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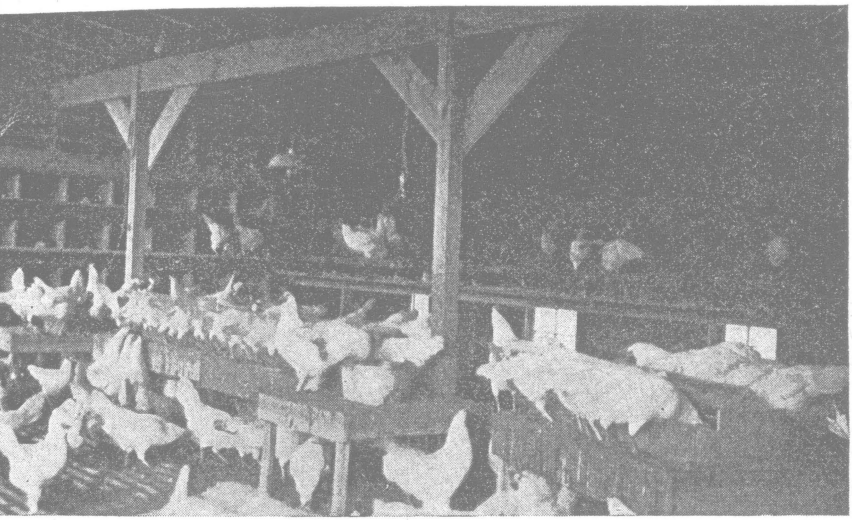
Poultry Feeding



Sufficient mash hopper space is an important factor in management for high egg production.

By

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Contents

Poultry Feeding

MORE than half of the expense of producing poultry meat and eggs is for feed. Efficient feeding practices are therefore necessary to make poultry raising most profitable. Poultry feeding should be based on: (1) the feed requirements of birds, (2) the nutritive value of the different feeding stuffs, and (3) a knowledge of how to use them for growth, health, fattening, egg production, and hatchability.

Principles of Poultry Feeding

The bird may be compared to a factory (see Fig. 1). Feeding stuffs are the raw materials, and meat and eggs are the manufactured products. The manager of the factory is the poultry feeder. The efficiency of the factory will depend upon:

1. Suitability for purpose, or type of bird.
2. Quality of construction, or breeding of bird.
3. Working condition of equipment, or health of bird.
4. Raw materials, or feeding stuffs fed.
5. Management, or feeding and care given by feeder.

Nutrients

The animal body, eggs, and feeding stuffs are composed of varying amounts of chemical groups of substances known as *nutrients* (see Table II). Their chief functions, principal sources, and approximate quantities in poultry rations are shown in Table on next page.

Carbohydrates include sugars, starches, and cellulose. In chemical analysis of feeding stuffs, they are designated as *nitrogen-free extract* and *fiber*. The total dry matter in a feeding stuff minus the sum of the ash, crude protein, fiber and fat equals the nitrogen-free extract. The woody portion of a feeding stuff remaining after treatment with weak acid and alkali is fiber. It is poorly digested and utilized by poultry. Large quantities of feeding stuffs high in fiber content (Table II) should be avoided in poultry rations.

Proteins are composed of smaller units known as amino acids. Certain kinds of amino acids are as necessary for repair and growth of tissue as certain kinds of building material are essential for construction of a building. *Crude protein* is estimated in the usual feed analysis by determining the nitrogen content and multiplying it by 6.25. It gives no information concerning the essential amino acids present. One needs to know the source of the crude protein of a ration as well as the quantity. The feeding of two or more feeding stuffs that contain different essential amino acids supplement each other or overcome the deficiencies.

Fats are manufactured efficiently by animals from the cheaper and more abundant carbohydrates. *Fat* or *ether extract* is determined by extracting the dried pulverized feed with ether. It includes true fats, waxes, and fat soluble vitamins.

Nutrients	Chief Functions	Principal Sources	Approximate Per Cent of Rations
Carbohydrates	Heat, energy and fat production	Corn, wheat, oats, barley, middlings, and bran. See pages 7-11 for additional sources.	75–90
Proteins	Repair of tissue. Body and feather growth. Production of egg white and yolk.	Milk, meat scraps, fish meal, and soybean oil meal.	5–20
Minerals	Growth of bones. Egg shell formation. Body processes.	Bone meal, oyster shell, limestone, salt and meat scraps.	1–5
Vitamins	Body processes.	See Table II	
A	Growth and prevention of nutritional roup and respiratory troubles.	Yellow corn, green grass, alfalfa, or other legume hays and cod liver oil.	
B and G	Growth and prevention of nervous disorders.	Germs of grains, milk, and yeast.	
D	Mineral metabolism, hatchability, prevention of rickets, and thin eggshells.	Sunshine, cod liver oil, and ultra violet light.	
E	Hatchability.	Middlings, alfalfa and green grass.	
Water	Body processes, growth, and egg formation.	Water and liquid milk.	

Minerals vary in kind and quantity in different feeding stuffs. *Ash* the residue after a feed is burned. This determination does not give the ki or quantity of mineral elements present. They should be known, because t quantity and balance between them are important factors. Therefore, certa kinds and amounts of feeding stuffs should be chosen to supply essenti mineral elements.

Vitamins are widely distributed in feeding stuffs, but occur only in trac They can only be determined by feeding tests and observation of the effe produced on animals. Proper choice of feeding stuffs is essential to meet t vitamin requirements of poultry.

Water requirements are met when fresh clean water or milk is ke before the birds at all times.

Metabolism

Metabolism may be considered here to mean the total processes which feeding stuffs undergo from the time they enter the body until they leave it. It includes digestion, assimilation, and excretion.

Digestion of Feed

Digestion is the preparation of feed which has been eaten, for use in the body. The feed is stored temporarily in the crop (Figs. 1 and 2) where it is softened. It passes to the gizzard where it is mixed with acid digestive juice and ground. It next passes into the duodenal loop of the small intestines. Here excretions from the pancreas and alkali salts from the bile are poured in. The portion of feeding stuffs which is digestible is digested in the upper part of the small intestine. Digested feed passes through the intestinal walls into the blood stream. It is carried by this medium to the tissues for assimilation.

Coefficient of Digestibility is the per cent of feed consumed which is digested. For example, if 100 grams of corn are consumed and 10 grams pass out in the droppings, the amount digested is 100 — 10, or 90 grams. This amounts to 90÷100 or .9 digested, or in terms of per cent, .9×100= 90, or 90 per cent is the coefficient of digestibility. Calculation of the digestibility of a ration from tables of coefficients of digestibility of feeding stuffs is of little value, because combinations of ingredients used change the digestibility of each of them. The only satisfactory way to determine the digestibil-

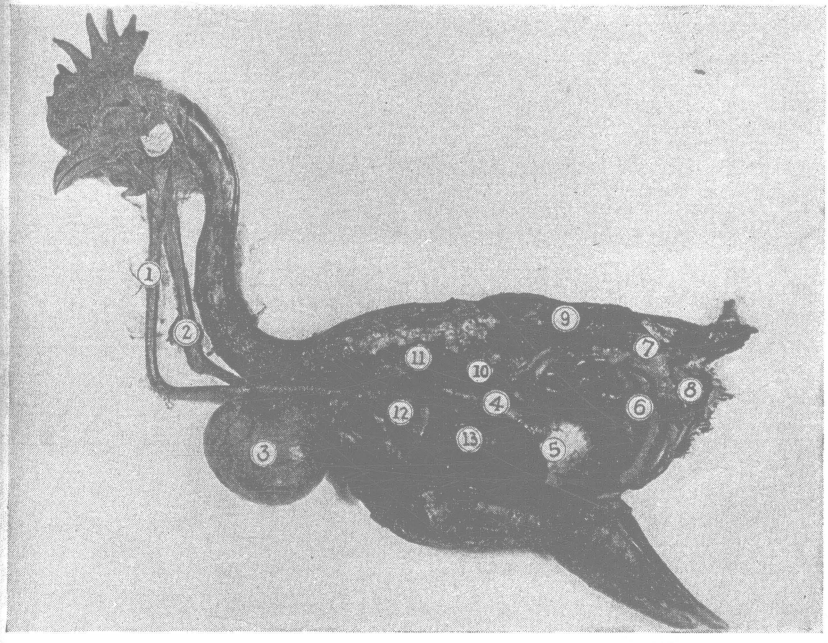

Fig. 1.—Sectional view of the chicken showing: (1) windpipe or trachea; (2) esophagus or gullet; (3) enlargement of gullet or crop; (4) glandular stomach or proventriculus; (5) gizzard; (6) duodenal loop of small intestine; (7) large intestine; (8) rectum; (9) kidneys; (10) ovary; (11) lungs; (12) heart, and (13) the liver.

ity of a ration is to make the determination with the material under the con dition which it is to be used. This procedure is too expensive to be practica

Nutritive Ratio is the ratio of available energy producing nutrients t tissue-building nutrients. The formula is:

$$\frac{\text{Digestible carbohydrates} + (\text{digestible fat} \times 2.25)}{\text{digestible crude protein}}$$

The digestible fat is multiplied by 2.25 because it has this much greater he and energy production value than carbohydrates. The nutritive ratio o most poultry rations varies from about 1:3 to 1:5, which means that th energy part of the ration is three to five times that of the tissue building pa of the ration. The 1.3 ration would be called narrow and the 1:5 woul be wider. Narrow rations are used for early growth, wider rations for late growth and egg production, and still wider rations for maintenance an fattening.

