THEESIS
ON
EGGS AS A FOOD
Submitted to the Faculty
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by
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APPROVED:
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Department of Domestic Science and Art
EGGS AS A FOOD.

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EGGS AS A FOOD.

"But for life the universe were nothing and all that has life requires nourishment."

There is probably no article of diet of animal origin more commonly eaten in all countries or served in a greater variety of ways than eggs. Milk is the nearest rival and it resembles eggs in that both are intended by nature for food for the young. Although not a perfect food because of the almost total absence of carbohydrates, an important food principle, they are a very nutritious and valuable food, filling a large place in the dietary of nearly all countries. They are
used extensively in pastries, deserts and as a substitute for meat. It is in the latter capacity that they are most advantageously used. Dietitians and physicians agree that as an ingredient or rich pastries and deserts they could well be dispensed with.

SIZE AND COMPOSITION.

The average size of a hen's egg is 2.27 inches in length and 1.72 inches in diameter at the broadest point and weighing about 2 ounces. This makes 8 eggs to the pound or 24 ounces to the dozen. The eggs of other fouls are larger or smaller according to the size of the bird, and of the same species, the domesticated fouls have much larger eggs than their wild sisters. Duck's eggs are from 2.36 inches to 2.56 inches in diameter while those of the wild duck range from 1.97 inches to 2.17 inches in diameter. The eggs of the domestic goose weigh from 5.5 to 6.7 ounces, making 5 pounds to the dozen, nearly three times the weight of hen's eggs, which is in proportion to the size of the birds. Although the eggs of some wild birds are considered a delicacy in some countries and the eggs of the duck, goose, and turkey are used to some extent in this country, they are not in common use and this discussion will concern hen's eggs only.

The shell of the egg makes up 11.2 percent of the entire weight. The edible portion is composed of
Water ------------ 65.5
Nitrogenous matter-- 13.1
Fatty materials---- 9.3
Ash-------------- 0.9

The white of the egg is almost wholly albumen, or protein, combined with a large percent of water and a small quantity of mineral salts. The albumen of the egg white consists of four bodies; ovalbumen, conalbumen, ovomuein, and ovomuevid. Of these the one most predominant in the egg white is ovalbumen. Ovomuein and ovomuevid are present in very small quantities.

The yolk of the egg contains a larger variety of the food principles. The yolk is the store-house of nutriment for the young chick and for this reason the egg has been called a perfect food, though it is wanting in one of the important food principles, namely, carbohydrates. It cannot, therefore be considered a perfect food for human beings, although it contains all the ingredients necessary to the maintenance of life and the development of the organism. Out of the egg the entire structure of the young bird is developed. The complexity of the egg yolk is shown in the following analysis by Hutchinson.

Water---------------------- 51.8 percent.

Proteids

<table>
<thead>
<tr>
<th>Protein</th>
<th>Amount</th>
</tr>
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<tbody>
<tr>
<td>vitellin</td>
<td>15.8</td>
</tr>
<tr>
<td>nuclein</td>
<td>1.5</td>
</tr>
</tbody>
</table>

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These different constituents are not merely mixed up in the yolk but to a large extent form chemical compounds, very complex in nature which have not yet been entirely unravelled by chemists. The protein, vitellin, of the yolk is found to be combined with lecithin and is by some chemists called lecithin-nucleo-vitellin. There is also a compound of the proteids free from lecithin which is called nucleo-vitellin. The phosphatides are fat-like bodies containing phosphorous and are often classed with the fats, though they differ considerably in composition from the true fats. The relative proportions of the food principles is clearly and graphically shown by the following diagram from Hutchinson's "Food and Dieteties."
There is a popular belief that there is a difference in the composition of brown shelled and white shelled eggs, that those with the brownshells are richer than those with a white shell. There seems, however, to be no foundation for this belief, the only difference being in the proportion of yolk which varies slightly with different breeds.

THE PLACE OF EGGS IN THE DIETARY.

In composition eggs resemble such animal foods as milk, meat and cheese more than vegetable food, such as potatoes. The following table shows the relative percentage of the different nutrients in white and brown shelled eggs, raw and cooked, and a comparison with a few other common foods, as to nutritive value.
Average Composition of Eggs and other foods.  

