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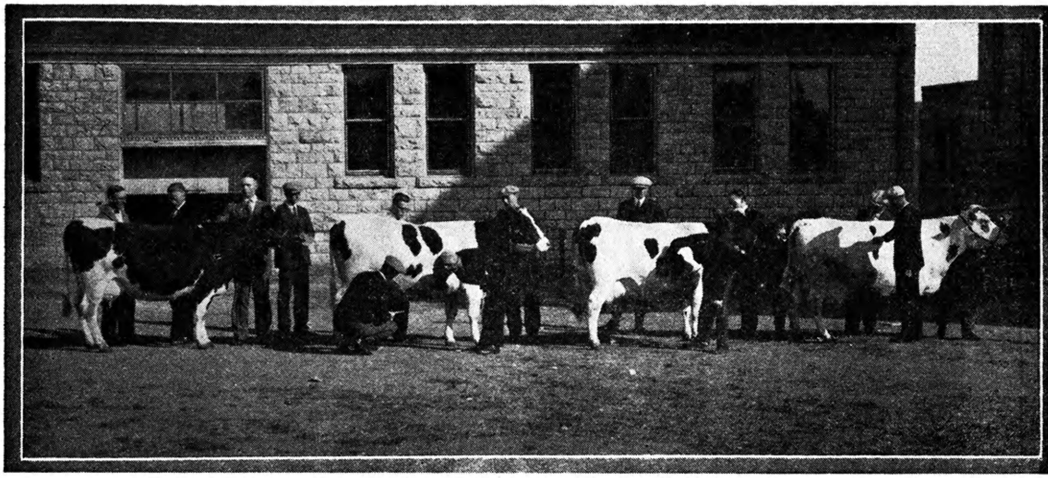

Judging Purebred Holsteins
(See page 110)

CONTENTS

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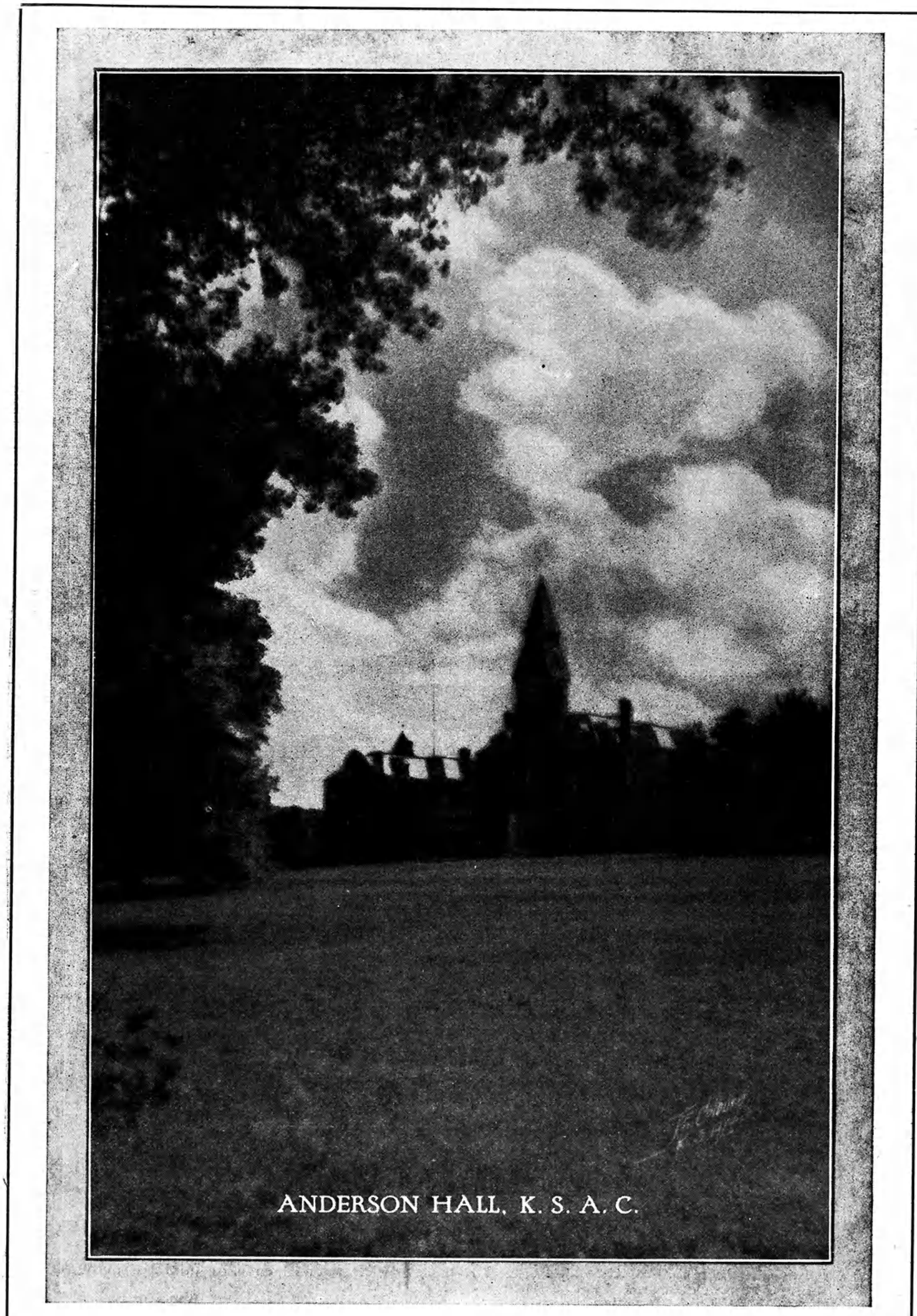

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An Adequate Diet for Poultry*

J. S. Hughes, in charge of Animal Nutrition, Agricultural Experiment Station

Out of the vast amount of experimental work conducted during the past few years to determine just what substances must be contained in an adequate feed for the various classes of animals, a few simple practical facts of untold value to the poultry industry have been discovered. While there are many facts concerning the feeding of poultry yet to be discovered, enough is now known concerning an adequate feed to enable any poultryman who will make use of this knowledge in his feeding practices to eliminate some conditions which in the past have been responsible for losses.

The most important of these facts concerning poultry feed are presented in the accompanying table. The substances necessary to make an adequate feed, their sources in common available feeds, and the deficiency diseases which will result if the necessary substances are left out of the feed are hereafter discussed in some detail.

Oxygen

The first necessary substance named in the table is oxygen. If oxygen be withheld within a few minutes the animal loses nerve control and faints. Just as the withholding of oxygen from any animal will produce definite disastrous results, so the withholding of any other essential substance in the diet will bring some definite deficiency disease. The only way to avoid these diseases is to be sure that the feed used is adequate, that is, contains the necessary substances listed in the right-hand column of the table.

Water

The importance of water in the diet is so well known that no discussion of it will be given.

*This article presents in abstract form materials used in lecture delivered by the author before the poultry sections of State Farm and Home Week at Purdue University, University of Kentucky, and Ohio State University.

Protein

Protein is used in the animal body in building all of the body tissues. It makes up the largest part of the dry matter in the muscle tissues. In the case of laying hens, protein makes up a considerable portion of the dry matter of the yolk and practically all of the dry matter of the white of the eggs. In order to secure satisfactory results either in the growing of young stock or in the production of eggs, it is necessary to include in the feed some protein substances which will supplement the protein of the grains which usually make up the bulk of the feed.

In order to understand why these protein supplements are necessary and why some protein supplements are of greater value than others, it is necessary to know something about protein structure. Proteins are complex compounds, built up of a few relatively simple compounds called amino acids. The relation of amino acids to proteins may be thought of as being about the same as the relation of letters to words. By combining 26 letters in various ways an almost unlimited number of words can be made. In the same way, the 20 amino acids used in building the various proteins can be combined in a great many ways. The thousands of proteins found in nature are thus produced.

By the process of digestion the animal splits these complex proteins up into relatively simple amino acids. It makes no difference what the source of protein may be, whether it is corn, meat, alfalfa, or anything else, when the protein is digested by the animal the same group of about 20 amino acids is produced. However, although the same 20 amino acids are produced when any of the above-named groups of protein are digested, they are not produced in the same proportion, that is, an amino acid which might be produced in large quantities from the proteins of meat, might be produced in very small quantities from the proteins of grains.

These amino acids pass through the walls of the intestinal tract into the blood stream and are carried throughout the body. The various cells of the body use them for the purpose of building the particular proteins needed. Unfortunately the body uses the amino acids in different proportions from the proportions found in the ordinary cereal grains. As a result, if the animal receives only cereal grains in its feed it will exhaust the supply of some of the amino acids and the building of proteins will cease. This applies equally to the building of the body tissues or the building of proteins which go into the white and the yolk of the eggs. In order to provide enough of these amino acids, which are the buildingstone of the body protein, it is necessary to put into the feed some proteins which contain in relatively large quantities the amino acids found in relatively small quantities in the cereal grains.

For this purpose proteins of animal origin, such as milk, tankage, or meat scraps, may be used. Or vegetable proteins, such as soybeans and cottonseed meal, may be used to almost equal advantage. It has been maintained by some that proteins of animal origin were far superior to proteins of the vegetable origin. Since more has been learned about an adequate diet, however, it has been found that the difference between these so-called animal proteins (milk, tankage, and meat scraps) and the vegetable proteins (soybeans and cottonseed) is not in the protein content but in the minerals which they add to the diet. It so happens that milk, tankage, and meat scraps, all contain a fairly high percent of the mineral elements which are lacking in the ordinary grain rations, so when these animal proteins are included in the diet they not only supplement the protein, but they also make good the mineral deficiency. This is not true in the case of vegetable proteins, for these protein feeds do not contain sufficient minerals to make good the mineral deficiency of the ordinary grain rations.

No definite statement can be made as regards the actual percent of protein supplement necessary to use under all conditions. For practical purposes, however, where ordinary poultry feeds are used, the mash of growing chicks should contain about 10 percent and the mash of laying hens about 20 percent meat scrap or high-grade tankage. As new protein supplements are developed the percent to be used will have to be determined by practical experiments.

Carbohydrates

Carbohydrates include the starches and sugars. They are used in the body almost entirely for energy. As the body can utilize equally well the starch and sugar from various sources, the problem of providing carbohydrates in the diet is comparatively simple. If more carbohydrate is entering the body from the intestinal tract than is needed at the particular time for energy production, this carbohydrate is changed over into fat and is stored as a reserve energy supply.

Under the general head of carbohydrates is also grouped most of the material known as crude fiber. About the only attention which need to be paid to the question of crude fibre in the feeding of poultry is to see that too much of it is not included in the feed. Very little of this material is digested. The digestive tract of a chicken is limited in capacity. If it is filled up with crude fibre a sufficient quantity of the materials necessary for building tissue and for energy cannot be eaten.

Fats

Fats, like carbohydrates, are used in the body almost exclusively for the production of energy. Fats from various sources can be used equally well by the body provided they can be digested in the intestinal tract. For this reason no attention need be paid to the source of the fat in the diet.