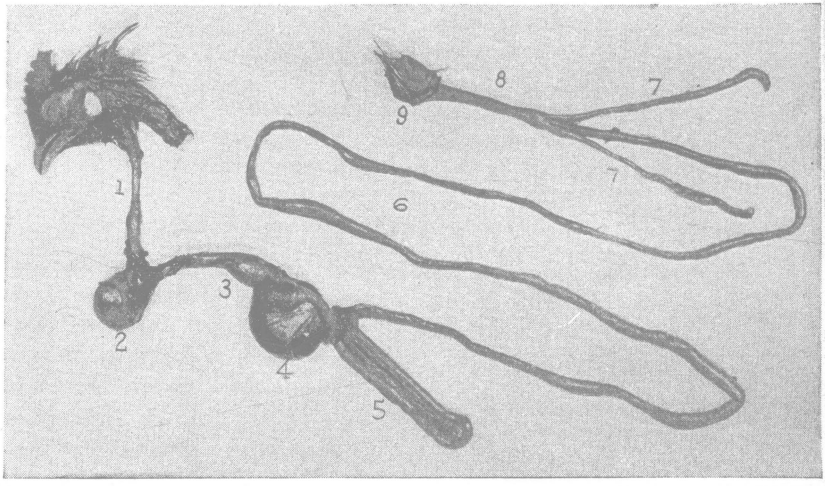

Fig. 2.—The digestive tract of the chicken showing: (1) gullet; (2) crop; (3) glandular stomach; (4) gizzard; (5) duodenum; (6) small intestine; (7) cecae or blind guts; (8) large intestine, and (9) the cloaca.

Calculation of the nutritive ratio of a ration is limited by the same fac tors which limit the calculation of digestibility. Its use in determining th value of a ration is further limited because it does not take into consideratio amino acids, vitamins, and minerals, which are esential parts of all rations

Assimilation of Digested Nutrients

Assimilation of digested nutrients carried from the intestinal tract take place in the various tissues of the body.

Carbohydrates are burned or oxidized with oxygen from the air. Thi is brought to the tissues from the lungs by means of the blood stream. Hea or energy is liberated and carbon dioxide and water are given off as by products. Excess carbohydrates may be transformed into fat and stored a fat tissue as a reserve supply of energy.

Proteins are used for repair of worn-out tissue, for building new tissue, and for egg formation. The chief waste by-products are uric acid and ammonia. Excess protein may be broken down and the carbohydrate portion used for heat, energy, or fat production.

Fats are stored as tissue fat or burned, when the carbohydrate supply is low, for heat and energy production with carbon dioxide and water as waste products.

Excretion

Excretion of undigested feed is by way of the intestinal tract as droppings or feces. Protein waste products are excreted by way of the kidneys. As the urine passes out much of the water is re-absorbed into the body and the residue is excreted into the cloaca as a pasty mass and passes out with the feces. Mineral wastes are excreted by both the feces and urine. Carbon dioxide is excreted in the breathing process. Water is excreted by the breathing process and also by the urine and feces.

Poultry Feeding Stuffs

The four principal groups of feeding stuffs are the carbohydrate, protein, mineral, and vitamin products. Characteristics of some of the most common feeding stuffs of the various groups and their use in poultry rations is given below.

Carbohydrate Feeding Stuffs

The cereal grains—corn, wheat, oats, barley, etc., are much alike in composition (Table II) and feeding value. The amount of different grains in poultry rations may be varied, depending on price and availability. Grains are graded according to moisture content, weight per bushel, soundness of kernels, and freedom from foreign seeds and dirt.

Corn is generally more plentiful and cheaper than other grains in Ohio, and under such conditions should predominate in poultry rations. Yellow corn is preferable to white or red corn since it contains vitamin A. If white corn is fed, other feeding stuffs (Table I) should be used to supply vitamin A. Cracked corn is more palatable than whole corn, but it is doubtful if sufficient benefit will be derived by cracking to justify the cost.

Corn Feed Meal is the by-product obtained in the manufacture of cracked corn, with or without aspiration products added to the siftings. It is not a standard product. The feeding value will vary, depending on the amount of corn bran, screenings, etc., it contains.

Hominy Meal is a by-product of the manufacture of hominy, hominy grits, and corn meal by the degermination process. It contains the corn bran, germ, and part of the starchy portion of the grain. It varies in composition, depending on the amount of germ and bran it contains.

Wheat is well liked by poultry. It is consumed in greater quantity than any other feeding stuff when chickens are given free choice of ingredients. When wheat is cheaper than corn, it may be used to replace about half of the corn in the ration. Ground wheat may be used to replace the bran and

middlings in poultry rations, but it is not quite as desirable. The bran and middlings have greater feeding value because they contain the germ and outer coating of the grains and, therefore, much of the vitamin, mineral, and protein content of the grain. There is probably very little difference in the feeding value of winter and spring wheat products.

Wheat Bran is the coarse outer coating of the wheat kernel as separated from cleaned and scoured wheat in the usual process of commercial milling. Middlings contains much bran. Flaky bran is preferable to finely ground bran. It is bulky and laxative and should not constitute more than 5 to 10 per cent of the ration.

Standard Middlings consist mostly of fine particles of bran, germ, and very little fibrous offal obtained in the milling process. They should not contain more than 9.5 per cent crude fiber. Good middlings are low in fiber and contain little or no screenings. Middlings may constitute 15 to 30 per cent of poultry rations.

Screenings consists of the smaller imperfect grains, weed seeds and other foreign materials, having feed value, separated in cleaning the grain. Most screenings are objectionable because they are unpalatable and of little value as a feed.

Flour Middlings consist of standard middlings and red dog flour combined in the proportions obtained in the usual process of milling. They should not contain more than 6 per cent crude fiber. More bran may be used in rations containing flour middlings than where standard middlings are used.

Wheat Mixed Feed (Millrun) consists of pure wheat bran and flour middlings in the proportion obtained in the milling process. It should not contain more than 9.5 per cent crude fiber.

Oats are a valuable constituent of poultry rations. They should not constitute more than 10 to 20 per cent of the ration because of the fiber content. Heavy oats (32 pounds per bushel up) should be used. They give best results when finely ground and fed in the mash. The feeder is not justified in paying the extra price for hulled oats, since finely ground oats give satisfactory results even in chick rations.

Oat Groats (Hulled Oats) are the kernels of the oat.

Clipped Oats have the hulls clipped at the pointed end.

Rolled Oats consist of nearly the whole oat kernel with only a portion of the skin and sometimes the tip removed.

Barley is a very good feed for poultry. It may be used to replace as much as 20 per cent of the corn, wheat, or oat products in the ration.

Buckwheat is not well liked by poultry. It may be used to replace 5 to 10 per cent of one of the other grains in the mash.

Rye is not well liked by poultry, nor does it seem adapted for poultry feeding.

Cane Molasses or blackstrap, the by-product of the manufacture of cane sugar, is palatable and relished by poultry. It may be used to replace cereal grains, pound for pound, up to 10 per cent of the ration. The most satis-

factory way of feeding molasses is to incorporate it in the mash feed. This can be done most satisfactorily by the use of a power molasses mixer. Where little or no milk is fed in the ration, molasses increases palatability, increases water consumption, serves as a mild laxative, and appears to keep poultry in more healthy condition.

Bread and other stale bakery products are sometimes fed to poultry. The analysis of bread (Table II) shows that it does not vary much from that of grains. Bakery products may be used to replace part of the grain mixture fed to poultry.

Potatoes which are too small for sale are sometimes cooked and fed to poultry. In such cases a gallon of cooked potatoes may be used to replace about one-half gallon of scratch grain for 100 birds daily.

Dried Whey is a by-product of cheese manufacture which contains about 70 per cent milk sugar (lactose). It is milk with most of the protein removed. Dried whey is not as desirable a feeding stuff as dried milk.

Kafir, Millet, Milo and Feterita seeds are sometimes used in scratch grain mixtures. They are not as valuable as corn and wheat, but make satisfactory substitutes in some states where the latter grains are not readily available.

Complex Scratch Grain Mixtures are no better than a corn and wheat mixture. In fact they are less palatable and generally inferior in value. They are sold on the theory that the variety afforded will give better results. However, each grain supplies about the same kind of nutrients and experimental evidence is lacking to justify their use.

Protein Concentrates

The protein feeding stuffs commonly fed to poultry are of animal and vegetable origin. *The animal protein concentrates* include milk, meat scrap, tankage, and fish meal. *The vegetable protein concentrates* include soybean oil meal, corn gluten meal, cottonseed meal, and linseed oil meal. The animal protein feeding stuffs, if of good quality, are more palatable, digestible, and better utilized than the vegetable protein feeding stuffs. Combinations of animal and vegetable products, if properly chosen, supplement each other and produce very good results. Vegetable protein concentrates must be supplemented with minerals for satisfactory results.

Liquid Milk, sweet and sour, are of equal value for both young chicks and laying hens. Milk may be taken directly from the separator to the chickens to avoid the trouble of keeping it setting around in containers until sour. If it sours during warm days before it is consumed no harm will be done. Skimmilk and buttermilk are also of equal value, provided neither one has been diluted with water. The feeding value of liquid milk in comparison with other protein feeding stuffs is about as follows: 1 gallon liquid milk = 3 lbs. condensed milk = 0.9 lb. dried milk = 1 lb. meat scraps.

Therefore, where liquid milk is available, it is generally a much cheaper feed than the other products. A hundred hens will drink from 3 to 4 gallons of milk a day.

Condensed Skimmilk and buttermilk are of equal feeding value. The products as commonly marketed contain about 72 to 74 per cent water. The most satisfactory way to feed the material is to paste it on boards and let the birds pick it off. It requires about 11 pounds of condensed milk per 100 hens per day to furnish the same amount of milk as would be consumed if given as the only drink in liquid form.

A less satisfactory way to feed the material is to dissolve it in water and give it in the place of liquid milk. It requires 2½ to 3 pounds of condensed milk in every gallon of water to produce a solution equal in strength to liquid milk. Condensed milk may also be mixed in the mash and fed. The feed cannot be held very long, especially in warm weather, for it will heat and mold.

Dried Milk, skimmilk and buttermilk are of equal feeding value. These products are nearly as efficient as liquid or condensed milk when compared on the same solid basis. The equivalent feeding basis of various forms of milk is about as follows:

Liquid milk only as a drink	=	10 to 11 lbs. of condensed milk daily per 100 hens or diluted at rate of 2½ to 3 pounds to a gallon of water.	=	About 13 lbs. of dried milk in every 100 pounds of total feed eaten.

Skimmilk is more constant in composition than buttermilk because it does not contain neutralizers. Age or method of manufacture has no significant influence on feeding value provided the products have not been overheated. Choose dried milk for feeding purposes which is white or creamy white in color.

