The Journal of the

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CONTENTS

THE VALUE OF MINERAL ELEMENTS IN POULTRY FEEDING.

Observations from practice in poultry feeding suggests the general impression that the quantity of mineral matter supplied to fowls should be sufficiently large, but, beyond this, little attention has been given as to its composition.

All foods do not contain the fourteen elements, from which the animal body is constructed, in amounts sufficient to sustain growth and it is recognized that deficiencies in the amount and kinds of nutriment available may affect not only the size, but also the character of the growth of animals. On the other hand, there is a prevalent idea that the mineral nutrients are present in all foods in excessive amounts and that, therefore, the study of this matter is not of great practical importance. The fallacy of such an assumption is clearly borne out by experimental data at hand, although detailed information with reference to mineral nutrients in poultry feeding, in particular, is limited. Available results of such work are obtained from Ingle in England and South Africa, Laurie in Australia, Wheeler and Bolté in the United States. Valuable comparative data is obtained from the investigations of Forbes of the Ohio Experiment Station (U. S.)

Concerning feeding practice it may be said that there is no particular relationship between the compounds of the ash and the compounds in which the elements occur in plants and animals. But with this particular phase we are not chiefly concerned since our object is to determine the mineral requirements for specific purposes.

Mineral Elements in the Fowl's Body.

Calcium appears abundantly in the form of calcium oxide (CaO); three-fourths of the ash of body is lime and seven-eighths of the ash of bones is phosphate of lime. The presence in the body of calcium salts is necessary to muscular contraction.

Phosphorus occurs in a number of forms; inorganic phosphates, lecithins phosphoproteins and nucleuproteins. In the inorganic phosphates phosphorus is present as salts of the mineral bases, calcium, magnesium, potassium and iron. These are readily digested and assimilated and may be retained in the body and used for the various functions. Three-fourths of the mineral matter of the body is inorganic calcium phosphate.

Iron is one of the least abundant though most important elements in the body. Without iron the blood cannot carry oxygen.

Sodium is present principally as chloride, common salt, (NaCl), but also as the phosphate and carbonate. Sodium salts, are essential to cardiac relaxation. Without sodium and calcium salts the heart is unable to function at all.

Potassium is present mostly as salts of mineral acids.

Magnesium, mostly as the phosphate, is found in small quantities in the bones.

Sulphur is an essential constituent of all of the proteids of the body.

When we consider that the mineral elements in the body are most of them strongly acid or basic, we know that their compounds have a tendency to become exceedingly active when in dilute solution. Thus, through their peculiar attributes the mineral elements maintain a very important relation to practically all the vital processes and they enter into the composition of every tissue and fluid of the body.

Application made for entry as second class matter at New Brunswick, N. J., P. O.

In considering the constructive purposes of the mineral elements we note that calcium, phosphorus, sulphur and iron are used in the formation of the essential structures in the body. Iron, also, through its affinity for oxygen becomes a carrier of gaseous products and functions in the liberation of energy. Sulphur and phosphorus contained in proteid substances give rise to sulphuric and phosphoric acids and these acids are neutralized through the equilibrium existing in the blood between the alkali carbonates and the phosphates. Again the activity of enzymes, which function in building up and tearing down chemical compounds in the animal body, requires certain degrees of acidity and alkalinity which are maintained through the presence of mineral salts. Other functions of mineral salts are to serve in the movement of liquids throughout the body and its tissues, to facilitate vital processes involving the proteids, and keeping in solution certain nitrogenous constituents in the liquids of the body. Calcium in the blood is essential to its coagulation and mineral chlorides diminish the chlorine of the hydrochloric acid in the gastric juice, pepsin being inactive except in the presence of hydrochloric acid.

It will be noted at once what a variety of functions the mineral elements serve in nutrition and it is also interesting to note the effects of lack of mineral nutrients. From Forbes* we learn that Forster, a German physiologist, first proved that animals can live but a few days on food that is practically free from mineral matter, and, strangely, "that animals will live longer if given no food at all." In considering the possible causes of the deficiency of mineral matter—chiefly phosphate of lime—in the bones of animals suffering from a peculiar bone disease (osteoporis) Ingle† was led to attribute its prevalence in South Africa to the peculiar diet used for working animals in that country—a diet composed often, entirely of oat-hat or oat-hay and maize grain. Both of these foods are characterized by containing a high proportion of phosphoric acid and a low proportion of lime in their ash. In experimenting with rations to overcome the conditions resulting from continued feeding of oat hay, Ingle prepared a diet to which he added various mineral salts and which gave very beneficial results. His work with horses led to further work with poultry.

