THE PRACTICAL AND THEORETICAL FEEDING OF LAYING HENS.

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OUTLINE

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The subject of stock-feeding as related to poultry, is hardly appreciated by most farmers and poultry breeders of this State. Poultry keeping as a special business or an extended branch of other farming, is not carried on as yet to any extent. In the Eastern part of the United States, especially, this is an important occupation, and all of the State Experiment Stations are doing considerable work along this line. To the general farmer of this State, a little knowledge of how to feed his flock of hens would increase his Winter income, as does the improved methods of feeding his other livestock. But to the one who keeps laying hens on an extended scale for the most profit, this subject is of the greatest importance. Is he feeding more than is necessary for the maintainance and the maximum egg production? Is he feeding protein in one kind of feed when he can feed it in a different form for one fourth less money? Is he feeding nutrients in the proper proportions?

These are questions to be studied. The present haphazard methods require it. Each has his own method, which his own narrow experience has taught him is the most successful. No two poultry-men feed alike, and on a great many feeding questions they have many diverse opinions of what is correct. The common method is to throw them what grain they will eat, usually corn, and let them do the rest.

Balanced rations are as necessary for poultry, as for other stock. They do not always work out to be the best in practise, with the stock on the farm, but in the majority of cases they prove to be the most economical. All of the most successful dairy-men feed their cows reasonably well balanced rations. A balanced ration is necessary for the most economical consumption of food with poultry

for the same reasons as other stock. A Fowl can profitably use only a certain amount of protein, carbohydrates and fat. It is used in body maintainance, deposit of fat, product and excrement. If too much protein is consumed, the excess is waste, and so with the other nutrients. They must be supplied in certain amounts and proportion to maintain the body and provide for a maximum product. But with our present knowledge, we can only use feeding standards as guides, and not as anything absolutely correct.

Table showing the composition of poultry feeds.

Feed stuffs	% Dry matter.	% of digestible nutrients. Protein	Carbohydrates	Fat	Calories per lb.	Nutritive ratio.
Corn	89.1	7.14	66.12	4.97	1572.37	10.8
Kaffir Corn	87.5	5.78	53.58	1.33	1160.22	9.8
Oats	89.	9.25	48.34	4.18	1247.57	6.2
Wheat	89.5	10.23	69.21	1.68	1548.5	7.1
Sorghum seed	87.2	7.	52.1	3.1	1229.46	8.4
Wheat screenings	89.5	8.	50.02	1.50	1141.85	6.67
Bran	88.5	12.01	41.23	2.87	1111.38	4.
Middlings	84.	12.79	53.15	3.4	1369.96	4.8
Shorts	88.2	12.22	49.98	3.83	1318.55	4,8
Cornmeal	85.	6.26	65.26	3.5	1477.97	11.7
Gluten feed	91.9	19.95	54.22	5.35	1605.33	3.3
Gluten Meal (Chicago)	90.5	33.09	39.96	4.75	1559.18	1.5
Linseed Meal (O.P.)	90.8	28.76	32.81	7.06	1443.13	1.7
Linseed Meal N.P.)	90.1	30.59	38.72	3.9	1445.5	1.5
Cottonseed Meal	91.8	37.01	16.52	12.58	1526.53	1.2

Green Cut Bone	84.	22.3		16.5	1111.08	1.7
Animal or Meat Meal	90.	35.		10.	9957.6	.63
Beef Scrap	89.3	50.	.3	13.7	1415.04	.5
Bloodmeal (dried	91.5	52.3		2.5	1078.28	.1
Skim-milk	9.4	3.01	5.1	.3	163.51	1.9
Alfalfa (cut hay	91.6	10.58	37.33	1.38	949.36	3.8
Clover	84.7	7.38	38.15	1.81	923.24	5.7
Potatoes	21.1	.9	16.3	.1	325.012	18.3
Cabbage	15.3	1.8	8.2	.4	181.12	5.0$
Beets	13.	1.21	8.84	..05	189.04	7.4
Mangels	9.1	1.03	5.65	.11	128.89	5.7
Turnips	9.5	.81	6.46	.11	139.86	8.3
Ruta-baga	11.4	.88	7.74	.11	164.97	9.1

The following shows the relative cost of feeds at Kansas prices for the last several years.