Meat Scraps is a ground, dry rendered residue from animal tissues exclusive of hoof, horn, manure, and stomach contents, except in such traces as might occur unavoidably in good factory practice. When this product contains more than 10 per cent phosphoric acid, it should be designated Meat and Bone Scrap. The larger the amount of bone in the product the lower will be the protein content. The material may vary from about 40 per cent ash and 35 per cent protein in the case of meat and bone meal to 10 per cent ash and 75 per cent protein in the case of meat meal.

Most of the meat scraps on the market carry about 50 per cent protein and 20 to 25 per cent ash. Therefore with each 4 or 5 pounds of meat scrap there is about 1 pound of bone meal included. Good quality meat scraps contains less than 10 per cent fat, is light brown in color, and comparatively free from black particles and foreign material.

Tankage has the same definition as meat scraps except it may be prepared for feeding purposes by tanking under live steam as well as by the dry rendering process. Most tankage is prepared by the old live steam process which gives an inferior product. Furthermore, much tankage is diluted with blood meal, a poor feeding stuff. Most tankage is inferior to meat scraps as a feeding stuff for poultry.

Material from local packing plants or soap and tallow works is available in some communities. Such products make good tankage or meat scrap provided they have first been thoroughly cooked, fat rendered, dried and ground.

Blood Meal is ground, dried blood. It is a poor feeding stuff for poultry.

Fish Meal is the clean, dried, ground tissue of undecomposed fish, with or without the extraction of part of the oil.

Fish Residue Meal is the clean undecomposed residue from the manufacture of glue or other fishery products from non-oily fish.

Fish meals resemble meat scraps closely in protein and ash content. Fish meals also vary in feeding value, depending on method of manufacture and the amount of internal organs the products contain. Meat scraps and fish meal are generally considered of equal feeding value, and may be used in combination or interchangeably, depending on prices.

Liver Meals as ordinarily marketed are not as desirable as meat scraps or fish meal as a protein concentrate. Fish liver meals vary in vitamin D content. Some contain only a trace of it and others are good sources. Unless fish liver meals carry a reliable guarantee regarding vitamin content, they should not be substituted for good cod liver oil.

Soybean Oil Meal promises to become one of the leading protein concentrates of the future. Soybeans improve the soil on which they are grown, the oil extracted from the beans is valuable for industrial processes and the resulting beans (soybean oil meal) is a good protein feed when supplemented with minerals. Ground soybeans are not as desirable as soybean oil meal because the presence of the oil reduces the palatability.

Corn Gluten Meal is that part of commercial shelled corn that remains after the separation of the larger part of the starch, the germ and the bran, by the process employed in the manufacture of corn starch and glucose. Corn gluten meal, when used with some animal protein concentrate in the ration, produces very good results.

Cottonseed Meal is a product of the cotton seed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil; provided that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent protein. Good cottonseed meal contains 40 per cent or more protein and should be finely ground, of sweet odor, reasonably bright in color, yellowish (not brownish or reddish in color), and free from excessive lint.

When properly supplemented with minerals, cottonseed meal may be used to replace part of the animal protein feeding stuffs in poultry rations. The use of more than 5 per cent cottonseed meal in rations results in the production of poor quality eggs if they are held in storage.

Linseed Meal (Oil Meal) is made from flax seed by extracting the oil. It may be used in quantities not to exceed about 5 per cent of poultry rations. It is laxative in action.

Mineral Feeding Stuffs

Mineral feeding has been over-emphasized in recent years. Simple mineral mixtures to supplement vegetable protein feeding stuffs, and oyster shell or limestone kept available for layers are about all that are needed. Meat scraps contain more bone meal than formerly and supply sufficient quantity for growth where this material alone or with milk is used as the source of protein. There is not sufficient evidence to warrant the addition of iron, iodine, sulfur, and less common elements to ordinary poultry rations.

Salt is generally added to poultry rations at the rate of 0.5 to 1 per cent to increase palatability and aid digestion. Meat scraps, fish meal, and milk contain a considerable quantity of salt. Where these products are used as the source of protein the addition of salt is of doubtful value.

Bone Meal varies in composition, depending on method of manufacture. Raw bone meal, sometimes called poultry bone meal and steamed bone meal, has been thoroughly cooked, dried and ground. These products contain about 23 per cent protein. *Special steamed bone meal* is a by-product of gelatin or glue manufacture. Practically all of the fat and protein material have been removed from the product. It is cheaper than poultry or steamed bone and probably just as good for mineral feeding purposes. *Fertilizer bone* is unpalatable, has a disagreeable odor, and is not suitable for poultry feeding. Bone meal is not needed in rations where animal protein feeds such as meat scraps, tankage, fish meal, and milk are used as the protein concentrates.

Rock Phosphate resembles bone meal in composition but is not a satisfactory substitute for it. The product is not a satisfactory feeding stuff probably because it contains fluorine and other elements as impurities.

Phosphatic Limestone is a natural mineral consisting of a mixture of limestone and rock phosphate in which the former predominates. It may be substituted for bone meal or a mixture of bone meal and limestone in rations for growth. It is also a fair substitute for oyster shells for eggshell formation.

Oyster Shell is one of the best sources of calcium for eggshell formation. The intermediate size particles are more desirable than the large or fine material. It is doubtful if clam or other sea shells will give as good results as oyster shell. A hen will consume 2½ to 4 pounds of shell in a year, depending on the egg production. This would be equivalent to about 4 per cent of the ration. One might incorporate the oyster shell or limestone in the laying ration to avoid keeping it available in hoppers. However, until more is known about mineral feeding the latter practice is preferable.

Limestone for use as a mineral feed should contain 95 per cent or more calcium carbonate. It is a fair substitute for oyster shell as a source of calcium for eggshell formation. A satisfactory practice is to keep both oyster shell and limestone grit available for layers.

Grit, such as sand, mica, etc., which do not supply mineral elements for growth or egg production are of no value in poultry rations. Feeds are softened sufficiently in the crop and the muscles of the gizzard are sufficiently strong that grinding is easily accomplished without the presence of a lot of hard grit cluttering up the gizzard.

Mineral Mixture Supplement for vegetable protein feeding stuffs is simple and cheaply compounded. A satisfactory mixture consists of bone meal 40, limestone 40, and salt 20 parts. One pound of mineral mixture is generally used with each 5 pounds of vegetable protein feeding stuff.

Kelp is a sea weed and should be classed as a carbohydrate but is here classed as a mineral feeding stuff because of its high ash content and because it is advocated for its mineral content. It is doubtful if kelp improves the poultry rations.

Complex Mineral Mixtures are not necessary in poultry rations. They are generally expensive and often reduce the value of a ration.

Vitamin Feeding Stuffs

In addition to certain feeding stuffs which contain one or more vitamins (Table I), there are some products which deserve special mention.

Alfalfa Leaf Meal is a good substitute for green grass. It supplies vitamin A and some factor which is needed for hatchability. The leaf meal is preferable to the alfalfa meal because it contains more leaves and less stems. The leafy portion contains the essential nutrients. Leaf meal should be bright green in color, have an alfalfa fragrance, and contain not more than 18 per cent fiber. Alfalfa meal may contain as much as 35 per cent fiber. A brown color indicates low vitamin content.

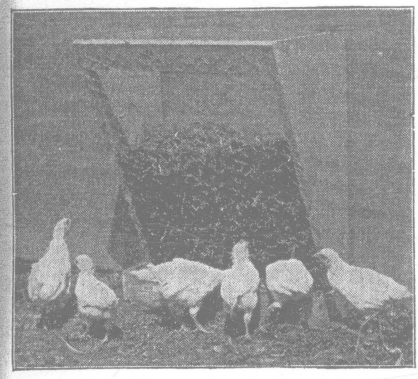

Fig. 3.—Wire netting for chopped alfalfa, clover, or soybean hay. It may be used for chicks or mature birds. When used for older birds it is elevated 4 inches off the floor.

Alfalfa, soybean or clover hay give equally good results when fed in wire baskets, racks (Fig. 3) or on the litter so that the birds may eat the leafy portions. A combination of sunshine or cod liver oil, and green grass or legume hay are essential for good hatchability.

Cod Liver Oil is a rich source of both vitamins A and D. As sufficient vitamin A is generally supplied in poultry rations by yellow corn, green grass, or legume hay, it is seldom necessary to feed cod liver oil for this purpose. The vitamin D factor is supplied in abundance by allowing chickens to run outdoors. In early brooding, battery brooding, and confinement of layers, direct sunshine is unobtainable. Under such conditions cod liver oil is a very satisfactory substitute. The amount required will vary with the potency of the product. Generally ½ to 1 pint per 100 pounds of feed is used. It may be mixed with a portion of the bran or corn meal and this in turn mixed with the other ingredients of the mash. The cod liver oil may also be sprayed over the scratch grain or mash in hoppers at the rate of about ½ pint per 100 hens every two or three days. Still another way is to pour the oil over the corn before it is ground.

Use an oil that is guaranteed by a reliable firm to be rich in vitamin A and D. Chemical analysis and appearance of oil are no indications of vitamin content. Feeding tests are necessary to determine the vitamin content. They are too expensive to be conducted in ordinary laboratory control work.

Yeast is a good source of vitamins B and G. These are supplied in adequate amounts by the grains of the ration so that use of yeast is unnecessary.

Vitamin Preparations such as combinations of minerals, oil, yeast, and irradiated substances are frequently found on the market. Their use is not necessary if well balanced rations are properly fed.

Miscellaneous Materials

Poultry Tonics as sold on the market are seldom of much value. The best tonic is a good ration and milk is the best ingredient. Avoid the purchase and use of tonics, mineral feeds, remedies, etc., that have not been approved by reliable sources. Personal testimonials are not sufficient proof of value.

Charcoal is of no value as a feed. There is not sufficient experimental evidence to warrant its use in poultry rations for other purposes.

Glass Substitutes are used to let through the beneficial rays of the sun which ordinary window glass will not let through. Some of them are satisfactory for this purpose and others are not. A wire base material is more desirable than a cloth base. They must be kept free from dust to be effective. To obtain much success with glass substitutes will necessitate having windows extending nearly from the ceiling to the floor, or the construction of sun porches (Fig. 4) with the roofs and sides covered with the glass substitute.

Ultra Violet Light may be supplied for poultry as a substitute for sunshine or cod liver oil. This may be accomplished by the use of ultra violet lamps or specially constructed light bulbs. Short life of the materials and cost of electricity make them uneconomical at the present time.