In regard to the erroneous assumption that it is the amount and not the composition of the ash constituents that is important in bone formation, the feeding of bran to chicks may be taken as an excellent example. Bran is rich in ash and on this account it has been extolled as being peculiarly well fitted for bone formation. It contains, as a matter of fact, about 3.3% phosphorus pentoxide (P_2O_5) and only about 0.3% lime and is therefore not especially suitable for the promotion of bone formation.

The results of the analyses of Lawes and Gilbert of the whole carcasses of various farm animals show that the total lime present slightly exceeds the total phosphoric acid. In bones of animals the ratio is about 100 of phosphoric acid to 150 of lime. Seeds of all kinds contain far more phosphoric acid than lime though many contain considerable quantities of magnesia; there is always a preponderance of phosphoric acid. Stems and leaves of plants, as a rule contain a preponderance of lime. If, as we have reason to believe, animals require for healthty bone formation and renewal, lime and phosphoric acid in approximately equal proportions, it is evident that a diet composed exclusively of the grains is not adapted to supply their needs and cannot be used, for long, without injury to health. From a consideration of these facts it appears possible that the value of green food or substitutes may depend chiefly upon the lime content.

Some years ago Ingle devised a preparation intended to be administered along with the usual food, adapted to ensure that the animals, so fed, should receive adequate supplies of all the necessary mineral constituents which might be lacking in their ordinary rations.

An interesting and suggestive contribution to the study of this question is given in experiments undertaken at the College Farm, Theale, England, under Mr. Edward Brown, late of the College Farm and at present President of the International Association of Instructors and Investigators in Poultry Husbandry. Experiments were conducted with a preparation of mineral salts prepared by Ingle and is as follows: common salts 30 parts, phosphate of soda 9, calcium fluoride 1, ferrous sulphate 1, bone ash 30, chalk 14, epsom salts 10, charcoal 2 and flowers of sulphur 3 parts, making 100 parts in all. Two lots of White Wyandotte chickens, besides others, were fed from birth in exactly the same way, excepting that one pen received a small quantity of the "mineral food" while the other did not. At eleven weeks old the nine chicks in the former pen weighed 18 lbs., or an average of 28 oz., the twelve chicks in the latter pen weighed 17lbs. 2 oz., or an average of 20 oz. Remembering that the chicks were all fed in the manner usual at Theale— i. e., doubtless upon a varied diet—these results afford strong evidence of the usefulness of the "mineral food," for had the diet been composed of only one or two items, as is often the case with chickens in confinement, there can be little doubt that without this

* E. B. Forbes, Ohio, Agr. Exp. Sta. Bull. 201.
† Herbert Ingle, Art. Successful Poultryman. B. C. Vol. 3, No. 1, Jany. 12.

addition the growth would have been less than it was and the advantage correspondingly greater. Trials of laying hens, with a grass run, carried out by Mr. Edward Brown, showed little or no effect so far as number or weight of eggs produced was concerned, but the birds receiving the mineral food came on to lay more quickly, but whether this result was due to the mineral food or to other causes cannot be stated. In other trials, carried out by Mr. F. Parton, Poultry Expert of the Leeds University, it was noticed that with pullets the mineral food induced the growth or larger combs, and that with Leghorns the combs of the pullets receiving the preparation grew perfectly erect instead of pendulous, as is usually the case.

In experiments to determine the source of material for the egg shell, Wheeler at the New York Experiment Station, found that lime in the egg shell was largely derived from calcium in oyster shell when fed in a test with broken glass.

Wheeler found that most grain rations for growing chicks were improved by the addition of bone ash. Oyster shell was found to be less valuable than bone ash and rock phosphate.