Refuse  Water  Prot  Fat  Carbohydrates  Ash  Full value per lb. Calories.

<table>
<thead>
<tr>
<th>Item</th>
<th>Refuse</th>
<th>Water</th>
<th>Prot</th>
<th>Fat</th>
<th>Carbohydrates</th>
<th>Ash</th>
<th>Calories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole egg, as purchased</td>
<td>11.2</td>
<td>65.5</td>
<td>11.9</td>
<td>2.3</td>
<td>---</td>
<td>0.9</td>
<td>635</td>
</tr>
<tr>
<td>Whole egg, edible portion</td>
<td></td>
<td>73.7</td>
<td>13.4</td>
<td>10.5</td>
<td>---</td>
<td>1.0</td>
<td>720</td>
</tr>
<tr>
<td>Whole egg, boiled, edible portion</td>
<td></td>
<td>73.3</td>
<td>13.2</td>
<td>12.0</td>
<td>---</td>
<td>.8</td>
<td>725</td>
</tr>
<tr>
<td>White shelled eggs, as purchased</td>
<td>10.7</td>
<td>65.6</td>
<td>11.8</td>
<td>10.8</td>
<td>---</td>
<td>.6</td>
<td>675</td>
</tr>
<tr>
<td>Brown shelled eggs, as purchased</td>
<td>10.9</td>
<td>64.8</td>
<td>11.9</td>
<td>11.2</td>
<td>---</td>
<td>.7</td>
<td>695</td>
</tr>
<tr>
<td>Cheese, as purchased</td>
<td></td>
<td>34.2</td>
<td>25.9</td>
<td>33.7</td>
<td>2.4</td>
<td>3.8</td>
<td>1950</td>
</tr>
<tr>
<td>Sirloin steak, as purchased</td>
<td>12.8</td>
<td>54.0</td>
<td>16.5</td>
<td>16.1</td>
<td>---</td>
<td>.9</td>
<td>985</td>
</tr>
<tr>
<td>Oysters as purchased in shell</td>
<td>81.4</td>
<td>16.1</td>
<td>1.2</td>
<td>.2</td>
<td>.7</td>
<td>.4</td>
<td>45</td>
</tr>
<tr>
<td>Wheat flour</td>
<td></td>
<td>12.0</td>
<td>11.4</td>
<td>1.0</td>
<td>75.1</td>
<td>.5</td>
<td>1650</td>
</tr>
<tr>
<td>Potatoes as purchased</td>
<td>20.0</td>
<td>62.6</td>
<td>1.8</td>
<td>1.1</td>
<td>14.7</td>
<td>.8</td>
<td>310</td>
</tr>
<tr>
<td>Milk</td>
<td></td>
<td>87.0</td>
<td>3.3</td>
<td>4.0</td>
<td>5.0</td>
<td>.7</td>
<td>325</td>
</tr>
</tbody>
</table>

As shown by their composition, eggs are a nutritious food, comparing very favorably with most of the standard food stuffs. They are more concentrated than milk or oysters. In water content they do not differ greatly from the average value of lean meat. As shown in the table, Sirloin steak and potatoes and oysters as purchased contain much more refuse than eggs with relatively no more nourishment. From numerous dietary studies carried on by the United States Department of Agriculture and the Agricultural...
experiment stations, it was found that on the average of the total food used by man per day; eggs furnish 3 percent of the total food, 5.9 percent of the total protein, 4.3 percent of the total fat, while beef and veal together were found to furnish 10.3 percent of the total food, 24.6 percent of the total protein and 19.5 percent of the total fat. Eggs, therefore, have less protein and more fat comparatively and are not so popular as they deserve to be. It was found that cheese furnished 0.4 percent of the total food, 1.6 percent of the total protein and 1.6 percent of the total fat, showing the far greater popularity of eggs over cheese. This is probably due to the fact that eggs are so often made to take the place of meat and the necessity of their use in rich pastries, making eggs one of the important articles of diet in the households of today.