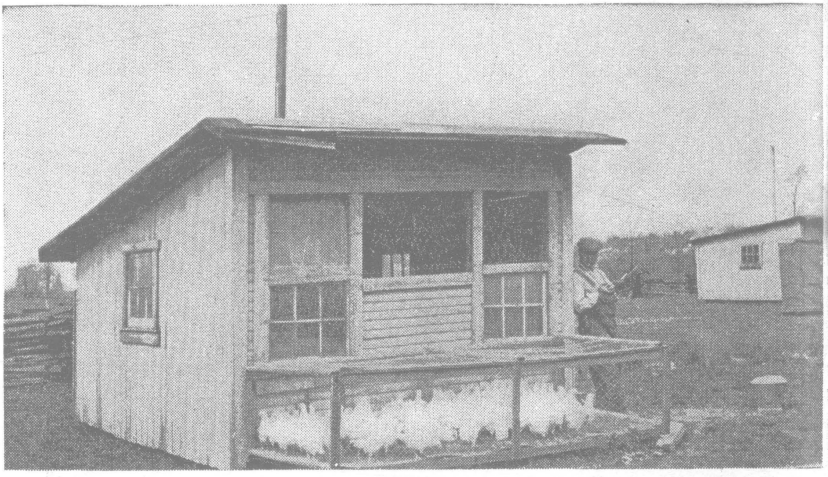

Fig. 4.—Sun porches supply the vitamin D factor and reduce the requirements of this factor in the ration.

Feeding Poultry

Rations for Young Chickens

Growing chickens require more tissue and bone-building material than mature birds. Hence they need more meat scraps and milk or other protein and mineral substances. All-mash feed is preferable to grain and mash for the first 8 to 12 weeks.

If birds are raised in confinement or in batteries, it is necessary to supply substitutes for things they would get if running on range. Cod liver oil may be substituted for sunshine, and alfalfa leaf meal or legume hay for green grass (page 13).

Ground wheat may be substituted for bran and middlings in the rations and barley may be used in place of oats or 10 to 20 parts of the corn. If nothing but liquid milk is given as a drink, the dried milk may be omitted and the other protein concentrates reduced to 5 or 10 per cent of the ration. Vegetable protein concentrates may be used to the extent of 50 per cent of the total protein concentrates, provided mineral supplements are used (p. 13).

It is not necessary or even practical to have both a starting and growing mash for chicks. One ration will suffice until the birds are 8 to 12 weeks old. Some satisfactory rations for this purpose are as follows:

Starting and Growing All-Mash Ration No. 1

	Pounds
Ground yellow corn	41
Wheat middlings	20
Wheat bran	5
Finely ground heavy oats	10
Alfalfa leaf meal	5
Meat scraps	12
Dried milk	5
Salt	1
Cod liver oil	1
	100

This ration is intended for poultrymen who keep chickens in confinement or in batteries, but may be used for birds given range. Note above substitutions that may be made.

Starting and Growing All-Mash Ration No. 2

	Pounds
Ground yellow corn	40
Wheat middlings	20
Wheat bran	5
Finely ground heavy oats	10
Alfalfa leaf meal	5
Meat scraps	8
Dried milk	10
Salt	1
Cod liver oil	1
	100

This ration is intended for those who desire a good percentage of milk in the ration. If liquid milk is given as a drink, the dried milk may be omitted and corn substituted in its place. When the chicks have plenty of sunshine and green grass the cod liver oil and alfalfa meal may also be replaced by corn.

Starting and Growing All-Mash Ration No. 3

	Pounds
Ground yellow corn	36
Wheat middlings	20
Wheat bran	5
Finely ground heavy oats	10
Meat scraps or fish meal	5
Dried milk	5
Soybean oil meal or corn gluten meal	10
Bone meal	2
Alfalfa leaf meal	5
Salt	1
Cod liver oil	1
	100

This ration is designed for the use of vegetable protein concentrates. It should also suffice for those who wish variety in a ration.

Starting and Growing Mash and Grain Ration No. 4

Mash

	Pounds
Ground yellow corn	28
Wheat middlings	20
Wheat bran	10
Finely ground heavy oats	15
Alfalfa leaf meal	5
Meat scraps	10
Dried milk	10
Salt	1
Cod liver oil	1
	100

Grain Mixture

	Pounds
Finely cracked corn	50
Cracked wheat	50
	100

This ration is designed for those who prefer to feed grain with the mash to growing chicks. Mash should be fed alone the first one or two weeks. Then begin feeding a little of the grain and gradually increase the amount until the time the birds are 8 to 12 weeks old they should be eating about equal parts of grain and mash. After the chicks are four or five weeks old, cracked corn and whole wheat may be used as the grain mixture, or any of the mixtures listed under Ration No. 7 on page 21 may be used.

Feeding the Chicks

Put feed in suitable size chick feeders (Figs. 5 and 6) before the birds as soon as they are placed in the brooding quarters. It is harmful to delay the feeding of chicks for longer than 24 to 48 hours after they are hatched. Have sufficient feeding space so that all the birds can eat at one time. It will

lessen the chances of tail-picking and poor feathering caused by hungry birds fighting to reach the feed hoppers. Keep feed before the birds all the time. The more often feed is added or stirred up the greater will be the consumption.

Feeding a little of the mash wet once or twice a day generally results in faster growth. This practice is seldom justified unless one wishes to hasten the growth of broilers. One can also hasten growth by using all-night lights in the brooder house or battery room.

Clean drinking water or milk should be kept before the birds at all times. Avoid feeding in open boxes on the floor or ground, as the practice is unsanitary and the birds are more likely to contract disease.

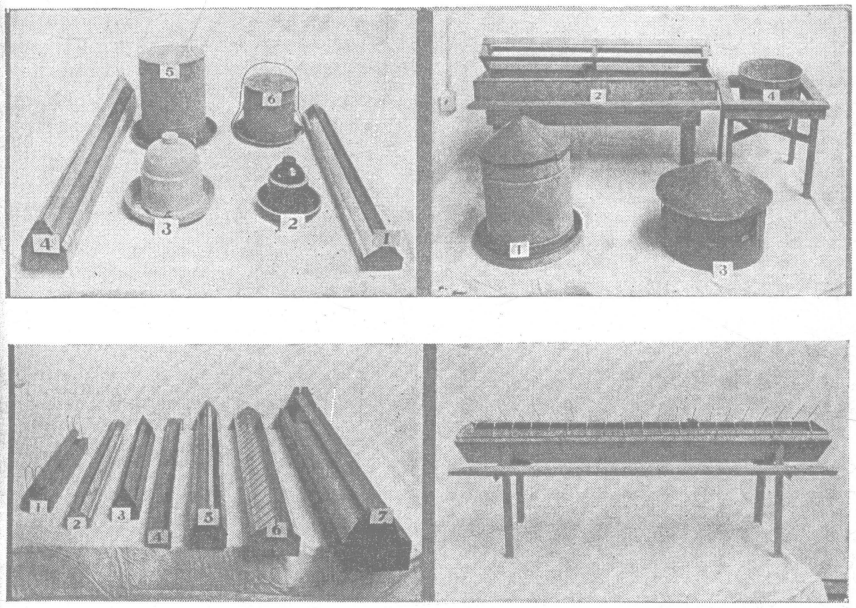

Fig. 5.—The use of equipment which keeps the birds out of the feed and water, will reduce contamination by droppings and therefore lessen the spread of bacterial and parasitic diseases.

Upper illustration: 1 to 3, drinking vessels for small chicks; 4 to 6, drinking vessels for pullets; 1-3-4, drinking vessels for mature birds; 2, feed hopper for mature birds.

Lower illustration: 1 to 4, mash hoppers for small chicks; 5 to 7 mash hoppers for pullets. Right, sanitary hopper for mature birds.

Battery Feeding.—Rations 1, 2, 3, and 4 are satisfactory for raising chicks to broiler age in batteries. *Poor feathering* in batteries is more often due to overcrowding and improper temperature than any deficiency in the ration. Double the space every week for the first four weeks and thereafter allow ½ square foot battery floor space. *Cannibalism* is more often due to overcrowding, improper temperature, and humidity and light distribution than to any fault of the ration. Dim the lights or use artificial light if trouble starts, and remove any chicks that may have been picked. *Slipped tendon* may result from excess or improper balance of minerals. *Paralysis* of rapidly growing chicks is probably a vitamin B deficiency. It can be checked by

diluting the ration with about 20 per cent bran or by reducing the protein in the feed. (See pages 26-29 for a discussion of nutritional troubles).

Feeding Broilers

Cockerels removed from the growing flock as soon as the sex can be determined, and battery or confinement brooded birds, constitute the bulk of the broilers marketed. They will generally reach the market when 8 to 12 weeks old. They are still at a rapidly growing age and should be kept on the starting and growing ration rather than being placed on a fattening ration. Dry feed and water should be kept before the birds all the time.

The use of all-night lights and a wet mash one or more times a day will generally speed up the rate of growth. Cod liver oil may be omitted from the ration the last 10 to 14 days before the birds go to market. See directions under fattening poultry (page 24) for additional suggestions.

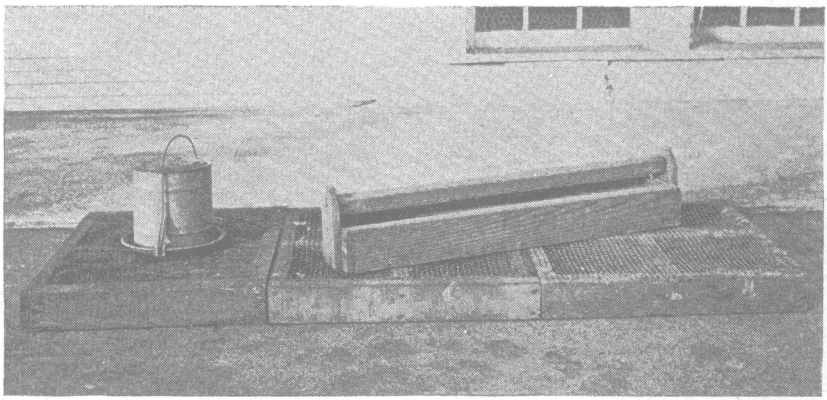

Fig. 6.—Feeders and water fountains should be placed on wire frames to prevent wet litter and to keep the chicks from eating from soiled litter. Feeders must be changed to suit the size of the chicks; as they grow larger, they need larger utensils.