Growing chicks need calcium phosphate as a mineral supplement to the grain rations. Laying hens need calcium carbonate as a mineral supplement to the grain rations; egg shells are high in percentage of calcium since they are almost pure calcium carbonate.

In conclusion it may be observed that comparatively little has been done to determine specifically the value of mineral elements in poultry feeding, and, yet, notwithstanding this, the available data shows conclusively that mineral elements are essential for the functioning of the vital processes as well as for the development of bone and eggs. It is clearly essential, then, that definite work must be undertaken to determine the most economical methods of supplying the required mineral salts in specific rations.

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RECENT FINDINGS CONCERNING THE PHYSIOLOGY OF DIGESTION IN THE DOMESTIC FOWL.

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Some foodstuffs are easily digestible with a small amount of waste, while others, although containing, theoretically, all the requirements of an economical foodstuff, may be found in practice to be expensive foods. It is just as important to know how food is digested and how much of it is digested as it is to know how much protein, carbohydrate and fat are in the foodstuff given.

Foodstuffs are divided into:

Mineral or inorganic compounds.

Organic compounds or compounds of carbon.

A convenient method of grouping these proximate principals of food is as follows:

	Water,
Inorganic,	Salts, viz: common salt, iron, lime, etc.
	Carbohydrates, viz: sugar and starch.
Organic,	Proteins, viz: albumen, milk-curd, etc.
	Fat.

Water is absolutely necessary as a solvent for numerous compounds. It brings into play numerous chemical reactions and takes part in the building up and breaking down of substances without number. It is a carrier of nourishment to the body and conversly it provides the means for carrying away the waste products.

Salts, such as lime, common salt, combinations of iron, etc., have been found necessary to the life of all animals.

Some salts are known to enter the circulation without undergoing any previous change, but no doubt some are absorbed combined with fats and proteins.

Carbohydrates are extremely abundant in nature. They take a prominent share in the building up of the vegetable kingdom, and play an important part as food in the animal economy.

Proteins occur both in the animal and vegetable kingdoms. They are very important substances because they contain an element, nitrogen, which is not contained in carbohydrates or fats, and which is absolutely essential to the life of all living tissue. Proteins are made up of a number of small groups chained together to form one complex body. All proteins do not contain the same groups and all the groups are not of the same food value. For example, feathers are made up of protein and the protein of feathers contains a group called Glycocoll. Now we find that milk-curd or casein does not contain this group, but that the protein of the seeds of certain plants like the sunflower and hemp do contain this group. It is reasonable to suppose that the seeds of these plants are good foods for moulting birds. It has been found also that certain proteins lack certain groups which are essential to the life of the animal and starvation will result, although theoretically, based upon the amount of protein fed, the ration contains a sufficient amount of nitrogenous food.

Fats occupy a peculiarly important place due to their high caloric value. The animal organism stores tremendous reserves of vital energy in the form of fats. They are the principal sources of heat in animals. As a non-conductor of heat the fat deposited under the skin protects the fowls from cold in winter. A very important source of fats are the carbohydrates. Birds as well as animals are able to convert starch and sugar into fat.

Digestion. From the *mouth* the food passes into the gullet through which it is forced into the *crop*. The crop serves as a storage sack so that poultry can collect a large amount of food, rapidly, and digest it at leisure.

While in the crop of the fowl the food becomes mixed with the saliva secreted by the glands of the mouth. The saliva is a liquid containing mucus and a ferment which acts on starch changing it into sugar. The moisture softens the grain and causes it to swell bursting the outer coat and allowing the ferment to act on the starch therein contained.

Stomach. The semi-fluid mixture coming from the crop is made acid by the muriatic acid secreted by the cells of the stomach. This acid activates the ferment of the stomach called pepsin. This ferment has the power of digesting protein material to the peptone stage.

The peptone stage represents the first stage in the digestion of protein and is as far as the gastric juice is able to carry it. The curdling ferment (rennin) is not very well developed in birds, as milk is not their natural food.

Gizzard. From the stomach the food passes into the gizzard. This is a thick, muscular organ with a tough, horny lining. The function of this organ is to grind to pulpy mass the hard particles of food. This process is very much facilitated if sharp particles of grit are mixed with the food. The gizzard does not possess digestive glands. In young chicks sharp sand takes the place of grit stimulating muscular action and preventing impaction.

