hatchery at Sedalia. Mrs. Bagby, owner and operator of this hatchery, gave a summary of her program, conducted a tour through the hatchery, and showed a series of slides dealing with her operations.

Following this visit to the hatchery, the group ate a fried chicken dinner at the Flat Creek Inn near Sedalia. They stayed overnight at the Bothwell Hotel in Sedalia.

The last morning, October 25, the first stop was made at Swift and Company’s Processing Plant in Sedalia. Here the group studied processing of commercial fryers. They saw a plant that is capable of processing 2500 fryers per hour. At the time of the visit, however, birds were being processed at the rate of 1800 per hour. They had a chance to observe each of the various operations that go into the processing job. Also, they gained information as to the way fryers are packed and the speed with which they are moved to the consumer.

In Kansas City they visited the Safeway store and the Ralph Hurst Egg Plant.

1952

A summary of the annual report prepared by Poultry Specialists Winner and Bodenhamer follows.

Missouri’s poultry industry contributes more than 100 million dollars annually to the cash income of Missouri farmers, and ranks fourth in im-
importance as a source of cash farm income. In addition, poultry products valued at 15 to 20 million dollars are consumed in farm homes of Missouri. About 60 percent of the cash farm income from poultry is from the sale of eggs. Some 21 percent arises from the sale of poultry other than commercial broilers. The remainder comes from the sale of turkeys and commercial fryers, with the sale of commercial fryers now totaling slightly more than the total income received from the sale of turkeys.

This year saw an increased interest in the move to larger flocks. Agents' reports showed that 408 of the 24-foot wide houses were built. In addition, 168 houses 30 feet wide and 55 houses 48 feet wide were constructed.

Poultrymen are becoming more conscious of the importance of ordering the strain of bird to fit their particular need. This is particularly true with the considerable difference in egg laying ability between strains. Many poultry houses are being remodeled to allow the housing of an economical size of flock and also to install labor saving equipment. These factors have become increasingly important with the need for labor efficiency and to offset a lower egg-feed ratio.

One hundred seventy-nine poultry producers kept a complete set of records in cooperation with the Missouri College of Agriculture during the September 1, 1951, to August 31, 1952, poultry recordkeeping year. There was a continuance of the trend of an increasing number of commercial flocks keeping records. Record keepers showed an average income over feed cost per hen of $2.13. This was approximately 31 percent lower than the previous year. The return of $1.39 for each one dollar's worth of feed fed was considerably below the 35-year average of $1.89. Income per hen was $7.61, while feed cost per hen was $5.48. The average number of hens during the year was 216 with an average egg production of 183 eggs.

Eighteen counties had entries judged in the 1951-52 Missouri Flock Improvement Contest, now in its tenth year. One of the requirements to enter this contest is to have over a 200 egg average per hen.

During the past year, 48 counties held Poultry Days with 3,789 local people attending.

The Poultry Production Project has worked closely with the Poultry Marketing Project to establish a continual better quality egg and poultry marketing program. An active part has been taken in encouraging the producer to produce and market a quality egg, the buyer to buy eggs by grade, and the retailer to sell eggs by grade. County agents report that quality egg sales were made in 76 counties. Twenty-nine counties had one or more quality egg meetings in cooperation with quality egg outlet representatives.
Missouri’s broiler industry has entered a new phase of its growth. It was in 1951 that the production per capita in Missouri exceeded the U.S. average for the first time. This means that as the Missouri broiler industry continues to grow at a more rapid rate than the national average, Missouri growers must compete for additional out-of-state markets. Broiler production in Missouri in 1952 will probably slightly exceed the 22,004,000 produced in 1951.

Estimates on Missouri turkey numbers this year placed the crop at 1,712,000 birds, some 10 percent below last year. This downward trend in turkey numbers in Missouri this year is in contrast to the 10 to 12 percent increase in turkey numbers for the U.S. as a whole. Profits from turkeys were down compared to the past several years because of a less favorable ratio between feed and turkey prices.

1953

Poultry Specialists Bodenhamer, Walter Russell, and E. B. Winner report that the drought in Missouri the past two years has caused many families to place new emphasis on the importance of poultry in supplementing the farm income. There is increased demand for house plans for housing larger flocks. Agents’ reports show that 364 of the 24-foot wide houses were built this year. In addition, 203 houses 30 feet wide and 48 houses 48 feet wide were constructed.

Poultrymen are becoming more conscious of the importance of ordering the strain of bird to fit their particular need. More producers are starting them early to get the pullets in production during the time when egg prices are highest. There is a slow but noticeable increase in the amount of crossbred and incrossbred hens on Missouri farms. The amount of green pasture available for birds on range was greatly reduced this year by the drought, but the value of clean ground was clearly evident. One thousand one hundred thirty-six new range shelters were constructed during the year. As the demand for broiler chicks continues to increase, more poultrymen are keeping broiler strain hens and selling hatching eggs. Many of these birds are off-season hatches and are raised in complete confinement.

One hundred sixty-two poultry producers kept a complete set of records in cooperation with the Missouri College of Agriculture during the September 1, 1952, to August 31, 1953, poultry recordkeeping year. The average number of hens per farm flock in 1953 was 253, the highest number on record. Record keepers showed an average income over feed cost of $3.32 per hen, compared to the 36-year average of $2.29.

Twenty-five counties had entries judged in the 1952-53 Missouri Farm Flock Improvement Contest, now in its eleventh year. The entry require-
ment of 200 eggs per hen will be raised to 215 eggs in the 1953-54 contest. Recognition awards and $50 checks went to five Missouri poultrymen.

Forty-seven counties held Poultry Days with 3120 local people attending.

It has been the policy of the poultry production specialists to work closely with the marketing project in promoting better poultry and egg marketing. Getting poultrymen to market their eggs on a quality basis has been given much attention through news articles, radio, and meetings with hatcherymen, egg buyers, and producers. County agents report that quality egg sales were made in 80 counties. A new plan for an insulated built-in egg room was made available to producers this year.

The broiler industry in Missouri began to take hold in 1948 with a production of over five million broilers. The average production from 1940 to that time was about 2½ million broilers. The production in 1952 was reported to be 23,544,000, or an increase of 460 percent since 1948.

Turkey production in Missouri has been estimated at 1,493,400 birds in 1953, or five percent below last year. Turkey numbers for the U.S. as a whole are down eight percent. Part of the reason for the downward trend was due to the small profits realized in 1952 and to the request of the National Turkey Federation to hold production more in line with demand.

1954

The poultry industry continues to contribute a large share of the cash income to Missouri farm families, Poultry Specialists Bodenhamer and Russell reported. Poultry, according to 1953 reports, ranked fourth in importance as a source of cash farm income with a contribution of $120,889,000. Sixty percent of the poultry income came from the sale of eggs. Nineteen percent came from the sale of commercial broilers, while 13 percent came from the sale of farm chickens. Turkeys contributed about eight percent of the total poultry income.

The year 1954 was unprofitable for the average Missouri producer. Increases in production of all poultry products occurred. The egg:feed and chicken:feed ratios were the lowest on record since 1924. The turkey:feed ratio was the third lowest since 1933. Only the most efficient poultrymen, following the best management and marketing practices, were able to realize a profit. In spite of unfavorable prices, poultry raisers continued to expand their operations by remodeling their buildings or building new ones. Reports from county agents show 585 new houses were built this year. Several new caged layer operations were started in southeast and south central Missouri.
An increased number of producers are boosting their volume of fall egg production by holding over yearling layers for an additional three to four months of lay. The low fowl price and increased depreciation on yearling hens has forced adoption of this practice. Many producers are now starting chicks in the fall and early winter in order to even out the flow of eggs to market throughout the year. Flock owners selling hatching eggs to broiler hatcheries were first encouraged to follow this program. Agents report additional progress is being made in the installation and use of various labor-saving practices and methods. Five hundred thirteen egg rooms were built in laying houses this year. Four hundred forty-three producers installed automatic waterers. Over 14,359 producers are using built-up litter in their laying houses. More producers are also following the practice of confining their flock throughout the year.

The best Missouri poultrymen are using a clean range program or raising birds in total confinement. Twice-a-year brooding is common on many of the large poultry farms. The drought in Missouri severely reduced the amount of pasture available to birds on range this year. Agents report 738 producers raising pullets totally in confinement. Two hundred sixty-two farmers built brooder houses of 20' x 20' size or larger.

County-wide Poultry Days were held in 52 counties with 3,554 local people attending.

Recognition awards and $50 checks went to five Missouri poultrymen who were winners in the Flock Improvement Contest.

Missouri broiler producers faced new obstacles this year: Broiler prices remained at a low level throughout the year, averaging only 24.4¢ for the period November 1, 1953, to October 31, 1954. The first Broiler Day was held at the college in October. One hundred persons attended this meeting which included discussion on results of the broiler test conducted at the college, outlook, and marketing. Meetings on disease prevention and treatment were held in three counties. Chicken barbecues were popular during the summer months. A study of Missouri broiler records was made on 22 broods of broilers grown during the year 1952-53. Personal visits were made to broiler farms to assist with housing and management problems.

In 1953, there were 1,493,000 turkeys raised in Missouri. Estimates for 1954 production are for about a 2 percent increase in Missouri and about 9 percent increase in the U.S. Profits on this year’s crop have been extremely low due mainly to overproduction and competition with other meats which are also in abundant supply. Hot weather caused moderate death loss and slow gains. Turkey pastures were very poor due to the drought.
Seventy-eight counties reported producers selling eggs on a graded basis. Thirty new graded egg outlets were established during the year. A large number of quality egg meetings were held in cooperation with feed companies and produce dealers.

A Junior Chicken of Tomorrow Contest was held for the first time this year to interest young people in poultry. Fifty-one 4-H and FFA members were enrolled in the contest and 34 members exhibited birds at the Missouri State Fair where $250 in cash awards was made available. There were 802 4-H boys and girls enrolled in the poultry project in 1954.

1955

Poultry Specialists Schell Bodenhamer, Leonard Voss, and Walter Russell reported a wide scope of activities in 1955. In addition to their normal work in assisting poultrymen and county agents through training meetings, counseling service, and mass media, they produced a movie on range shelters and assisted the State Department of Agriculture with meetings on Missouri's new egg law.

1956

Poultry Extension work in 1956 was summarized by Specialists Leonard Voss and Walter Russell as follows:

Missouri poultrymen moved in the direction of more efficient production by establishing larger flocks, lowering the cost of production through the use of home-grown grains and marketing 50 percent more eggs on the graded basis.

Poultry record keepers with flocks of 500 or more hens averaged $2.95 labor income per hen for the laying year ending September 1, 1956. These flock owners generally followed closely the recommendations of the Agricultural Extension Service. They followed a good marketing program averaging 44 cents a dozen for eggs. The income from laying hens is up sharply from the previous year, a sharp contrast to most agricultural enterprises.

County Agents report a growing interest in houses for flocks of more than 300 hens. Poultry specialists received more calls to plan lay-outs for flocks of 1,000 or more hens. An efficient sized flock is a part of many Balanced Farming plans. County agents state there was a 33 percent increase in flocks of 1,000 hens or more, and a 20 percent increase in flocks of 300 or more hens. While the total number is still low, the trend is definite. Missouri farmers must produce efficiently to compete.
Making use of the natural advantages is one of the indications of a good producer. More Missouri producers with flocks of over 300 birds are using the 20 percent protein and 26 to 32 percent protein concentrate. These rations make possible the utilization of whole home-grown grains, reducing the feed cost 3 to 8 cents per dozen eggs or about 25 percent.