Finishing Pullets

When pullets are 8 to 12 weeks old, it is desirable to change them to the regular laying ration rather than feed a so-called growing or finishing ration which is considerably lower in protein. The birds will be larger and more uniform in weight at the time production begins, will be in better physical condition, and early egg production will be greater and more uniform. This practice simplifies the feeding by doing away with one ration.

Reducing the protein to any significant amount below that of the laying ration will not keep the birds from coming into production, but will keep the rate of production low. It will not produce a larger and more vigorous bird at the time production starts. A lower protein ration will be slightly cheaper, but its use is seldom justified.

The system of feeding to use after the birds are 8 to 12 weeks old will depend on the type of ration that is to be used when the birds come into

production. If one plans to feed grain and mash to the layers, he can begin feeding grain (see Ration No. 7, page 21, for grain mixtures) with all-mash rations Nos. 1, 2, or 3 until such time as he is ready to change to a grain and mash ration. In fact, as long as not more than about 40 per cent as much grain as mash is fed with these rations, they make satisfactory laying rations. In case of Ration No. 4, no change need be made. Any of the grain mixtures listed under Ration No. 7, page 21, may be used. The grain and mash may be hopper fed or fed in about equal amounts.

Grain and mash feeding for finishing pullets and layers should be more desirable than all-mash feeding for farmers who produce their own grain. It saves the expense of grinding and mixing half of the ration.

Satisfactory all-mash rations for finishing pullets or for egg production may be made by reducing the protein concentrates in Rations 1, 2, or 3 to 10 to 12 pounds and making up the difference with corn. The proportion of meat scraps and milk may be varied according to prices. As an example, the system of feeding at the University has been so simplified that Ration No. 2 is used for starting and growing the chicks for the first 8 to 12 weeks; then the milk is reduced to 4 pounds and the corn increased 6 pounds in the ration. After this simple change the ration is used as an all-mash for finishing the pullets and for an all-mash laying ration.

Rations for Laying Hens

Rations for laying hens should carry about 85 per cent grain, 10 per cent protein concentrates, 5 per cent minerals, and an ample supply of vitamins. Feeding stuffs for supplying these different materials and information concerning their use in poultry rations are given on pages 7 to 14. The tables on pages 30 and 31 show the average composition of feeds and also their vitamin content.

Grains most commonly used are corn, bran, and middlings or wheat, and oats or barley. The proportions used may be varied within rather wide limits, depending on price and availability.

Protein concentrates generally used are meat scraps and milk. Vegetable protein concentrates are sometimes used to make up as much as half of the protein concentrates. In such cases they should be supplemented with minerals (page 13).

Minerals are generally supplied by allowing the layers free access to oyster shell or limestone grit or both for eggshell formation. The amount consumed by good layers is equivalent to about 4 per cent of the ration. Not more than about 1 per cent salt is added to the mash feed.

Vitamins are generally supplied by proper choice of grains, green feed or green feed substitutes, and the system of management. Yellow corn and green grass or alfalfa leaf meal are generally used to supply vitamin A. The other vitamins except D are generally present in sufficient quantity so that no attention need be given them. The vitamin D factor may be supplied by direct sunshine or the use of cod liver oil in the ration.

Systems of Feeding

There are five types of rations that may be used for layers, but they all supply about the same nutrients. These are:

1. Grains and milk.
2. Free choice of ingredients.
3. Grain and mash.
4. All mash.
5. Grains and protein supplement feeds.

Following are typical rations that may be used:

Grains and Milk Laying Ration No. 5

Free choice of corn, wheat and oats.
Nothing but milk to drink.

Feed the layers all the grain they will eat and give them nothing but milk as a drink. Corn and wheat, or corn, wheat, and oats or barley may be kept before the birds in separate hoppers, or added in the proportion desired (any grain mixtures under Ration No. 7). Birds should not be allowed to drink water from the range or elsewhere, otherwise the consumption of milk will not be sufficient to meet the protein requirements. If birds are not given green grass range, feed leafy alfalfa, soybean or clover hay in racks (Fig. 3) or on the litter. If the birds do not get direct sunshine, sprinkle ½ pint of cod liver oil per 100 birds over the grain every two or three days.

This system of feeding is certainly simple and well suited for the farmer who has grains and milk. It has given satisfactory results at the Washington and Kentucky Agricultural Experiment Stations and at Ohio State University. No grinding or mixing is necessary. Sudden changes to or from such a ration should not be made. It is better to start this system of feeding with growing pullets than to attempt it with birds in production. If the feeder wishes to boost feed consumption and production when using this system of feeding, he may do so by soaking some of the grain in milk and feeding it in wet condition and by putting meat scraps before the birds in hoppers.

Free Choice of Ingredients (Cafeteria Feeding) Laying Ration No. 6

Free choice of corn, wheat, and oats or barley.
Free choice of meat scraps and dried milk.

Keep grains and protein concentrates before the birds at all times in separate compartments of the feed hoppers. The birds are able to balance their own rations. They consume more wheat than corn or oats, eat about equal parts meat scraps and milk, and the consumption of these protein concentrates amounts to about 10 per cent of the total feed consumption.

Ration No. 6 is very similar to No. 5. The same means of supplying green feed and vitamin D, changes in ration and means of stimulating feed consumption are used. Liquid or condensed milk may be used in place of dried milk. Water is kept before the birds when Ration No. 6 is used.

Grain and Mash Laying Ration No. 7

Mash

	Pounds
Ground yellow corn	20
Wheat middlings	20
Wheat bran	16
Finely ground oats	16
Alfalfa leaf meal	6
Meat scraps	14
Dried milk	6
Salt	1
Cod liver oil	1
	100

Grain Mixtures

No.	1	2	3	4	5
Corn	75	50	25	50	25
Wheat	25	50	75	25	50
Oats or barley	0	0	0	25	25
	100	100	100	100	100

If birds are given green grass or legume hay (page 13), the alfalfa leaf meal may be replaced by corn. If the birds have direct sunshine, the cod liver oil may also be replaced by corn.

If birds are given both milk and water as a drink, the dried milk and 4 pounds of meat scraps may be replaced by one of the grains. See pages 7 to 14 for other feeding stuffs that may be used.

Approximately equal parts of grain and mash should be fed. Keep the mash before the birds in hoppers and feed the grain on top of the mash and in the wet mash troughs. The amount of grain that should be used will vary from 1 to 2 gallons per 100 birds per day, depending on season of year, size of birds and rate of production. Any one of the grain mixtures may be used.

Grain and mash rations are used by many Ohio farmers. Only half of the ration needs to be ground and mixed.

Grain and Mash Laying Ration No. 8

Mash

	Pounds
Ground yellow corn	20
Wheat middlings	20
Wheat bran	14
Finely ground oats or barley	14
Alfalfa leaf meal	6
Meat scraps or fish meal	5
Dried milk	5
Soybean oil meal or corn gluten meal	10
Linseed oil meal	2
Mineral mixture (page 13)	3
Cod liver oil	1
	100

Grain Mixture

Any one listed under Ration No. 7 above.

This ration is designed for the use of vegetable protein concentrates in the mash. It should also suffice for those who wish variety in the ration. The same substitutions and system of feeding apply as for Ration No. 7.

All-Mash Laying Ration No. 9

	Pounds
Ground yellow corn	46.5
Middlings	20
Bran	5
Finely ground oats	10
Alfalfa leaf meal	5
Meat scraps	8
Dried milk	4
Salt	0.5
Cod liver oil	1
	100

If birds are given green grass or legume hay (page 13), the alfalfa leaf meal may be replaced by corn. If direct sunshine is available the cod liver oil may also be replaced by corn.

If liquid milk and water are both kept before the birds, the dried milk and 3 pounds of the meat scraps may be replaced by corn. See pages 7 to 14 for other feeding stuffs that may be used.

The mash should be kept before the birds in hoppers (about 30 lineal feet of hopper space per 100 birds) at all times. Fresh mash should be added daily. *No scratch grain should be fed with an all-mash ration.* Better results are obtainable if the mash is granular and if part of it is fed as a wet mash once or twice daily.

All mash and grain and mash rations give equally good results if properly fed. All mash is easier to feed, once it is ground and mixed, than a grain and mash ration.

The above all-mash ration makes a desirable laying ration for birds kept in batteries when 4 pounds of oyster shell or limestone grit (chick size) is substituted for an equivalent amount of corn in the ration.

Poultry Supplement Feeds

These concentrated feed mixtures contain the necessary nutrients to make a balanced ration when mixed with home-grown grains. Following are some of the mixtures that may be used:

	No. 1 Pounds	No. 2 Pounds	No. 3 Pounds
Meat scraps	43	23	15
Dried milk	15	15	15
Fish meal	..	10	10
Corn gluten meal	..	..	10
Soybean oil meal	..	10	10
Linseed oil meal	..	..	5
Alfalfa leaf meal	10	10	10
Wheat middlings	20	20	15
Wheat bran	11	9	5
Bone meal	..	1	2
Limestone	..	1	2
Salt	1	1	1
	100	100	100

Any one of the following grain mixtures may be ground and mixed with any one of the above supplement feeds.

1. 200 lbs. wheat and 100 lbs. corn or barley.
2. 200 lbs. corn and 100 lbs. wheat or barley.
3. 100 lbs. corn, 125 lbs. wheat, and 75 lbs. oats.
4. 100 lbs. wheat, 100 lbs. barley.

To make a good laying mash feed to be fed with grain, mix 200 pounds of one of the ground grain mixtures with 100 pounds of one of the supplement feeds.

To make an all-mash laying ration, mix 400 pounds of one of the ground grain mixtures with 100 pounds of one of the supplement feeds.

Feeding for Egg Production

Good feed consumption is necessary for high egg production. Keep feed always before the birds in suitable hoppers (Fig. 5).

Fresh Mash should be added daily.

Granular Mash is preferable to finely ground mash.