Whether an extensive use of eggs is advisable, economically considered, or whether they are to be considered a luxury must be determined by the varying prices. These usually vary with the season and locality. In poultry raising districts in the spring and summer, eggs would be the cheapest and most practicable. For families of moderate means in the cities and especially in the winter time the price often makes them a great luxury indeed, although considering their high nutritive value compared with other
standard foods they may not be so expensive as at first appears. They are valuable for giving variety to the diet and for furnishing a light, easily digestible food. For persons of sedentary habits of life they are especially desirable, as they take the place of meat, which should not be fully indulged in by persons not leading an active life. By considering the cost of the different foods and the relative amount of nutrition contributed by each, in proportion to the total cost, it has been found that eggs at 12 cents per dozen are a very cheap source of nutrition; at 16 cents per dozen they are fairly expensive; at 25 cents per dozen or over they are very expensive. By comparing eggs to meat and considering not the nutritive value but the relative amount required to satisfy the appetite, we find, however, that eggs at 25 cents per dozen are not more expensive than meat. At the prevailing prices at this time in Corvallis, with beef at 10 cents per pound, 1 pound of beef is required for the breakfast of a family of five. With eggs at 20 cents per dozen, one half dozen furnishes the necessary amount for the family of five, if the eggs are boiled or fried. If they are made into an omelet 4 are sufficient, if coddled or scrambled, 5 are necessary. Thus we see that they are not more expensive or not so much so and they are preferred for the morning meal rather than meat, both because they afford a variety and because it is not desirable that the morning meal should
be heavy. Eggs make a light, easily digested food for breakfast. They are, from a hygienic point of view, also greatly preferable, because as dietitians tell us, most persons, especially those leading sedentary lives, are given to eating too heavily of meats.

The Digestion and Absorption of Eggs.

The digestibility of eggs, that is, the rapidity with which they are digested depends largely upon several conditions. These conditions are the method of cooking, the degree of heat to which they are subjected and the freshness of the eggs. It will be seen that these conditions relate to the ease with which the eggs can be broken up in the stomach into their constituents. If cooked until the egg white is hard and tough a much longer time and more thorough mastication will be required for chymification in the stomach.

Since the majority of persons neglect to masticate their food properly, if the egg is cooked "hard", until the yolk is firm and mealy, and the white tough, it is swallowed in large pieces which cannot readily be dissolved by the gastric juice. If cooked "soft" or taken nearly raw it is of such a consistency that the gastric juice readily penetrates to all parts of it.

Dr. Beaumont, who has made extensive experiments in digestion, had under his care a man who was wounded in the stomach by the discharge of a musket and which healed, leaving a permanent opening in the stomach, but
with his health unimpaired. Beaumont had the opportunity to make many conclusive experiments, being able to remove the contents of the man's stomach at any time and to watch the action of the gastric juice. The experiments made include tests of the length of time required to digest eggs. "Hard boiled" and fried eggs each require 3 1/2 hours for digestion in the stomach; "soft boiled" eggs require 3 hours; roasted egg, 2 1/4 hours; raw egg, not whipped, 2 hours; and raw egg whipped 1 1/2 hours. It must be remembered that personal idiosyncrasy is an important factor in the digestion of any food. With eggs this is especially true. Some people being unable to swallow even one bite of egg without becoming very ill. This is caused sometimes through a production of hydrogen sulphide gas by the action of the gastric juices. Persons of this sort are fortunately rare, certainly not in the majority.

Many very nutritious foods do not furnish much nourishment to the human body because their nutrition is not in a form which can be used by the body. Only that part of food nourishes us which is absorbed through the villi of the stomach and intestines into the general circulation. The absorption of the different food principles of egg is very complete, only about 5 percent of the dry substance being lost, leaving a very small residue in the intestines.
USE OF EGGS IN DIET OF SICK.

In the dietary of invalids, eggs are prescribed when a very nutritious, highly concentrated food is desirable, such cases as of tuberculosis, some forms of anaemia and any wasting disease where the treatment is to build up the tissues as rapidly as possible, being most commonly treated in this manner. Eggs should not be eaten by patients suffering from flatulent dyspepsia, gastric dilatation or in fact, any severe gastric derangement or severe Brights disease.