Duodenum. The gizzard opens into the intestinal tube, the first part of which is the duodenum which is bent back upon itself. In the hollow of the loop thus formed is situated the *pancreas,* a gland which secretes three powerful ferments. The secretion from the pancreas enters the duodenum close to the ducts from the liver carrying the bile. When the food becomes of the proper consistency in the gizzard it passes into the duodenum a little at a time. Here it comes in contact with the alkaline bile and pancreatic juice; the acid of the stomach is neutralised, the starch is rapidly broken down to maltose, the peptone which was formed in the stomach is further acted upon and broken down into smaller groups of building blocks until these groups are separated into single blocks. Pancreatic juice not only acts on peptone but is able to act on any proteins which have escaped digestion in the stomach and break them down to single blocks.

The fats are split up into glycerine and fatty-acids. These fatty acids form soaps with the soda, potash and other alkalies of the bile and pancreatic juice. The bile, although containing no ferments, aids the pancreatic juice in various ways.

The author has observed that the digestive functions of the stomach are developed by the second day after hatching, whereas the pancreatic ferments are imperfectly developed before the seventh day.

Small Intestine. The juices which are secreted by the walls of the small intestine contain ferments which aid the pancreatic juice to digest protein and carbohydrates.

Cane sugar is present in the sugar beet and before it can be absorbed by the fowl it must be changed into glucose. This change is produced to some extent by the acid of the stomach but more particularly by a ferment in the intestinal juice. The maltose produced by the digestion of starch by saliva and pancreatic juice is also changed by the intestinal juice into glucose.

In most animals we find a ferment in the intestinal juice which acts on milk sugar. This ferment is absent in poultry and they must depend on bacteria to break up this substance. Fresh milk is easier digested than sterilized milk, sour milk than fresh milk. The glucose formed from the digestion of starch and sugar is rapidly absorbed by the intestinal wall, taken up by the blood and carried to the liver and muscles where it is stored as animal starch (glycogen). Excess of sugar is transformed into fat.

If we burn sugar and fat it is changed into carbon dioxide gas and water with the production of heat. The same thing takes place when these substances are burned in the fowl's body.

Protein food we have found has been broken down into individual building blocks. These various building blocks are absorbed and carried by the blood to the liver, which sorts them out, so to speak, allowing those to pass which can be used by the animal in building up its tissues. No matter what the protein material was originally, animal or vegetable, the fowl first breaks it down and then reconstructs it into its own peculiar form of flesh.

THE CONTROLLING FACTORS IN THE FEEDING OF CHICKS—ASH AND PROTEIN.

WILLARD C. THOMPSON.

Nutrition is one of the most important factors in the growth and development of chicks. Much of the success of chick raising depends upon the foods that are furnished. As the bodies of the birds are being constantly enlarged and built up it is necessary that considerable protein and ash material should be given in the rations to meet this requirement. These two elements are comparatively hard to get at economical figures and therefore work along this line seemed justified. There are

(Continued on page 7, column 1.)

Editorial

An organization of individuals and institutions primarily engaged in instruction, investigation and extension in poultry husbandry.

Publication Committee.

W. F. Kirkpatrick.

Raymond Pearl.

James E. Rice.

Editor.

Harry R. Lewis,
New Brunswick, N. J.

This Journal is published monthly for ten months each year.

While published primarily for the use of the members, additional copies may be secured for individual or library files at the following rates:

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The editor wishes again to call the attention of the members to the necessity of promptly sending in abstracts to be published in the Journal, at an early date, in order that the following issue may be planned to the best advantage.

Keep the editor notified of interesting facts pertaining to the work at the departments or of any personal matters relative to the members which would be of interest to all.

The first number of the Journal which you have already received was published on a grade of paper which to the editor and the publication committee did not seem heavy or durable enough to admit of binding and preservation. The editor wishes to announce at this time that the first number will be reprinted on much heavier paper, more similar to that used by the publication known as 'Science' and will be sent to the members at the same time that Vol. 1, No. 3 is mailed. The paper used will be the same as used in this issue. This reprinting of Vol. 1, No. 1, has been done at no expense to the association, and with the belief that although small our Journal should be published in the best possible form, so that at future dates it can be increased in size without changing the policy or general type of publication.