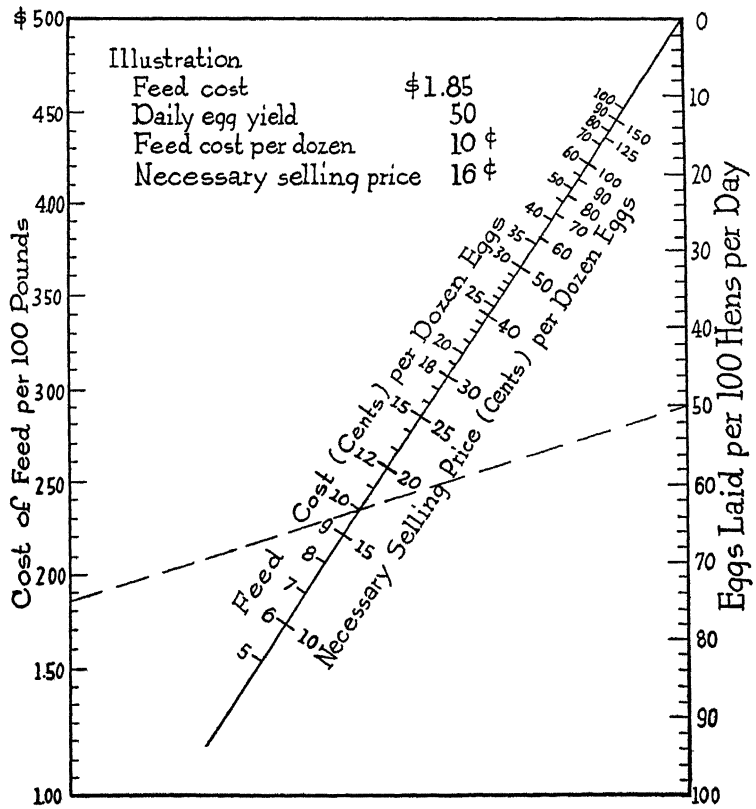

Chart adapted from Dr. Card's chart, University of Illinois. Calculation of feed cost per dozen and necessary selling price at varying feed prices and at various levels of egg production. It is assumed that 100 hens will consume 22.5 pounds of feed per day and that feed cost is 60 per cent of the total cost of production.

Wet Mash stimulates egg production. One may feed the amount the birds will clean up in 5 to 10 minutes' time as a moist crumbly mash. It may be fed once or twice daily.

Lights lengthen the day and give the birds more time to eat. Morning, evening, or all-night lights may be used.

Increasing the protein in the ration stimulates egg production and decreasing it retards egg production.

Feeding for Hatchability

Rations for hatchability need not be different from those which have been given for egg production. Green grass or legume hays, and sunshine or cod liver oil are necessary for good hatchability. Milk is also a desirable constituent of the ration for hatchability. Good rate of production is associated with good hatchability. Previous production appears to have no influence on hatchability.

Feeding to Control Molt

Proteins are essential both for egg production and growth of feathers. Therefore when birds get in poor physical condition and start to molt, try to encourage mash consumption by the use of wet mash and lights. One may also stimulate feed consumption by feeding a wet mash of ground grains and liquid milk once or twice a day. The milk serves as an appetizer and is a good protein feed for feather growth. The grains will add body fat. It is almost impossible to maintain good body weight and high egg production at the same time.

Birds may be thrown into a molt by a sudden change in ration, by stopping lights or wet mash abruptly, or by exposure which results in lowered vitality.

Fattening Poultry

The purposes of fattening poultry are to improve the quality of the meat and to add weight. The two main classes of chickens marketed are hens that have passed their time of profitable production and the surplus cockerels that have been separated from the growing pullets. The raising of broilers the year around is also becoming a business of considerable importance.

Fattening Ration No. 10.—The following ration is more suitable for mature birds than for growing stock: Corn meal, 54 pounds; wheat flour middlings, 25 pounds; finely ground oats, 10 pounds; dried milk, 10 pounds; salt, 1 pound. Mix the ingredients with water to make a batter that will pour.

If liquid milk is available the dried milk may be replaced by corn and the ration mixed with liquid milk to make a batter. This will amount to about 40 parts of grain mixture and 60 parts of liquid milk by weight.

Corn meal may be substituted for the oats.

Fattening Ration No. 11.—This ration is more desirable for fattening young birds than for mature stock because of the higher protein content: Corn meal, 39 pounds; wheat flour middlings, 20 pounds; finely ground oats or rolled oats, 15 pounds; corn germ meal, 10 pounds; meat scraps, 5 pounds; dried milk, 10 pounds; salt, 1 pound. The ration is mixed with water to make a batter and fed.

If liquid milk is available the dried milk may be replaced by corn and the feed mixed with milk to make a batter.

The corn germ meal increases the absorption capacity of the feed for liquid but is not essential; it may be replaced by corn meal.

Feeding Fattening Rations.—Birds should be shut up in a pen, or better still, placed in coops or batteries for fattening. The fattening period for mature birds is usually 7 or 8 days and for young birds 10 to 14 days.

Very little feed should be given the first day of confinement. Get the birds hungry. Give about as much feed as they will clean up in 5 minutes in the morning of the second day, and as much as they will clean up in 10 minutes in the evening. On the third day, feed morning, noon, and evening all the birds will clean up in 10 to 15 minutes' time. Continue the procedure throughout the feeding period. Do not give water to drink as the birds will secure sufficient quantity from the wet feed.

See page 18 for finishing broilers in batteries.

Feeding Miscellaneous Poultry

Turkeys, ducks, and pheasants may be raised on chicken rations. More rapid growth is secured with turkeys if the protein concentrate of the ration is increased 5 to 10 per cent over that used in chick rations.

The Value of Feeds

Many requests come to the University, Experiment Station, and State Department of Agriculture for analysis of feeds. In most cases there has been loss of birds where the feed was used, or the feeder is planning to use a certain ration and wants to know its value. In either case chemical analysis is of very little value.

Chemical Analysis.—The general chemical analysis of a feed does not give the essential amino acid, mineral element, and vitamin content. Without this information very little is known concerning its value. Calculation of analysis of rations from the analysis generally listed for ingredients is of limited value because feeding stuffs vary greatly in analysis and quality. Calculation of digestibility and nutritive ratio have very little significance. (See pages 5 and 6 for reasons.)

The only satisfactory way to determine the value of a ration is to feed it and note the results obtained.

Comparison of Feeds.—Divide the birds evenly in pens. Make all conditions exactly alike except the feeds. Feed a feed that is known to be good to one pen, and feed to the other pens the feeds that are to be compared. Keep records of growth or egg production, feed consumption, and mortality. A four- to eight-weeks' feeding trial with young chickens and a four- to eight-months' feeding trial with laying hens is sufficient to give an indication of the value of a feed.

Commercial Feeds.—The only way to determine the value of a commercial feed is to compare it with a good home-mixed ration such as listed in this bulletin and as directed under "Comparison of Feeds." There is generally very little difference in results obtained.

Nutritional Troubles

Proper feeding builds up resistance and helps to ward off many troubles which may be traced to faulty nutrition.

Digestive Troubles may be caused by chilling or overheating chicks, by depriving chickens of feed or roughage and then suddenly allowing them an abundance of the material, and by the use of spoiled feed. Symptoms are diarrhea, crop impaction, and constipation. A laxative followed for a time by mash feed and milk is the best remedy. In case of crop impaction an operation may be necessary.

Laxatives that may be used are 1 pound of Epsom salts or 1 pint of castor oil for each 100 mature birds. Mix the laxative in a small amount of wet mash and place the feed in small piles so all the birds can get to it. In case birds are too weak to eat mash, it will be necessary to give ½ teaspoonful of Epsom salts or 3 or 4 teaspoonfuls of castor oil to each mature fowl. Reduce the dosage for young birds according to size.

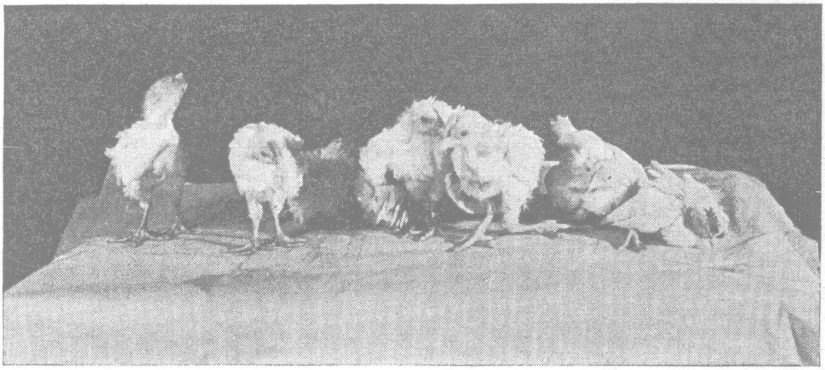

Fig. 7.—A group of chickens with characteristic symptoms of rickets.

Rickets or Leg Weakness sometimes occurs in young chickens deprived of sunshine or other sources of vitamin D (Fig. 7). Birds show signs of soreness or stiffness of joints, sit down much of the time to keep body weight off their legs, and finally become crippled and lose control of their legs. The use of 1 per cent good cod liver oil in the ration or allowing the birds direct sunshine will prevent the trouble. There is no cure for the crippled birds.

Paralysis of rapidly growing chicks 3 to 5 weeks of age sometimes occurs. The chicks show staggering gait and fall over on their sides. Such birds are probably growing faster than the available vitamins will permit. Dilute the ration with 20 per cent bran, or the mere change to another feed for a few days will generally check the trouble.

Poor Feathering is more often due to overcrowding and improper temperature than to other causes. An abundance of good protein, especially milk, in the ration is conducive to good feather growth. Poor feathering may also be due to a genetic factor.

Slipped Tendon or "Hock Disease" resembles rickets so far as crooked legs are concerned (Fig. 8). In rickets the bone ash analysis is low (30 to 40 per cent), and in case of slipped tendon, it is normal (45 to 55 per cent). Slipped tendon may be found where birds have sunshine or good cod liver oil. Excess mineral feeding is generally the chief cause of the trouble.