Feed stuff	Ave. cost per 100 pounds.	Cost of protein per pound, not allowing for other nutrients.
Corn	$ .712	$ .10
Kaffir Corn	.474	..0975
Oats	.912	.0986
Wheat	1.00	.0976
Wheat Screenings	.80	.10
Cornmeal	.75	.1198
Bran	.80	.0666
Shorts	.80	.0654

Middlings	.80		.062
Linseed Meal	1.20	(O.P).0417	(N.P).0392
Cottonseed meal	1.40		.0378
Gluten feed	1.10		.0551
Gluten Meal	1.30.		.0392
Green bone	1.00		.0448
Meat scrap	2.50		.05
Animal meal	2.50		.0714
Dry blood-meal	3.00		.0573
Skim-milk	.20		.0664
Cut Alfalfa hay	1.00		.0935
Cut Clover hay	1.00		.1355

The different nutrients of the feeds have different functions in the animal body, although they are interchangeable to a certain extent in some respects. With laying hens, of which we are speaking, protein is used for maintainance and repair of body tissues and any excess is used in the natural product of that individual.It will also produce heat when there is not sufficient carbohydrates and fats furnished. Carbohydrates maintain the body temperature and produce muscular energy. Any excess is deposited as fat. Fats have practically the same functinns as carbohydrates. Their fule value is two and one fourth that of the protein and carbohydrates. Fats and carbohydrates are also necessary constituents of the egg. Mineral matter, which is not a nutrient, strictly speaking, is, nevertheless, necessary for the health of the birds.

It hardens the bone and furnishes material for the egg shell, and is also contained in the egg.

We will next consider the different feeds as to their use in feeding poultry. Of the grains, Corn is the most plentiful in Kansas. It is desirable in Winter, being a heating food, and low in cost. Wheat is one of the best poultry foods. It is the ideal whole grain. It has a good percent of protein, and is not heating. Oats is good for variety, but are too bulky to feed in large quantities. The nutrients are well proportioned. Kaffir Corn is well liked by fowls and is an excellent food, similar to corn in composition, but does not contain as high a percent of nutrients. Sorghum seed is a valuable feed, but it is so expensive that it can be replaced by other feeds cheaply. These are the only whole grains that it is practicable to feed in Kansas.

Considering the other concentrates, ground corn is similar to whole corn, though slightly lower in digestible nutrients. Mill by-products are not necessary where a ration can be balanced without them, but they are often cheaper considering their nutritive value, especially where a part of the feed is purchased. Wheat bran is a very valuable food. When in the mash it lightens the food, but when fed in large quantities it is often not thoroughly acted upon by the digestive juices. Middlings and shorts are similar in composition, and not much different from Bran. Linseed meal is useful in small quantities to balance the ration with respect to protein. It is also a good conditioner. Cotton seed meal is so concentrated as to require great care in limiting the amount to be fed.

The principal foods of animal origin are green bone, blood-meal, meat-scrap, and skim-milk. Green cut bone is the most valuable although it does not contain the most nutrients. Dried blood is

highly concentrated in protein and too expensive for common use. Commercial meat-scrap is very valuable and often a cheaper source of protein. A difference in composition of different brands makes this food sometimes misleading. Skim-milk is more valuable than whole milk for poultry feeding, and should always be used when it can be secured either in mash or to drink.

Grasses, legumes, and vegetables are ordinarily considered equal in value, but there is a vast difference. Leguminous plants are superior on account of the higher protein content. Alfalfa is more valuable than clover. The more common vegetables are beets, mangels, turnips and ruta-baga. Of these beets are the highest in protein and mangels have the narrowest nutritive ratio. They are all low in nutrients and are not fed primarily for the nutrition to be gained from them. Their succulency is the important factor, aiding in the digestion and neutralizing the effects of continued dry feeding.

Different animals differ in their powers to digest a given food. All foods have a different percentage digestibility. Different mixtures with other foods and cooking also affect the digestibility. Cooking lessens the digestibility of albuminoids but increases the digestibility of vegetables. Sufficient data on experiments in digestion with chickens is lacking to give any definite conclusions. So far, all the standards are based on the digestibility being the same as that for farm animals, some even claiming that there is no difference between the food being masticated in the mouth or gizzard. There is at least no probability that the digestibility would be any less with fowls.