A number of our members have already secured subscriptions from their college libraries and from individuals. Possibly our circulation can be materially increased in this way if we all take a hand.

Do not forget the annual dues for 1914-1915.

The annual proceedings for the years 1908, 1909 and 1910 of this association can be secured in one volume for $1.50, by addressing the editor.

PROGRESS IN POULTRY DEPARTMENTS.

Report of the Committee on Education and Experimentation in Poultry Husbandry, James E. Rice.

The report of the committee will appear in each issue of the Journal under the heading "Progress in Poultry Departments." It is proposed that the report be sub-divided under the following sub-titles:

1. Bibliography.
2. Financial Development.
3. Staff Changes.
4. Biography.
5. New Buildings.
6. Legislation.
7. Historical Development in States and Provinces.
8. Landmarks in the development of Poultry Departments.
9. Extension Enterprises.
10. Courses of Instruction.
11. Investigations under way.
12. Number of students taking courses in Poultry Husbandry.

BIBLIOGRAPHY.

The Poultry Departments have established a new record in the matter of publication. We received copies of seventy-seven publications relating to poultry, bearing dates July 1, 1913 to July 1, 1914. This is a substantial increase of thirteen over the preceding year. A classification of the publications shows forty bulletins, thirty-five circulars, leaflets and pamphlets and two reports. A study of the literature shows the following classification, according to subject matter: Marketing, 16; Diseases, 10; Houses, 9; General Care and Management, 9; Breeding, 7; Incubation, 6; Feeding, 5; Brooding, 4; Breeds, 3; How to tell age, 1; Anatomy, 1; Ducks, 1; Turkeys, 1; Geese, 1; Poultry Clubs, 1; Capons, 1; Egg-Laying Competitions, 1.

It will be seen that the greatest stress is being laid upon questions relating to Marketing, Diseases, General Care and Management, House Construction, Breeding, Incubation, Feeding and Breeds in the order named. A careful review of the publications each year shows a commendable improvement in quality of material and method of presentation. The record of the Poultry Departments in the matter of publication, clearly reflects great credit upon persons connected with them. This is especially true when we consider the handicaps under which Poultry Departments have been administered.

The accompanying list of publications is the result of personal request to each department. It is hoped that additions or corrections will be reported promptly.

Received from July 1, 1913 *to July* 1, 1914.

Cal.—Correspondence Course in Poultry Husbandry No. XIV, Lesson No. I and II.

Canada—Ottawa Bul. No. 16 (Second Series) How to tell the Age of Hens and Pigeons—Nov. 25, 1913.

Exhib. Cir. No. 1—Natural Incubation.

Exhib. Cir. No. 2—Artificial Incubation.

Exhib. Cir. No. 6—The Farmer's Poultry House.

Exhib. Cir. No. 12—The Farm Flock.

Exhib. Cir. No. 13—Brooding and Rearing of Chicks.

Exhib. Cir. No. 29—Duck Raising.

Exhib. Cir. No. 30—The Management of Turkeys.

Exhib. Cir. No. 31—The Management of Geese.

Leaflet No. 1—Rules for Production and Marketing of New Laid Eggs.

Leaflet No. 2—Importance of Removal of Male Birds after Breeding Season.

Leaflet No. 3—Suggestions for Egg Circle Numbers.

Bul. No. 25—Fleshing Chickens for Market.

Pamphlet No. 2—Crate Fattening of Poultry.

Pamphlet No. 3—(2d Ed.)—Candling of Eggs.

Pamphlet No. 4—Organization of Co-operative Egg Circles.

Pamphlet No. 5—Plan of Permanent Laying House for Poultry.

Pamphlet No. 6—Payment for Eggs according to Quality.

Canada—Quebec, Ont., No. 5—Feb. 1914. Boy's and Girl's Poultry Club. Bul. Vol. 1.

Canada—Quebec, Ont., No. 9—June 1914. Broilers, Friers and Roasters.

Canada—New Brunswick, Bul. No. 1—Opportunities in Poultry Culture in New Brunswick—1914.