Minerals

Most of the minerals in the animal body are used for the purpose of building bone, and in the case of laying hens, for the production of egg shell. All of the other tissues, however, contain a very definite proportion of the various mineral elements. While the nerves and muscles and blood do not contain the minerals in as large quantities as the bones, the minerals are just as essential for the proper functioning of these tissues.

Some minerals are always found in ordinary poultry feeds. The ones likely to be deficient, and therefore requiring special attention, are calcium, phosphorus, and salt. Under some conditions iron and iodine may be lacking in the diet, but so far as known now, in providing the mineral supplement attention need be paid only to calcium, phosphorus, and salt. If the so-called animal proteins are used in the feed they will usually add a sufficient quantity of both phosphorus and salt, so that the only mineral that must be added under these conditions would be calcium. It has been the practice of poultrymen to add this element in the form of oyster shells. Recent experiments have shown that very good results can be obtained by adding this calcium in the form of limestone or marl.

Steamed-bone meal makes a very good source of mineral if one wishes to add both calcium and phosphorus, as it is composed very largely of calcium phosphate. Egg shell, however, is composed of almost pure calcium carbonate. Some recent work seems to show that sufficient calcium to make the egg shells must

Adequate Feed for Poultry

Substances essential in an adequate feed	Some feeds which may be considered sources of these essential substances	Some effects of the lack of these essential substances
Oxygen	Air	Failure of the nerves to function—fainting
Water	Water, milk, almost all feeds	Thirst; prevents body organs from functioning, especially the nerves
Proteins (Amino acids)	Meat scrap, tankage, whole or skimmed milk, oilmeals, legumes, grains, etc.	Failure to grow; low egg production
Carbohydrates	Grain, tubers, fruits, milk (whole or skimmed), etc.	Lack of energy for work and growth; low egg production
Fats	Some in most all feeds	Lack of energy for work and growth
Minerals	Whole or skimmed milk, meat scrap, tankage, outer coat of grains, green leaves, mineral mixtures, oyster shells, etc.	Bones undeveloped, nervous disorders, low egg production, thin shelled eggs, low hatchability
Vitamins: A	Green leaves (fresh or dried), egg yolk, whole milk, yellow grains, yellow tubers, liver and liver oils	Nutritional roup, low resistance to colds and pneumonia, few eggs, low hatchability
B	Outer coverings and germ of grains; yeast, tubers, milk, eggs, fruits, leaves, fresh meat	Failure of certain nerves to function, digestive disturbances, few eggs, low hatchability
C	Poultry can make their own Vitamin C	
D	Cod-liver oil, whole milk from cows receiving direct sunlight, eggs from hens receiving direct sunlight, substances irradiated with untra-violet light. Ultra-violet light will cause the development of this vitamin in the animal body	Rickets—failure to utilize calcium and phosphorus of food resulting in nerve, muscle, and bone disorders. Birds predisposed to tuberculosis. Egg paralysis; low egg production and eggs with thin shell and low hatchability

Note.—Vitamin E has not been included in this table as its relation to poultry nutrition has not been studied. There are probably other vitamins essential in a poultry ration yet to be discovered.

be put in the diet in the form of calcium carbonate, such as oyster shell, limestone, or marl.

The question of the exact quantity of minerals to use is complicated by the fact that utilization of some of the minerals is dependent upon the amount of Vitamin D or ulta-violet light the animal has. In fact, if the animal does not have Vitamin D or the ultra-violet light, calcium and phosphorus will not be used properly even if they are included in the diet in very large quantities. On the other hand if the animal has an abundance of Vitamin D or ultra-violet light, it seems to be able to develop normally when these two elements are included in the feed in fairly small quantities. Until further experimental work is carried out, in which these factors governing the utilization of the minerals are carefully controlled, it will be impossible to make any definite statement in regard to the percent of these minerals required in an adequate diet. However, since these mineral feeds are relatively cheap and are not harmful, it would be advisable to feed them in fairly liberal quantities.

In this connection it might be well to call attention to the possibility of harmful results being produced by the long continued use of a mineral mixture containing substances of a character such as Glauber's salts and Epsom salts. While no experiments have been run to show that the feeding of a small quantity of these substances continuously over a long period of time is harmful to poultry, such experiments have been carried on with dairy cows. Until definite information is secured on this point it would be safer, at least, to use a mineral mixture which does not contain such substances.

Nothing definite is yet known in regard to the iron content of an adequate feed for poultry. No definite results have been obtained on the feeding of iron and other metallic elements which may be necessary in small quantities in other animal feed.

It has long been the common practice of poultrymen to provide some mineral substances to serve as grit for chickens. Experimental work has shown that excellent results can be obtained without the use of any grit at all. Baby chicks have been raised to maturity and ordinary egg production has been obtained without the use of any grit whatever. All the minerals in this case were fed in pulverized form.

Since conditions vary so much it is impossible to make a definite statement in regard to the quantity of minerals to use as supplements in poultry feeding. One can be quite sure, however, that the ordinary mineral requirements have been met if the ration for growing chicks contains 4 or 5 percent minerals, including calcium phosphate, such as bone products, some form of calcium carbonate, and some salt. If the feed contains much bran or shorts, more carbonate and less phosphate may be used in the mineral supplement as these wheat products are relatively high in their phosphorus content. Many minerals of this composition can now be purchased mixed ready for use.

Vitamins

The vitamins differ from the classes of compounds described above in that their composition is unknown and they cannot be tested chemically. There is no more question, however, about their importance in the feed and the results which will be obtained if they are left out than there is in the case of oxygen and water. Their presence or absence in any particular feed can be determined by feeding the unknown material to experimental animals under very carefully controlled conditions. Three of the vitamins are known to be necessary in the poultry ration. These are Vitamin A, Vitamin B, and Vitamin D. Vitamin C, which is necessary in an adequate feed for certain animals does not seem to be necessary for poultry.

Vitamin A.—Wherever in nature plants are growing in sufficient sunlight for the leaves to develop a green color, Vitamin A is being made. So far is is known it is not made under any other conditions. In the ripened plant, Vitamin A is stored in the part which retains the green or the yellow color. It is not identical with the color but is merely found in the same part of the plant in which the color is found. The only one of the common grains used in poultry feeds that contains any considerable quantity of Vitamin A, is yellow corn. Red corn contains some Vitamin A, but white corn and all the other common grains can be considered as containing very little, if any.

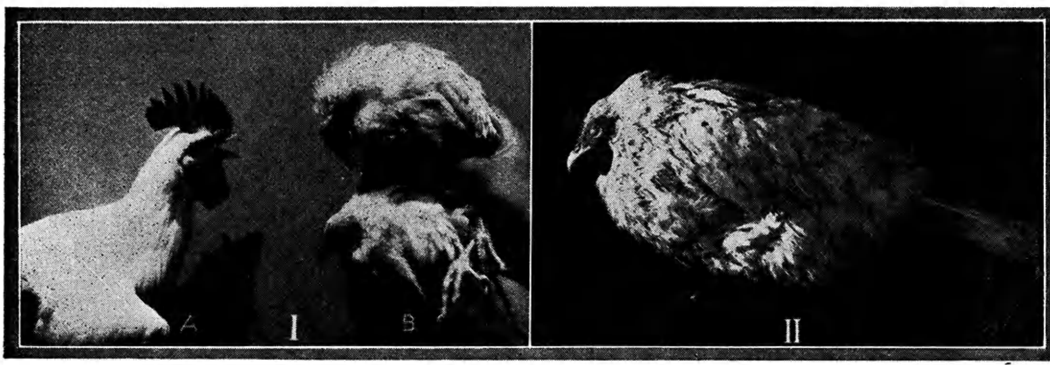
This vitamin is found also in yellow carrots, but not in the white. Other tubers, such as beets and potatoes, contain very little Vitamin A. It would be found in sprouted oats grown in sufficient sunshine to produce a good green color, but very little, if any, is found in sprouted oats if the oats are grown under such conditions as to be yellowish or white in color. So far as experimental results go at the present time, the only value to be obtained from sprouted oats over that obtained from unsprouted oats is in the Vitamin A which is developed in the sprouting process. Therefore, if the oats are sprouted under conditions such that the sprouts are not green, the sprouting process adds very little value.

The outer green leaves of cabbage and head lettuce contain a considerable quantity of Vitamin A, while the white leaves on the inside contain very little. Drying does not destroy much of Vitamin A, so alfalfa hay contains almost as much Vitamin A as the green alfalfa from which it was made. Some experiments seem to indicate, however, that the Vitamin A content of the hay slightly decreases as the hay ages, so that alfalfa leaves two or three years old would contain very much less Vitamin A than the newly made hay.

Whole milk contains Vitamin A if the feed which the cows have been fed contains it. When the milk is centrifuged, however, the Vitamin A is practically all removed in the cream. For this reason skim milk and buttermilk contain very little, if any, Vitamin A and are of no value in the feed so far as providing this vitamin is concerned.

If Vitamin A is left out of the ration of poultry a diseased condition is developed which has been called by some experimenters nutritional roup. The early stages of this disease are exactly those of the beginning of a cold. A fluid-like exudate forms in the eye, followed by a swelling of the tissue under the eye. In severe cases the eye fills up with a cheesy-like material. Under ordinary conditions bacteria will invade the eyes and the condition commonly called roup will result.

At the same time this eye trouble is developing, the small glands which line the esophagus become so enlarged that when the esophagus is open it appears to be covered with pimples. The kidneys are affected in such a way that uric acid is retained in the body. The quantity in the blood may increase forty or fifty times above normal and many of the body tissues may be covered with urate crystals. Death usually results in from four to twelve months if an adult bird is placed on a feed low in Vitamin A. In the case of chicks, death will result in from four to eight weeks.



Illustrations Showing the Effects of Failure to Provide Adequate Vitamins

I. Three cockerels of the same age. Each received an adequate diet. One (A) received direct sunlight. The others (B) had no direct exposure to the sun. II. A typical case of "nutritional disease" due to the lack of Vitamin A in the feed. The white exudate in the eye is similar to the beginning of ocular roup.

These statements are based on the results of eight years study of this subject during which time more than 1,000 individual birds have been used in the experimental pens. In no case in this entire time has a bird failed to develop the above conditions when given feed low in Vitamin A. One of the commonest faults in the feeding of poultry in Kansas is the use of feeds low in Vitamin A. Deficiency in this vitamin is most likely to occur during the winter months when the flock cannot secure

(Continued on page 124)

Agricultural Surpluses

Mary E. Haise, '26

There are many varying conceptions of the problem of agricultural surpluses, which is commanding so much attention of our leading statesmen and economists. One farm paper in an editorial states that a farm surplus is a necessity to the farmer in order that he may be able to satisfy his wants and purchase his necessities. Obviously this writer's understanding of a farm surplus is that it consists of a quantity of a farm product greater than that required by the family on a given farm. At present, this can hardly be considered an agricultural surplus because the prime objective of the farmer is to produce exchangeable goods. The writer of this article did not have a broad enough conception to fit the term "agricultural surplus."

Another popular idea is that a surplus is an excess of a given commodity over consumption. Embodied in this is the idea that a surplus exists if the product is not eventually entirely consumed. In this conception no consideration is given to the fact that this commodity has been produced because of its exchange value, which is materially lessened by the excessive production. A surplus, if thought of in this manner, would rarely be produced except in the case of perishable goods.