In balancing any ration the nutritive ratio is the important factor. What is considered the proper ratio for laying hens

varies somewhat with different authorities. However, 1 : 4 is generally proposed as correct. It appears at first sight that the ratio should be wider for the smaller breeds, which are more active, but the following will show that it should not be. Smaller birds usually eat less, and lay as many or more eggs, which are fully as large. More than one half of the nutrients of the egg is protein, so that the smaller bird produces more protein in the egg in proportion to the total food consumed, than the larger bird, thus making no change in the nutritive ratio. However, we will show later that this ratio is not always the most economical in practise.

In making a feeding standard, it is necessary to know the composition of an egg. According to Jordon, an egg has the following composition.

		In a 2 oz.egg.
11.4%	Shell equals	.228 oz.
.8%	Ash not in shell	.016
65.7%	Water	1.314
8.9%	Fat	.178
13.2%	Protein	.264

According to James Shackleton, we have in a two ounce egg-

.263 oz protein.

.1866 oz fat.

.7 oz dry matter

79.8 calories fuel value.

Several feeding standards have been suggested by different authors. At New York it was found that the amount of food required for maintainance per pound live weight decreased as the hens increased in weight.The following maintainance standard was suggested,-

Ounces digestible nutrients per hen, per day.

	Dry matter.	Protein.	Carbohydrates.	Fat.	Calories.	Nutritive ratio
Fowls,3 to 5 pounds wt.	2.496	.32	1.888	.192	307.2	1:7.4
Fowls,5 to 7 pounds wt.	2.59	.3841	1.92	.192	318.	1:6.2

Egg production can only be sustained by food in excess of that required for maintainance. The following standards are suggested for hens in full laying.

Ounces digestible nutrients per hen,per day.

	Dry matter.	Protein.	Carbohydrates.	Fat.	Calories.	Nutritive ratio.
Fowls,3 to 5 pounds wt.	3.52	.64	2.40	.224	412	1:4.6
Fowls,5 to 8 pounds wt.	3.432	.676	2.34	.208	406.4	1:4.2

This leaves each day for the production of one egg:-

	Dry matter.	Protein.	Carbohydrates.	Fat.	Calories.
Fowls,3 to 5 pounds wt.	1.024 ozs.	.32	.512	.032	104.8
Fowls,5 to 8 pounds wt.	.942	.292	.42	.016	88.4

This is much more than sufficient to produce a 2 ounce egg according to the composition of an egg, given above.

James Shackleton has deducted a set of standards after making a thorough study of the subject. He concludes that for the same weight fowls there is very little difference in the number of calories required for maintainance. The breed makes no difference. As the weight of the fowl increases the fuel value per pound weight of fowl required for maintainance decreases . Studying with breeds from the Leghorn to the size of the Brahma, he found the following

number of calories required for maintainance:-

Weight of fowl.	Calories per fowl.	Calories per pound live wt.
3 1/2 lbs.	220.5	63
5 1/2 ..	302.5	55
7 1/2 ..	360	48

which were disposed among the different nutrients to compound the following standard for maintainance:-

Ounces digestible nutrients per fowl, per day.

Weight of fowl.	Dry matter.	Protein.	Carbohydrates.	Fat.	Calories.
3 1/2 lbs.	3.4968	.29	1.40	.10	222.8
5 1/2 ..	3.3882	.40	1.95	.13	307.5
7 1/2 ..	3.9556	.55	2.22	.15	361.5

The fuel values do not exactly correspond, but the difference is small. Adding the nutrients required to produce one egg per day gives the following standard for maintainance and the production of one egg per day.

Ounces digestible nutrients per fowl, per day.

Weight of fowl.	Dry matter.	Protein.	Carbohydrates.	Fat.	Calories.	Nut. ratio.
3 1/2 lbs.	3.1968	.55	1.8233	.10	302.6	1:3.8
5 1/2 ..	4.0882	.663	2.3733	.13	387.2	1:4
7 1/2 ..	4.6556	.813	2.6433	.15	441.3	1:3.6

A two ounce egg is taken for a standard, since from day to day they average about this. They vary somewhat with the breed, but often the smaller breeds lay larger eggs than the larger breeds, so we see the size of the fowl is not a safe guide.