Canada—New Brunswick, 2d Leaflet No. 1—Fattening and Marketing Poultry.

Canada—New Brunswick, 2d Leaflet No. 2—Poultry House Construction.

Canada—New Brunswick, 2d Leaflet No. 3—The Baby Chick.

Canada—Nova Scotia—Annual Report for year 1913—Poultry P. 94.

Conn.—Storrs Press Bul.—Campaign for the Eradication of Bacillary White Diarrhoea of Young Chicks—April 1914.

Conn.—Storrs, Bul. No. 75—The Bacteriology of the Hen's Egg with special reference to its freedom from Microbic Invasion—Nov. 1913.

Conn.—Storrs, Bul. No. 76—Carbon Dioxide in Incubation—March 1914.

Conn.—Storrs, Bul. No. 77—Bacillary White Diarrhoea of Young Chicks, 4th Report, June 1914.

Hawaii—Press Bul. No. 46—Poultry Management.

Ind.—Purdue Cir. No. 40—Report of Poultry Conditions in Ind., Sept. 1913.

Maine—Bul. No. 214—Biology of Poultry Keeping—July 1913.

Maine—Bul. No. 215—The Measurement of the Intensity of Inbreeding—Aug. 1913.

Maine—Bul. No. 216—Poultry Notes 1911-1913—Sept. 1913.

Maine—Bul. No. 218—Tables for Calculating Co-efficients of Inbreeding—Oct. 1913.

Maine—Bul. No. 221—Ability of Chickens to Digest small pieces of aluminum.

Maine—Bul. No. 228—Factors Influencing, Size, Shape and Physical Constitution of Egg of Domestic Fowl.

Mass.—Facts for Farmers, Vol. I. 1913—No. 1—Poultry Hygiene, Sept. 1913.

Mass.—Facts for Farmers, Vol. IV, 1913—No. 4—Poultry Culture, Dec.

Mass.—Bulletin No. 1—Opportunities in Poultry Culture in Mass.

Mass.—Bulletin No. 148—On the Diagnosis of Infection with Bacterium Pullorum in the Domestic Fowl.

Minn.—Extension Bul. No. 21—Care and Management of Poultry.

Missouri—Cir. No. 3—Capons are Profitable—July 1913.

Missouri—Cir. No. 8—Swat the Rooster—May 1914.

Missouri—Bul. No. 4—Fool Proof Poultry House—Feb. 1, 1914.

Missouri—Bul. No. 7—The Baby Chick—May 1, 1914.

Montana—Care of Market Eggs.

Montana—Packing Eggs in Water-Glass.

Montana—Cir. No. 34—Artificial Hatching of Chicks.

N. J.—Bul. No. 265—The Ash and Protein Factor in Poultry Feeding—Dec. 31, 1913.

N. J.—Cir. No. 32—Diversified Poultry Farming.

N. J.—Hints to Poultrymen, Vol. 1, No. 10—Poultry House Construction—July 1913.

N. J.—Hints to Poultrymen, Vol. 1, No. 2—Profits from Winter Broilers—Aug. 1913.

New York—Cornell Bul. No. 345—A Continued Study of Constitutional Vigor in Poultry—April 1914.

N. D.—Bul. No. 108—Avian Tuberculosis—April 1914.

Oregon College Bul. No. 92—Some External Parasits of Poultry.

Oregon College Bul. No. 99—Fowl Tuberculosis.

Oregon College Bul. No. 127—R. C. Lesson No. 1—Breeds of Chickens.

Oregon College Bul. No. 159—R. C. Lesson No. 2—Housing of Chickens.

Oregon College Bul. No. 157—R. C. Lesson No. 3—(4th Ed.) Feeding for Eggs.

Oregon College Bul. No. 158—R. C. Lesson No. 5—(3d Ed.) Inc. and Brooding Chicks.

Rhode Island—Bul. No. 156—The Availability of the Nitrogen of Cotton Seed Meal and Beef Scrap for Chicks—March, 1914.

Rhode Island—Bul. No. 157—Studies of Fowl Cholera: III Inheritance in Rabbits of Immunity of Infection with Bacterium of Fowl Cholera.