Hatcherymen report an increasing demand for light breed chicks. Farmers are recognizing the importance of buying the breed bred to lay the most eggs at the lowest feed cost. Breeds developed for broiler hatching egg production do not have a high rate of lay and require more feed and a hatching egg premium for a profit. Producers are buying the breeds to fit the available egg maker.

Enrollment in 4-H poultry projects was 657 with 513 members completing the required work. The attraction of boys and girls to a project having state-wide shows and contests was recognized. The Junior Chicken of Tomorrow Contest and Junior Market Turkey Show, supported by industry, helped to create more interest in poultry projects. Industry members bought the champion dressed broilers at $11.50 per pound. The top dressed turkey sold for $10.00 per pound. The turkey project and show was started this year through excellent turkey industry cooperation.

Since the passage of the Missouri Egg Law in 1955 there has been increased demand by producers for quality egg markets. There are 905 quality egg outlets operating in 105 counties in 1956. Fifty percent more graded eggs were sold this year as a result of cooperative effort of the State Department of Agriculture, Extension Service, and industry members. Agents also report large increases in the number of producers following necessary practices in the production of quality eggs. These practices include confining laying flock, gathering eggs often, production of infertile eggs, and proper cooling and storage of eggs. Average premium received per dozen eggs was 7 cents above local unclassified price. One county report showed producers who sold graded eggs averaged $259 more per year by selling eggs on a graded basis. This marketing practice alone resulted in an additional net income of $91,584 to poultrymen in this county. One county reported 50 percent of the eggs marketed on the graded basis.

Outdoor cooking is the mode of the day. County Extension Agents made use of the training in barbecuing given them by specialists to train local leaders. These leaders report the barbecue is a popular drawing card for group and community activities. Last year a lot of chicken was consumed at the 448 barbecues held.

1957

Specialists Walter Russell, Leonard Voss, and Glenn Geiger reported the following for 1957:
Small poultry flocks are disappearing from Missouri farms at a rapid rate. Many people remaining in the business are increasing the size of their flocks. The number of flocks with 300 or more hens increased from 6,554 in 1956 to 7,869 in 1957. About 353 of these flocks are composed of 1,000 or more hens.

This year was one of the poorest years in the history of record keeping. With a sale price of 34 cents per dozen, the average farm flock record keeper ended his year with a labor income of 80 to 95 cents per hen. This included the income received from the sale of fowl. The average commercial flock netted in the neighborhood of $1.50 to $1.65 labor income per hen. Farmers who used concentrates and home grown grains were able to come through the cost-price squeeze in good shape. In some cases poultrymen were able to reduce feed cost per dozen eggs to as low as 12 cents by utilizing home grown grains rather than all-mash commercial rations.

More producers are raising their pullets in confinement. Nine hundred fifteen producers followed this practice in 1957. They found it reduces the amount of labor required. Poultrymen are demanding the best breeds and strains to fit their particular markets. Random sample test results are being used to a large extent in selecting the strain of baby chicks to buy. Poultrymen and hatcherymen who are not keeping up with the trends continue to go out of business. Approximately 87 hatcheries closed their doors during the period 1952-56.

County agents report fewer Missouri egg producers selling on the grade—this is probably due to the decline in flock numbers. Most producers still selling on a grade are making an average of 6 to 8 cents more than the current receipt market offers. The importance of a good market is indicated in the following survey results of 203 poultry record keepers: Those selling graded eggs 8 to 12 months made a labor income of 93 cents per hen; unclassified eggs, 8 cents per hen; grocery stores 8 to 12 months, $1.41 per hen; and to individual customers, $1.45 per hen.

Broiler producers are operating on a small margin of profit and having a difficult time. The 1957 average price per pound was 19 cents and at times as low as 13 cents, which is well below average production costs. The number of producers in Missouri is declining. According to county agents’ reports, there were 1,590 producers in 1957 compared to 1,677 last year. The number of farmers producing hatching eggs is also down, with 1,288 fewer than in 1956.

The majority of broiler growers are able to produce a three pound bird in nine weeks with 8.1 pounds of feed. On some broods, reports of three pound broilers at eight weeks of age with feed efficiencies between
2.3 to 2.5 are not uncommon. Diseases, especially CRD, are one of the biggest production problems facing today’s growers.

Surplus of broiler meat in 1957 created a need for more work on promotion to increase consumption. The increase in chicken barbecuing during the warm months is probably responsible for the greatest increase in per capita consumption of broiler meats. Per capita consumption has doubled since 1935, now being at 25 pounds.

Turkey production in Missouri was at about the same level in 1957 as in 1956, slightly more than three million birds. The National figure of 81 million birds, however, is 5 percent higher than in 1956. The majority of producers either broke even or lost money on their flocks marketed before Thanksgiving. A few producers made 25 cents to a dollar a bird.

Enrollment in 4-H poultry projects was 655 with 511 members completing the required work. The Junior Chicken of Tomorrow Contest and the Junior Market Turkey Show continue to create interest in poultry projects. Another Chicken of Tomorrow Contest was started this year in southeast Missouri. Seventeen 4-H members enrolled in this contest at the Cape Girardeau District Fair.

1958

Specialists Walter Russell and Glenn Geiger summarized the poultry situation and their work during 1958 as follows.

The number of hens and pullets on Missouri farms has been steadily decreasing since World War II. Farmers with only a casual interest in poultry are dropping out of the business at a rapid rate. Those keeping poultry as a farm enterprise are enlarging their flocks and producing for special markets. Number of flocks of 1,000 hens or more increased from 353 in 1957 to 506 in 1958.

Efforts this year were devoted to helping producers make the necessary adjustments in their poultry operation and to improving overall efficiency. The Missouri “U” Plan for Egg Production was published to give producers a packaged deal which they could use in establishing a 1,000 bird operation all in one building. Eighteen hundred copies of this plan were distributed.

Most of the 28 million or more broilers grown in Missouri are produced on contract. Growers are averaging between 5 and 6 cents per bird for labor, taxes, depreciation, and interest in investment. Several new broiler houses were built during the year. Production is expected to increase but at a slower rate than in other major broiler areas.

Major production problem of the broiler grower is disease. A Disease Control Short Course was held in Columbia for field servicemen and pro-
ducers. Less work is being done directly with producers. More effort is being directed toward working with servicemen, feed dealers, and others who offer grower contracts.

Missouri's turkey production increased 2 percent this year over the year before, while the nation's total was off 4 percent. The trend is for more turkeys to be raised on contract as in the broiler industry. Margin of profit is extremely low, averaging around 50 cents per bird.

As the number of laying flocks has declined in the state, there has been a similar decline in the number of markets available. Producers and dealers who remain in the business are doing an exceptionally good job of getting quality eggs to consumers. The Missouri Egg Law has helped in this respect. Forty-five egg dealers installed refrigerated egg rooms this year. Two hundred sixty-three producers purchased refrigeration units or cabinets for use on the farm.

The large supply of broiler meat in 1958, particularly during the last six months, created a need for more work on promotion. Plans for a portable barbecue pit and grill were distributed to county agents and industry leaders.

Number of 4-H members enrolled in poultry projects declined from 655 members to 530. Enrollment in the major projects such as the Chicken of Tomorrow Contest and Junior Turkey Show was maintained at near the same number as last year. In most cases, members enrolled in 4-H poultry projects have been able to make a higher return per unit than the average adult producer.

1959

All producers—broiler, turkey, and laying flock owners—were plagued with low prices during the year. Egg prices during the first part of the year were quite favorable, but they hit record lows during the latter part of the season. Broiler prices remained below costs of production throughout the year. Producers, however, were protected from disastrous prices to some extent by producing under contract. They averaged between 5 to 6 cents per bird for labor, taxes, depreciation, and interest in investment. Hardest hit by low prices were the integrators who financed broiler operations.

Turkey producers experienced a better-than-average year. Although prices were low early in the season, they rose sharply as the season progressed. The number of turkeys raised continued on its upward trend.

Extension methods of teaching were revised in 1959 to meet the needs of the changing poultry situation. Fewer county meetings were held with poultry producers. Specialists kept in direct contact with egg producers
by publishing a monthly newsletter, "Poultry News and Views." More emphasis was placed upon teaching industry service personnel through college short courses and through personal contacts during the year.

The Missouri poultry record keeping program is one of Extension's best teaching tools. One hundred and fifty-five record keepers completed their records in 1959. Records were summarized and used by Extension personnel to illustrate the value of following certain recommended practices in breeding, feeding, and management.

The number of 4-H boys and girls enrolled in poultry projects declined in 1959 as expected. Two industry-college sponsored youth programs, the Junior Chicken of Tomorrow Contest and the Junior Market Turkey Show, were redesigned to make them more attractive to young people interested in poultry.

A 4-H broiler circular was published in 1959. Material in this bulletin and that in circular letters sent to Junior Chicken of Tomorrow contestants helped youngsters do a better job of growing broilers. The quality of birds entered in the 1959 contest was extremely good, as were the records submitted by the boys and girls competing.

Fewer boys and girls participated in the State 4-H Poultry Judging Contest in 1959 than in 1958. The top four individuals in the state contest participated in the Invitational Contest in Chicago. Prior to the Chicago contest, two training sessions were held for the team.

1960

The poultry extension program for 1960 was summarized by Russell and Geiger as follows:

In prices, it has been a good year for the poultry industry. Substantial gains were made in both broiler and turkey production. These two segments of the industry appear to be keeping pace with the national trends and are making satisfactory adjustments to meet the needs of a changing economy. The egg business is the only segment of the industry that appears to be lagging behind. Extension work during the past year has been focused on helping egg producers and others allied with the industry to change their production and marketing practices.

Several new projects were started in 1960. One project was to concentrate our efforts in two major areas where egg production accounts for a high percentage of the farm income. The idea was to improve the quality of eggs produced, concentrate poultry numbers within the area, and to reduce costs of production. Programs were started in the Perry-Cape county area of Southeast Missouri, and in the Springfield trade area. Both programs have been given a great deal of publicity and have created interest
and awareness among producers. They will be followed up in 1961 with more emphasis on action.

Another new project was to help edit and publish a turkey newsletter in cooperation with the Missouri Turkey Federation. This publication serves to keep the industry informed on the latest research and news. It goes to almost everyone associated with the turkey industry.

Extension's teaching methods have been revised to meet the needs of the changing poultry situation. Fewer county meetings were held with poultry producers. More emphasis was placed upon working with egg dealers, feed dealers, and others who service the producer. Newspapers, special newsletters, radio, and T.V. were used more frequently to supply producers with information. The number of farm visits was increased. A start was made in revising bulletins and writing new ones to keep this important channel of information up to date. Less work was done through county Extension offices due to the fact that fewer people are depending upon county personnel for solutions to their problems.

The poultry industry sponsors some very fine youth projects, but the response to these projects leaves much to be desired. Part of the difficulty in getting more youth enrolled in poultry projects is closely related to the changing trends from the general farm flock to large commercial sized operations.

