FARM ARITHMETIC

BURKETT AND SWARTZEL

"Agriculture is the most healthful, most useful, and most noble employment of man."—Washington.

FARM ARITHMETIC

TO BE USED WITH ANY TEXT-BOOK
OF ARITHMETIC OR WITHOUT

By

CHARLES WILLIAM BURKETT

Editor American Agriculturist

Formerly Professor of Agriculture in the New Hampshire and the North Carolina Colleges of Agriculture and Mechanic Arts, and Director of the Kansas Agricultural Experiment Station

and

KARL DALE SWARTZEL

Professor of Mathematics, Ohio State University

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PREFACE.

This book is primarily, as its title implies, a farm arithmetic. It is not intended to be a medium for the setting forth of the general principles of arithmetic. It is hoped that it may serve two other very important ends in elementary and higher schools. First, it will supply new, concrete, useful, and interesting problems for practice, drill, and review. Second, it will tend to develop in the mind of the pupil an appreciation of and an insight into the quantitative side of farm life. A boy or girl who has once become interested in solving the problems of the farm will not easily be drawn away from the farm.

This book may be used at any time after the fundamental principles of arithmetic have been covered, *i. e.*, during the last two or three years of the elementary school, and should ordinarily be completed before the high school is reached. It may be used alone or in conjunction with any standard grammar school, advanced, or high school arithmetic.

It is also hoped that this volume may be helpful to a large number of farmers and country folk generally who are interested in the many numerical and quantitative problems that have so much to do with success on the farm.

CHARLES W. BURKETT,
KARL D. SWARTZEL.

May, 1913.

TO THE TEACHER.

There is much in modern higher arithmetic that is of but little value to certain classes of pupils. Particularly is this true of the subject matter of many text-books now in use in rural schools—country, town, and village. These books were made by city people for city children and are, for the most part, admirably adapted to city schools. The problems deal very largely with city affairs and occupations. Now, it is a fact that the fundamentals of arithmetic may be stated in terms of agriculture and that such a statement is much needed in rural life affairs.

The main object to be secured in the study of arithmetic is to learn to "think number"—*i. e.,* to learn to think quantitatively. After the elements of number study are mastered the field opens up in distinct directions. There is little use of spending many weeks on problems of cube root, partial payments, bank discount, stocks and bonds, merchandising, etc., in the rural and country town schools, since these subjects seldom, if ever, enter into the lives of the children.

Arithmetic may be taught in terms of agriculture. The household, the soil, the dairy, the field, the crops, and the animals offer wonderful opportunities for the introduction of number and arithmetical problems into the school work as a vital part of the life of the children. Thus farm arithmetic falls directly into line with the environment of farm boys and girls.

On the other hand, agriculture may be taught in terms of arithmetic. When so taught the real nature of the all important problems with which the country youth of the present and the future must deal, both in school and after taking up home and farm life, will become apparent to him and will receive adequate attention at his hands. Farm arithmetic, therefore, should be a basic study in every school in every rural community.

USING THE BOOK.

After the ordinary elementary work in arithmetic has been covered, this book should follow at once. The fundamentals of the first books in arithmetic will find application and expression in this. In case it is desired that further study be required in higher arithmetic, this book may be made a supplementary text, alternating with the other in the regular weekly periods. The problems should be solved and the informational questions discussed and answered in the same manner as is followed in the use of an ordinary text-book on higher arithmetic.

The authors believe that an earnest use of this book in the schools will be of inestimable value to every child. This will be apparent both in the present school work and in the practical results when school days are over and the text-book problem becomes the real problem of the home and farm. In every way the book aims to teach arithmetic in terms of agriculture and agriculture in terms of arithmetic, and to be a real part of the country life environment.

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CHAPTER I.

PLANT FEEDING.