Rhode Island—Bul. No. 158—Studies on Inheritance of Pigeons. I Hereditary Relations of the Principal Colors—May, 1914.

Rhode Island—Bul. No. 159—Studies on Fowl Cholera IV Reciprocal Relations virulent and avirulent culture in active Immunization.

South Australia—Egg Laying Competition 1913-1914.

U. S. Bu. Chem—Bul. No. 17—Refrigeration of Dressed Poultry in Transit—Nov. 5, 1913.

U. S. Bu. An. Indus.—Bul. No. 21—Commercial Fattening of Poultry—Jan. 15, 1914.

U. S. Farmers' Bul. No. 562—Organization of Boy's and Girl's Poultry Clubs—Dec. 18, 1913.

U. S. Farmers' Bul. No. 574—Poultry House Construction—April 7, 1914.

U. S. Farmers' Bul. No. 585—Natural and Artificial Incubation of Hen's Eggs—May 5, 1914.

U. S. Farmers' Bul. No. 594—Shipping Eggs by Parcel Post, June 4, 1914.

Utah—Cir. 14—Housing Farm Poultry—Nov. 1913.

Washington—Extension Series I, No. 3—Prin. and Practice of Poultry Feeding

West Va.—Bul. No. 145—Some Factors Affecting the Weight, Composition and Hatchability of Hen's Eggs—May, 1914.

(Continued from page 4.)

several high containers of these materials, some of which are of an organic nature and some of which are inorganic in type. Of the former some are from vegetable sources and some are from animal sources. With these facts in mind the work of which this is a report was done to compare the efficiency of protein from vegetable and animal sources, to compare the efficiency of ash in the form of phosphoric acid and lime from both organic and inorganic sources, to determine the effect of increased protein consumption upon the loss of nitrogen in the manure, and to determine the effect of the ash materials mentioned upon the digestibility of the protein. This plan included the study of bone products as carriers of phosphoric acid and lime and also of Hen-e-ta, a commercial product which derives its phosphoric acid and lime from a purely inorganic source. The end of this effort was flesh production, either in the form of broilers or in the form of birds to be developed for future layers and breeders.

In the first series of experiments S. C. White Leghorn chicks were used. A uniform basal mash was used, the supplements to this being the varying factor. The same basal grain ration was used in all flocks. Each ration was fed to two pens, so that there was a check run to every varying ration. The basal dry mash, fed in large hoppers open at all times, was composed of 200 lbs. corn meal, and 100 lbs. each of gluten feed, wheat middlings, and wheat bran. The basal grain ration was composed of 200 lbs. each of cracked corn and cracked wheat and 50 lbs. oat meal.

At the end of the ninth week the males and females were separated and the males weighing one pound or over were sold as broilers and the pullets kept for future layers and breeders. The average weight of the chicks in each flock at the end of the ninth week indicates the relative progress of the different lots. In every case the determining factor seemed to be the protein rather than the phosphoric acid. The chicks in 3 and 4 made much better progress than those in 1 and 2, which received no animal protein. The chicks in 7 and 8 seemed to prove the value of an availability of phosphoric acid from an organic source greater than from an inorganic source. Altogether the use of bone and meat scraps together seemed to form a very desirable source of protein and ash materials.

A second series of experiments was run along the same lines, except that Barred Plymouth Rock chicks were used as well as S. C. White Leghorn chicks. In every instance the same general results were obtained and the same conclusions reached.