Some say that a surplus is an excess over the needs of the people. As long as there are people in the world who are in need, no surplus can exist. This conception disregards the fact that farm goods are produced for sale.

Still others consider that goods produced in the United States and exported are surplus products. But the United States often exports commodities in which it has no surplus problem. Some industries, such as cotton growing, are largely dependent on foreign markets for disposal of their products. The exportation of these commodities could hardly be considered as indication of an agricultural surplus. On the other hand a serious surplus might be experienced in a commodity of which little is exported. One must consider here the market—world or domestic—for which a commodity is produced.

An excess over average production has been considered by some to be a surplus. In this conception the factor of elasticity of demand has been overlooked. Demand does not necessarily remain constant. For some years now there has been a surplus of horses, due to lessened demand because of an increased use of motor power.

Because of so many misconceptions and differing conceptions of surpluses, a subcommittee of the special committee on Marketing, Distribution, and Surpluses of the Land Grant College Association was appointed to consider the surplus problem and to work out an adequate definition for a surplus. This subcommittee consisted of Dr. George F. Warren of New York, Dr. B. H. Hibbard of Wisconsin, and Dr. W. E. Grimes of Kansas. The definition of an agricultural surplus submitted by this commitee is as follows: "A surplus is a supply in excess of the quantity which can be sold at a price sufficient to induce farmers to attempt to produce that quantity."

Such a surplus does not necessarily mean immediate reduction in production. In fact immediate reduction is not usually feasible under ordinary farm conditions. A farmer can hardly afford to junk equipment for large-scale production and fit his farm for some other use every time a surplus occurs in the commodity he is producing. Neither can a cattle breeder afford to sell all his stock immediately. It pays him to hold it for a time. Thus, a surplus may be extended over several years. This results, however, in a lack of incentive to start new production and efforts toward production are materially decreased.

It is believed by many that our present agricultural depression and the existence of surpluses are resultant from the World War and were caused entirely by this factor. It is true that the problem is magnified by the conditions following the World War, but it is also true that the surplus problem would have become acute if the World War had never occurred. The surplus is like the proverbial bad penny—always returning. We have records of surpluses in Egypt and China since about 2,000 years before Christ. They are not a new thing. It seems that our surplus problem is not ours alone, but is a problem of the ages.

Furthermore, it is a problem which grows progressively more difficult to solve. In its beginning it was not complex. In America it was comparatively simple. Our pioneer families were all more or less self-sufficient. Practically all of their production was for home consumption. An excess of food products was rejoiced over rather than deplored. But, with advancement in education, invention of new machinery, the increase in population, and the increased division and organization of labor, the self-sufficing family unit has vanished. Farm production is now on an exchange basis, which makes the farmer dependent on the exchange value of his product. His business has been commercialized. He no longer rejoices when there is an excess of his goods. That means it will be more easily obtainable by those whose desire it satisfies, and therefore will not command as high a price in exchange. Obviously, with the increasing interdependence of people, the surplus problem becomes more serious. The past 50 years have brought about a great increase of interdependence. There has also been a very marked increase in capitalization which increases the farmer's tax and interest problems. These factors would have given us a surplus problem if the war had never occurred.

What are we going to do about our surplus problem? There are two ways of handling it. First, to prevent its occurrence and, second, to care for the surplus after it is produced. Obviously, the most desirable thing would be the prevention of surpluses. This is a difficult task, though there are some practices which will tend to bring it about. Price and production forecasting is one. The dissemination of this information is of great value to the farmer. If he takes advantage of it, it will tend to iron out the peaks in production and reduce it more nearly to a level plane. General education is necessary to be able to make general use of such information. Acting on reliable information would result in the regulation of the number of acres planted to a given crop or the size of the pig crop, for example.

However, there are some factors which cannot be regulated or forecasted, such as prevailing weather conditions and number of acres of crops abandoned. There are others—the diversion of consumers' demands and the effect of competitive regions in supply—which are partially controllable. Then there are those factors which can be controlled. Among them are individual actions, such as acreage planted, farming methods, and number of livestock grown; and governmental action, including tariffs, taxes, freight charges, land policies, monetary policies, and available credit.

The absolute prevention of surpluses is impossible with our present understanding of economic methods and practices. It is impossible to state what may come in the future. But what are we going to do with the surplus on hand? Several means have been suggested. There is evident disagreement at Washington as to the best method of procedure.

S. P. Clark, '12, is assistant professor of agronomy in the University of Arizona, Tucson.

Oscar Steanson, '20, is employed in the Office of Cost of Production, Bureau of Agricultural Economics, United States Department of Agriculture. He is co-author of U. S. D. A. Department Bulletin 1381 on "Cost of Producing Hogs in Iowa and Illinois, Years 1921-1922." The data used in this publication were secured from farmers and cover all phases of hog raising. It is a valuable publication for all persons interested in hog production. Various factors influencing hog production costs are carefully discussed.

John Carter, '26, has accepted a position as superintendent of the experimental fields of northeastern New Mexico and will report for duty immediately after commencement.

O. B. Burtis, '16, is managing Dean Umberger's farm near Hymer, Chase county.

G. C. Wheeler, '95, managing editor of "The Western Farm Life," of Denver, broadcasts answers to farm questions from station KOA.

J. R. Wells, f. s., is teaching in the St. George schools.

Bread, Ninety Minutes from the Flour Sack

C. M. Murphy, '26

Visitors at the recent Ag Fair had the opportunity of seeing one of the latest innovations in scientific bread baking, a method by which light bread raised with yeast can be produced in just 90 minutes. This speeding up of bread baking is the result of a new type of mixer invented by Dr. C. O. Swanson, head of the Department of Milling Industry of K. S. A. C., assisted by Prof. C. E. Pierce, of the Department of Machine Design, and Prof. W. W. Carlson, head of the Department of Shop Practice.

The best method for testing flour for quality at the present time is the baking test. However, one of the difficulties with this test is the personal equation or the individual differences in persons making the baking test. About two years ago Dr. Swanson determined to eliminate, as far as possible, this personal equation factor of variation from the baking experiments. In an attempt to measure the viscosity of dough, he got the idea which later developed into this bread mixer.

In the bottom of the bowl of the machine, which is made of tinned copper, there are three upright pins. With the machine assembled for mixing, there are four pins extending down from above which, by means of gears, are made to revolve in pairs around the three bowl pins, alternately straddling and hurdling them. The action on the dough may be described as pack-squeeze-pull-tear. Each pair of movable pins hurdle the bowl pin; the dough is packed and squeezed between the pins and the side of the bowl; they straddle the next pin, and the dough is pulled and torn.

The dough is made of 340 grams of flour, approximately 215 cubic centimeters of water, 15 grams of sugar, 5 grams of salt, 10 grams of yeast, and 5 grams of lard. This approximates the baker's formula for a one-pound loaf.

The first effect of the mixer is a thorough mingling of all the ingredients, a purely mixing action. The machine is then speeded up to 120 revolutions per minute and the gluten is quickly developed. The strands of gluten are alternately squeezed and pulled until they are sufficiently fine to produce thin-walled membranes capable of holding the gas bubbles formed by the yeast during the panary fermentation. Care must be taken to avoid working the dough too much or the threads will become too fine and will not be strong enough to hold the gas. As a result of weakening the gluten strands too much, the bread will have large holes caused by several small bubbles coalescing.

Perhaps it would be well here to digress a little and explain something of the nature of gluten. Gluten is a tough, rubbery substance which is largely protein in nature and which is dependent for its toughness and resilience upon the quality and percent of protein present.

In ordinary baking, the bread is allowed to rise. That is, the yeast in breaking down sugars and starches for food, sets free carbon dioxide gas. As this gas is produced it forms bubbles, the walls of which are gluten. This gluten may be compared to the rubber wall of a toy balloon, although it is composed of a network of fine strands covered with water.

When the bread rises these strands are pulled and stretched. Then the bread is worked down and the attenuated strands are distributed through the dough. The next rising again stretches the threads. Too hard working or kneading at this stage masses the threads together and partly destroys the effect of the first and second rises.

By this invention of Dr. Swanson's, the first two periods of stretching are eliminated. The mechanical pulling of the threads shortens the fermenting or rising time and also prevents the yeast from breaking down some of the flour to obtain food, since the sugar added is sufficient for a short time.

When bread is baked by this short-time method, the water, containing the salt, sugar, and yeast, and heated to approximately 90 degrees Fahrenheit, is mixed with the melted lard and placed in the bowl of the mixer. The flour, also heated to 90 degrees, is added and the machine is started slowly to prevent dry flour from being thrown from the bowl. After the liquid has permeated the flour, the machine is speeded up to 120 revolutions per minute and is allowed to run for 7 minutes. The dough is then transferred from the mixer to the baking pan and allowed to rise for about 40 minutes, after which it is put into the oven and baked. The baking time is also about 40 minutes, which makes a total of 87 minutes from the mixing of separate ingredients to the finished loaf, exclusive of the time required to remove the dough from the mixer.

It must be noted here that this mixer is distinctly different from the ordinary high-speed mixers on the market. It is so designed as to get the maximum of mechanical action with a minimum of mechanical motion. This eliminates the detrimental heating of the dough in the mixer, and it mixes all the dough thoroughly.

The work of the machine has proceeded far enough to prove definitely and positively the value of the machine in a laboratory for testing flour. Weak gluten flour is unable to stand the vigorous action and the resultant loaf shows large cells where the gluten strands have given away and allowed the bubbles to coalesce. The texture of a good strong flour loaf is exceptionally fine; almost as light and delicate as angel-food cake.

Experimental Tests in Beef Production

E. F. Carr, '27

A feeding experiment carried on by the Department of Animal Husbandry of the Agricultural Experiment Station, beginning in the winter of 1924, gives some valuable data on finishing steers on bluestem pasture as compared to dry-lot finishing, and the relation of gains on bluestem pasture to the condition of feeders at the close of the winter period. Three lots of light-weight yearling steers, selected on the basis of uniformity were used. The average initial weight per steer for the three lots was 536 pounds.

Lots 1 and 2 were fed for a 150-day period, beginning December 5, 1924, on a light grain ration consisting of 4.83 pounds of shelled corn, 1 pound of cotton-seed meal, 2 pounds of alfalfa hay, and 33.93 pounds of cane silage per steer per day. Lot 3 was fed no grain during this 150-day winter period. Their daily ration consisted of 1 pound cottonseed meal and 33.93 pounds of cane silage per steer. The two grain-fed lots made average daily gains of 2.3 pounds per head and lot 3 made an average daily gain of 1.14 pounds per head during the winter period.

The three lots were grazed together on bluestem pasture for 90 days, beginning May 5, and ending August 3, 1925. During this 90-day period, the steers in lot 1 made an average total gain of 59.6 pounds; those in lot 2, an average total gain of 70.6 pounds; and those in lot 3, an average total gain of 173.4 pounds. These tests show that fleshy steers did not gain so much as did the steers from the no-grain lot. The gains made by steers on grass depend upon the amount of flesh they carry when going on pasture.