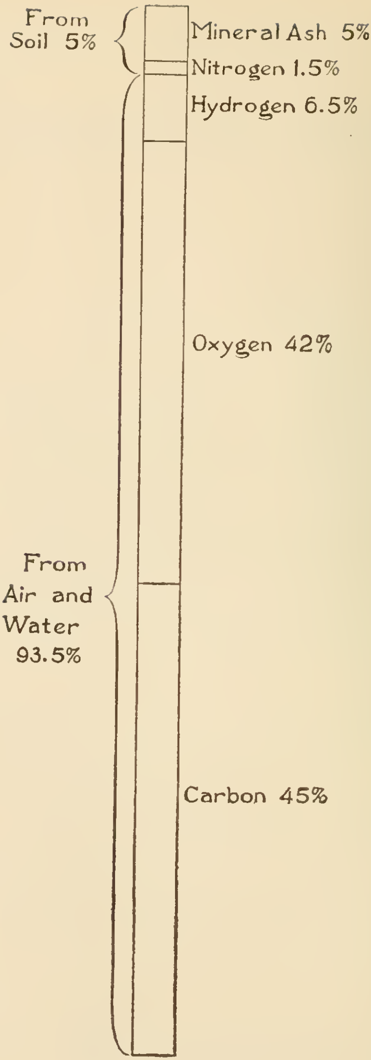
Farming profits are derived directly and indirectly from the soil; directly through the growing of plants and indirectly through the feeding of animals. The wise farmer, therefore, gives much thought to the care and enrichment of the land. Although the greater part of the substance actually entering into the growth of plants comes from water and air, all plant growth may be said to depend upon the soil. The comparatively small part which comes from the soil is absolutely essential to the growth of the plant and must be present in a sufficient quantity and in the proper form.

Where plants get their food. The young plant beginning its life obtains its first food from the seed. With this food it starts its roots into the soil and its stems and leaves into the air. Both roots and leaves begin immediately to gather food for further growth.

The leaves take from the air carbon and oxygen.

The roots take from the soil water (oxygen and hydrogen), nitrates (nitrogen), phosphoric acid (phosphorus), potash (potassium), lime (calcium), iron, sulphur, sodium, chlorine, magnesium, silicon, manganese, etc.

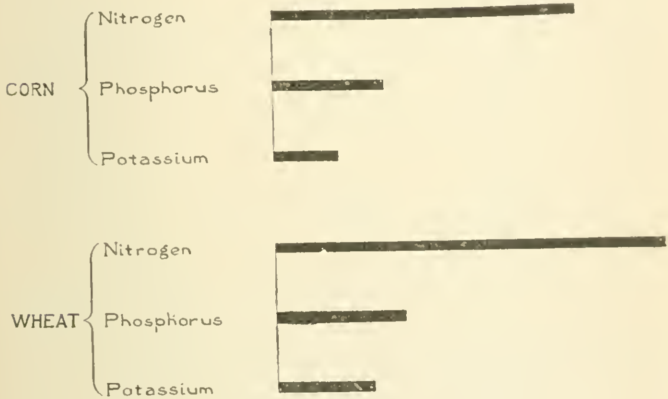
Composition of plants. A mixture of all kinds of plants after having all moisture driven off by heat, contains the following percentages of elements:



WHAT PLANTS CONTAIN.

Element	*Per cent.*	*Where it came from*
Carbon,	45	Air
Oxygen,	42	Air and water
Hydrogen,	6.5	Air and water
Nitrogen,	1.5	Soil
Minerals (ash),	5	Soil
Total,	100.0	

1. In a ton of dried mixed plants how many pounds of carbon? How many pounds of each of the other constituents?



COMMON ELEMENTS IN TWO LEADING CROPS.

As shown in the table the amount of carbon is 45 per cent (45%) of the total weight. To solve this problem we must find 45% of 2,000 pounds. One per cent (1%) of a number means one part in one hundred parts, which is the same as saying one one-hundredth (.01) part of the number. 45% is .45 of the number. To get 45% of a number we therefore multiply by .45.

Solution:

45% of 2,000 pounds = .45 × 2,000 pounds = 900 pounds.

Answer: 900 pounds carbon.