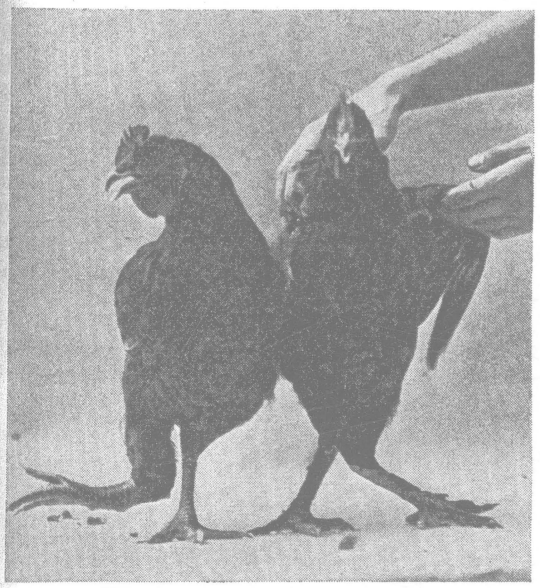

Fig. 8.—Slipped tendon or "hock disease."

Removal of the bone meal and limestone from rations where meat scraps and milk are fed will prevent the trouble. The meat scraps and milk supply sufficient bone-building material. There is no cure for the crippled chicks.

Coccidiosis is caused by a small parasite which saps the vitality of the bird. It usually affects chicks 4 to 8 weeks of age, and during warm, damp weather. The birds show droopy wings (Fig. 9) and the droppings are often streaked with blood. The heavy feeding of milk helps to prevent heavy losses

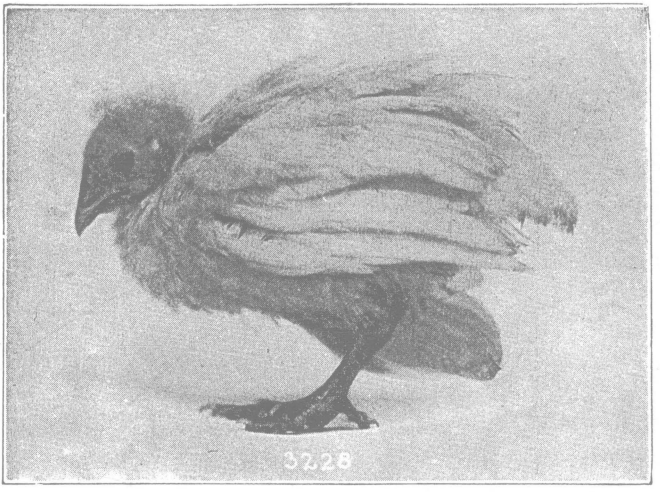

Fig. 9.—Chick showing typical symptoms of coccidiosis.

in case of an outbreak of the disease. It is probably effective because of its laxative effect, and because it is such a good food that it helps to build up resistance so that the birds can withstand the attack.

Mix 40 parts dried milk (by weight) with 60 parts of the mash being used and feed the mixture for a week or 10 days. Clean the brooder house frequently during the time, then place the birds back on the regular mash feed.

Prolapse of Oviduct in heavy producers in the spring of the year is probably the result of overwork and a weakening of the muscles of the reproductive organs. Give the birds range if possible. Be sure they are getting plenty of good oyster shell or limestone grit for eggshell formation. Also see that they are getting good cod liver oil in the ration or have plenty of sunshine.

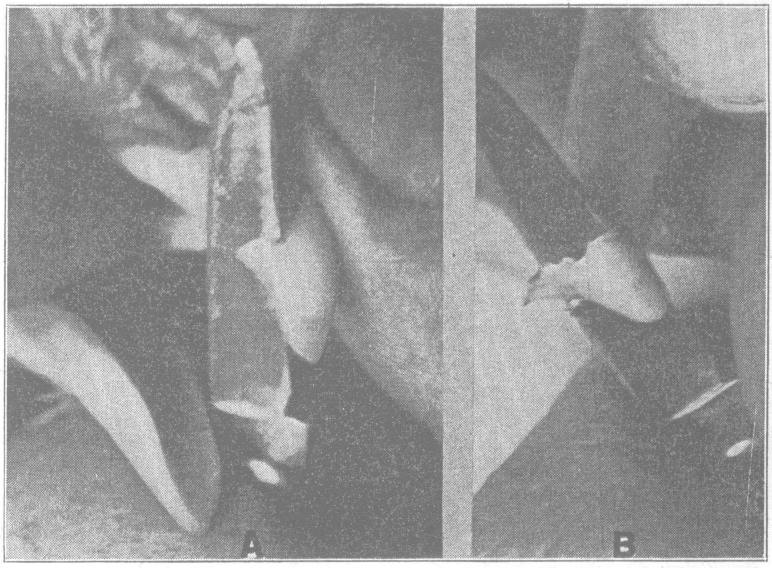

Fig. 10.—Trimming beaks for prevention of cannibalism or "pickouts."

Cannibalism is more often due to habit than to a deficiency in the ration. Overcrowding and improper temperature and humidity are sometimes responsible for the trouble. Remove the birds causing the trouble and also those that have been picked. Throwing in fruits, vegetables, fresh meat, grass, or other material will give the birds something to do and keep them from picking at each other. Do not keep birds of considerably different ages together. It may be necessary to trim the beaks (Fig. 10). The darkening of rooms and the use of artificial light also aid in the control of cannibalism.

Thin Shelled Eggs result from heavy production and poor mineral and vitamin D supply. Use the same preventive as for prolapse of oviduct (above). Also sprinkle a handful of oyster shell over the mash occasionally or keep shell in the ends of the feed hoppers.

Poor Hatchability sometimes results from inadequate vitamin supply. Be sure the birds have green grass or one of the legume hays as alfalfa, and plenty of direct sunshine or 1 per cent of good cod liver oil in the ration. Liberal feeding of milk is also conducive toward good hatchability and livability of chicks. See page 24 for management of breeders.

Nutritional Roup results from a deficiency of vitamin A in the ration. Probably colds, pox and diphtheria are also somewhat related to a deficiency of vitamin A. Nutritional roup is characterized by swollen eyes, (Fig. 11) a non-odorous discharge from the nostrils, small pin-point-like colonies on the

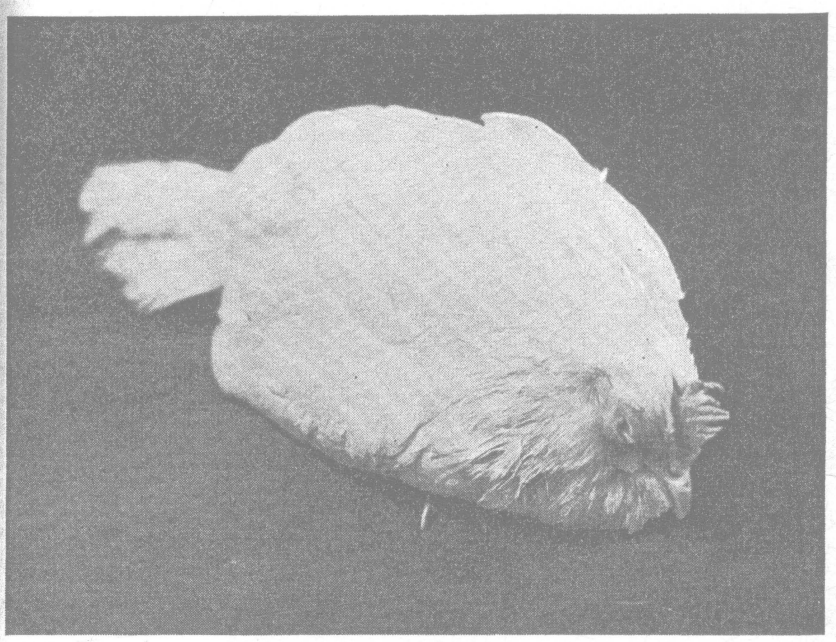

Fig. 11.—General appearance of bird with nutritional roup.

trachea, and whitish kidneys filled with urates. Liberal feeding of vitamin A in the form of yellow corn, legume hays, and cod liver oil build up resistance and help to ward off colds and nutritional roup.

Poison is shown by paralysis of birds and inflamed intestinal tract. High mortality of young chicks receiving a given ration is more often due to disease or poor management than to anything in the ration. In case birds have been poisoned by eating dead animals, insect powders, etc., give a laxative and feed as directed for digestive disturbances (page 26).

In case one believes that the feed is causing mortality, select four or five healthy birds which have not been receiving the ration and feed them the feed that is believed to be the cause of the trouble. Feed the birds for about a week. If no trouble results, it is proof that the feed was not responsible for the losses.

Table I.—Vitamin Content of Common Poultry Feeds

Feeds	Vitamins					
	A	B	C	D	E	G
CEREALS:						
Barley	o	**	o	–	**	o
Corn, white	o	***	o	–	**	o
Corn, yellow	**	***	o	–	**	o
Oats	o	**	o	–	**	o
Oats, sprouted	*	**	*	–	–	–
Wheat	o	***	o	–	**	o
CEREAL BY-PRODUCTS:						
Hominy	o to *	***	o	–	–	o
Gluten feed	–	–	o	–	–	o
Wheat bran	o	**	o	–	**	o
Wheat middlings	o	***	o	–	***	o
ANIMAL PRODUCTS:						
Buttermilk	*	*	o to *	–	–	**
Buttermilk, dried	*	*?	o to *	–	–	***
Cod-liver oil	****	o	o	****	–	o
Eggs	**	*?	o	**	–	**
Fish meal	o	o	o	*?	–	–
Meat scrap	o	o	o	o	–	*
Skimmilk	*	*	o to *	o	–	**
Skimmilk, dried	*	*?	o to *	o	–	***
Whole milk	**	*	*	*	–	**
FORAGE:						
Alfalfa, green	***	*	***	*	***	***
Alfalfa, well cured	***	*	o	*	***	***
Alfalfa, bleached	o?	*?	o	*?	–	*?
Cabbage, white portion	*	*?	***	–	–	*?
Cabbage, green leaves	**	*?	***	–	–	*?
Clover, green	***	*	***	*	***	***
Grasses, green	***	*	***	*	***	***
VEGETABLES AND FRUITS:						
Carrots, yellow	**	*?	**	–	–	–
Mangels	o	o	o	–	–	–
Potatoes	o	*?	**	–	–	–
Rutabagas	–	*?	***	–	–	–
Tomatoes	**	*?	***	–	–	–
MISCELLANEOUS:						
Yeast	o	****	o	o	o	****

Explanation of Table

o Indicates none or no appreciable amount of vitamin.