Climate would vary our standard somewhat as would the difference between Summer and Winter, requiring a slightly wider ration in the Winter, by adding to the Carbohydrates. In Summer

Ounces per hen per day:-

D.M.	Pro.	Carbo.	Fat.	Cal.	N.R.
4.0693	.4928	2.0128	.2048	345.55	1:5.

The birds were Plymouth Rocks averaging in weight 7.95 pounds and gained 22 pounds in weight.

Number of eggs laid = 1,094

Ozs. nutrients per hen per day used in eggs produced:-

subtract from the Carbohydrates and Fats, making the ration narrower. This does not take into account the food obtained by forage, which should be subtracted from the above. The main difference in the two above standards is an excess of fat in the former, giving it a larger heat value. The latter standard will be used in any following discussions.

We will compare some of the rations fed in practise with these largely theoretical standards. The following are taken from actual records.

One hundred hens were fed for thirty days during November and December, on the following ration :-

	No. of pounds.	Cost.
Cornmeal	50	$ .356
Middlings	50	.400
Ground Oats	50	.475
Ground green bone	127.7	1.277
Oats	177.7	1.62
Wheat Screenings	416.6	3.333
Total	694.3	$ 7.461

Pounds digestible nutrients in the ration.

Dry matter.	Protein.	Carbohydrates.	Fat.
762.995	92.393	377.355	38.409

Ounces per hen, per day. Notice correction.

Oz. nutrients per hen per day used in eggs produced:-

Dry matter.	Protein.	Carbohydrates	Fat.	Calories.
.2555	.0969	0	.0681	29.127

leaving for maintainance :-

3.8138	.3959	2.0128	.1367	316.423

while our standard calls for :-

3.3882	.40	1.95	.13	307.5

Practically a balanced ration was fed. A gain in weight showed an excess of Carbohydrates, and fat was fed, and this excess was probability not used for a larger egg production on account of not sufficient protein. About 4% increase in protein and 15% increase in fuel value would be required to produce one egg per day. At 20¢ per dozen eggs, the profit would be 10.77¢ per hen. An abscence of green food is noticeable in this ration.

Light feeding was compared with heavy feeding in an experiment. Feed was kept constantly before one lot, in the litter, while the amount given the other lot was limited.

Rations fed.

	Corn-meal.	Bran.	Ground oats.	Beef scrap.	Corn.	Wheat.	Oats.
Heavy feeding	34 lbs	34	34	60.5	254	370	270
Light feeding	30.3	30.3	30.3	49	177	291.5	249

Pounds digestible nutrients in each ration.

	Dry matter.	Protein.	Carbohydrates.	Fats.
Heavy feeding	941.04	120.568	607.404	42.001
Light feeding	763.504	98.629	486.207	33.992

Each flock consisted of twenty females and two males, averaging in weight 5 1/2 pounds in the first, and 5 pounds in the second. The former gained 8 pounds during the experiment, and the latter lost 3 pounds.

Heavy fed lot produced 1259 eggs.

Light .. .. .. 1030 ..

Time of year was December to July.

Figuring the males consuming the same amount of nutrients as the females, the following pounds of nutrients were supplied per hen :-

	Dry matter.	Protein.	Carbohydrates.	Fat.	Calories.	N.Ratio.
Heavy fed.	42.77	5.48	27.61	1.91	69526.8	1:5.82
Light fed.	34.70	4.48	22.10	1.54	55893.	1:5.7

Subtracting the nutrients used in the eggs produced leaves pounds for maintainance per hen :-

	Dry matter.	Protein.	Carbohydrates.	Fat.	Calories.
Heavy fed	40.02	4.45	27.61	1.176	64254.34
Light fed.	32.45	3.634	22.10	.94	41783.3

The requirements for maintainance according to the standard, would be as follows :-

	Dry matter.	Protein.	Carbohydrates.	Fat.	Calories.
Heavy fed.	51.9524	6.16	29.90	1.99	74337
Light fed.	48.5744	5.719	27.799	1.886	60143.5