These three lots of steers were full fed from August 3 to November 1, 1925. Two methods of feeding were used. Lot 1 was fed in a dry-lot, while lots 2 and 3 were full fed on bluestem pasture. The three lots received the same average daily ration of 17.55 pounds of corn and 1 pound of cottonseed meal per head per day. However, lot 1 received 4.7 pounds of alfalfa hay per head daily in the dry-lot.

There was only $1.75 per steer difference in the feed cost of lots 1 and 2, but the steers in lot 1 had more finish, and were valued at 50 cents more per hundredweight than the steers in lot 2. The steers in lot 1 returned a profit of $12.57 per head, while those in lot 2 returned a profit of only $3.26 per head.

Lot 3, that received no grain during the winter period and were then handled the same as lot 2 during the summer, were thinner in flesh and sold for 50 cents less per hundredweight than steers in lot 2. However, the

(Continued on page 120)

Hay Marketing and Inspection

E. I. Chilcott, '27

There are two important methods of marketing hay—the straight sales method and the consignment method. By the straight sales method the shipper sells the hay at a fixed price, either at point of shipment or at destination. This method is used when selling hay to an individual buyer who may or may not move it from the locality. The buyer usually sees the hay and does his own crude grading and inspecting.

The consignment method consists in shipping to a broker or commission merchant who will act as the representative of the shipper in selling the hay on the market to which it was shipped, usually at the price prevailing when it arrived.

The selection of a market to which to consign is one of the most important functions in successful and profitable marketing. The nearest central market is usually the one to which the hay is consigned, although more profit might be secured at other more distant markets. In making a market choice the distance to market, character of demand, preference for certain kinds of hay and for a certain size of bales, methods of weighing and grading, method of sale, and the character and reliability of the dealers, must all be considered if the most profitable returns are to be obtained. Factors other than distance may be so important as to outweigh the higher freight charge.

Usually it is the best policy to consign only to those markets that have a broad, general demand sufficient to absorb large quantities of different grades of hay. Although definite sales can frequently be made very advantageously on the smaller markets, their current demand for hay is generally so small that a few cars may overstock the market and cause the shipper serious losses.

Since weighing and inspection fees are almost always charged in full to the shipper when the hay is consigned, he is directly interested in the method employed and in the degree of economy with which these functions are administered. Shippers should insist that only accurate weighing methods which will furnish correct weights be used and that complete data upon which claims can be based in case of loss, be furnished. The shipper is entitled to and receives an official certificate, if official inspection is maintained at the market. In accordance with recent provisions most markets have federal inspection services at hand.

Standardization of grades and marketing methods is one of the most important and recent phases of hay marketing. Notwithstanding its ranking position, hay has until recently received less attention with respect to standardization of the product and marketing methods than have other crops of major importance, such as wheat, corn, and cotton. Under past conditions contracts have been difficult to enforce and the marketing of hay was often a risky business. In other instances grades which had some merit were devised and in local use, but had little recognition in other communities. Often these local grades and standards had been complained of by producers, that such grades favored the buyer and discriminated against the shipper.

Problems in hay standardization are by no means simple or easy of solution. Hay as a commodity cannot be tested and graded in a rapid manner by any mechanical method such as is available for grading grain. Foreign matter and damaged portions cannot be separated readily, nor can moisture and accurate nutritive value tests be applied quickly. Hay is bulky, its component parts are not easily or quickly separated, and its quality and relative feed value can be measured only by characters and factors which are visible and correlated with intrinsic value.

From careful analyses and studies of hundreds of baled-hay samples from many markets, grades were devised giving proper recognition to farm conditions and production. On September 1, 1925, the Secretary of Agriculture made the following standards official for the United States, for the inspection and certification of the hays specified:

Group I—Timothy, clover, and grass hay.
Group II—Alfalfa and alfalfa mixed hay.
Group III—Prairie hay.

Group IV—Johnson and Johnson mixed hay.
Group V—Mixed hay.

Each group is divided into classes which are in turn divided into grades. For example, the alfalfa and mixed group, which is the chief hay of Kansas, is divided into nine classes which are each divided into three grades. The term "class" refers to the kind or type of hay and has no reference to quality or condition. The term "grade" on the other hand, is used to describe the quality of the hay. Each class is divided into grades designated as U. S. No. 1, U. S. No. 2, and U. S. No. 3, each having different quality requirements. In all classes there is a "sample grade" for inferior hay not good enough for other grades. Grade requirements are based upon leafiness, color, and foreign material each having a minimum or maximum percent requirement. Detailed requirements and standards for inspection and grading may be secured from the United States Department of Agriculture, if desired.

When hay is graded U. S. sample grade, federal inspectors are instructed to show on certificates (1) that the hay is U. S. sample grade, (2) the reasons for assigning this grade, and (3), if determination is possible, the grade to which the hay would be entitled otherwise.

The Federal Hay Inspection Service has been organized in the Hay, Feed, and Seed Division of the Bureau of Agricultural Economics under the authority of the appropriation act of February 10, 1925. The general plan of this service provides for the employment of federal hay inspectors at important central markets and at shipping points under cooperative agreements between the Bureau and organizations such as state departments of agriculture, commercial exchanges, and dealers' or growers' associations.

The Bureau of Agricultural Economics trains the inspectors employed under these agreements in the use of the United States hay standards and in the Department's methods of inspecting hay. After completion of the training the inspectors are licensed as federal hay inspectors and the Bureau supervises their work during the life of the license. The organization and the Bureau cooperatively pay the inspector and all other local expense.

A three or four weeks training school is held at Washington or Kansas City and at other points where needed at hay standardization laboratories, whenever sufficient number of persons require training. Men admitted to these training schools are required to have at least a common school education and to have had either sufficient experience in handling and marketing hay or a college training along agricultural lines to qualify them to grasp readily the principles on which the United States hay standards are based.

To care for various conditions existing in the hay trade it has been necessary to provide for several forms of inspection, as partial inspections, and appeal inspections, differing as their respective names signify.

Inspection certificates are delivered to the person who made application for the inspection and the shipper of the hay if he is known and is not the applicant for inspection. Copies of inspection certificates for hay which has been inspected previously and is called upon for appealed inspections are sent to all interested parties known.

Brief marketing suggestions:

1. Choose the method of marketing best suited to your business facilities.
2. Consign only to markets having broad demand.
3. Sell only to reliable and responsible dealers and buyers.
4. Study local and national production figures in deciding when to sell.
5. Consult market reports.
6. Repeat all terms of sale in confirmation.
7. Follow billing instructions closely.
8. Prepare invoices carefully and forward promptly.
9. Present claims only when supported by adequate proof.
10. Lastly in field of marketing but first in importance, cut at proper time and sell only good hay.

It is quite likely that several Kansas towns from which large quantities of hay are shipped, will establish local shipping point inspection this summer. Towns now considering the establishment are Larned, Fredonia, Emporia, and Garden City.

Roy W. Kiser, '14, has resigned his position as extension specialist in animal husbandry to take up work in the life insurance business.

H. I. Richards, '22, associate economist in the Bureau of Agricultural Economics of the United States Department of Agriculture, is now in Manhattan pursuing farm management studies in cooperation with the Department of Agricultural Economics.

THE KANSAS AGRICULTURAL STUDENT

KANSAS STATE AGRICULTURAL COLLEGE

MANHATTAN, KANSAS

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JUDGING PUREBRED HOLSTEINS

The picture over the "contents" page of this issue shows a class of outstanding purebred Holstein cows from the college dairy herd being judged by a small group of students. Opportunity to work on such classes of outstanding livestock makes livestock class work and judging contests in K. S. A. C. really worthwhile and unsurpassed by any institution.

From left to right in the picture the names and records of these cows are as follows:

Canary Paul Walker

Record as a three-year-old: Milk, 17,116 pounds; Butterfat, 580 pounds.

Canary Paul Cornucopia

Record as a three-year-old: Milk, 19,645 pounds; Butterfat, 617 pounds.

Canary Paul Josephine De Kol

Record as a four-year-old: Milk, 14,872 pounds; Butterfat, 471 pounds.

Inka Hijlaard Walker

Record as a mature cow (seven-year-old): Milk, 21,068 pounds; Butterfat, 775 pounds. Her three records, made at 5, 7, and 8 years of age average 20,033 pounds of milk and 756 pounds of butterfat.

LOAFERS

More than 95 percent of the students in the Division of Agriculture took an active part in the Sixth Annual Ag Fair. Just 15 students, in fact, make up the blacklist of the Division—those who were entirely indifferent and felt no responsibility for the success of the enterprise.

This is a remarkable record and the students of the Division of Agriculture should receive commendation for their splendid cooperation. We venture that some of the other divisons of the college could not do so well.

But why didn't we have complete cooperation on the biggest agricultural student enterprise of the school year? There may be one or two exceptions, but in general the 15 students of the division who failed to boost the Ag Fair do not have reasonable excuses. We may call it human frailty, but it looks as if those men thought their slicked-back hair and their neat bow tie excused them from work. The fact remains that the Ag Fair found 15 Ag students loafing on the job. They have shown they are not interested in agriculture and the Division would be better off without them than with them. In fact, we are anxious to miss such loafers from the Division. We are out for good men to fill their places and we will get them.

THE AG FAIR SHOWS THE MAN

The Ag Fair is a big worthwhile enterprise. It is a great teacher. By the cooperative effort necessary to put across the Fair the students come to know each other. No other project of the year shows the real men of the Division, the real key men of the present and future, as does the Ag Fair.

True it reveals the loafers; unfortunately there are always a few of them. But even more strikingly the Fair lines up in the lime light, so to speak, large numbers of men whom all their associates recognize for their vision, initiative, perseverance, and success. These men are resourceful and dependable. Their projects are cared for every minute and under all circumstances.

It may not seem so important today to label the real men among our fellow workers. As years go by, however, the contrast between the indifferent and careless on the one hand, and the efficient and responsible on the other hand will become more and more striking. These real men are recognized by their fellows for their outstanding qualities today; their recognition will be larger in the future. They are built on the right plan; they ring true to the core; they are the corner stones of the communities of tomorrow.

OUR COVER PAGE

Our cover page presents a composite picture. The background shows a beautiful and familar college view. In the foreground are three of the best specimens of hogs one is ever permitted to see. The photograph was taken by Smith-Morton, Kansas City, Mo. The three spring barrows were first, second, and third in their class and first-prize pen of three, and the barrow at the right, Champion Poland China barrow in the American Royal Livestock Show, Kansas City, 1925.

The Effect of Sorghums on Succeeding Crops*

Robert W. Fort, '26

The introduction of the sorghum crops, kafir, milo, feterita, Sudan grass, and the various canes or sweet sorghums, has been an important factor in stabilizing Kansas agriculture, due to the ability of these crops to withstand periods of limited rainfall. However, the common belief that sorghums are hard on the land has curtailed the acreage that would otherwise be planted. Farmers are close observers and generally have a logical reason for their beliefs.