Note.—The above solution may be made as follows:

1% of 2,000 pounds = 20 pounds.
45% of 2,000 pounds = 45 × 20 pounds = 900 pounds.

Solution for the remaining constituents:

2,000 × .42	= 840	Oxygen
2,000 × .065	= 130	Hydrogen
2,000 × .015	= 30	Nitrogen
2,000 × .05	= 100	Mineral
	900	Carbon
Total	2,000	

This addition serves to check or prove the correctness of the work.

2. How many pounds in each ton are obtained from the soil? From the air and water?

Wheat contains:

	Carbon	*Oxygen*	*Hydrogen*	*Nitrogen*	*Ash*
In grain	46.1	43.4	5.8	2.3	2.4
In straw	48.4	38.9	5.3	0.6	7.0

Note.—The percentages given in the preceding table, as well as in those to follow, are merely average values. The corresponding percentages for any given sample may differ greatly from these figures. For example, two varieties of corn grown in the same soil and under the same climatic conditions may have greatly different chemical analyses. This may also be true of two samples of the same variety grown under different climatic conditions or in different soils.

3. In producing a ton of wheat, how many pounds come from the soil? A ton of wheat straw?

4. How many pounds of carbon in 25 bushels (60 pounds each) of wheat?

5. When wheat yields 25 bushels of dry grain an acre

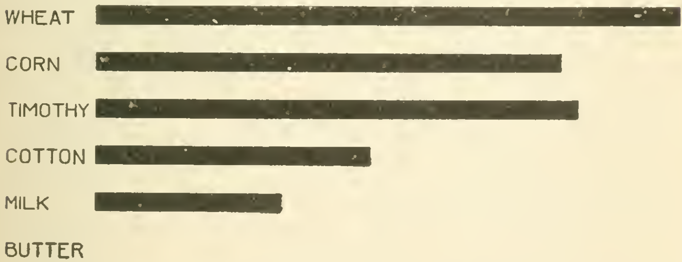
and two tons of dry straw, how many pounds of soil material have been removed?

The three important elements. As a rule all the soil elements essential to the growth of plants, except nitrogen, phosphorus and potassium, are abundantly present in the soil. These are therefore the only ones with which the farmer is seriously concerned in the feeding of his plants. The problem of fertilizing the land demands a careful study of these three very important elements.

WHAT CROPS REMOVE FROM SOIL, IN PER CENT.

Crop	Nitrogen	Phosphoric Acid	Potash
Corn	1.9	0.7	0.4
Wheat	2.3	0.9	0.6
Oats	2.1	0.8	0.6
Cotton Lint	0.3	0.1	0.4
Timothy	1.3	0.5	0.9
Potatoes	0.2	0.1	0.3
Corn Stover	1.0	0.3	1.4
Wheat Straw	0.6	0.1	0.5
Oat Straw	0.6	0.2	1.2
Cottonseed	3.1	1.3	1.2

6. How much nitrogen is removed from the soil in one ton of shelled corn? How much phosphoric acid? How much potash?



WHEN A TON IS SOLD.

The relative amounts of plant food removed when a ton of each product is sold is indicated in the sketch.

Solution:

.019 × 2,000 pounds = 38 pounds..................Nitrogen
.007 × 2,000 pounds = 14 pounds..................Phosphoric acid
.004 × 2,000 pounds = 8 pounds..................Potash

7. When corn yields 40 bushels an acre, how many pounds of nitrogen are removed from each acre of soil? Phosphoric acid? Potash?

Solution: If a bushel of shelled corn weighs 56 pounds, 40 bushels will weigh 40 times 56 pounds = 2,240 pounds.

.019 × 2,240 pounds = 46 pounds..................Nitrogen
.007 × 2,240 pounds = 16 pounds..................Phosphoric acid
.004 × 2,240 pounds = 10 pounds..................Potash

Note.—In the above examples, as well as in those to follow, the answers should not be carried out to a greater number of significant figures than are shown in the table. The reason for this is obvious.