The apparent deficiency might be partly due to the climate. Since one lot was given all the food they would consume, either they had insufficient digestive capacity to produce more eggs, or it "was not in the blood". A lack of green food might be an important consideration here. The relative profits per hen were as follows :-

	Food cost per fowl.	Value of eggs per fowl.	Profit per f
Heavy fed.	$ .424	$ .763	$ .339
Light fed.	.3502	.623	.2728

Narrow compared with wide ration. Climate, Massachusetts. December 12th to April 30th - 140 days. Nineteen pullets in each pen, with average weight about five and one half pounds. The narrow ration lot lost 2 1/2 pounds, and the wide ration lot 1 1/2 pounds. The former laid 860 eggs, and the latter 1071.

The following rations were fed :-

	Narrow ration.		Wide ration.	
	Lbs.fed.	Cost.	Lbs.fed.	Cost.
Wheat	257	$2.75	126	$1.26
Oats	147	1.34	63	.575
Bran	43	.344	39	.312
Middlings	43	.344		
Gluten feed	43	.473		
Animal meal	43	1.075	39	.975
Clover	44	.44	39	.39
Cornmeal			108	.81
Corn			136	.968
Cabbage	18.3	.366	16.3	.326
Total	638.3	7.132	616.3	6.616

Digestible nutrients in ration, in pounds.

	Dry matter.	Protein.	Carbohydrates.	Fat.	Calories.	Nut.Ratio.
Narrow.	353.405	77.796	331.106	20.628	809675.	1 : 4.7
Wide	487.058	56.693	310.348	21.079	770910.	1 : 6

After subtracting the amount consumed in the eggs produced we have the following left for maintainance per hen, per day, in ounces.

	Dry matter.	Protein.	Carbohydrates.	Fats.	Calories.
Narrow.	3.1019	.3831	1.932	.0637	278615.
Wide	2.6476	.2353	1.866	.051	257360.4
Standard for 5 1/2 pound hen is :-	3.3882	.40	1.95	.13	307.5

Both rations show a deficiency of nutrients which might be accounted for in two ways. The fowls lost slightly in weight, and over 65% of the eggs were laid in March and April, when a much smaller amount for maintainance is required. The following compares the profits

	Cost of feed per hen.	Val.of eggs per hen.	Profit per hen.
Narrow.	$ .375	$ .754	$ .379
Wide.	.348	.954	.606

Medium narrow and wide rations compared. Climate, Rhode Island. August 18th to November 18th., - 92 days. During the molting season. Ten hens in each pen, average weight about 3 1/2 pounds. Number of eggs laid; medium 181, narrow 214, wide 114.

Rations fed.

	Medium.		Narrow.		Wide.	
	Lbs.	Cost.	Lbs.	Cost.	Lbs.	Cost.
Bran	28	$ .224	28	$ .224	29	$ .232
Cornmeal	23	.1725	23	.1725	32	.24
Cotton s.meal	7	.098	7	.098		
Linseed meal	5	.06	5	.06		
Beef scrap	9	.225	9	.225		
Cracked corn	85	.6375			85	.6375
Oats			54	.493		
Gr.bone			62	.62		
Total	156	1.417	188	2.8925	147	1.1095

Pounds of digestible nutrients in the rations.

	D.matter.	Protein.	Carbohydrates.	Fat.	Calories.	Nut.ratio.
Medium.	139.033	21.287	85.998	8.092	233415.12	1 : 4.9
Narrow.	163.438	32.201	55.890	16.355	232293.54	1 : 2.7
Wide.	128.600	13.355	89.042	6.176	116304.98	1 : 8

The lots gained respectively, 2 , 3 & 1 pounds in weight. After subtracting nutrients used in the eggs produced, we have left for maintainance, in ounces per bird, per day :-

	D.matter.	Protein.	Carbohydrates.	Fats.	Calories.
Medium.	3.2808	.3185	1.495	.1042	238.039
Narrow	3.6789	.5098	.972	.2406	233.897
Wide	3.1512	.1994	1.549	.0839	116.515

There is more than sufficient nutrients in the medium and narrow rations. There is apparently a deficiency in the wide ration since it maintained the fowls, a part of the other rations must have been wasted. The comparative profits were as follows.