Where fall wheat has been planted directly after the harvesting of kafir, the yields of wheat have been decreased 3 bushels per acre at Manhattan and 5.5 bushels per acre at Hays, compared with the yields of wheat following corn. On the other hand, because of the usual farm practices in cropping, farmers have not had opportunity to observe the effects of spring crops after kafir and the effect of kafir on fall wheat when a period of summer fallow intervenes.

In experiments at Hays, barley planted in the spring after kafir has shown very little if any injury due to kafir. In a rotation of winter wheat, kafir, barley, and peas for green manure, barley has averaged 18.4 bushels per acre for an 18-year period. In a comparative rotation in which corn takes the place of kafir, the yeild of barley has averaged 17.1 bushels per acre. Barley cropped continuously upon fall-plowed land during this same period has yielded 17.1 bushels per acre.

By the use of a summer fallow after kafir, the experiments at Hays show that there is not any evidence of kafir depressing the yield of wheat planted on the fallow. The yield of wheat grown after kafir by this method has averaged 23.0 bushels per acre. This yield compared with one of 21.2 bushels per acre where the land is alternately cropped to wheat and summer fallowed, shows that the introduction of a summer fallow following kafir, obviates any depressing effect on crop yields that may be attributed to kafir. For the same period of years, the yield of wheat cropped continuously on the same land by the best tillage methods has been 16.9 bushels per acre.

There are two reasons why kafir, a sorghum crop, may decrease the yield of wheat when planted soon after the harvesting of kafir: (1) In producing a greater acre yield than corn, kafir may deplete the soil of mois-

(Continued on page 122)

*Excerpts from an article by Dr. M. C. Sewell of the Department of Agronomy, printed in the Weekly Kansas City Star, May 5, 1926.

College Notes

THE SIXTH ANNUAL AG FAIR

The Sixth Annual Ag Fair is a matter of history. The day and the early part of the evening (Saturday, May 8) were ideal, all that could be hoped for as far as the weather was concerned. Everything was in readiness and all events started on scheduled time. The entire performance was practically free from objectionable features and the boys are to be complimented on its general character and success.

Special credit is due Mr. A. C. Hoffman, the manager. He showed himself to be a thoughtful, far-sighted, and efficient leader. Every worker on the fair recognized his quiet influence and executive ability.

The unfortunate phase of the fair was the early rain in the evening, clouds beginning to be threatening soon after 8 o'clock. While the crowd of the early evening was large, beyond doubt many people were kept away by the threatening storm. Before 10 o'clock a steady rain, a real downpour, cleared the pike and made everyone hunt shelter. About two hours and a half of the best end of the fair that normally would have yielded good financial returns was therefore practically eliminated. Under such conditions it could not be expected that the fair would be a brilliant financial success. With such a handicap, however, the boys more than broke even, increasing their reserve and insurance for the future by not less than $200.

The parade was interesting and educational and received much favorable comment. A new feature was the crowning of the Goddess of Agriculture and placing her at the head of the procession. Miss Alice Englund, senior in home economics, had been selected by popular vote for the honor and added a touch of interest, beauty, and romance to the agricultural features of the parade.

The educational exhibits were the best ever shown in an Ag Fair at K. S. A. C. Each of the seven departments of the division had a large and creditable exhibit as did also the Departments of Agricultural Engineering, Entomology, and Zoology, and the Divisions of Home Economics and Veterinary Medicine. These exhibits filled the available space in the south side of the judging pavilion and formed an exceptionally instructive display.

The rodeo was held in the afternoon in the animal husbandry pasture north of Waters Hall. The performance of the boys on a score of bucking horses entertained and pleased their large audience.

The follies in the north half of the judging pavilion under the direction of Harry Wilson, senior in music, furnished pleasing entertainment.

The minstrels put on a good show although they were somewhat at disadvantage in location.

The dance was held on the first floor of the west wing of Waters Hall. It was a big success to the end. Its good shelter furnished a refuge in the late evening to many who would otherwise have visited the other attractions.

Other features of the fair on the big pike were the merry-go-round, the crazy house, the house of a million thrills, the sideshow, concessions, and various refreshment stands. Barbecued beef sandwiches were among the many eats available.

Plans are well under way for next year's Ag Fair. The officers elected for the event are: Raymond H. Davis, manager; Vance M. Rucker, assistant manager; and H. L. Murphy, treasurer.

AG STUDENTS ELECTED TO HONOR SOCIETIES

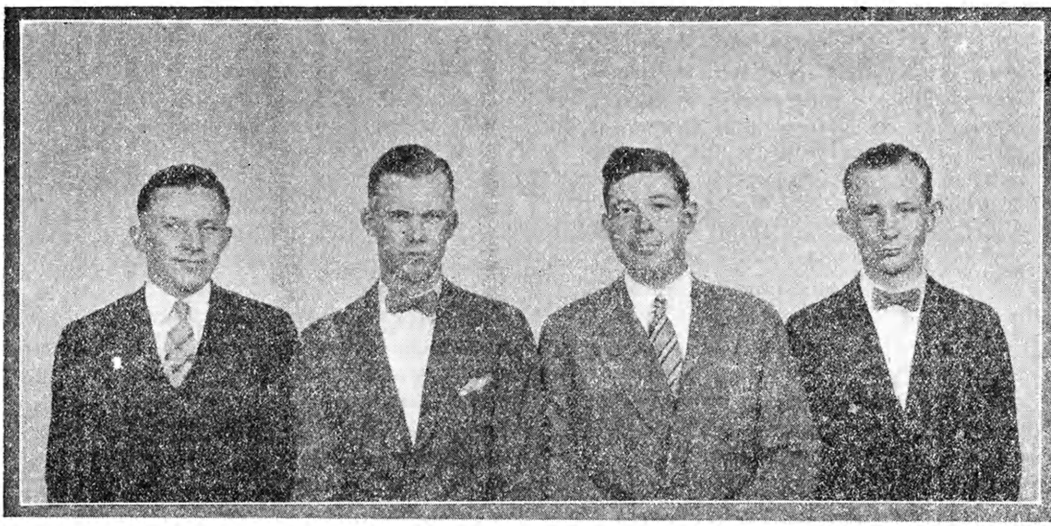
Alpha Zeta

Alpha Zeta, national honorary student agricultural fraternity, held formal initiation on April 27, 1926, for the following students: G. K. Terpening, La Pryor, Texas; H. L. Murphy, Protection; C. R. Bradley, Mayetta; C. M. Carlson, Lindsborg; W. E. Schaulis, Wakefield; H. E. Myers, Bancroft; E. A. Stephenson, Alton; and G. B. Wagner, Netawaka.

Alpha Zeta holds an election each semester of the college year, electing to membership students of the Division of Agriculture who have attained high scholastic standing and have those qualifications requisite for leadership in the judgment of the members of the local chapter. Students may not be elected to membership earlier than the second semester of their sophomore year, nor may students be elected whose scholarship standing is not high enough to place them in the upper two-fifths of the class.

Gamma Sigma Delta

The Honor Society of Agriculture, Gamma Sigma Delta, recently elected to membership eleven undergraduate students and fourteen graduate students and faculty members. Membership is open to senior students in agriculture, veterinary medicine, and closely related sciences who are in the upper 15 percent of the class in scholastic standing. Graduate students and faculty members outstanding in scholarship are elected at the discretion of the local chapter.



Ag Seniors Elected to Phi Kappa Phi

From left to right these outstanding representatives of the Division of Agriculture in the Class of 1926, honored by election to Phi Kappa Phi in the spring election are: Cecil M. Murphy of Talmage; Charles E. Dominy of Atwood; Merritt Paul Brooks of Columbus; and Lionel Holm of Vesper.

Phi Kappa Phi

In the spring election to Phi Kappa Phi, the following men were elected from the Division of Agriculture: Lionel Holm, Vesper; Merritt Paul Brooks, Columbus; Cecil M. Murphy, Talmage; and Charles E. Dominy, Atwood.

Every year 10 percent of the senior class of K. S. A. C. is chosen for membership in Phi Kappa Phi. Elections are held each semester and summer term. Election to Phi Kappa Phi is made on the basis of scholarship and is the highest scholastic honor which is bestowed at K. S. A. C.

The following students were elected from the Division of Agriculture: Adolph G. Jenson, Walter Wisnicky, Lionel Holm, Merritt Paul Brooks, C. M. Murphy, Charles E. Dominy, Albert A. Haltom, Ralph M. Karns, and Gilbert K. Terpening. Wayne S. O'Neill and Philip R. Carter were elected from the Division of Veterinary Medicine.

Candidates for the master's degree elected to membership were: I. L. Hathaway, I. N. Chapman, W. R. Hinshaw, G. T. Klein, H. M. Tysdal, H. G. Walker, H. P. Morris, S. O. Burhoe, and B. H. Luebke. Those elected from the college faculty were: C. H. Kitselman, A. H. Helder, E. A. Stokdyk, K. M. Renner, and R. H. Lush.

BABY CHICK AND EGG SHOW

The first annual K. S. A. C. baby chick and egg show was held April 14-17, 1926. The show was handled entirely by student members of the freshman and sophomore classes.

The purpose of the baby chick phase of the show was to encourage commercial hatchery men to produce strong and vigorous chicks that will be strong enough to ship. The purpose of the egg exhibit was to foster the production of high-quality eggs and a closer selection of hatching eggs.

In quality of products and number of exhibits the show exceeded all expectations. This was especially true of the chick show.

The winners of sweepstakes, cups, or first prizes in one or more of the various classes of the show were as follows:

Egg Show

J. E. Payne, Manhattan
Mrs. Henry Weiranch, Pawnee Rock
Topeka Packing Company, Topeka
Jamestown Produce Company, Jamestown
Miss Margaret Briggs, Hope, Ark.
Esbon Leghorn Farms, Esbon
A. A. Glenn, Woodston
Ivan Schwab ,Chapman
K. S. A. C. students as follows: A. O. McIntire, Catherine Waters, M. C. Axelton, V. J. Klinefelter, R. W. McBurney, J. E. Payne, Jr., Louise Magaw, Ben Grosse, and F. J. Hanna.

Chick Show

Leghorns:
Master Breeders' Hatchery, Cherryvale
White Breeds:
Master Breeders' Hatchery, Cherryvale
Black Breeds:
Master Breeders' Hatchery, Cherryvale
Buff Breeds:
Ross Hatchery, Junction City
Rhode Island Reds:
Ross Hatchery, Junction City
Parti-colored:
A. B. Maclaskey, Burlington

FIRST ANNUAL H. S. CONTEST IN SHOP WORK

The Department of Shop Practice sponsored a contest in shop work for the high schools teaching vocational agriculture. This was the first contest of its kind to be held in Kansas. One section of the contest consisted of knot tying and a second of rafter cutting. First honors were won by the team representing Norton Community High School, Kenney L. Ford, coach. Cecil McMillen of Norton won first place in rafter cutting, second place being won by John Wilson of Iola. In knot tying Earl Posson of Norton and John Wilson of Iola tied for first place.

This contest was held Wednesday, April 21, the day before the sixth annual contest in the judging of farm products. It is probable that this demonstration of skill in shop work will grow rapidly in popularity and importance during the next few years.