1961

Specialists Russell and Geiger summarized 1961 as follows:

Too much production—that's the story on broilers and turkeys in 1961. As a result of overproduction, prices dipped to new lows, and producers scampered to Washington to seek government help. By year's end it was still uncertain as to what role government would play or should play in getting these two segments of the poultry industry back on solid footing. In fact, it was equally uncertain as to whether or not the majority of producers even wanted government assistance. The egg industry was left out of the mad scramble. Prices were fairly high and egg producers were quite happy. However, everyone is predicting that their rough year is coming up in 1962.

Missouri broiler and turkey producers went along with the crowd in increasing production in 1961. Estimated broiler production was around 40 million birds. Turkeys will probably be near 5.5 million head. The number of hens and pullets on farms showed their usual percentage decline. Hen numbers in Missouri are declining faster than the national average and this has us quite concerned. It indicates that we are not keeping pace
with the changing industry and are being forced out by competition of other areas.

Extension's major activities in 1961 were geared to solving problems in the egg business. Two projects which were started in 1960 were continued. These were projects aimed at concentrating poultry production in Southwest Missouri and in a smaller area around Cape Girardeau.

Our efforts are already beginning to bear fruit. We were able to get a new egg grading plant at Jackson, which will help expand the market for eggs in that area. Although the plant is just now getting into operation, it is already stimulating new production. The Springfield Chamber of Commerce provided the main channel for working in the Southwest Missouri area. Reports show that 28 producers built new facilities in 1961 for 167,000 layers.

Extension has had to revise its teaching methods to better serve the changing poultry industry. More emphasis is being placed upon working with egg dealers, feed dealers, and others who serve the producer. Fewer general meetings are held. Most of meetings now are held with small groups and for the purpose of planning action programs. Newspapers, special newsletters, radio, and TV, are used more frequently to supply industry members with information. More circulars and folders were written in 1961 than in any previous year. More work with mass media needs to be done.

Less work is now being directed through county Extension offices due to the fact that fewer poultrymen are depending upon county agents for assistance. In view of this situation we are requesting that an area poultry agent be assigned to the Southwest Missouri area in 1962. Requests for poultry agents in other areas will be made as soon as conditions warrant it.

The trends which we have been developing in the egg business for the past several years appear to be gaining momentum. Small family size flocks continue to disappear. Most of the building activity was by producers with 5,000 to 6,000 birds, and in most cases they were starting to produce for a specific market. Several quality egg programs got underway in Missouri. The Kraft Food Company of Neosho expanded its program to 190,000 layers. Approximately 130,000 layers were producing for Seymour Foods Inc., of Topeka, Kan. Ralston Purina Company, in cooperation with LaMear Produce, St. Louis, hopes to soon have a million hens on feed. Kroger Company started their operation with 450 cases of eggs per week and have plans for further expansion. There were numerous other instances where egg dealers either expanded their volume or dropped out of the business. This seems to be the trend we are in—either get big or get out,
and it applies to everyone connected with the poultry business—egg dealers, feed dealers, hatcherymen, processors, and producers.

1962

An example of the work being done by poultry Specialists Russell and Geiger was their effort to improve production and marketing of eggs in 1962.

Working with producers, egg dealers, feed dealers, and hatcherymen, they attempted to increase awareness in the egg industry of the need for concentrating production in an area and for developing quality egg programs which will result in low cost production and marketing of their product. Steady gains were made during the year in Southwest Missouri toward increasing the number and size of commercial market egg flocks. A recent survey of the 15 county area showed 110 flocks in the area with 1,000 or more birds per flock. Average size flock was 7,100 birds. The total birds in these flocks was 1,987,500.

In Newton County many of the egg producers are remodeling their housing facilities and are changing to community type cages. They are getting good egg production with birds in cages. Their investment cost per hen is being lowered from approximately $2.00 to $1.30 per hen. Labor, they estimate, is being cut in half compared to the old system of housing birds on the floor. Hollis Osborne and Associates built a new hatchery just south of Diamond.

Two egg dealers in Springfield, each handling approximately 250 cases of eggs per week, merged. Their volume of eggs has increased to better than 1,200 cases weekly. They are doing a fine job in marketing high quality eggs in the Springfield area. Two new egg dealers were established in Springfield during the year. Steps were taken toward getting two farm cooperatives interested in developing quality egg programs.

The Kroger firm in Jackson, which Extension helped to get established, is doing a fine job and is providing an excellent market for eggs. They are now buying some 2,000 cases of eggs per week.

Walter Russell served as area poultry specialist for a 15 county area in Southwest Missouri from July 1—December 31. He worked primarily with egg dealers, feed companies, hatcheries, and the Chambers of Commerce. He developed a program for increasing egg consumption in the area and assisted S.M.S. in improving their annual Poultry Day program. Several important contacts were made toward getting new egg grading plants in Southwest Missouri.
An illustration of the poultry extension efforts in 1963 was exemplified by work with the turkey industry. One of the largest and most modern turkey processing plants in the nation was built at California, Mo., by Ralston Purina Company. The firm purchased turkeys during the fall months and was a major factor in maintaining a firm market price on turkeys in Missouri during the bulk of the marketing season.

The Midwest Turkey Association at Crane applied for a government loan to build a new processing plant. The loan has not been approved to date; but, it may develop that C.C.A. will build the plant if the government fails to approve the loan.

M.F.A. Producers Produce at Springfield remodeled their turkey processing plant and increased their purchase of turkeys this year. M.F.A. plants at Sedalia and Shelbina also stepped up their purchase of turkeys as they moved toward putting more of their turkeys into turkey rolls, turkey luncheon meat, and other products.

Turkey growers in Central Missouri made a concentrated effort to stamp out cholera and other turkey diseases by following a vaccination program and putting birds on clean range. Their efforts paid off in reducing mortality and down-grading of turkeys that went to market.

Sam Crum, a producer near Eldon, used the sudan-sorghum cross for turkey pasture. The grass produced an abundance of pasture and was a major factor in reducing his production costs. Crum averaged $1.50 labor income per bird in 1963.

Loading turkeys for market has always been a difficult, time-consuming job. Wayne Bennett, Green City, helped ease the problem by developing a loading cage that can be mounted on a hydraulic lift on the front of a tractor. Bennett placed the cage on the market for the first time this year.

Extension workers cooperated with the Missouri Turkey Federation in publishing a quarterly magazine, "Missouri Turkey News," and with the poultry organizations in the state in holding one of the largest poultry industry conventions at Springfield. Some 450 people attended the two-day meeting.

Commercial egg production continues to be widely scattered over the state. The volume of eggs produced in any one area is too small to result in the most efficient production and marketing. Few egg dealers in Missouri can supply the volume and quality of eggs that are being demanded by today's chain store buyers. For those reasons, we recommend
that egg production be concentrated in certain areas in the state and that industry develop programs which will result in low cost production and marketing.

One of the most interesting developments in egg production programs in 1964 occurred in Linn County. Most of the activity here was stimulated by the Linn County RAD Agricultural Committee. One of the findings of this group was that the county has lost 100,000 layers during the past seven years, with a corresponding loss in farm income. The committee felt an opportunity existed to regain some of this loss through encouraging the establishment of larger laying flocks.

During late 1963 and early 1964, four tours were organized to observe laying flocks in Southwest Missouri and Northwest Arkansas. A total of 40 people went on these tours. Those going on the tours included feed dealers, bankers, ministers, farmers, businessmen and others interested in helping improve the economy of Linn County.

Those especially helpful in promoting the program were: the Rev. Fred J. Barnett, Chairman, Linn Co. RAD; Donald Ledbetter, Ext. Balanced Farming agent; Bob Rice, Fieldman, Pioneer Red Comb Feeds; Wilford Biggs, hatcheryman; Glenn Tomlin, farmer and local DeKalb chick dealer; Glenn Burkeholder, manager, Brookfield Production Credit Ass'n; Ray Wade, Fieldman, Linn Co. PCA; Don Kincheloe, businessman.

Some groups that helped promote interest were: Linn Co. RAD, Brookfield Chamber of Commerce, and Marceline Chamber of Commerce.

In February, 1964, a public meeting was held to discuss the possibilities of promoting a modern egg industry in the area. It was the opinion of many people that the area of N.W. Arkansas and S.W. Missouri had no real advantages over this area, except the concentration of the industry which already is there.

Much to the surprise of everyone, about 200 people attended the meeting and additional interest was created as a result. Shortly after the meeting it was decided that construction of a demonstration house in Linn County would be helpful in promoting the idea. A small group of people formed a corporation, Linn County Eggs, Inc., and a cage laying house with automatic feeders and waterers for about 7,500 hens will soon be in operation.

Houses in operation or under construction now include Harvey Carothers, Laclede, 4,000 hens; Edward Weimer, Marceline, 5,000 hens; Joe Gauthier, Marceline, 6,000 hens, and Linn Co. Eggs, Inc. 7,500 hens.

A modern egg producing unit requires a large amount of capital. Only flocks of 5000 hens or more were encouraged, so this meant a large amount of credit was often needed. Some of the traditional sources of credit are
not permitted to make loans for poultry operations in this area, and this has been one of the biggest problems, especially credit for construction of buildings.

In evaluating the program, it appears that progress has been slow. However, if the 22,500 hens that will soon be in production do well, it appears that Linn County may recapture some of the loss it has had in egg production. Plans are already being discussed of the possibility of establishing an egg grading and poultry dressing plant in the county to provide a better market for the poultry products in the area.

Most of the new construction was cage houses built according to the Mo-Ark plan promoted by Hollis Osborne, Carthage, Mo. The father of Max Vaughn, Neosho, built the first environmental control laying house in the area. Size of the cages have been reduced to hold eight birds instead of 16 birds as originally planned. Several houses were remodeled and cages installed. Paul Kidwell, Lamar, installed cages in his laying houses and increased his capacity from 6,500 birds to slightly over 10,000 birds.

1965

Efforts were continued toward developing concentrated egg production areas, according to Russell and Geiger. Counties and leaders report some growth in this respect. Linn County reports the formation of Mar-Brook Farms, Inc. Within the new organization is a hatchery, pullet raising farm, egg production units and an egg grading plant. Over 130 individuals in the area have purchased stock in the corporation. Extension's role has been to provide the officers with information, publicity, and guidance.

Another area that continues to make substantial gains in concentrating production is centered around Neosho. Eggs from an estimated million hens in the area move into several markets in Missouri, Oklahoma, and Texas. A group of producers have established an egg grading plant in the area.

New production units are being seen in Ste. Genevieve County. Extension has worked closely with a feedman, Dick Becker, in developing his program.

Improvements are noted in management practices followed by commercial started pullet growers.

Chicken barbecues become more popular. Promotion of the chicken barbecue for large groups was assisted by the extension publication "Planning a Chicken Barbecue."

Missouri turkey production reached an all time high in 1965 of 7.6 million birds. Extension provided growers and industry with a guide, "Downgrading of Turkeys—Causes and Remedies." Special meetings deal-
ing with disease, turkey nutrition, and artificial insemination were held.

A total of 292 4-H poultry projects were completed, with 132 adults involved as leaders. Progress was made in developing materials for new science projects. The Junior Market Turkey Show was held with 23 boys and girls participating. Missouri sent eight delegates to the Jr. Fact Finding Conference, one to the 4-H Club Congress and four to the Interstate Judging Contest in Chicago.

A two-day Poultry Youth Tour was attended by 26 high school boys. The program was educational, with emphasis on career exploration. Special efforts were made to develop publications and articles to provide pesticide information and recommendations to all segments of the poultry industry.

A five session short course for egg producers was held at Neosho with 32 people attending.