Raw eggs are most frequently given to invalids and where that is the only article of diet as many are sometimes given as from 3 to 12 a day. To avoid monotony they may be combined advantageously with milk and salt, cod liver oil, soups and purees or meat broths. The white may be whipped and added to coffee, cocoa, wine, cream or sweetened water. Eggnog is an appetizing mixture which is very nutritious and offers a variety. It is made of egg, milk and sugar with alcohol in the form of brandy, wine or sherry. It is prescribed especially for forced alimentation as in phthisis and melancholia, and occasionally in cases of biliousness where eggs cannot be digested except when beaten in wine. The presence of alcohol makes it undesirable when there is any fever and it is sometimes nauseating to feeble stomachs.
It is thought that the white or albumen of the egg is more digestible than the whole egg because of the fat and higher percent of solids contained in the yolks. For very feeble stomachs the white is taken raw or nearly raw. It may be diluted with milk or water. It may also be predigested, being flavored with lemon juice, sherry or wine, coffee, cocoa, cream or sweetened water to avoid its being tasteless or disagreeable. Most persons, however, soon tire of it and it becomes nauseating to them. Egg albumen is sometimes used to prepare fresh albumenate of iron. It is made of two tablespoons of a solution of 1 part egg white and two parts water to a teaspoon of three percent solution of ferrous chloride. This should be taken through a tube on account of the injurious effect of iron compounds upon the teeth. Another compound of egg albumen is Protogen, an uncoagulable form of egg albumen made by the action of formalin upon egg white. This may be taken by mouth or as a nutrient enema.

TESTS FOR FRESHNESS OF EGGS.

It is of great importance in all cookery but especially for the use of invalids that the eggs used should be fresh. There are several ways of judging as to their freshness. One of the most common of these "candling". Hold the egg up so the light will shine through it. The fresh egg will appear unclouded and almost translucent. If it is old a dark spot is visible.
which increases in size with the age of the egg. A spoiled egg appears dark colored or opaque. A second way to test the freshness of eggs is by dropping them in a solution of salt. The solution is made of two ounces of salt to 1 pint of water. An egg 1 day old will sink in this solution but not quite reach the bottom. An egg 3 days old will float just below the surface and one 2 weeks old will float above the surface, only partially dipping beneath it. The difference in weight is due to the evaporation of water through the porous shell and to the formation of gases of putrefaction within the shell. As the age of the egg increases, the faster is the rate of evaporation. The rate of the loss of water after 10 days is 1.60 percent, after 20 days is 3.16 percent, after 30 days is 5 percent. If the temperature of the room in which they are kept is high the evaporation of moisture from the eggs is much more rapid. This is one reason for cold storage keep-eggs in good condition.

THE COOKING OF EGGS.

The methods of serving eggs alone or in combination with other food materials are very numerous. Cooking produces in eggs a physical but not a chemical change. This physical change is governed greatly by the method of cooking. The egg begins to coagulate at a temperature of 134° F., fine threads or fibers first appearing in the white. As the heat is increased the fibers thicken
and at 160 F. the entire mass is coagulated, of a milky color and a tender, gelatinous consistency and the yolk if firm. If the temperature is raised the white becomes a dense, white, tough mass while the yolk becomes mealy and darker in color. The numerous ways of cooking may be classified into two general groups; first, eggs used as a meat substitute, second, eggs combined with other materials into made dishes. They are used in doughs and batters to improve the flavor, color, and texture as in muffins, cakes, pancakes, etc. They are also used in some doughs as a leavening agent. The beaten white incloses air in small bubbles, which are distributed throughout the dough and on baking the air expands and the dough becoming firm holds its porous structure. The power to inclose and retain air when beaten, varies, being greater in the fresh egg. Familiar examples of this use of eggs are pop-overs and sponge cakes. Another important class of foods in which eggs are concerned are the deserts, puddings, custards, filling for pies and cakes, salad dressings, and ices. In these the eggs are used to thicken the material and give it the desired consistency, to improve the flavor, color and texture. In any of these made dishes the white or yolks are often used separately. Beaten whites of eggs are also used for icings and meringues.

As a meat substitute eggs are cooked in four general ways; first, boiled (in the shell), second, poached
BOILED EGGS.

"There is a best way to do everything even if it be to boil an egg". Emerson.

Yet the best way is not to boil it at all. The ordinary method of boiling eggs is to plunge them into boiling water and boil for different lengths of time according to the consistency desired. The albumen on the outside nearest the shell being subject to this high heat becomes hard and tough and indigestible before the yolk has hardly been warmed at all. The best way to cook them is to keep them at a temperature of from 134° to 160° F for the required length of time. This may be accomplished in the household where a thermometer is not available by three different methods.