8. A hundred bushels of wheat, weighing 60 pounds a bushel, would represent the removal from the soil of how much nitrogen? How much phosphoric acid? How much potash?

9. A 20-acre field of wheat yielded 32 bushels an acre. What was the draft per acre upon the soil for nitrogen? For phosphoric acid? For potash? For the three combined? What was the total amount of each of these three important elements removed from the field?

10. When oats yield 50 bushels (32 pounds each) an acre, what is the draft upon the soil for these three elements?

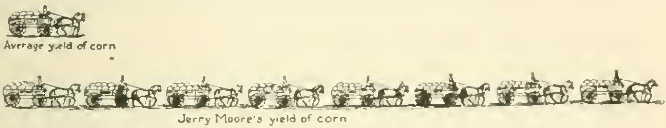
11. What is the draft when cotton yields one-half bale (a bale weighs 495 pounds) an acre? When timothy yields two tons an acre? When potatoes yield 100 bushels (60 pounds each) an acre?

12. Jerry Moore of South Carolina, a member of the Boys' Corn Club, raised 228¾ bushels of corn in 1910 on one acre, and won the first prize for the state—a trip to Washington. What was the draft upon that acre of soil?

Average Production Per Acre in the United States.

Wheat	Oats	Cotton	Corn	Timothy	Potatoes
14 bushels	28.6 bushels	1-3 bale	29.4 bushels	1.1 tons	85 bushels

13. Determine feeding draft on the soil for each of the above crops on the basis of the average production per acre in the United States.



How a Boy Beat the Average.

Jerry Moore's acre yield of corn is here contrasted with the average yield of the county.

14. A yield of 14 bushels of wheat and 1,680 pounds of wheat straw per acre entails what loss to the soil in nitrogen? What loss in phosphoric acid? Potash?

Solution for nitrogen:

14 bushels wheat weighs 14 × 60 pounds = 840 pounds.

According to our table, page 5, 2.3% of this is nitrogen.

.023 × 840 pounds = 19 pounds.

Our table shows that wheat straw is .6% nitrogen. 1,680 pounds would therefore contain

.006 × 1,680 pounds = 10 pounds..................Nitrogen.

In an average crop of wheat there is removed from the soil 19 pounds + 10 pounds, or 29 pounds, of nitrogen an acre. The amount of phosphoric acid and of potash may be calculated in the same way, and will be found to be 9 pounds and 13 pounds respectively.

15. Determine number of pounds of each kind of plant food the average crop of corn removes from the soil when the yield is 29.4 bushels of corn and two tons of stover per acre.

16. Determine number of pounds of plant food an average crop of cotton removes from the soil when the yield of cotton lint is 165 pounds and cottonseed 330 pounds an acre.

17. Determine number of pounds of plant food the average oat crop removes from the soil when yield is 28.6 bushels and 2,400 pounds straw an acre.

Important truth. These problems show how the soil is depleted when various crops, including cottonseed. corn stover and straw, are sold or otherwise not returned to the land.

DAIRY FARMING HELPS THE LAND.

In the sketch are shown the amounts of nitrogen, phosphorus and potassium removed from the land when 1,000 pounds each of beef, milk, butter and wheat are sold.

18. How many bushels of wheat an acre has been grown when 36 pounds of nitrogen are removed by the grain from the soil?

Solution: Wheat grain is 2.3% nitrogen; therefore 2.3% of the number of pounds of wheat per acre must equal 36, *i. e.*:

2.3% = 36
1% = 15
100% = 1,500 .... Pounds an acre, or
1,500 ÷ 60 = 25 .... Bushels an acre.

This amounts to dividing 36 by 2.3 and multiplying the result by 100, which is the same as dividing 36 by .023.

19. In problem 18, suppose the 36 pounds to be the total nitrogen removed, and suppose the weight of the straw to be 2½ times that of the grain.

Solution: 2.3% of the grain is nitrogen, .6% of the straw is nitrogen, and since there is 2½ times as much straw as grain the nitrogen in the straw amounts to 2½ × .6%, or 1.5% of the weight of the grain. The nitrogen in both grain and straw, therefore, amounts to 2.3% + 1.5%, or 3.8% of the weight of the grain. The weight of the grain is 36 ÷ .038 = 947 pounds, or about 16 bushels.