1966

Efforts were continued toward developing concentrated egg production areas in the state. Extension Specialists, County Directors, and local leaders are active in all areas where egg production makes a sizeable contribution to the farm income. The area experiencing the most rapid growth is around Neosho.

During 1966 several new laying houses were built in the Ste. Genevieve—St. Francois counties area, Marceline—LaPlata area, and north of St. Louis. In all cases the new production was being produced for a specific market.

One of the big innovations to appear this year in poultry housing was the use of the evaporative pad cooler for keeping birds comfortable during the hot summer months. The pad cooler was tested on several houses during the summer in 100°F. weather and was found to be quite effective.

Started pullets were in good demand throughout the year. Most hatcheries could not supply the demand. The practice of growing pullets on wire received much attention and may result in major changes in the method of raising pullets in the future.

Missouri's broiler production continued to decline with production being limited primarily to two counties in Southwest Missouri. Chicken barbecues remained popular with many people taking advantage of our barbecue service. Broiler prices during the fall and winter months were extremely low, eventually causing drastic reductions in breeder flocks.

Turkey production reached an all-time high of an estimated 10.2 million birds. This represented a 34 percent increase over the previous year. Several new brooder and confinement rearing houses were built in Central Missouri. Most of the turkeys were processed in 11 plants in Missouri; however, many turkeys were shipped out of state for processing.
Extension maintained close contact with the turkey industry through the quarterly turkey magazine published by the Missouri Turkey Federation and through various meetings and short courses. Since turkey diseases are a major problem in Missouri, specialists worked closely with the Veterinary Department in carrying out their educational program.

There were 274 4-H poultry projects completed, with 131 adults involved as leaders. Progress was made in developing materials for the new animal science project. The Junior Market Turkey Show was held with 21 youth participating. Missouri sent eight delegates to the Jr. Fact Finding Conference, and four to the National 4-H Poultry Judging Contest in Chicago. A two-day Poultry Youth Tour was attended by 30 high school boys. The program was educational, with emphasis on career exploration.

A program of emergency nature was put into effect to assist small producers selling eggs in the Soulard Market, St. Louis, when new state egg law regulations went into effect. Information on how best to meet egg temperature requirements was furnished.

Six short course programs were conducted for 173 egg and turkey producers. A guide sheet, “Keeping Layers for the Family Egg Supply,” was developed with low income farm families in mind.

### Poultry Extension Specialists

<table>
<thead>
<tr>
<th>Name</th>
<th>Date Appointed</th>
<th>Date Resigned</th>
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<tbody>
<tr>
<td>T. S. Townsley*</td>
<td>April 1, 1917</td>
<td>Feb. 28, 1923</td>
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<tr>
<td>Ralph Mason</td>
<td>Oct. 16, 1917</td>
<td>June 30, 1919</td>
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<tr>
<td>Hubert Cosby</td>
<td>June 30, 1918</td>
<td>June 30, 1919</td>
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<tr>
<td>W. L. R. Perry</td>
<td>Oct. 14, 1918</td>
<td>April 8, 1920</td>
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<tr>
<td>George Hervey</td>
<td>July 1, 1920</td>
<td>April 30, 1921</td>
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<tr>
<td>H. L. Shrader*</td>
<td>Aug. 3, 1921</td>
<td>Sept. 30, 1926</td>
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<tr>
<td>Harold Canfield</td>
<td>Dec. 1, 1925</td>
<td>June 1, 1932</td>
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<tr>
<td>Charles Rohde*</td>
<td>Feb. 1, 1936</td>
<td>Feb. 1, 1944</td>
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<tr>
<td>D. D. Moyer</td>
<td>Feb. 7, 1936</td>
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<tr>
<td>Elmer Winner*</td>
<td>June 15, 1944</td>
<td>Feb. 1, 1953</td>
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<td>Norman Clizer</td>
<td>April 1, 1946</td>
<td>Nov. 13, 1948</td>
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<td>Ted Joule</td>
<td>Feb. 1, 1949</td>
<td>July 1, 1951</td>
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<tr>
<td>Schell Bodenhamer*</td>
<td>Feb. 1, 1951</td>
<td>June 1, 1955</td>
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<td>Walter Russell*</td>
<td>Feb. 1, 1953</td>
<td>April 30, 1957</td>
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<tr>
<td>Leonard Voss*</td>
<td>June 1, 1955</td>
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<tr>
<td>Glenn Geiger</td>
<td>June 1, 1957</td>
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*Project Leader

Winton on leave, Univ. of Tenn., Sept. 15, 1925 to Oct. 3, 1926
Russell followed Voss as Project Leader
POULTRY INDUSTRY SEMINARS

Though the department has held seminars for many years and occasionally people from industry have been invited to participate in them, not until 1964 did the department arrange for industry leaders to present the poultry seminars for a whole semester (fall, 1964). These seminars were planned around career opportunities in the poultry industry for college trained students. The seminars held were:

October 12  *Convenience Foods and Careers for College Graduates.* Howard Stamper, President of F. M. Stamper Co., St. Louis, Missouri. The Stamper Co. prepares and distributes nationally the Banquet Brand of Foods.

October 19  *Opportunities in the Feed Industry for College Trained Personnel.* Lloyd Larson, Executive Secretary of the Midwest Feed Manufacturers’ Association, Kansas City.

October 26  *Breeding and Distributing Better Poultry by Modern Methods.* Dr. Estil Schnetzler, in charge of poultry breeding for the DeKalb Agricultural Association, Sycamore, Illinois, and President of Poultry Breeders of America.


November 16  *The Poultry Equipment Business Around the World.* L. V. Taylor, Director Food Sciences, Gordon Johnson Co., Kansas City, Mo. Manufacturers and world-wide distributors of poultry equipment.

It is hoped that similar seminars may be held at regular intervals of three or four years. The students and staff gain much valuable information from such meetings.

POULTRY TRAINING FOR DISABLED VETERANS OF WORLD WAR I

After World War I the U.S. Government offered training for disabled veterans. Those who applied and were accepted received a living allowance in proportion to the size of their family. The Poultry Department provided training for these veterans in college and in non-college courses. More practice was provided for the non-collegiate students. Since there were more of these non-college students in Missouri than the University could handle due to limited facilities for practical training, special training schools under the Veterans Administration were established at the Poultry Experiment Station at Mountain Grove; at Carleton College, Farmington;
and at Marionville. The author taught poultry (1922-25) at Farmington where as many as 150 disabled veterans were enrolled at one time and several hundred received training during the three-year life of this special school.

The records of the University of Missouri show that this Poultry Department enrolled 574 students in non-college courses from 1919 to 1923. Most of these students were disabled veterans.

The veterans' poultry program, which paid the department $10 per month per veteran, made possible the construction of more than twenty-nine 10’ x 12’ colony brooder houses, a 30’ x 30’ laying house, a feed room 24’ x 24’ and a three story laboratory building (24’ x 36’). Some of these are still in use. As a part of their practical training, each student was assigned one of these houses for brooding chicks and rearing pullets for egg production.

M. A. Seaton, later Poultry Extension Specialist at Kansas State College from 1928-1958, was in charge of the training of the non-collegiate veterans. Some of these veterans later became leaders of the poultry industry in Missouri.

**TRAINING VETERANS OF WORLD WAR II**

The GI Bill of Rights passed by the U.S. Congress after World War II provided for training of all veterans of that war. It was not limited to
Veterans' class in hatchery management on field trip in the summer of 1947.
disabled veterans as was the legislation enacted after World War I. Large numbers of veterans enrolled in college.

In addition to regular poultry instruction, the Poultry Department offered a special group of courses for non-collegiate "training of veterans in poultry and hatchery management." The courses offered were: 1a, Poultry Production; 2b, Judging Poultry and Poultry Products; 3c, Marketing Poultry Products; 4d, Diseases of Poultry; 5e, Incubation and Brooding; 6f, Turkey Production; 7g, Parasites of Poultry; 8h, Poultry Farm Management; 9i, Field Flock Work in Culling and Testing for Pullorum Disease; and 10j, Hatchery Management. Courses were taught for 12 weeks during the summers of 1946, 1947, and 1948. Forty-seven students enrolled in the first summer session (1946). Figure 15 shows the students and staff of the 1946 session. Figure 16 shows the 1947 group on a field trip. Swift and Company enrolled thirteen of their employees in this special course. Thirty-eight students enrolled in 1947 and 14 in 1948.

Dr. A. J. Durant and Dr. H. C. McDougle of the Veterinary School taught courses in diseases and parasites. The members of the Poultry Department Staff teaching these veterans were H. L. Kempster, E. M. Funk, Noel Hall, Frank Wright, Q. B. Kinder, and M. R. Irwin.
POULTRY SHORT COURSES AND MEETINGS

Two-year Winter Course in Agriculture

The University Catalog for 1916-17 stated that "this course is a practical [one] ... for practical farmers. More than 2,800 young men have enrolled in this course ... At present nearly 300 men and boys annually enroll in this course." Since the 1912-13 Catalog stated that 1,600 had attended these courses, there evidently were about 300 enrolled each year. "They came from nearly every county in Missouri and from many adjoining states ... The course is divided into four terms. Two terms are offered each year. Each term is seven weeks long. Students who complete the required work of the two-year winter course will be given a certificate of graduation."

The courses offered by the Poultry Department were: First year, first term, Farm Management; First year, second term, Poultry Judging; Second year, first term, Farm Poultry Practice and Second year, second term, Incubation and Brooding Practice.

The University Catalog for 1912-13 stated that: "the purpose of the winter course in agriculture is to teach how to farm better. More than sixteen hundred Missouri young men have attended the winter course." The statement of studies that year (1912-13) listed only one poultry course, Poultry Husbandry.

The number of non-collegiate students enrolled in Two-year Winter Poultry Courses from 1911, when the Department of Poultry was organized, until 1932 when these courses terminated, were as follows:

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Early Short Courses

Since its beginning in 1911, the Department of Poultry Husbandry has been closely associated with the poultry industry of the state. One way the staff has tried to assist industry has been through short courses dealing with subjects of interest to poultry producers and industry members. In the very early days, programs of a short course nature were held as a part of Farmers Week. Professor Kempster gave many lectures on poultry subjects at county and community meetings, and on the Demonstration Trains which were operated by railroads.

Culling Schools

Culling of non-layers was a very popular subject in the early years of extension and many culling demonstrations were held out in the state. In the 1920's, when Missouri hatcherymen became interested in improving the quality of their chicks by better breeding, the Poultry Department responded by holding annual training schools for them and for their employees on culling and selecting breeding stock. These schools were usually of less than one week duration (3 or 4 days).

When practical methods for field testing for pullorum disease were discovered, these culling schools were expanded into schools for Flock Selecting and Testing Agents and were then called Hatchery Short Courses.

Hatchery Short Courses
(for training flock selecting and testing agents)

When the National Poultry Improvement Plan became effective in 1935, it provided that U.S. Approved males and females be selected by authorized
Second culling school, held at University of Missouri, July, 1923.

Flock selecting agents attending hatchery short course in 1946. Five hundred attended.
agents according to standards prescribed by the official state agency or the State College of Agriculture. In Missouri, the training of these “authorized agents” was done by the Poultry Department and the Department of Veterinary Science (later the School of Veterinary Medicine). The attendance became so large (500 in 1946; see pic, bottom pg. 183) that the crowd was divided for 6 days into (1) new agents and (2) hatchery owners, managers, and those renewing certificates for three days. A rather intensive program was followed for new authorized agents.