First- For each egg put one pint of boiling water into a hot saucepan, gently lower the eggs into the water and let stand, uncovered, on the back of the range, for 8 to 10 minutes. If to be very firm they should stand 40 or 45 minutes, covering the pan after the first five minutes.

Second- Allow one quart of boiling water to four eggs. Pour the water into an earthen jar that has been previously heated. Put in the eggs, cover the jar and wrap with a heavy flannel cloth. The eggs will be "soft boiled" in six minutes, solid in ten.
Third—Place the eggs covered with cold water over the fire and remove at the first boil. For garnishing dishes with eggs it is desirable that the yolks and whites be very firm. For this purpose they should be kept just below boiling for 40 minutes and then placed in cold water for 10 to 15 minutes. This makes the removal of the shell easier.

POACHED OR DROPPED EGGS.

Poached eggs are removed from the shell and cooked in water, stock, or milk, shirred or molded.

POACHED EGGS ON TOAST.

Drop the egg into scalding milk and cook until the whites are tender. Serve on toasted circles, well buttered.

POACHED EGGS.

Break the eggs into hot water and cook for two minutes, pour off the water and beat until they are light. Season with salt, pepper and butter. Serve on toast or in sauce dishes.

SHIRRED EGGS.

Eggs poached in a dish are said to be shirred. They may be served in the dish in which they are cooked or several may be cooked in one dish, cut out with a round pastry cutter and served on toast. Eggs are shirred in flat dishes, in cases of china, or paper, or cocottes. A cocottes is a small earthen saucepan standing on three feet.
SHIRRED EGGS WITH CHOPPED HAM.

Butter the egg shirrer, line with chopped ham and break an egg into each. Season slightly and bake until the whites are firm.

SHIRRED EGGS WITH CHEESE.

Butter the egg shirrers, line with grated cheese and break an egg into each. Season slightly, sprinkle over with cheese and bake until the whites are firm.

BAKED EGGS.

Have hot small earthen cups or molds. Butter, and break into each an egg. Sprinkle with salt, pepper, and cover with one teaspoon of cream and a speck of butter. Bake until firm.

OMELETS.

Omelets are probably the most appetizing form in which eggs are served. Scrambled eggs resemble omelets in the method of preparation but there is no effort to preserve any definite form in scrambled eggs. In an omelet, lightness is desired, in scrambled eggs, thorough mixing, thus the omelet is beaten and the scrambled eggs stirred.

OMELET VARIATIONS.

From 1/4 to 1/2 cup of any hot meat or vegetable minced and seasoned may be mixed in an omelet or folded into it just before serving.

PLAIN OMELET.

Beat two eggs slightly, add one fourth teaspoon
of salt and a shake of pepper and two tablespoons of milk, or water. Pour into the omelet pan in which one tablespoon of butter has been melted. Shake gently and with a fork or palette knife, roll or scrape toward one side of the pan. When creamy turn on to the other side and when slightly colored, serve at once. The variations I found appetizing were the following:

Cheese Omelet—Grate cheese and sprinkle over omelet just before folding.

Ham Omelet—Sprinkle finely chopped ham over eggs as soon as put in pan.

Oyster Omelet—A small can of oysters cooked in a little of their liquor and thickened slightly. Use oyster liquor in omelet instead of water or milk. Spread oysters over omelet just before folding.

Some variations that I tried and did not like are the following:

Bread Omelet—Soak 1/2 cup of bread crumbs in 1/2 cup of milk and mix with eggs before cooking.

Orange Omelet—Use juice of orange in place of milk or water in omelet. Sweeten slightly. Cover with thin slices of orange just before folding.

Jelly Omelet—Sweeten the omelet slightly when mixing and spread one or two tablespoons of warm jelly over it before folding.

SCRAMBLED EGGS.

The following recipes are those I tried and found
to be favorites generally.

Scrambled Eggs--Country Style--Heat the omelet pan, put in two tablespoons of butter and when smoking hot turn in unbroken eggs. Cook until the whites are partially set, then stir until the cooking is complete. Season with salt and pepper.