SIXTH ANNUAL STATE HIGH SCHOOL CONTEST IN THE JUDGING OF FARM PRODUCTS

The annual state high school contest in the judging of agricultural products was held at the college Thursday and Friday, April 22 and 23, 1926. Forty-nine high schools entered teams of three men each who competed in the entire contest. A team from each of ten other high schools competed in certain sections of the contest.

The contest was arranged in four sections, a half day being devoted to the work in each section. The sections were: (1) Poultry judging, (2) grain judging, (3) judging dairy cattle, and (4) judging beef cattle, horses, sheep, and swine.

A parchment certificate was awarded to the team making the highest total score on all classes of farm products. A certificate was also awarded to each team making the highest score in any section of the contest. Further in recognition of individual honors a certificate was awarded to the high individual in the entire contest.

In each section of the contest a medal was awarded to the high individual. Ribbons were awarded to the five teams making the highest scores in the entire contest; to the teams making the five highest scores in each section of the contest; to the five highest individuals in the entire contest; and to the five highest individuals in each section of the contest.

A partial list of prize-winning teams and individuals follows.

High teams in the entire contest:

Team	*Coach*	*Score*
Chase Co. Com. H. S.	L. F. Hall	5,595
Lawrence H. S.	W. R. Essick	5,390
Manhattan H. S.	H. W. Schmitz	5,388
Frankfort H. S.	H. F. Irwin	5,356
Argonia R. H. S.	A. R. Paden	5,334

High individuals in the entire contest:

Individual	*School*	*Score*
Athol Sayre	Chase Co. Com. H. S.	1,999
Kent Nauman	Frankfort H. S.	1,964
Ray Ellis	Norton Com. H. S.	1,922
Max Wickham	Manhattan H. S.	1,886
Robert Bagley	Pleasanton H. S.	1,879

In poultry judging the Arkansas City High School team placed first, W. R. Sheff, coach. The high individual in this section was Jay Bentley of the Ford Rural High School, W. E. Stone, coach.

The next four ranking teams in poultry judging on the basis of total scores were:

Rank	*Team*	*Coach*
2	Ford R. H. S.	W. E. Stone
3	Miltonvale R. H. S.	L. J. Schmutz
3	Washburn R. H. S.	C. A. Davis
3	Argonia R. H. S.	A. R. Paden

In grain judging first honors went to the team representing Chase County Community High School, L. F. Hall, coach. The high individual in this section was Myrl Martin of the Argonia Rural High School, A. R. Paden, coach.

On the basis of total scores the next four ranking teams in grain judging were:

Rank	*Team*	*Coach*
2	Lawrence H. S.	W. R. Essick
3	Norton Com. H. S.	K. L. Ford
4	Frankfort H. S.	H. F. Irwin
5	Ottawa H. S.	C. O. Banta

In the judging of dairy cattle the Manhattan High School, H. W. Schmitz, coach, won first place. The high individual contestant in dairy judging was Kent Nauman of the Frankfort High School, H. F. Irwin, coach.

The next four ranking teams in the dairy section of the contest were:

Rank	*Team*	*Coach*
2	Hill City H. S.	E. F. Burk
3	Argonia R. H. S.	A. R. Paden
4	Washburn R. H. S.	C. A. Davis
5	Chase Co. Com. H. S.	L. F. Hall

In the animal husbandry section of the contest, the judging of beef cattle, horses,

Some of the Outstanding Winners in the Sixth Annual State High School Contest in the Judging of Farm Products

(1) L. F. Hall, coach, (2) Harry Broughton, (3) Athol Sayre, and (4) Louie Rufener of the Chase County Community High School, high team in the entire contest; also high team in the grain judging section of the contest, fourth team in animal husbandry judging, and fifth in dairy judging. Athol Sayre was high individual in the entire contest and Harry Broughton was high individual in animal husbandry judging. (5) Dwight Patton, coach, (6) Elwin Noffsinger, (7) Clayton Weaver, and (8) Ernest Detweiler, of the Harper High School, high team in animal husbandry judging. (9) H. W. Schmitz, coach, (10) Warren Ljungdahl, (11) Max Wickham, and (12) Gilbert Deibler of the Manhattan High School, team making the third highest score in the entire contest and the highest score in dairy judging. Max Wickham was fourth high individual in the entire contest. (13) W. R. Sheff, coach, (14) Albert Wilhelm, (15) Arthur Lawson, and (16) Ellis Blatchford of the Arkansas City High School, high team in the poultry judging section of the contest. (17) H. F. Irwin, coach, and (18) Kent Nauman of the Frankfort High School. Kent Nauman made the second highest score in the entire contest and the highest score in the judging of dairy cattle. (19) A. R. Paden, coach, and (20) Myrl Martin of Argonia Rural High School. Myrl Martin was high individual in grain judging. (21) W. E. Stone, coach, and (22) Jay Bentley of the Ford Rural High School. Jay Bentley was high individual in poultry judging.

sheep, and swine, first place was won by Harper High School, Dwight Patton, coach. The winner of individual honors in this section of the contest on the basis of total scores, was Harry Broughton of Chase County Community High School, L. F. Hall, coach.

The teams making the next four highest scores in animal husbandry judging were:

Rank	*Team*	*Coach*
2	Miltonvale R. H. S.	L. J. Schmutz
3	Marysville H. S.	Percy Sims
4	Chase Co. Com. H. S.	L. F. Hall
5	Arkansas City H. S.	W. R. Sheff

The record of the Lawrence High School team merits special commendation. This team consistently made high scores without outstanding high points or outstanding individuals. Their scores placed them second in the entire contest and second in the grain judging section of the contest.

The entire contest was a demonstration of serious, hard work. Many scores were high and close. In many respects it was the best contest of its kind ever staged at K. S. A. C. The accompanying picture presents a limited number of the winners.

WINNERS IN K. S. A. C. STUDENT JUDGING CONTESTS

During the second semester of each college year the departmental clubs of the Departments of Dairy Husbandry, Agronomy, and Animal Husbandry conduct judging contests. Each contest is divided into two or more divisions on the basis of the scholastic attainments of the entrants and suitable prizes are offered in each division.

Eighth Annual Students' Grain Judging Contest

This spring's contest in grain judging was the eighth to be conducted by the Klod and Kernel Klub of the Department of Agronomy. It was divided into three divisions—Senior, Junior, and freshman. The winners in these divisions were as follows:

Rank	*Contestant*	*Score*
Senior Division		
1st	A. M. Watson	848
2d	C. M. Carlson	695
3d	I. M. Atkins	692
Junior Division		
1st	George J. Caspar	703
2d	L. M. Clausen	691
3d	LeRoy Melia	620
Freshman Division		
1st	F. J. Raleigh	564
2d	Louis P. Reitz	457
3d	C. S. Channon	376

In the senior division there were 14 contestants; in the junior division, 47; and in the freshman, 7.

It is interesting to note that A. M. Watson has been a consistent winner in student grain judging contests. In the spring of 1924 he won first honors in the freshman division of the contest; in 1925 he ranked first in the junior division; and in 1926 had a strong lead in first place in the senior division.

Twenty-Fourth Annual Contest in the Judging of Beef Cattle, Horses, Sheep, and Swine

The Block and Bridle Club of the Department of Animal Husbandry staged their annual contest Monday afternoon, April 19, 1926. As usual there were two divisions of the contest. In the Senior division there were 19 contestants and in the junior division, 136. The contest consisted of placing eight classes of livestock and giving reasons on four of them. Oral reasons were given in the senior division and written reasons in the junior division.

In each division the winner of first place was awarded a silver cup; the winner of second place a silver medal; and the winner of third place a bronze medal. The five highest men in each division were as follows:

Rank	*Contestant*	*Score*
Senior Division		
1st	W. W. Taylor	492
2d	George J. Stewart	481
3d	H. E. Skoog	461
4th	Howard Vernon	455
5th	E. F. Carr	435
Junior Division		
1st	L. S. Perkins	502
2d	Glenn F. Wiswell	494
3d	S. G. Kelly	493
3d	J. E. Endicott	493
5th	R. L. Rawlins	486
5th	Gerald I. Moyer	486

The high men on each class of livestock in each division were as follows:

Class	*Division*	*Contestant*
Cattle	Senior	W. W. Taylor
Cattle	Junior	F. E. Carpenter
Horses	Senior	H. E. Skoog
Horses	Junior	T. H. Gile E. B. McKnight
Sheep	Senior	George J. Stewart
Sheep	Junior	V. D. Foltz
Swine	Senior	C. M. Carlson
Swine	Junior	R. L. Remsberg S. M. Raleigh F. M. Blauer Paul W. Sargent Harold Platt

Nineteenth Annual Students' Dairy Judging Contest

The annual dairy judging contest conducted by the Dairy Club was held Saturday afternoon, May 1, 1926. There were two divisions of the contest, a senior division for those entrants having had advanced dairy judging and a junior division for all others. In the senior division there were 15 contestants and in the junior division, 101. A gold watch was awarded to the high man in each division. Other appropriate prizes were awarded not only to several of the next highest men in each division but also to one or more of the highest men on each breed of dairy cattle in each division.

The winners were as follows:

Rank	*Contestant*	*Score*
Senior Division		
1st	Howard Vernon	970
2d	F. Dale Wilson	955
3d	J. C. Wallace	895
4th	E. I. Chilcott	874
5th	K. W. Knechtel	870
6th	L. L. Davis	865
7th	A. O. Turner	860
Junior Division		
1st	O. H. Fisher	820
2d	E. L. McClelland	819
3d	Robert T. Schafer	813
4th	J. P. Isaak	799
5th	Paul B. McKibben	783
6th	C. S. Channon	778
7th	Ralph Wood	776

The men winning prizes on each breed of dairy cattle in each division in the order of their rank were as follows:

Breed	*Division*	*Contestant*
Jerseys	Senior	Howard Vernon
Jerseys	Junior	E. L. McClelland
		D. E. Tedrow
		N. J. Springer
Guernseys	Senior	E. C. Russell
Guernseys	Junior	H. P. Blasdel
Holsteins	Senior	E. C. Russell
Holsteins	Junior	Oliver Lear
Ayrshires	Senior	J. C. Wallace
Ayrshires	Junior	E. S. Fry
		F. J. Hanna

Growing Broom Corn in the Great Plains Area

Elmer L. Canary, '27

Broom corn is a member of the sorghum family and may have been derived from some sorghum with a loose open head. In Italy the growing of this sorghum for the making of clothes brushes dates back more than 350 years. It was introduced into the United States in 1798.

New York and Virginia led in the production of broom corn 60 years ago. The center of production has since that time moved westward until now the leading states are Oklahoma, Kansas, and Texas, in the order named. During the early period only the Standard variety was grown. However, since about 1900 dwarf types have come into general use.

In its requirements broom corn differs but very little from the other sorghums, making its best growth in a warm sunny climate. It is both drouth-resistant and drouth-evasive.

Broom corn is especially suited in many ways to the Great Plains area, especially the southern section. It provides a dependable cash crop on cheap new land. It can be grown successfully in spite of the light rainfall and the drouths that are so common in this particular section. The usually dry summer weather during and following harvest is very favorable for the curing of the brush, so that it retains its natural green color.