The decline in chicken breeding stock used by Missouri hatcheries resulted in the need for fewer selecting agents and thus these Short Courses are now held on request by the poultry industry.

Turkey Short Courses

The College of Agriculture, in cooperation with the turkey industry of Missouri, held the first turkey short course in 1942. This type of short course for training turkey selecting agents was held annually for 17 years (1942-1958). In 1959 the annual turkey meetings at the University were changed from a short course of several days to one-day meetings. Since that time an annual meeting called a Turkey Day has been held annually at the University of Missouri.

These meetings have been attended by 150 to 300 each year.

Missouri Egg Day

As the poultry industry became more specialized and increased in scale, the demand for meetings of producers led to the development of special one-day programs, such as Egg Day and Turkey Day.

Missouri Egg Day programs were started in 1954 and have continued each year for 14 years (1954-67).

Missouri Hatching Egg Shippers Day

In the 1940’s and early 1950’s Missouri hatcherymen were shipping large quantities of hatching eggs of broiler strains and crosses to hatcheries in the South.

In 1952, Missouri hatcherymen shipped to other states under the supervision of the National Poultry Improvement Plan, 60, 156, 704 hatching eggs. These eggs were valued at $3,000,000. A study of this business was published as Missouri Agricultural Experiment Station Bulletin 606.

In 1951 special one-day programs were developed for hatching-egg producers and handlers. These meetings were held by the Department of Poultry Husbandry and were known as Missouri Hatching Egg Shippers Days. They continued for four years (1951-54) until this business declined.
because hatcheries in southern states established their own nearby supply flocks.

**Missouri Broiler Days**

During the two years when broiler tests were held at the University of Missouri, programs were developed under the heading, Missouri Broiler Day. These meetings were held October 14, 1954, and October 13, 1955, when the results of the broiler tests were announced.

**Missouri Feed Conferences**

The first special feed conference at the University of Missouri was held in 1948. Professor H. L. Kempster was instrumental in selling his colleagues on such a meeting. He served as chairman of the committee that developed the first program. Other members of the committee were Dr. A. G. Hogan, Professor L. A. Weaver and A. C. Ragsdale. These conferences became joint endeavors between the College of Agriculture and the Mid-Western Feed Manufacturers Association and have continued until the present (1967). In recent years they have been oriented toward technically trained animal nutritionists.

**Poultry Products Short Course**

In 1953 the College of Agriculture, under the leadership of the Department of Poultry Husbandry and the poultry industry of Missouri, developed a program for poultry and egg processors. Since those most interested were processors of eggs, this meeting was the forerunner of the egg processors meetings which have become the Annual Egg Processors Day.

**Egg Processors Day**

Missouri is a leading state in egg breaking or the processing of eggs into egg products. Since 1954, these processors have held an annual conference at the University of Missouri to discuss their problems and get the latest technical information pertaining to processing egg products.

**Artificial Insemination School**

Within recent years it has become necessary for those who produce turkey hatching eggs to use artificial insemination to secure satisfactory fertility. Since techniques vary and some inseminators obtain much better fertility than others, the industry requested the Department of Poultry Husbandry to hold a one-day meeting for Missouri turkey inseminators. A program on the subject was held December 2, 1965. Meetings of this kind are held at irregular intervals and only when requested or needed.
Poultry Days

Beginning in 1956, meetings have been scheduled by the Department of Poultry Husbandry in which members of the staff have presented results of their research. A meeting was held in 1957 and then it was decided to hold such meetings at two or three year intervals and change the name to Poultry Research Field Days. In 1963 and 1965 the proceedings were printed and distributed at the meetings.

Special Poultry Conferences

Soon after World War II ended there was need for an all industry poultry conference to make plans for the post-war period. Such a meeting was scheduled and held January 17 and 18, 1946, under the title of Missouri Poultry Industry Conference. This was primarily a conference of poultry leaders, and out of this conference developed the Missouri Poultry Council which functioned as an industry organization for several years.

In 1962 a Missouri Broiler Industry Conference was held to consider what Missouri could do to develop the Missouri Broiler Industry.

In 1966 an advisory group of poultry industry leaders was invited to meet with the Dean’s staff of the College of Agriculture and the Poultry Department to consider trends in the industry and its future needs.

TRAINING FOREIGN STUDENTS

Since the United States has become more involved in World affairs, an increasing number of students from other countries have enrolled in the University of Missouri. The U.S. Agency for International Development (USAID) has sent graduate students interested in poultry to the Poultry Department to work on their Masters’ and Ph.D. programs. They have also sent students for short-term training sessions of six months (Fig. 19) and groups for visits of only a few weeks or days.

Most of the graduate students have been financed under the University of Missouri USAID India Contract.

The following foreign students have completed their master's degrees in Poultry Husbandry:
- Bannerjee, B. T.—Calcutta, W. Bengal, India
- Bora, L. C.—Jorhat, Assam, India
- Elamin, H.—Khartoum, Sudan
- Mahonty, P.—Bhubaneswar, Orissa, India
- Mitra, A.—Bhubaneswar, Orissa, India
- Osama, E.—Khartoum, Sudan
- Panda, N. C.—Bhubaneswar, Orissa, India (1966 returned to work on Ph.D.)
Pandey, Gopal—New Delhi, India
Rahman, U.—Gauhati, Assam, India
Other graduate students from foreign countries have included:
Baz, Salvador—Mexico City, Mexico
Pasquel, Moises—Mexico City, Mexico
Shaﬁ, Rehana—Pakistan (1965-67 working on Ph.D.)
Yamagami, Y.—Japan

The following graduate students from India have attended the special six-months training programs.

1964-65

Ahmad, N.
P.O. Lohia, Poultry Extension Centre
Varanasi, Uttar Pradesh State, India

Bhaskar, N. V.
Patancheru, District Medak
Andhra Pradesh, India

Mati, K. L.
Dwarahatta, District Hooghly
West Bengal, India

Mitra, S. B.
State Poultry Farm
Ranaghat, District India
West Bengal, India

Mokashi, D. V.
F. 32/266, Shaha Alam Roza
Government Quarters
Ahmedabad, India

Mukhergi, K. K.
Regional Poultry Farm
Bhubaneswar 3, District Puri
Orissa State, India

Neb, Y. P.
WZ. 272 G. Block
Harinagar, P. O. Tilak Nagar
New Delhi, India

William, C.
Ramanathapura District Livestock Farm
Chettinad
Madras State, India

1966

Aday, S. G.
c/o Vakil, N. K.
Kirana Chavadi Road
Aurangabad Deccan
Maharashtra, India

Bassen, H. S.
10 M, House no. 206 1
Sector 27-C
Chandigarh, India

Brahma, R. N.
Poultry Farm
Biarubari G. N. Memorial
T. B. Hospital Road
Gauhati, India

Malli, V.
Poultry Extension Center
Bijapur, India
The author reported that when he visited eight of his former Indian students in India in 1965 he found them in responsible positions and doing excellent work.

**Short Courses for Foreign Students**

Groups from Brazil, Turkey, Holland, Spain, Italy, and Yugoslavia have been trained by the Poultry Husbandry Department (see pictures on the next page). Included among short term students also were K. S. Faheem, Egypt; H. Bretschneider, Uruguay; Dr. U. Mackaman, Thailand.

**TRAINING PEACE CORPS WORKERS**

In 1966 one hundred and sixty Peace Corps workers preparing for work in Thailand and India were given training by the Poultry Department. They were given practical training in starting, brooding, feeding, and other steps in growing chickens to fryer size. They even dressed the chickens and later used them in learning how to barbecue chicken.

As the University develops its Peace Corps training program, the Department of Poultry Husbandry will, no doubt, be called upon for further assistance. Poultry and eggs are generally used by people in the developing countries and they provide highly nutritious animal protein, vitamins, and minerals in the daily ration of many people who are undernourished.
Eight Indian poultry officers are shown on arrival at the Poultry Department for six months of special training. January, 1966.

Poultrymen from Turkey visiting the University in 1959.

Poultrymen from Brazil visiting the University in 1957.

Poultry officials from Holland are shown conferring with Profs. Kempster and Funk about research at the University of Missouri.
Looking to the Future

As we pause in 1967 after 56 years of development in poultry research, teaching, extension and public service in the Department of Poultry Husbandry, we need to look into the future and try to see what its demands may be and also how industry and the College may work together more closely in building a more efficient industry.

It is evident that the industry will continue to be a dynamic, ever-changing industry and that it will be difficult for the research workers and teachers to keep up with it.

The industry is rapidly becoming more commercialized, large in scale, and more integrated. This type of industry will make entirely different demands upon educational and research institutions than the kind that existed in its developing years. There are evidences that these large firms will conduct much of their own research and train their own personnel. They may carry on their own extension or service work.

The public educational and research agencies will need to adjust to this new situation and develop programs that mesh into this new and changing industry. This will not be easy but it is imperative that the educational institutions give this matter serious and immediate attention. Otherwise they may find their services out-of-date and therefore not in demand by industry.

The author would not want to leave this subject on a pessimistic note but, instead, make some suggestions as to how the needs of the industry of the future might be served by the public educational institutions. It was Lincoln who said that government should do for the people what they cannot do for themselves. In this case, the public institutions should do for industry what industry cannot do for itself or what it cannot do as well as the public educational agencies.
In research the state and federal agencies should engage in the more basic research, some of which may not appear to be related to the current industry. But knowledge for knowledge's sake is still important and no one can forecast when such knowledge may become the key that unlocks the doors to the solution of important practical problems for the industry.

The research workers needed to solve the problems of the future and serve the poultry industry must be better trained than ever before and they must have better research equipment and facilities than existed from 1911 to 1966. The training of such research workers becomes a major task of every research institution. This is one service industry must ask the colleges and universities to assume. No other American institution can do this job for industry and for federal and state research agencies.

Training at the undergraduate level can best be done by the public and private schools and colleges. But this training should be more basic and more industry-oriented than in the past. Industry must become more involved in finding better students and encouraging such students to find a career in agriculture and in the poultry field. The colleges and industry need to cooperate in training these students—through field trips, seminars, and field training. Summer employment offers excellent training for students and gives industry an opportunity to "size up" future prospective employees.

The colleges and universities have tried to serve industry in many ways—sometimes more effectively than at other times. In the future, these institutions need to maintain even closer working relationships with industry through conferences and short courses for specialized groups. Their staffs need to be better acquainted with the industry people and make themselves available gladly for personal consultation on industry problems and without charge or fee (unless the service is on vacation time).

Extension possibly has the most difficult problems in adjusting to the future needs of the poultry industry. They must be abreast of the latest developments and technology and also have the confidence of their counterparts (servicemen) in industry. Industry is employing better trained research and service personnel, many with Ph.D. degrees. These men are under pressure to disseminate the latest information they can get.

To be most successful, extension specialists must work very closely with industry firms—possibly one firm at a time—cooperating in upgrading personnel at the higher levels of management. Though industry may at times believe they are out ahead of everyone else, this is often not true and their methods and practices can be improved by cooperating with extension specialists.
Extension specialists must be equally as well or better trained than industry people they will work with, in order to gain and keep good working relations.