Scrambled Eggs with Tomato Sauce--Heat 3/4 cups of tomatoes and 2 teaspoons of sugar together. Fry the butter and 1 slice of onion. Remove the onion and add the tomatoes and 6 eggs slightly beaten. Cook as scrambles eggs. Serve with toast.

Scrambled Eggs with Tansy--Have omelet pan smoking hot. Put in 1 tablespoon of butter, when melted turn in 4 eggs slightly beaten and season with 4 tablespoons of cream, 4 sprigs of Tansy, chopped fine and salt and pepper. Stir constantly until done to a creamy consistancy. Serve immediately. This recipe is not found in cook books, I believe, but is certainly delicious.

THE PRESERVATION OF EGGS.

The importance of the preservation of eggs is increasing with the size of the cities and greater shipping facilities. In earlier times eggs, if sold at all were marketed near the place where they were produced. If this was true now it would be impossible to get eggs in the city markets and the poultry raising districts could use but a very small part of their supply. There
is also a necessity for keeping eggs from summer through winter because of the greater production in the summer time. Since the advent of the large cold storage plants in the cities, eggs have largely been preserved in this way. They can be kept in good condition for many months but cannot be kept in good condition after removal from the cold of the plant, more than one or two days. This is a common experience with any food kept in cold storage, that it decomposes rapidly after being removed.

Another method of preservation is packing the eggs in some substance which will exclude the air. The substances used for this purpose are numerous. Packing in bran or oats or salt are common but these substances injure the flavor of the egg. Covering with limewater is another method but it does not give uniform results. Wrapping in paper, covering with a solution of salicylic acid and glycerin, covering with paraffin are other ways employed. With these, from 40 to 80 percent of the eggs spoil. Of the many ways of excluding air, packing in a solution of water glass has been found to be the most practicable. At the North Dakota Experiment Station, eggs packed in a ten percent solution of water glass (potassium silicate) kept for 3 1/2 months and when unpacked had the flavor and appearance of fresh eggs.

There is another method of preserving eggs which has been recently introduced and which promises much. This method is drying or desiccation of the eggs. They are prepared by being first slightly beaten and then
dried in a forced draught of filtered air. The product looks like the yolk of egg dried into cakes and broken up into small flakes. Two and one-half pounds of fresh egg when dried makes one pound of dried egg. In one pound of dried eggs there are three dozen eggs. Their greatly decreased bulk makes them easily transported from place to place and the shipping very much cheaper, because not only is the weight decreased but the danger from breakage is eliminated.

To prepare dried eggs for cooking, they are put with equal amount of cold water and left to stand for several hours. The egg will thoroughly dissolve and be of the consistence of eggs freshly beaten. They can be used as any fresh eggs except when the method requires that the egg be enclosed in the shell or the whites and yolks separate. They are not so good for use as a leavening agent because they tenacity of the albumen is not so great as in fresh eggs.

The two samples I was able to obtain were "Truegg", manufactured by the Merril-Soule Co., Syracuse, N.Y., and "Keith's Dried Eggs", manufactured by the H.J. Keith Co., Boston, Mass. The "Truegg" is a powder put in cans and the sample I obtained had a very bad odor as well as an unpleasant taste when cooked. It was so unpleasant that I tried it only once, in a rice pudding. The "Keith's Dried Eggs were in small flakes and pleasant in odor and tasting exactly like fresh eggs.
I used the dried eggs in an omelet and there was no possible difference between it and one made of fresh eggs. Scrambled dried eggs flavored with tansy could not be told from one made of fresh eggs.

Cakes made from dried eggs when compared with one made from fresh eggs was found to be exactly like it.

Custards made from dried eggs were thought to have a slightly different taste but several persons not knowing which was which, guessed wrongly as to which was made of dried eggs.

Fop-overs made from dried eggs raised only about half as much as they should but were very palatable nevertheless.

Salad dressing made from dried egg was the exact counter part of that made from fresh eggs. It is safe to conclude from these results that dried eggs are very usefull, cheaper at most seasons of the year and very easily transported in such expedition as would carry one away from the railroad where limited baggage only were possible. When the convenience of this form of eggs is more widely appreciated, they will no doubt be extensively used.
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