The two groups of broom corn differ mainly in the height of the plants, in the tenacity of the attachment of the peduncle to the upper node, and in the length and texture of the brush. Standard broom corn grows to a height of 8 to 10 feet under favorable conditions on the field station of the United States Department of Agriculture, Woodward, Okla. The number of leaves varies from nine to eleven and the heads usually range in length from 18 to 24 inches. Dwarf broom corns range from 3.5 to 6 feet in height, with short internodes. The heads range in length from 15 to 22 inches. A third group of broom corn is the Acme broom corn which was developed from a selection made in a field of Standard broom corn by Mr. A. H. Leidigh, at Channing, Tex., in 1906. It has the long brush of good texture similar to the Standard and the short stalk of the Dwarf type. The Acme requires less water than the Standard, which makes it more desirable for the Great Plains area. Many varietal names are applied to each group; but these are insignificant in most cases since they do not represent distinct varieties. The following tabulation shows comparative results of tests at Woodward, Okla.

Group	*Av. yields per acre 1914-1918*	*Percent of good brush*
Standard	331 pounds	80
Acme	392 pounds	88
Dwarf	392 pounds	87

The most satisfactory method of preparing a seedbed for broom corn is to list in the fall and allow the ground to remain over winter in this rough condition. It is important that the listing be done east and west where possible so as to prevent the winds from blowing the soil and snow. At the Hays, Kan., and Woodward, Okla., stations it has been proved that fall listing followed by nosing out the furrows in the spring is the best method for obtaining a good stand. In regions where it is not possible to list in the fall because of winds, it is desirable to allow the stubble to stand over winter and list in the spring. Plowing is not practiced much in the Great Plains region, but when the land is plowed, it is desirable to plow in the fall.

The first step in producing a good crop of broom corn is to secure good seed. In order to obtain the maximum yield of high-quality brush, a uniform stand must be had. Since broom corn crosses very readily with other sorghums, it is essential to know the exact source of the seed. There are three sources from which seed may be obtained: (1) From growers who make a business of growing seed for sale; (2) from piles of seed which accumulate at the broom corn threshers; and (3) from home-grown seed from the field. There are some objections to each of these sources. The danger of getting smut-infected seed is a very perplexing problem and one to which the grower should give most careful attention. In order to safeguard against such infection, it is desirable to treat with copper carbonate.

Planting broom corn may begin in the southwestern part of Texas as early as April 1. In the southeastern part of Oklahoma it begins about April 15, while in western Oklahoma, the Panhandle of Texas, and southwestern Kansas planting begins as late as May 10 and continues for some two weeks. A poor stand is apt to result from early planting in a cold soil.

The rate of seeding will depend upon the available moisture and the fertility of the soil. Experiments have shown that one plant every 6 or 8 inches in the row is about right where the rows are 3.5 feet apart. Thin stands on rich soils tend to produce long coarse brush. Too thick stands on poor soils or in dry sections produce short brush, or in extreme cases fail to produce brush at all.

Cultivation should begin early and be continued regularly while the plants are small, because it is then that the plants are easily choked by weeds. When the crop is surface planted, a spike-tooth harrow is an efficient tool for the first and second cultivations. Later cultivations are made with the regular cultivator.

In order to obtain brush of the best quality, the harvesting should be done early. It may be done at any time from the blooming stage until the seed is in the early dough stage. However, the exact time will depend upon the development of the fiber. The fiber will increase in strength until the natural pea-green color extends from the tip to the base and from the outside to the center of the head. If harvesting takes place before the green color has developed throughout the base of the brush, the result is a weak base and poor quality. When the crop is grown for seed, the brush is not harvested until after the seed is fully mature. Ripe brush, however, is of little value for making brooms.

There are two general methods of harvesting broom corn, due to differences in the height of the plants and the strength of the peduncle where it is attached to the upper joint. The Standard broom corn, which grows tall, must be bent over or tabled, to bring the brush within reach so that it can be cut off. The brush from the Dwarf and Acme broom corns is harvested by pulling or jerking the heads from the standing stalks. As the brush is harvested it is placed in piles, either on the ground between the rows or between the stalks in the row. The latter is more desirable since the brush is less likely to be splashed with soil in case of rain.

Removing the seed from the brush is termed threshing, seeding, or scraping. The machine used for this purpose consists essentially of two cylinders, one placed above the other, revolving rapidly in opposite directions. The surfaces of both the cylinders are set with spikes or teeth. In threshing, only the part of the head containing the seed passes into the cylinders. After the seed has been removed the head is withdrawn.

Broom corn may be cured to best advantage in a shed built especially for this purpose. The gables are usually sheeted but the sides and ends are left open to permit the circulation of air. The brush is cured in shallow layers spread on a series of slats. If placed more than three inches deep curing will oe retarded and the brush may mold, lose its green cloor, and become brittle. Rick curing is not practiced to a great extent where Dwarf broom corn is grown. This method is next best to shed curing, but the loss from damage is often considerable.

A common loss to the broom corn grower in the past has been caused by baling the brush without grading it. However, growers are finding that it pays to separate the good from the poor brush before baling. The appearance of the bale also has an influence upon the selling price of the product. In order to have a neat appearing bale the heads must be laid straight in the baler and the wires made tight and secure.

If the bales are not sold directly from the press, they must be stored in a dry dark place for protection from the weather and sunlight. Bleached bales will not command the price that natural-colored bales command.

The profit or loss in growing broom corn depends upon the cost of production, the yields, and the market price of the product. It is a rather expensive crop to produce because so much hand labor is required. Previous to the World War successful growers in Kansas and Oklahoma placed the cost of production at $35 to $40 a ton. Prices received for broom corn vary with the grade and the supply. When the production is large and the quality poor it often sells for $20 to $30 a ton, while the better grades bring from $50 to $60 a ton. Where there is a scarcity prices have advanced to $250 for a good grade. However, the normal market price ranges from $75 to $100 a ton for good brush. Practically all the brush is consumed in this country.

The yield varies greatly in different sections according to soil fertility and rainfall. Data from the sixteen leading states shows the average to be about 400 pounds per acre. Oklahoma leads in the total number of tons produced even though it has the lowest average yield per acre.

Broom corn stover consists of the stalks and leaves remaining after the brush has been removed. It is usually harvested by means of a corn binder or a mowing machine. Broom corn stover is considered by some growers to rank nearly the same as sorghum stover and corn stover in feed value. The value is, of course, much less than that of kafir or corn fodder, because these contain grain in addition to the stalks and leaves. The value of broom corn stover from which the brush has been taken at the proper time is estimated to vary from $1 to $3 an acre.

BEEF PRODUCTION

(Continued from page 107)

feed cost for lot 3 was less than for lot 2 and they returned a profit of $7.89 per head.

These feeding methods were carried on in a practical manner and the conclusions to be drawn from them should be reliable. The experiment showed first, that under the conditions obtaining in lots 1 and 2, dry-lot finishing is superior to finishing on bluestem grass pasture. Secondly, the test showed that under the conditions of these feeding trials greater and cheaper gains can be secured on bluestem grass pasture after roughing through the winter without grain, than after feeding a light grain ration for the winter period. The feeder, however, should adapt his method to the relative prices of feeds and to his supply of hay, grain, bluestem pasture, and silage.

J. A. Mier, '24, writes from Aguascalientes, Mexico, that he finds himself very busy managing his father's ranch. In the spring of 1924, Mr. Mier shipped a purebred Holstein bull calf to the Mexico ranch. He now plans on purchasing another and two heifers, not only to improve his grade Holstein herd but to build up a purebred herd. Thus K. S. A. C. Holstein blood is being transplanted in Mexico.

G. J. Raleigh, '22, has resigned his position as instructor in horticulture in Massachusetts Agricultural College and is working for his doctor's degree in Chicago University. His major line of investigation is plant physiology.

C. O. Dirks, '24, is instructor in entomology at Purdue University, LaFayette, Ind.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THE EFFECT OF SORGHUMS ON SUCCEEDING CROPS

(Continued from page 111)

ture, and in maturing late in the summer or by a tendency to sucker after harvesting, kafir may remove more moisture from the soil than corn. (2) Kafir stubble and roots have been found to give rise to a decomposition product that is toxic to wheat plants.

For a six-year period at Manhattan, corn soil contained more surface moisture than kafir soil equivalent to one-third of an inch of absorbed water. Though this is not a large quantity of extra moisture, it would be sufficient to give an advantage to wheat planted after corn if the soil moisture supply was critical at the time of planting wheat.

At Manhattan there has been one or two weeks difference between the time of cutting corn and kafir. At Hays, corn is harvested about August 20, and kafir about September 20. After harvesting kafir the stubble though disked will sucker and continue to draw moisture until frost which usually occurs about October 7. Corn stubble would thus have a considerable advantage in soil moisture because the corn matures and dries about the middle of August.

In studies of corn and kafir soil at Manhattan, it was found that in the decomposition of kafir stubble, a product toxic to wheat plants was produced. Under conditions that promoted aeration, the injurious effect of this product upon wheat disappeared.

The above explanations for the fact that kafir may deplete the yield of wheat planted soon after kafir harvest, are in accord with the results of field experiments previously cited. Spring crops after kafir are not usually injuriously affected nor winter wheat when a fallow intervenes between kafir and wheat.

The Iowa Agricultural Experiment Station has obtained six years results comparing the yields of corn following Sudan grass, oats, and soybeans. Sudan grass did not cause any decrease in the yield of corn planted the following spring on fall plowing. The average yields were: (1) Corn following Sudan grass, 61.6 bushels; (2) corn following oats, 57.9 bushels; (3) corn following soybeans, 59.3 bushels.

In northern China, sorghums have been grown for a thousand years or more and there are no reports of sorghums having been injurious to succeeding crops. But the sorghum stubble with attached roots are one of the sources of fuel and are pulled up after the sorghum is harvested.

Sorghums are a very important crop in Kansas and the Southwest. Except in the eastern third of Kansas and the two northern tiers of counties in the northwest, sorghums are a more profitable crop than corn. The data and results of the observations presented, show that kafir is not "hard" on the land if attention is given to the cropping system. Any injurious effect of kafir on the soil is temporary and can be avoided by proper rotation. Where injurious effects occur they are most probably due to exhaustion of soil moisture and decomposition products from kafir roots and stubble. Spring crops and crops on fallow after kafir have produced normal yields. The effect of milo has been found to be similar to that of kafir but to a less degree.

S. L. Copeland, '22, assistant professor of dairy husbandry in South Dakota Agricultural College, Brookings, has accepted a position as head of the American Jersey Cattle Club and will report for duty at headquarters in New York City, September 1. In the meantime, Mr. Copeland plans to visit the Isle of Jersey and make a further study of the Jersey breed.

Lynn is simply coming to his own. He has always been an ardent lover of the Jersey breed. In K. S. A. C., his close friends called him "Old Jersey," becuse of his knowledge of Jersey records and his acquaintance with outstanding Jerseys everywhere. He has just finished a mimeographed textbook giving a history of the Jersey breed.

Charles W. Tozzer, Ohio State University, '26, began work as graduate assistant in horticulture in K. S. A. C. in March, 1926.