	Cost of feed per hen.	Value of eggs per hen.	Profit per hen.
Medium.	$ .1417	$ .181	$ .0393
Narrow.	.28925	.214	.17525
Wide.	.11095	.114	.00305

The medium ration made the most profit, and is approximately balanced.

The record of a flock of hens in New York is as follows:-

1st.- Dec.1st to 27th.- Number of hens 499 1/4

2nd.- Mar.1st to 28th.- 493 1/4

Eggs produced in December 2229 - in March 9553.

Rations fed.

	1st period.		2nd period.	
	Lbs.	Cost.	Lbs.	Cost.
Wheat	1845.5	$18.435	2235.9	$22.359
Fresh me.&bo.	706.5	10.597	786.3	11.794
Cabbage	329.2	6.584	48.2	.964
Total	2879.2	35.616	3070.4	35.117

Ounces digestible nutrients per hen, per day.

	D.matter.	Protein.	Carbohydrates.	Fat.	Calories.	Nut.Ratio.
1st.	2.722	.418	1.546	.175	275.3	1:4.6
2nd.	3.088	.469	1.795	.103	290.438	1:4.3

Subtracting amount used in eggs produced we have left for maintainance, in ounces per hen, per day :-

1st.	2.6065	.3746	1.546	.1442	262.133
2nd.	2.605	.2876	1.500	.103	233.376

An excess of nutrients is shown, the birds weighing 3 1/2 pounds, but in March it was practically balanced. At least a part of the excess in December was used in increased maintainance requirements at that season. The following shows the relative profits at the two seasons of the year:-

	Cost of food per hen.	Value of eggs per hen.	Profit per hen.
1st.	$ .0714	$ .0818	$ .0104
2nd	.0722	.2564	.1842

Record of another flock in New York.

1st.- Febr.1st to 28th - 349 hens.

2nd.- Mar. 1st to 28th. - 333 3/4 hens.

Average weight four and one half pounds.

The following rations were fed :-

	1st.Lot.		2nd.Lot.	
	Lbs.	Cost.	Lbs.	Cost.
Corn	756	$5.383	407.2	$2.899
Wheat	594.9	5.949	755.9	7.559
Oats	366.9	3.546	325.9	2.972
Bran	105.2	.842	96.1	.769
Cornmeal	105.2	.789	96.1	.721
Middlings	147.5	1.176	135.4	1.083

Gr.Oats	84.	.789	76.4	.718
Meat scrap	63.	1.575	48.3	1.108
Skim-milk	299.1	.598	325.8	.652
Cloverhay	47.7	.477	55.8	.558
Total	2559.5	21.204	2422.9	19.039

1st lot laid 2589 eggs.- 2nd lot laid 4874 eggs.

Ounces digestible nutrients per hen, per day.

	Dry matter.	Protein.	Carbohydrates.	Fat,	Calories.	Nut.ratio.
1st.	3.355	.384	2.231	.148	309615	1:6.67
2nd.	3.08	.369	2.053	.118	291937	1:6.28

Subtracting eggs produced, we have for maintainance per hen,per day,in ounces :-

1st.	3.1695	.3143	2.231	.0986	288568
2nd.	2.733	.2349	1.843	.118	251239

our standard is :-

2.9425	.345	1.675	.115	265.15

Here we have a deficiency of protein making the ratio wider than desirable. This and former examples suggest that our maintainance requirements perhaps, are too heavy. The following compares the profit :-

	Cost of food per hen.	Value of eggs per hen.	Profit per hen
1st.	$ .061	$ .111	$ .05
2nd.	.057	.195	.138

We find that 1:4 ratio is nearest the balanced ration, but about 1 : 5 produces eggs the cheapest in the coldest weather. The ration most nearly balanced produced eggs at the most profit per hen.

Summary of above rations.