Upon the completion of the work several conclusions were made from the results obtained. One of the most noteworthy of these was the fact that protein from vegetable sources, even when accompanied by a high phosphorous content in the ration, did not prove as efficient a method of furnishing protein as could be found in meat scraps, an animal protein. The addition of animal protein, meat scraps, seemed to increase the efficiency of vegetable protein. An increased protein intake, in the form of meat scraps, did not result in an increased loss of nitrogen in the manure. The opposite, however, seemed to be true. Phosphoric acid from an organic source, such as bone meal, seemed to be more efficient than phosphoric acid from an inorgranic source, such as Hen-e-ta. The efficiency of bone is measured not only by its increased assimilation as shown by the small percentage of phosphoric acid found in the droppings where bone was used as compared to the large amount where Hen-e-ta was used, but also by the fact that it increased the percentage of nitrogen assimilated over the amount assimilated by the Hen-e-ta. The loss of nitrogen in the manure in the Hen-e-ta pens was much greater than in the pens fed bone meal. Lime in itself has little effect upon the assimilation of nitrogen. The lime from the organic source was not as easily assimilated as that from the inorganic source, or Hen-e-ta. The difference was very pronounced. A general survey of the results points conclusively to the value of meat scraps in the ration of the growing chick. On the other hand Hen-e-ta did not prove to be an efficient or economical material to use in the feeding of growing chicks, not only because of its expense, but also due to the fact that the phosphoric acid in itself was not in as digestible a form as it may secured from the use of a cheaper material, such as bone meal. Furthermore, it did not replace the animal protein in the form of meat scrap, nor did the broilers raised upon Hen-e-ta rations make as satisfactory or practical growths as the broilers raised upon meat rations.

Altogether it would seem that in a large measure at least the final solution of the chick feeding problem will rest upon the ability of the poultryman to select and obtain those food stuffs which will most economically furnish these two controlling factors, ash and protein.

For full details see N. J. Bull. 265.

GREEN FEED AND ITS SUBSTITUTES IN POULTRY FEEDING.

By F. N. Marcellus.

It was found, after corresponding with all the experiment stations throughout the United States and Canada, that no definite research work had been carried on along this line. In one or two instances observations were made of the relative value of various kinds of so termed green feed and a substitute, as but one was used. This latter will be referred to later.

There might possibly be some difference of opinion as to what constitutes a green food, and also as to what different varieties of this class of food there are available, and considered satisfactory for poultry feeding. The general concensus of opinion appears to be that a green food for popultry may consist of any material which furnishes the birds with a green, watery, succulent material corresponding to the natural herbage or vegetation procured on the open range. Considering further the opinions of the different investigators, as stated in their correspondence with the writer, such materials as cabbage, mangels, sugar beets, rape, sprouted grains (oats preferably) are amongst those more commonly used, the first three on the list being used to a greater extent than the others. Turnips, beet pulp, apples, green clover, and alfalfa, are also used and the writer has, during the past year, met a large number of people who are using corn silage with excellent results.

There is some doubt on the part of some investigators as to whether it is possible to obtain any material which can be satisfactorily used in substitution for the different forms of green food. Bulletin No. 171 of the Maryland Agricultural Experiment Station on pages 96 and 97, gives some interesting material along this line using wheat bran as a substitute for green food. There is room, however, for much more work along this line so as to determine the efficiency or inefficiency of this or any other material which might be considered as a substitute.

That green food of some kind is absolutely essential for the most economical returns in poultry keeping, is believed to be true by practically everyone, yet the fact remains that there is little or no data available proving this to be the case. Bulletin No. 71 of the West Virginia Experiment Station, on pages 396 and 397, gives some interesting data showing the possible saving in the grain ration affected by the feeding of green feed in the ration.

The field for research work in this branch of poultry nutrition is certainly very large. More definite information is required at the present time on the comparative value of the different forms of green food, upon their effect on the fowl and the product.

To what extent do the different kinds of green food affect the health of the breeding stock, and the hatching power of the eggs, and to what extent, if any, do the different forms of green food affect the digestion and assimilation of the other nutrients in the ration. These are problems which today are demanding more attention by the poultry keeper.

THE POULTRY DEPARTMENTS.

Mr. H. L. Shrader, a graduate of the University of Missouri in the year 1914, is at present at work with Miss Pennington in the Research Laboratory, Bureau of Chemistry, United States Department of Agriculture.

Wilson Cramer a former student at the University of Missouri has taken charge of the poultry work at the South Dakota Agricultural College.

F. D. Crooks also of University of Missouri, is assistant in the poultry work at State College, Pennsylvania.

Mr. Ross M. Sherwood, until recently Associate Professor of Poultry Husbandry at the Iowa State College, has recently accepted the position of Poultry Extension Lecturer at Kansas State Agricultural College.

The address of Mr. Frank C. Hare given in the last issue as Washington, D. C., should read Clemson Agricultural College, Clemson College, South Carolina.