Russell Reitz, '27, is looking forward to a pleasant and profitable summer as assistant inspector for the Kansas Entomological Commission. His work will be confined largely to the control of San Jose scale in the northeastern part of the state.

Robert E. Mohler, M. S., '17, in charge of the agricultural work at McPherson College, has recently been made dean of the college.

AN ADEQUATE DIET FOR POULTRY

(*Continued from page 103*)

green feed and when often they are fed largely on white corn and other cereal grains very low in Vitamin A content. After a flock is kept on such a feed throughout the entire winter the condition described above is almost sure to result.

The best way to include Vitamin A in poultry feed is to use yellow corn and alfalfa leaves. The alfalfa leaves may be included in the the mash or they may be fed by simply throw-alfalfa hay in the litter. During the past few years the author has attended poultry meetings in various states and has so far had no reports of serious outbreaks of nutritional roup where the feed contained an abundance of Vitamin A in the form of yellow corn and alfalfa leaves. If it is impossible to secure yellow corn or dried green leaves it is possible to incorporate Vitamin A in the feed by the use of cod-liver oil, a substance usually very rich in Vitamin A content.

This discussion is not intended to give the impression that roup is not a bacterial disease, but it is intended to emphasize the fact that the lack of Vitamin A will reduce the resistance of the eye to such a point that the disease is sure to follow. The Vitamin A needs of poultry will be cared for if the grain consists largely of yellow corn and as much as 5 percent of the ration is composed of bright alfalfa leaves.

Vitamin B.—The outer covering of all grains contain an abundance of Vitamin B. Poultry feeds are seldom lacking in this vitamin since all poultry feeds contain considerable quantities of the outer covering of grains. For this reason the Vitamin B offers no problem whatever in poultry feeding.

Vitamin C.—Recent experiments seem to show conclusively that Vitamin C can be made by poultry. Vitamin C differs from the other vitamins in that it is practically completely destroyed by drying. It is the only one of the food elements listed that cannot be added to the feed very easily in a dry form. Since it is not needed in the poultry ration, it is possible to make a completely adequate poultry ration from dry material.

So far as the writer is aware, no experiments have been conducted which show that any value was obtained by adding fresh leaves such as sprouted oats, cabbage, etc., to a diet which contained in sufficient quantities all the necessary substances besides Vitamin C. If the feed is low in its Vitamin A content, as is very often the case, sprouted oats will be very beneficial because of its Vitamin A content, but as stated above, it is much simpler to include the Vitamin A in poultry rations during the winter months by the use of alfalfa leaves.

Vitamin D.—Vitamin D is made only by the action of ultra-violet light on certain chemical compounds. These compounds are quite widely distributed in both plants and animals.

When direct sunshine is passed through a prism it is spread out into its spectrum. There can be seen rainbow colors ranging from red to violet. These differ from each other only in their wave lengths, the red being the longest wave and the violet, the shortest. The human eye can see only a part of the sun's spectrum. There is beyond the violet a number of rays of shorter wave length which cannot be seen. This portion of the sun's spectrum in which the waves are too short to be seen has been called the ultra-violet, meaning beyond the violet. It is this portion of the sun's rays which brings about the production of Vitamin D.

It seems that Vitamin D is made when the ultra-violet light shines on these compounds either in the living tissue or in the dead substances. That is, the Vitamin D is developed when the ultra-violet light shines upon the skin of an animal and it is also developed when the light shines upon such products as grains, leaves, etc. From this it may seen that if the animal receives ultra-violet light, it will not be necessary to include Vitamin D in the feed, but if the animal does not receive the ultra-violet light, then some matreial carrying the Vitamin D must be incorporated in the feed.

The only commercial substance available at the present time for this purpose for poultry feeding is cod-liver oil. Milk from cows which are receiving the ultra-violet light and egg yolks from hens receiving ultra-violet light may contain a considerable quantity of the Vitamin D.

Most of this ultra-violet light is filtered out when sunlight shines through ordinary glass windows. For this reason animals kept indoors where all of the light they receive pass-

es through glass windows, will receive very little ultra-violet light, and Vitamin D will have to be provided in the feed.

There are on the market a number of glass substances which transmit a considerable portion of the ultra-violet light from the sun. Practical experiments are now being conducted which seem to indicate that it is profitable to replace the ordinary glass by these materials when climatic conditions are such that it is necessary to keep the windows of the poultry house closed during long periods of time. There is a question, however, as to the durability of these materials. In some instances some of them have completely deteriorated in one year. Until further careful experimental evidence has been secured, it is impossible to make any definite statements concerning the practical use of such materials.

Mercury arc lamps which have quartz tubes produce a light much richer in the ultra-violet rays than ordinary sunlight. Such lamps have been used for therapeutic purposes in many doctors' offices for the past eight or ten years. A year ago, the Cooper-Hewitt Company begun manufacturing a quartz mercury arc lamp which they designate as the "Uviarc Poultry Treater." An exposure of from 15 to 20 minutes to the light of this lamp is equivalent to several hours treatment of direct sunlight. Under present conditions, for ordinary use it is perhaps cheaper and more convenient to use cod-liver oil to provide Vitamin D for poultry than it is to develop this Vitamin D by the use of the Uviarc Poultry Treater. If, however, a person has some valuable poultry and wants to be absolutely sure of producing Vitamin D, he can do so by installing one of these lamps which produces this ultra-violet light.

If a growing chick does not receive Vitamin D either in its feed or by having the substance produced in its body under the influence of ultra-violet light, it will be unable to utilize properly its calcium and phosphorus and will develop rickets, a condition commonly known as leg weakness. In this condition none of the tissues develop normally. The most obvious derangement occurs by a failure of the bones to develop. Growing chicks are very susceptible to the lack of Vitamin D. If the proper minerals and the other essential elements in the diet are provided in the most satisfactory quantities, it is possible to keep chicks for six to eight weeks away from the direct sunshine without having to provide them any Vitamin D in their feed. When the ordinary chick feeds are used weak legs will develop in from three to six weeks if the chicks are kept out of the direct sunshine and not provided with feed rich in Vitamin D.

It was formerly thought that leg weakness developed when chicks were kept in the brooder house because they were prevented from scratching in the ground. The same brooding ranges used repeatedly often became infected with roundworms and coccidiosis and heavy losses resulted. There was no practical way of disinfecting the ground. Rotation of the brooding range would prevent the difficulty, but this often was not feasible.

It is now known that it is not scratching in the ground, but direct sunshine or Vitamin D that prevents weak legs in chicks. This discovery enables the poultryman to raise good chicks on cement floors without letting them out on the ground. By this method no rotation is necessary in order to eliminate the dangers from roundworms and coccidiosis.

The lack of Vitamin D in the laying hen interferes with the proper utilization of minerals just as it does in the growing chicks. This improper utilization of minerals results in the production of fewer eggs and eggs having very thin shells. A condition often develops which is known as leg paralysis. In this condition the hen will often retain a fully developed egg for two or three days and will be more or less completely paralyzed in her legs. Eggs from hens which do not receive Vitamin D, or the ultra-violet light which enables them to make it, produce eggs which contain very little Vitamin D. Such eggs will not hatch well. Undoubtedly one of the causes for poor hatches in the early spring is that hens during the spring months do not receive much direct sunlight. Of course, this may be overcome by getting the hens out in the sunshine as much as possible. Where the climate is such that the hens cannot receive sufficient sunlight, Vitamin D may be provided in the form of cod-liver oil.

No information is now available on the amount of sunshine which a hen must receive to produce the best eggs. In some of the experimental work at this station it was found that hens kept indoors all winter but treated 20 minutes each day with the Uviarc Poultry

Treater produced eggs having good shells and of good hatchability. Just as good results were obtained with another group of hens which received cod-liver oil at the rate of 1 pint per 1,000 birds per day.

In the use of cod-liver oil as a source of Vitamin D it must be remembered by poultrymen that various cod-liver oils differ greatly in their Vitamin D content. The only way to be sure that satisfactory results will be obtained is to purchase a cod-liver oil that has been tested for its Vitamin D content by actual feeding experiments. A number of the reliable firms in the country are selling oils which have been tested and are known to contain Vitamin D. The E. L. Patch Company of Boston has cooperated with the author in all his experimental work to the extent of providing such tested oils. Recent carefully conducted experiments have ascertained that at least for a six-month period, there is but little loss in the Vitamin D content of the cod-liver oil mixed with poultry feeds.

Cod-liver oil contains, besides the Vitamin D, a considerable amount of Vitamin A, so when it is included in the ration it adds both Vitamin A and Vitamin D, both essentials in poultry feeding. There is no need, however, of adding cod-liver oil if the Vitamin A has been provided as suggested above by the use of yellow corn or green leaves either fresh or dried and the Vitamin D is cared for by getting the poultry out in the direct sunshine.

Summary

From the above discussion, it will be seen that some of the earlier ideas in regard to poultry feeding have recently been modified as regards the following points:

1. The so-called animal protein supplements such as milk, meat scrap, and tankage, owe much of their superiority over the vegetable protein supplements, such as cottonseed meal, soybean meal, and peanut meal, to their mineral content rather than to the quality of their protein.

2. The vegetable protein supplements can be used with satisfactory results if at the same time a mineral supplement is put in the feed.

3. A mineral supplement should be included in practically all poultry feeds. The mineral content of the feeds used, the purpose for which the feed is used, and the conditions under which it is used, should be taken into consideration in determining the quantity and the composition of this mineral supplement.

4. Satisfactory results can be obtained when all of the minerals are included in the feed in the form of a fine powder. That is, good results can be obtained without the use of grit.

5. The lack of Vitamin A in the feed is a predisposing cause of practically all of the diseased condition of the eyes and throat commonly known as roup.

6. Vitamin A can be supplied in the feed most conveniently by the use of yellow corn and green leaves, either fresh or dried. As much as 10 percent of the laying mash may be composed of alfalfa leaves with excellent results.

7. Poultry feed need not contain any Vitamin C. The value of green sprouted oats is in the Vitamin A which they contain. If this is provided in other forms the fresh sprouted oats is not necessary for good results.

8. The lack of direct sunshine and not the lack of exercise on the soil is the cause of leg weakness (rickets) when chicks are kept in the brooder house. Chicks can be kept inside without the development of leg weakness if Vitamin D is provided in the feed or if an artificial source of ultra-violet light is used. One to two percent of a good cod-liver oil in the ration or the treatment of the chicks from 20 to 30 minutes a day with the Uviarc Poultry Treater would cause normal utilization of the minerals and prevent weak legs without direct sunshine.

However, if full use is made of the abundant sunshine in Kansas, it will not be necessary to employ an artificial source of ultra-violet light or use cod-liver oil in poultry production so far as Vitamin D is concerned.

9. Laboratory experiments show that growing chicks do not have to be placed on the soil to prevent leg weakness, but may be kept on a cement floor. This indicates that one should be able to eliminate the trouble with roundworms and coccidiosis without changing the broder range.

10. The lack of direct sunshine is one of the causes of poor hatches in the early spring. This condition may be corrected by the use of cod-liver oil in the diet or by providing ultra-violet light by an artificial source.

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