The future will not be without its problems, but working together, industry people and college people can build an even greater industry.
MEMBERS
OF THE
1967
POULTRY HUSBANDRY STAFF


Ph.D. at University of Missouri 1955. Member of University of Missouri Poultry Department as physiologist, 1955. Named Assistant Professor in 1955 and Associate Professor in 1958. Member Alpha Gamma Sigma, Gamma Sigma Delta, Alpha Zeta Sigma Xi, Poultry Science Associate, A.I.B.S., A.A.A.S.
Dr. Owen J. Cotterill
Associate Professor
of Poultry Husbandry


Membership in scientific and honorary organizations: American Chemical Society, American Society of Microbiology, Institute of Food Technology, American Association for Advancement of Science (Fellow), Poultry Science Association (Associate Editor), Gamma Sigma Delta (Jr. Award of Merit in recognition of outstanding service to agriculture), and Sigma Xi.

Dr. E. M. Funk
Professor of Poultry Husbandry
Chairman, 1954-1966

Born January 11, 1899 on a farm near Annapolis, Missouri. Was educated in Missouri public schools, the Teachers College (B.S.) at Cape Girardeau, Mo., the University of Missouri (M.A.), and the University of Wisconsin (Ph.D.).

Served in the U.S. Army, 1918. Instructor in Poultry Husbandry at the University of Missouri, 1927-1928. Assistant Professor of Poultry Husbandry at Pennsylvania State College, State College, Pennsylvania, 1928-1930. Teacher and research worker in Poultry Husbandry at the University of Missouri since 1930.

Coach of 14 Missouri collegiate poultry judging teams, winning the Intercollegiate Poultry Judging Contest at Chicago, 1941 and 1946. Author of numerous circulars, bulletins, and papers on Poultry Husbandry and co-author of Poultry Science and Practice by Winter and Funk and Hatchery Operation and Management by Funk and Irwin.
Secretary of the Poultry Science Association of the United States and Canada, 1944 to 1949. President of the Poultry Science Association, 1951. Winner in 1942 of the Poultry Science Research prize for the U.S. and Canada.


K. A. Holleman
Instructor in Poultry Husbandry


Member of University of Missouri Poultry Department, 1966.

Professor Q. B. Kinder
Professor of Poultry Husbandry


At University of Missouri as assistant professor from 1947 to 1950, associate professor in 1950, and professor in 1958. Instructor in poultry Farm management and poultry judging. Coach of poultry judging teams since 1948. Spent two years on poultry development in India under Uni-
versity AID contract. Has acted as technical leader in training three India Poultry groups in United States.


Dr. Savage's research interests lie in Amino acid, mineral, and unidentified factor requirements and their interrelationships in growth and reproduction. He has been serving on the Poultry Department staff since 1954. Prior to that he worked as nutritionist for the Farm Bureau Feed Mills, Fayetteville, Ark., 1950-54.

His professional affiliations include Poultry Science Association, American Institute of Nutrition, and American Association for the Advancement of Science.

Born May 24, 1912, at Unity, Va. Attended Virginia public schools. Obtained B.S. at Virginia Polytechnic Institute, M.S. at Rutgers University, and Ph.D. at Iowa State University.


Lieutenant in United States Army, 1942-1946. Graduate Assistant in Poultry Department at Iowa State University, 1949. Member of Poultry Department at Utah State Agricultural College, 1949-1953. Member of University of Missouri Poultry Department as geneticist since 1953.
A native of the state of Connecticut, Mr. Geiger has been active in the poultry industry of Missouri since his graduation from the University of Missouri with a B.S. in agriculture in 1950. He worked as a research assistant in the University's poultry department after graduation. From 1951 through 1953, he was the assistant manager of the Swift and Company Hatchery at Sedalia, Mo. In 1954 he was appointed state hatchery and flock inspector for the Missouri Poultry Improvement Association. He was appointed to his present position of extension poultry specialist in June of 1957. Mr. Geiger received his M.S. degree in Extension Education from the University of Missouri in June of 1964.

The following are professional, honorary and service organizations to which Mr. Geiger belongs: Poultry Science Association; World's Poultry Science Association; Gamma Sigma Delta; Epsilon Sigma Phi. He is a former secretary of the Missouri Poultry Council and is currently an ex-officio member of the Missouri Egg Council. While an undergraduate at the University he served as president of both the M.U. Poultry Club and the Christian Student Congregation. Since then, he has served as an elder and treasurer of the Broadway Christian Church in Columbia. He is now serving as a deacon and board chairman.

Mr. Geiger and his wife Delores live in Columbia. They have two children; a daughter, Leslie, and a son, David.
Mr. Russell came to the state staff of the Extension Division in 1953 as extension poultry specialist. Prior to that, he served as an assistant county agent in Johnson County from February of 1948 until July of 1949. He then served as county agent in Miller County for two and one half years. Just prior to joining the state staff, Mr. Russell spent a year as a farm manager for Central Missouri Turkey Hatcheries, Eldon, Missouri.

Born and reared on a farm near Springfield, he served in the armed forces for three years. He spent two years overseas with the field artillery in New Guinea and the Philippine Islands. He returned to the University of Missouri after his discharge, and completed his B.S. degree in agriculture in 1948. Mr. Russell has since completed an M.S. degree in extension education at Missouri.

Mr. Russell is a member of the following professional and honorary organizations: Poultry Science Association; Gamma Sigma Delta; Epsilon Sigma Phi; Alpha Zeta.

Mr. and Mrs. Russell live at 511 Longfellow Lane in Columbia. They have two daughters; Anne, married and living in Columbia, and Deborah Sue, 15.

Mr. Russell was winner of the Pfizer Extension Teaching Award ($1,000) in 1964.
REFERENCES

Annual Reports of the Directors of the Missouri Agricultural Experiment Station. 1911-1963.
Funk, E. M. Personal Files
Kempster, H. L. Personal Files
Appendix
GRADUATES IN POULTRY HUSBANDRY

UNIVERSITY OF MISSOURI
College of Agriculture
To September, 1966

The letters given in parentheses after year of graduation designate the following: poultry graduates (a), members of poultry judging teams (b), and graduate students whose theses were on a poultry problem (c). The degree is B.S. unless otherwise listed. Last known address is listed.

ADKINS, MARLIN MAX—4460 Royal Ave., Eugene, Ore., Industrial Arts Instructor. '53 (b)
ANDREWS, DAVID L.—Dept. of Animal Industry, University of Arkansas, Fayetteville, Ark. '66 (c) Ph.D.
ANNIN, GERALD E.—4125 Iroquois Dr., Madison 5, Wis., Assoc. Professor of Poultry Husbandry, University of Wisconsin, Retired. '26 (a, b)
ATTERBURY, H. BAKER—317 Locust St., S.E., Vienna, Va., Field Representative, Office of Rural Areas Development USDA. '37 (b)
BACHTEL, CLYDE—Hamilton, Mo., Farmer. '46 (b)
BANNERJEE, B. T.—111/1 Devi Nibash Road, Calcutta 28, India. '63 (a) MS
BARNES, H. EARL—326 Groves St., Chillicothe, Mo., retired country clerk. '25 (b)
BARROW, W. O.—Box 104, Rogersville, Mo., Vocational Agriculture Instructor, Rogersville High School. '32 (b)
BAY, WEBSTER—Hales and Hunter Co., 141 W. Jackson Blvd., Chicago, Ill. '54 (b)
BENTLEY, ALBERT B.—1403 28th St. Haleyville, Ala. '66 (c) MS
BIELLIER, HAROLD V.—Route 4, Columbia, Mo., Assoc. Professor of Poultry Husbandry, University of Missouri. '42 (a, b) '55 (c)
BIRD, DONAL—Research, Central Soya, Decatur, Ind. '64 (c) Ph.D.
BOBBITT, STEPHEN—Dekalb Chicks, Illiopolis, Ill. '61 (b)
BODENHARMER, SCHELL H.—109 S. Garth, Columbia, Mo., Assoc. Dean for Extension, University of Missouri. '47 (b)
BORA, L. C.—Assam Agricultural College, Jorhat, Assam, India. '62 (a) MS
BOUCHER, ROBERT V.—Box 481, Old Forge, New York, Retired Professor of Agricultural & Biological Chemistry, Pennsylvania State College. '27 (b) '33 (c)
BRAMHALL, ERVIN L.—684 Buena Vista St., Ventura, Cal., Poultry Farm Adviser, University of California. '41 (a)
BRIDGES, ROBERT L.—17 Great Oaks, Rolla, Mo., County Extension Agent, Rolla. '32 (a) '54 MS
BRUNE, FRED J.—Buckner, Mo., Poultry Farmer. '37 (a,b)
BULL, DAVID M—Star Route 1, Box 310 Labelle, Fla., semi-retired farmer. '17 (a)
BURNS, EUGENE L.—506 S. 2nd, Clinton, Mo. '49 (a, b)
CERVINKA, FRED—Route 4, P. O. Box 237, Columbia, Mo., Owner, Heart of Missouri Poultry Farm. '55 (a)
CHAMBERS, JOIE H.—119 E. Pine St., Warrensburg, Mo., Manager & Owner of Premier Hatchery. '22 (a, b)
CHANEY, PAUL H.—832 S. Illinois, Geneseo, Ill., Vocational Agriculture Instructor. '53 (a) '56 MS
CHUNG, HUNG LUM—1049 KoKo Head Ave., Honolulu 16, Hawaii, Franklin Life Insurance Company, Honolulu Office. '17 (a)
CLIZER, NORMAN R.—Allied Mills, 110 N. Wacker Dr., Chicago 6, Ill., Poultry feed sales coordinator. '39 (a)
CLOUD, LAWRENCE W.—2206 West 1st. St., Sedalia, Mo. '63 (a, b)
COBURN, JAY T.—Foods Research Division, Armour & Company, 801 Cermak Road, Oak Brook, Ill. '60 (a) MS
COOLEY, S. S.—322 W. Claflin, Salina, Ks., Hatchery. '36 (b)
COWAN, BILLY—727 Franklin Ave., Council Bluffs, Ia. '49 (b)
CUNNINGHAM, FRANK—Henningsen Foods Inc., 2501 College St., Springfield, Mo. '59 (c) MS '63 Ph.D.
DAKAN, EVERETT L.—108 E. Franches Ave., Columbus, Ohio, retired, formerly Chairman of Poultry Science Department, Ohio St. '18 (a)
Dale, Otis—Mon. Grove, Mo. '24 (b)
Day, Tom—411 Oak Tree Dr., St. Louis 9, Mo.—Salesman, welding equipment. '60 (a, c) MS
Dendy, Milton Y.—206 E. Meadow Dr., Athens, Ga.—Poultry Specialist, University of Georgia. '49 (a) '50 (c) MS
Devendorf, Raymond L.—1013 South 4th St., Moberly, Mo.—F. M. Stamper Company. '42 (a)
Elliston, Lloyd—Route 1, Stockton, Mo., U. S. Army. '61 (a)
Elamin, Hamid M.—Ministry of Agriculture, Khartoum, Sudan. '66 (a) MS
Estes, Charles Marvin—Estes Hatchery, Springfield, Mo., Estes Farm Hatchery. '50 (a, b)
Farmer, A. L.—1421 S. Euclid, Sioux Falls, S. Dak.—District Supervisor, Regional Mfg. Loan Office, Northwestern Mutual Life Insurance Co. '29 (b)
Farmer, Joseph H.—564 Harrison, Liberty, Mo.—Principal Englewood Elementary School. '25 (b)
Ferstl, Henry T.—P. O. Box 284, Millington, Mich.—Veterinarian. '41 (a)
Fox, Rudolph B.—1311 Sheridan Drive, University City 32, Mo.—Teacher, General Science 7-8 grades. '49 (a)
Frakes, Billy L.—Mann-Frakes, Inc., 102 Broadway, P. O. Box 888, Kissimmee, Fla. 32141. '49 (b)
Franz, Chester, Jr.—St. Leo, Fla.—Broker. '52 (a)
Froning, Glenn W.—Food Technologist, Poultry Dept., University of Nebraska, Lincoln, Neb. '53 (a, b) '57 (c) MS
Fulkerson, J. M.—Fulkerson Place, 1011 W. #10 Highway, Liberty, Mo.—Auctioneer & Registered Hereford cattle breeder. '36 (b)
Forward, James—Route 4, Columbia, Mo.—Technician, University of Missouri, Poultry Department. '35 (a, b) (c) MS
Funk, Ernest Marvin—111 E. Brandon Rd., Columbia, Mo.—Professor of Poultry Husbandry, University of Missouri. '27 (a) MA
Gardner, Fred—Poultry Department, Texas A & M University, College Station, Tex.—Poultry Products Technology. '60 (a, c) Ph.D.
Gardner, Jack R.—Route 5, Box 97, Nacogdoches, Texas. '65 (c) MS
Geiger, Glenn S.—1817 Katiy Dr., Columbia, Mo.—Extension, Assistant Professor of Poultry Husbandry, Extension Poultryman, University of Missouri. '50 (a) '64 MS
Golden, Ronald—Savannah, Mo. '61 (b)
Gordon, Hans Edward—629 E. Yerby, Marshall, Mo. Marshall Chick Hatchery. '50 (a, b)
Gray, Raymond—Route 1, Ellisville, Mo. '52 (a, b)
Greer, Jack F.—623 W. Portland St., Springfield, Mo.—Turkey buyer and growout manager, Russell Purina Co. '54 (a, b) (c) MS
Gretts, Robert F.—P. O. Box 505, Turlock, Calif.—Quality Control, Armour & Company. '56 (a, c)
Gyles, Nichols R.—University of Arkansas, Department of Animal Industry, Fayetteville, Ark.—Professor of Poultry. '53 (c) Ph.D.
Hagans, Paul E.—Ashland, Mo. '38 (b)
Halbrook, Everett Raymond—USAID, U. S. Embassy, Poultry and Livestock Specialist, Lagos, Nigeria. '30 (a, b)
Hall, Harold—Karkin, Ill. '54 (b)
Hall, Noel—Ozark, Mo. '43 (a, b)
Halsey, James L.—735 E. Yerby St., Marshall, Mo.—General Manager MFA, Livestock Marketing Association Inc. '39 (a, b)
Hamilton, James—6509 N. Grand, Kansas City, Mo. '39 (a, b) '41 AM
Hargrave, Ray—Superintendent, Poultry Experiment Station, Mtn. Grove, Mo. '33 (a, b)
Harper, John—416 Marion, Sikeston, Mo. '61 (b)
Harrison, Paul—Department of Animal Science, Washington State University, Pullman, Wash. '64 (c) MS '66 (c) Ph.D.
Hastings, Robert Allan—F. M. Stamper Co., Macon, Mo.—Superintendent of Poultry Processing Plant. ’57 (a,b)