*, **, ***, **** Indicates increasing amount of vitamin.

*? Indicates vitamin present but relative amount unknown.

– Indicates evidence of vitamin content lacking or insufficient.

*Table II.—Average Composition of Feeds**

Feed	Moisture	Ash	Crude protein	Carbohydrates		Fat, or ether extract
				Crude fiber	Nitrogen-free extract	
GRAINS AND SEEDS	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Barley (and barley meal)	9.6	2.9	12.8	5.5	66.9	2.3
Bread	33.8	1.5	7.9	.7	55.4	.7
Brewers' grain (dried)	6.8	3.6	26.9	14.3	41.4	7.0
Broomcorn	11.8	2.9	10.2	8.2	63.5	3.4
Buckwheat	12.6	2.0	10.0	8.7	64.5	2.2
Buckwheat middlings	12.0	4.8	28.3	4.8	42.7	7.4
Coconut meal (O. P.)	7.3	5.5	21.3	9.4	46.5	10.0
Corn	12.9	1.3	9.3	1.9	70.3	4.3
Corn bran	10.3	2.4	9.9	10.4	59.7	7.3
Ground ear corn	15.6	1.5	8.3	6.8	64.4	3.4
Corn-gluten feed	9.2	3.6	25.1	7.3	51.9	2.9
Corn-gluten meal	9.0	1.3	40.9	3.2	44.5	1.1
Corn meal or chops	12.9	1.3	9.3	1.9	70.3	4.3
Cottonseed meal (prime)	6.9	5.9	38.8	12.2	29.4	6.8
Cowpeas	9.8	3.6	23.8	4.3	57.1	1.4
Durra	9.9	2.0	10.1	1.7	72.8	3.5
Feterita	11.1	1.5	12.5	1.7	70.1	3.1
Field peas	9.2	3.4	22.9	5.6	57.8	1.1
Flaxseed	9.2	4.3	22.6	7.1	23.2	33.7
Flour middlings	10.7	3.7	17.8	4.7	58.1	5.0
"Red Dog" flour	10.1	2.9	17.2	3.1	61.9	4.8
Garden peas	11.8	3.0	25.6	4.4	53.6	1.6
Hempseed	8.0	2.0	10.0	14.0	45.0	21.0
Hominy feed	8.3	2.9	10.9	4.6	65.6	7.7
Kafir	9.4	1.6	11.1	2.1	72.6	3.2
Linseed meal (O. P.)	8.9	5.4	34.5	7.7	36.7	6.8
Malt sprouts	7.8	5.7	25.9	12.4	46.9	1.3
Millet	10.8	3.6	12.1	8.4	61.0	4.1
Milo	10.7	2.8	10.7	2.4	70.5	2.9
Navy beans	13.4	3.6	22.7	5.8	53.0	1.5
Oats or ground oats	7.7	3.5	12.5	11.2	60.7	4.4
Oatmeal, or rolled oats	7.9	2.0	16.0	1.5	66.1	6.5
Peanuts (hulls on)	6.0	2.8	24.7	18.0	15.4	33.1
Peanut kernels	5.5	2.3	30.2	2.8	11.6	47.6
Peanut meal (no hulls)	6.2	4.9	49.3	6.3	22.5	10.8
Rice (polished)	12.3	.5	7.4	.4	79.0	.4
Rye	9.5	1.9	11.1	2.1	73.7	1.7
Rye feed	10.2	4.0	15.6	4.3	62.7	3.2
Soybeans	6.4	4.8	39.1	5.2	25.8	18.7
Soybean meal	6.1	5.6	47.1	5.7	27.7	7.8
Shallu	9.7	1.6	12.5	1.7	71.1	3.4
Sunflower seed	6.9	3.1	16.1	27.9	21.3	24.7
Velvet beans	9.8	3.1	26.2	6.0	50.1	4.8
Wheat	10.6	1.8	12.3	2.4	71.1	1.8
Wheat bran	9.6	5.9	16.2	8.5	55.6	4.2
Wheat flour	12.3	.5	10.9	.4	74.6	1.3
Wheat middlings (shorts)	10.1	3.5	16.3	4.3	61.6	4.2
Wheat screenings	10.2	3.9	13.3	7.4	61.1	4.1
FEEDS OF ANIMAL ORIGIN						
Blood meal	9.7	3.3	82.3	.....	3.8	.9
Bone meal	7.2	61.5	23.1	3.3	.....	4.9
Bone meal (steamed)	4.1	70.0	4.9	.....	.....	.5
Buttermilk	91.0	.7	3.0	.....	4.8	.5
Buttermilk, condensed	71.5	3.3	11.5	.....	10.4	3.3
Buttermilk, dried	4.5	8.1	34.6	.....	48.3	4.5
Fish meal	6.6	21.0	56.1	.7	2.6	10.5
Fresh bone	30.4	21.1	19.7	.....	3.8	25.0
Meat scrap (50 to 55 per cent protein)	7.1	21.1	53.9	2.2	5.0	10.7
Pork cracklings	5.0	2.3	56.4	.....	4.1	32.2
Skim milk	90.6	.7	3.2	.....	5.2	.3
Skim milk, dried	4.7	7.3	37.0	.....	50.0	1.0
Tankage	7.6	22.2	53.7	1.8	3.8	10.9
Whey	93.8	.4	.6	.....	5.1	.1
GREEN FEEDS, ETC.						
Alfalfa (green)	72.9	2.6	4.7	8.0	11.0	.8
Alfalfa-leaf meal	5.6	14.2	20.5	15.2	41.1	3.2
Alfalfa meal or alfalfa hay (dried)	8.3	8.9	16.0	27.1	37.1	2.6
Beet pulp (dried)	8.4	3.5	9.3	18.7	59.3	.8
Cabbage	91.1	.8	2.2	.9	4.7	.3
Cane molasses	24.5	6.8	3.1	.....	66.1	.....
Carrots	88.6	1.0	1.1	1.3	7.6	.4
Kale	88.7	1.9	2.4	1.5	5.0	.5
Mangels	91.2	1.0	1.4	.8	5.4	.2
Potatoes	78.9	1.0	2.1	.6	16.3	.1
Rape	85.7	2.0	2.4	2.2	7.1	.6
Red-clover hay (dried)	12.9	6.9	13.6	24.1	39.1	3.4
Rutabagas	88.6	1.2	1.2	1.3	7.5	.2
Turnips	90.6	.8	1.3	1.2	5.9	.2

* From U.S.D.A. Farmers' Bul. 1541.

Table III.—Feed Consumption and Growth

A question often asked by poultry keepers is, How much feed is required to a chick to a certain age and what should the chick weigh? The table which follows is of interest in this connection.

Feed Consumption (including Milk Solids) and Weight of Birds by Weeks

Week	White Leghorns		Rhode Island Reds	
	Feed per bird	Wght. per bird	Feed per bird	Wght. per bird
	lbs.	*lbs.*	*lbs.*	*lbs.*
0	.....	.08	.....	.08
1	.09	.11	.10	.11
2	.28	.18	.29	.16
3	.57	.26	.56	.26
4	.94	.38	.95	.36
5	1.42	.50	1.48	.53
6	1.96	.69	2.18	.73
7	2.71	.90	2.96	.96
8	3.51	1.09	3.94	1.22
9	4.41	1.22	4.95	1.52
10	5.40	1.42	6.02	1.80
11	6.45	1.56	7.15	2.01
12	7.52	1.80	8.39	2.29
13	8.64	1.93	9.62	2.39
14	9.74	2.06	10.83	2.56
15	10.93	2.20	12.14	2.76
16	12.11	2.36	13.58	2.90
17	13.54	2.49	15.17	3.18
18	14.93	2.63	16.82	3.26
19	16.38	2.72	18.38	3.43
20	17.91	2.90	20.12	3.68
21	19.39	3.05	21.89	3.85
22	20.83	3.12	23.68	4.00
23	22.29	3.22	25.41	4.16
24	23.84	3.28	27.24	4.29

* The data were compiled from Storrs Agricultural Experiment Station Bulletin No. 9 being the averages of three experiments with a total of 1028 White Leghorns and 865 Rhode Island Red chicks. Birds had skimmilk to drink and no water during the first 10 weeks, after which both milk and water were supplied. An outdoor range was provided.

Leghorn cockerels were removed at the end of the eighth week.

Rhode Island Red cockerels were removed at the end of the twelfth week.

Poultry Data Averages Concerning Demonstration Farms

ITEM	1924	1925	1926	1927	1928	1929	193
Number of flocks	440	461	543	370	365	354	29
Average number hens per flock for year	234	242	259	275	284	278	31
Average number hens per flock, beginning year	294	300	329	336	369	361	40
Average number hens per flock at end of year	137	124	135	138	141	156	17
Per cent reduction in size of flock	53.4	58.8	59	58.9	61.9	57	5
Egg production per hen (based on flock avgs.)	138	140	145	149	152	152	14
Cash receipts per hen	$5.19	$5.85	$5.64	$5.55	$6.17	$6.08	$5.1
Total expenses per hen	3.15	3.54	3.26	3.43	4.27	3.87	3.7
Feed cost per hen (includes cost of rearing young)	2.08	2.65	2.30	2.56	3.20	2.91	2.7
Cash returns per hen above feed	3.11	3.20	3.34	2.99	2.97	2.21	1.4
Labor income per hen, based on:							
a. Number hens beginning of year	1.99	2.17	2.20	1.96	1.71	1.89	1.1
b. Average number of hens for year	2.50	2.69	2.78	2.40	2.22	2.45	1.5
Investment per hen	2.91	3.04	3.08	3.15	3.15	4.07*	4.0
Per cent mortality per flock	10.7	10.3	11.1	10.7	11.3	13.0	15.0
Number of hens consumed or sold per flock	125	145	158	162	186	159	175
Feed cost per dozen eggs (includes cost of rearing young)	.18	.23	.19	.21	.25	.23	.22
Total cost per dozen eggs (includes all expenses except labor)	27¼c	30c	27c	27½c	33¾c	30c	29c
Per cent feed cost of total expense	66.3	74.9	70.5	74.6	75.1	75.0	74.1

* Beginning with 1929, investment includes land used exclusively of poultry.