Lot.	% egg production.	Season.	Cost per doz. to produce.	Value per doz.	Profit per dz.	Pounds fed per hen, per day.	N.R.
1st.	36.46	Nov. to Dec.	.081	.20	.119	.233	1:5.02
a.	25.49	Dec. to Jul.	.089	.16	.071	.196	1:5.82
2nd. b.	21.02	.. .. ..	.089	.16	.071	.159	1:5.7
n.	32.33	Dec. to Apr.	.099	.20	.101	.247	1:4.7
3rd. w.	40.26	.. .. ..	.074	.20	.126	.232	1:6
m.	19.56	Aug. to Nov.	.094	.13	.036	.169	1:4.9
4thn.	23.26	.. .. ..	.16	,12	—.04	.243	1:2.7
w.	13.39	.. .. ..	.117	.12	.003	.159	1:8
a.	16.53	December	.192	.22	.028	.212	1:4.6
5th. b.	69.17	March	.044	.16	.116	.215	1:4.3
a.	26.5	February	.098	.18	.082	.261	1:6.67
6th. b.	51.07	March	.047	.16	.113	.259	1:6.28

Lots 1, 4-m, 5-b, and 6 were fed practically a balanced ration and produced the greatest number of eggs, and made the most profit per dozen. *lot 3 excepted.*

PART 2.

Shall we feed whole grain to the laying hens, or shall we grind it? The following shows the comparative egg production of Leghorns in full laying :-

	Number of eggs laid.
Whole grain	1675
1/3 ground ..	1804
All ground ..	1817

20 pullets in each pen for 240 days. Each pen ate practically the same amount of food. This shows the profitableness of

grinding at least a part of the grain.

Animal food is more efficient than vegetable food when both have the same nutritive value. This is especially so of protein. In Winter, vegetable protein has little value when used alone, but animal protein is very valuable. At New York it was found that 23% more food was required to produce one pound of eggs when there was no animal food in the ration. Animal food is already nearly like what it will be when assimilated, but vegetable food is enclosed in cellulose structures, which are not easily broken down.

There is on record an experiment showing the results of adding green food to a ration. Each lot had a run with some grass in it, but one pen had green food in addition. The pens were alternated every two months. Two dozen additional eggs per fowl were laid during the year by the pen receiving the green food.

PART 3.

In serving rations, there is only one important point under dispute - is the mash best fed in the morning or evening ? We have already seen that the most economical feeding requires a part of the grain to be ground, and this is best served in the form of a mash. We consider the best method to be to throw whole grain in the litter in the morning. This gives the necessary exercise. At noon feed vegetables. When the mash is fed in the morning, it satisfies their hunger enought to make them lazy. Some claim that mash fed at night is soon digested, and the birds are required to remain empty a long time. Then they must work hard while in this condition to receive more food, which is not quickly digested. A green range

should be furnished at all times possible. This furnishes needed exercise, keeps the fowls in health, and presents a more natural condition.

A classification of rations might be as follows :-

(a) Those for confined fowls in the coldest winter weather. We will take a 4 1/2 pound pullet for our purpose. Standard for maintainance and production of one egg per day, in ounces, per hen, per day :-

Protein.	Carbohydrates.	Fat.	Calories.
.608	2.0948	.115	344.28

For 100 hens :-

				Nut. ratio
3.8 lbs	13.09	.73	34480	1:3.86

Since it is practically impossible for a hen to produce one egg per day during these months, we will reduce the amount of protein, and make the nutritive ratio wider, the weather being colder than the average of the year. So we think the following would be a practical working standard for 100 hens per day.

Protein.	Carbohydrates.	Fat.	Calories.	Nut.Ratio.
3.3lbs.	13.20	.732	30492	1:4.5

(b) Confined fowls in pleasant winter weather with green forage. Reduce the carbohydrates slightly in class (a) also the fats.

(c) In pleasant winter weather with green forage :- Reduce all of the nutrients slightly in class (a) but the carbohydrates and fats more in proportion, making the nutritive ratio about 1:4.

(d) Confined fowls in Spring and Summer. In this class the fowls would be in full laying and require nearly the full standard requirements. The following standard I would suggest :-

Protein.	Carbohydrates.	Fat.	Calories.	Nut.Ratio.
3.5 lbs	12.40	.708	29288.24	1 : 4

(e) Free range fowls in Spring and Summer. Use the standard of Class (d) subtracting the nutrients estimated to be obtained from the range.

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R.I. .. ..

Maine .. ..

Mass. .. ..

West V. .. ..