Heidlage, Walter F.—Rt. #1, Columbia, Mo.—Extension District Director, University of Missouri. ’40 (a) ’60 MS

Hellersmith, R. C.—10388 Albion Rd., N. Royalton 33, Ohio, Field Supervisor—Milk Products Federation, Cleveland, Ohio. ’47 (a)

Henderson, E. W.—1612 Ann St., East Lansing, Mich.—Retired. ’22 (a,b,c) ’24 AM

Hershel, Robert J.—1725 Cliff Drive, Columbia, Mo. ’57 (a)

Hervey, George (Dr.)—2347 S. Meade St., Arlington 2, Va. 22202, Retired. ’20 (a,c) AM

Hill, Jack F.—Babcock Poultry Farm, Ithaca, N.Y.—Generalist. ’49 (a,b,c) ’50 MS

Hill, Warner Mike—507 High Street, Columbia, Mo. ’64 (a,c) MS

Hughes, Denzil—Department of Poultry Husbandry, University of Missouri, Columbia, Mo. ’63 (a,b)

Hunt, Vincent B.—103 Lakeview, Lee’s Summit, Mo. ’38 (b)

Hunter, J. E.—Box 459, Libertyville, Ill.—Vice President and Director of Research, Allied Mills, Inc. Retired. ’28 (c) Ph.D. ’25 AM

Hunter, Warren L.—Box 901, Brenham, Texas—Sales Representative, Allied Mills, Inc. ’52 (a)

Hurley, William—1745 Vaughn Drive, Manhattan, Kans.—Flour Technology, Kansas State University. ’57 (a,c) MS

Irwin, Richard M.—219 N. Randolph St., Pleasant Hill, Mo. President and General Manager, Colonial Poultry Farms. ’34 (a,b,c) ’41 AM

Jackson, David D.—629 N. Grant St., West Lafayette, Ind.—Poultry Extension Specialist, Purdue University. ’53 (c) MS

Jackson, Don—Hy-Line Poultry Farms, Des Moines, Ia. ’63 (a,c) MS

Jaynes, Warren—University Extension Center, Carthage, Mo. ’62 (a,b,c) ’64 MS

Jeannotot, Donald W.—Rt. #1, Box 13, Brighton, Colo.—Poultry Manager Henrietta Farms. ’55 (a)

Johnson, Earl W.—414 West McCord, Neosho, Mo. 64850—USDA Farmers Home Administration; County Supervisor. ’40 (b)

Joule, Ted L.—Southland Acres, Columbia, Mo.—Extension Associate Professor of Agricultural Economics (Poultry Marketing), University of Missouri. ’29 (a,c) ’47 AM

Karrash, Richard J.—Haynes Milling Co., Portland, Ind.—Nutritionist. ’41 (a,c) MA

Katzen, Sol.—Emilio Castelar #44 Col. Polanco, Mexico, D. F., Nutrition, Feed development, Mills Hatchery, Cattle. ’52 (a)

Kelly, Mike—Poultry Science Department, VPI, Blacksburg, Va. (a,b,c) ’55 AM

Kerr, Billy H.—U. S. Army (address unknown). ’41 (a,b)

Kinder, Quinton B.—704 W. Blvd. S., Columbia, Mo.—Professor of Poultry Husbandry, University of Missouri. (a,b,c) ’32 AM

King, Harold M.—Manito, Ill. ’51 (a,b)

Knight, Dale—Trenton, Mo. ’39 (a,b)

Knight, Francis—194, Pleaston, Tex. 78064—Work unit conservationist, Soil Conservation Service. ’31 (a,b)

Knopp, Russell H.—909 2nd St. Place, Ankeny, Ia.—Farmers Home Administration. ’27 (a,b)

Krueger, William—Poultry Department, Texas A & M University, College Station, Tex.—Geneticist. ’52 (a,c) Ph.D.

Lal, J. B.—953 College Station Road, Athens, Ga., ’63 (a,c) MS

Lasley, Robert G.—704 South Main, Nevada, Mo.—Owner of an insurance and real estate business. ’43 (a)

Le Grande Ernest—Farm Bureau Insurance Co., Jefferson City, Mo. ’46 (a,b)

Lemar, Clarence E.—125 W. Polar, Tayorville, Ill.—Farm Manager with Doane Agriculture Service. ’41 (b)

Lemar, Harold—Box 200, Bloomfield, Mo.—Reg. Vice-President, Family Benefit Life Insurance Co., Jefferson City, Mo. ’27 (a)
LEVI, DON—Instructor, Agricultural Economics, University of Missouri. '63 (b)
LEWIS, SAM J.—1 Johnnys Place, St. Charles, Mo., Field Representative, Federal Intermediate Credit Bank of St. Louis. '55 (b)
LUPARDUS, GLENN C.—615 Lewis St., Canton, Mo., Balanced Farming agent, Lewis County. '46 (a)
McCord, Gary—4849 Skyline Drive, Mission, Kans.—District Sales Manager, Veterinary Division Eaton Laboratories. '56 (b)
McCray, Henry W.—Box 243, Iliopolis, Ill., Poultry Research, Dekalb. '48 (a)
McDougale, Harold C.—1829 Cliff Drive, Columbia, Mo., Dept. of Veterinary Bacteriology & Parasitology, University of Missouri. '28 (a, b) '30 (b)
McGinnis, James P.—Box 478 Fulton, Mo., Veterinarian '48 (a, b)
McIntyre, Basil—Field Crops Department, University of Missouri, Columbia, Mo. '66 (a)
Major, Harry M.—1718 Rae Lane, Madison, Wis., Soil Conservationist on State Staff. '48 (a, b)
Maxwell, W. M. S.—163 18th St. N.W., Canton, Ohio. '53 (a, b)
Meinert, Clarence F.—Route 1, Warsaw, Ind., Maple Lead Duck Processing Plant Manager. '43 (a, b)
Mers, Jack W.—9512 Bascom St., Pico Rivera, Calif., USDA Federal State Supervisor, Poultry Grading Division. '50 (a)
Mohanty, P.—Orissa University of Agriculture & Technology, Bhubaneswar, Orissa, India. '66 (c) MS
Moore, W. T.—322 Jackson, Warrensburg, Mo., '35 (a, b)
Morrow, James—Rt. 1, Liberty, Mo. '52 (b)
Munson, Harold R.—Federal Land Bank, Aurora, Mo. '62 (a, b)
Murray, Frank—5817 Clover Drive, Lisle, Ill. 60532, Vice President Operations, Polo Food Products Co., Chicago, Ill. '50 (a, b)
Myers, Ronald—486 E. Exchange, Sycamore, Ill. 60718, Poultry Advertising Manager, Dekalb Agricultural Association. '55 (a, b)
Neel, Lyman G.—Route 3, Columbia, Mo. '25 (a, b). Retired
Neel, Wallace W.—Bolivar, Mo. '52 (a, b)
Newell, George W.—Poultry Department, Oklahoma State University, Stillwater, Okla. '39 (a, b)
Nichols, Loren—Central Soya, 310 Winchester, Decatur, Ind., Nutritionist. '59 (a, b) '61 MS
Nichols, Merlin—Grading Branch CMS, 503 Iowa Bldg, Des Moines, Ia. '66 MS
Norris, Max—Poultry Department, University of Missouri, Columbia, Mo. '65 MS
Offner, Walter L.—Rt. 1, Box 78A, Fenton, Mo. '52 (a, b)
O'Neal, Robert—Biochemistry Department, Oklahoma A & M, Stillwater, Okla. '58 (a, c) '59 MS
Ostmann, Orville W.—Smith, Kline & French Lab., 1500 Spring Garden St., Philadelphia 1, Penn. '56 (a, b) '59 MS
Panda, N. C.—Orissa Agricultural College, Bhubaneswar, Orissa, India (1967, working on Ph.D. at Missouri University). '62 (a, c)
Pandey, Gopal—XVII—3264, Ranjit Nagar, Delhi 8, India '62 (a, c) MS
Parker, J. E.—642 N. 9th, Corvallis, Ore., Professor and Head of Poultry Department, Oregon State University. '56 (a, c) AM '40 (c) Ph.D.
Paschang, Ronald—704 Swifts Highway, Jefferson City, Mo. '59 (a, b)
Patrick, Hartford L.—University Extension Center, Court House, Carthage, Mo., County Extension Director, Jasper County. '42 (a, b)
Patrick, Homer—West Virginia University, Morgantown, W. Va., Professor and Chairman of Department of Agricultural Biochemistry. '39 (a) '40 (c) MS

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PATTERSON, WAYNE C.—Linn, Mo. '43 (b)
PITTenger, CARL H.—Magnolia Road, Marianna, Fla., Owner-Operator Tri-States Hatcheries. '27 (a,b)
PITTMAN, D. D.—P. O. Box 1095, Oklahoma City, Okla. 73101, Agricultural Statistician in Charge, SRS, USDA. '39 (a)
PRICE, WILLIAM A.—Troy, Mo., Farmer. '33 (a,b)
PURDY, ALLAN W.—Green Valley Dr., Route 1, Columbia, Mo. Director of Aids and Awards, University of Missouri. '38 (b)
PUTNEY, ELMORE, JR.—Box 236, Dahlonega, Ga. '53 (b)
QUICK, JACK A., JR.—828 Vine St., Macon, Mo., Sales Representative MFA Feed Mill. '50 (a)
QUICK, PAUL—232 Spring, Webster Groves, Mo. '24 (b)
RAHMANN, GEORGE D., JR.—1264 B. 49th Pl, South Birmingham, Ala., Cosby-Hodges Milling Co. '65 (c) MS
RAHMAN, S.—Gauhati, Assam, India. '65 (c) MS
RAY, ROBERT H.—9524 Harrison, Kansas City, Mo. '50 (b)
RHOODE, CHARLES E.—Box 27, Aurora, Mo., Turkey Grower and Hatchery Operator. '29 (a,b)
ROSALES, ARMANDO, A.—Kennedy S. A., Avenida de America 2, Madrid 2, Spain. '63 (a,c) Ph.D.
ROSENBAUM, SAM.—? ? (b)
ROSS, DALE A.—Indiana Farm Bureau, Nutritionist, Indianapolis, Ind. '55 (a,b)
RUNNER, JAMES—3665 Ashway Drive, Indianapolis, Ind. '63 (a,b)
RUSSEL, JOHN PAUL—9308 Mohawk Lane, Leawood, Kans., Poultry Medicine, (I. D. Russell Company, Kansas City, Mo.). '50 (a)
RUSSELL, WALTER D.—511 Longfellow, Columbia, Mo., Extension Professor of Poultry Husbandry, Extension Poultryman, University of Missouri. '48 '59 (vc) MS
SAVAGE, JAMES E.—Rt. 4, Columbia, Mo., Professor and Chairman Department of Poultry Husbandry, University of Missouri. '48 (a,c) AM, '55 (c) Ph.D.
SCHMACK, L. D.—Stark City, Mo. '60 (a)
SCHNEIDER, VERNON—Successful Farming, Des Moines, Ia. '50 (b)
SCHNETZLER, E. E.—804 Normal Road, DeKalb, Ill., Director of Poultry Research DeKalb Chicks. '28 (a,b) '50 (a,c) AM
SCHROEDER, J. WESLEY—421 Sandy Ann Lane, Apr. H., Fort Wayne, Ind., Central Soya, International Dept. '37 (a)
SCHUCHAT, THOMAS R.— '57 (a,b) U. S. Amy
SCHULL, CLIFFORD—608 Hirth Ave., Columbia, Mo. '60 (a,b)
SCHULZE, JAMES H.—DeKalb Poultry Farms, Illiopolis, Ill. '58 (a) '64 (c) MS
SCOVILLE, CHARLES RAYMOND—118 Bedford St., Moberly, Mo., Retired, Formerly Government Service. '55 (a,b)
SEBRING, MIKE—Foods Research Division, Armour & Company, 801 West Cermaks Road, Oak Brook, Ill. '63 (a,c) MS
SEDERWALL, W. E "GENE"—11686 E. Stroud, Kingsburg, Calif., Sales Manager, and Manager Egg and Pullet Division, San Joaquin Valley Poultry Products, Fresno, Calif. '51 (a,b)
SEIDMAN, WALTER—Wilson & Company, Research & Technical Division, 4200 S. Marshfield Ave., Chicago, Illinois 60609. '52 (a,c) MS, '66 Ph.D.
SENAY, WAYNE—Agricultural Economics Department, University of Missouri, Columbia, Mo. '58 (a,b)
SHAW, ARTHUR J.—20205 Strathen St., Canoga Park, Calif., Attorney. '47 (a,b)
SHRADER, H. L.—1520 Maple St., So. Pasadena, Calif., retired from USDA. '14 (a)
SMITH, BEN M. A.—4847 Cayuga Dr., St. Louis 23, Mo., Manager Livestock Extension, Hunter Packing Company, E. St. Louis, Ill. '48 (b)
SMITH, E. Y.—340 Lake Seminary Circle, Maitland, Fla., retired. '33 (c) MS
SMITH, ROBERT M.—Animal Industry Department, University of Arkansas, Fayetteville, Ark. '24 (a,b)
SMITH, W. B. JR.—1023 W. Rollins Road, Columbia, Mo. '49 (a)
## AGRICULTURAL CHEMISTRY

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<tr>
<td>Bond, W. H., M.S. 1939</td>
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SNEED, RAYMOND G.—1208 Main, Bedford, la., Work Unit Conservationist, Soil Conservation Service. '29 (b)

STANBERRY, CECIL H.—312 W. Prairie, Centerville, la., Owner of Stanberry Hatchery and Poultry Farm. '40 (a)

STEINHOF, STANLEY—St. Charles, Mo., '66 (a,b)

STARK, W. W.—837 San Luis Rey, Coronado, Calif. '24 (b)

STEEN, WALDO S.—Iberia, Mo. '59 (a)

STEINBRUECK, HERBERT L.—Troy, Mo., Owner, Trojan Hatchery. '49 (a)

STONNER, FRED.—1411 Warnall Road, Excelsior Springs, Mo. '36 (b)

STOUT, KARL D.—Richland, Mo., Turkey Hatchery. '56 (a,b)

STOUT, RONNIE I.—Hart Schneider Turkeys, Medford, Ore. '61 (a,b)

TALBOT, CHARLES W.—268 Harwood, Lebanon, Mo., President United Amusement Company '38 (b)

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TERRILL, HAROLD—Rt. 1, Ashland, Mo., Chief Biologist Missouri Conservation Commission. '35 (a,b)

TINSLEY, PAUL J.—Stockton, Mo., Vocational Agricultural Instructor. '47 (b)

TUCKER, DONALD J.—Rt. 1, Willard, Mo., Vocational Agricultural Instructor. '39 (b)

VOSS, LEONARD A.—3204 Oakland, Columbia, Mo., Associate Professor of Agricultural Economics, University of Missouri. '34-52 MS '62 (c) Ph.D.

WADE, PAUL.—4186 Philadelphia, Chino, Calif. '34 (b)

WATKINS, A. HOWARD—1209 Ralph Circle, Las Vegas, Nev., Biology Teacher, Rancho High School, Las Vegas. '51 (a)

WILCOX, ROBERT R.—P. O. Box 369, Moberly, Mo., Production Manager, F. M. Stamper Company Mill. '47 (a,b)

WILLIAMS, CHARLES S.—411 Laws St., Bridgeville, Del., Vice President, O. A. Newton & Son Company. '35 (a,b)

WILLIAMS, I. L.—Roland, Ia., Poultry Breeding, DeKalb Agriculture Association, Inc. '41 (a,b) MA

WILLIS, GEORGE M.—2927 Easton Road, St. Joseph, Mo. '31 (b)

WILSON, JOHN R.—611 Salem Avenue, Rolla, Mo. '30 (b)

WINNER, E. B.—Foreign Agricultural Service, USDA, Washington, D.C. '49 (c)

WINTON, BERLEY—171 Orchard, East Lansing, Mich., Director, Poultry Regional Research Lab. (Retired) '26 (a,c) AM

WISDOM, GEORGE N.—Salem, Mo., Real Estate. '47 (a,c), '48 MS

WOOD, MITCHELL D.—6151 Pasco, Kansas City, Mo., Sales Representative Anderson Box Company, retired. '15 (a)

WOODRUFF, G. A.—Lutay, Mo., General Farming (Beef cattle and hogs). '31 (a,b) '33 MA

WRIGHT, FRANK W.—113 N. Glennwood, Columbia, Mo., retired. '25 (a,b)

WRIGHT, HAROLD H.—Route 3, Lebanon, Mo., USDA Farmers Home Administration. '38 (a,b)

YOE, MAYNARD E.—Sam Houston State College, Huntsville, Tex., Professor. '53 (a,b) '57 (c) MS '66 (c) Ph.D.

YOHE, JOHN.—American Hoechst Corp., Feed Additives Division, '62 (a,c) MS 1721 Baltimore, Kansas City, Missouri

YOUNG, DARRELL M.—1712 Grand Avenue, Carthage, Missouri, Calcium Carbonate Company, '28 (b)

YOUNG, J. L.—Box 522, LaGrange, Ga., Farmer. '27 (a,c) MS

YOUNG, WILLIAM J.—Alion, Mo. '56 (b)

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BRYAN, CHARLES GENTRY '31

DICKER, JOHN W. '41

DRUMM, L. M. '13

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Harold V. Biellier


Owen J. Cotterill


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E. M. Funk


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Q. B. Kinder


A. B. Stephenson


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Agricultural Chemistry

Hatch 137, Requirements of the Growing Chick for Minerals and Unrecognized Nutrients—B. L. O'Dell.

Agricultural Economics

Hatch 424, Secondary Economics in Concentration of Production and Marketing of Dairy, Fruit and Poultry Products—Jerry West, Professor, Project Leader, Carrol L. Kirtley, Instructor.

Agricultural Engineering


Home Economics

Hatch 464, Factors Affecting the Quality of Protein Foods Prepared by Electronic Cooking—R. Baldwin, Prof.; R. Upchurch, Asst.; B. Christy, Asst.; J. Matter. Asst.;
State 592, Subjective and Objective Study of Tenderness of Turkey Meat—R. Baldwin, Prof., J. Matter, Asst.

Poultry

Hatch 17, A Study of Egg Composition in Relation to Quality and Utilization of Eggs in Market Channels (NCM-7)—Owen Cotterill, Walter Seideman, Merlin Nichols, Max Norris, Herschel Ball, E. M. Funk, A. B. Stephenson (Poultry), Ruth Baldwin (Home Economics).
Hatch 164, Breeding Chickens by Recurrent Selection and by Family and Individual Selection for Greater Number of Eggs and by Family and Individual Selection for General Desirability (NC-47)—A. B. Stephenson (leader), Q. B. Kinder, E. M. Funk and Terry Kinney.
Hatch 244, Systems of Flock Replacement, Feeding and Laying House Management—Q. B. Kinder (leader), A. B. Stephenson and Alberc Bentley.
Hatch 292, The Effect of Light and Thyroid Gland Activity on Ovulation and Oviposition in the Domestic Fowl—Harold Biellier (leader), P. C. Harrison, E. M. Funk and A. B. Stephenson.
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Research staff members also prepared extension matter which was printed in Experiment Station Circulars which are listed herein. This series began in 1915 and ended in 1947.

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