20. One hundred and forty pounds of nitrogen were taken from a 10-acre field by the removal of cottonseed. What was the yield an acre in pounds of seed?

Plant food in the soil. Forty-nine different soils were analyzed. They showed an average of 3,053 pounds of nitrogen, 4,219 pounds of phosphoric acid and 16,317 pounds of potash an acre in the upper 8 inches of soil.

21. How many average crops of wheat (14 bushels of grain and 1,680 pounds of straw) will this nitrogen supply? The phosphoric acid? The potash?

22. How many crops if only the grain is removed and the straw is returned to the land?

23. How many crops of corn (grain 29.4 bushels, stover two tons)?

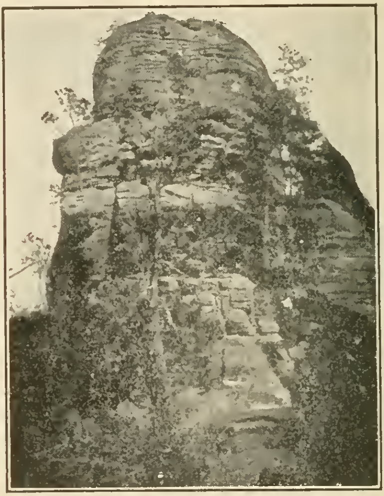
24. How many crops of corn if the stover is returned to the land?

25. How many crops of cotton (165 pounds lint, 330 pounds seed)?

26. How many crops of cotton lint, if all of the seed is returned to the land?

Important truth. Almost all soils contain large quantities of plant food. Any soil will become unproductive and exhausted long before it is depleted of plant food. Good tillage, the addition of straw, stover, cotton-seed, and stable manures, and the frequent growing of clovers, alfalfa, cowpeas, and soy beans will increase the quantity of plant food in the soil and will improve its productiveness. Barnyard manure is one of the best of all fertilizing materials.

Buying plant food. The practice of purchasing plant



LOCKED UP FOR AGES TO COME
All rock contains plant food. Nature releases but a small amount each year. All soil was originally rock.

food—nitrogen, phosphoric acid and potash—in order to supplement that already present in the soil has assumed enormous proportions in recent years. These commercial fertilizers are potential plant food, and are intended to assist in supplying the needs of the growing plant, but only in a small way. They are known as chemical manures, or chemical fertilizers.

Manures or fertilizers may be so compounded as to furnish the three important elements in any proportion desired.

Carriers of nitrogen. Nitrate of soda, sulphate of ammonia and dried blood are commercial forms of fertilizing materials that supply nitrogen only. The per cent of nitrogen is shown in the following table:

Material	*Per cent Nitrogen*
Nitrate of soda,	16
Sulphate of ammonia,	20
Dried blood,	14

27. How many pounds of nitrogen in a ton of nitrate of soda?

Process: $2{,}000 \times .16 = 320$

28. How many pounds of nitrogen in a ton of sulphate of ammonia?

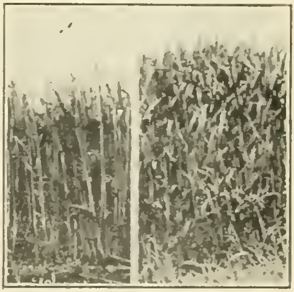
29. How many in a ton of dried blood?

30. When you apply 100 pounds of nitrate of soda to an acre of land, how many pounds of actual nitrogen are applied?

Process: $100 \times .16 = 16$

31. How many pounds of actual nitrogen are applied to the soil when a mixture of 50 pounds of nitrate of soda and 50 pounds of sulphate of ammonia is used?

32. How many pounds of dried blood will be necessary to increase the application to 30 pounds?



WITH AND WITHOUT FERTILIZER.

Wheat was used here as a soiling crop. The plot at the left made 4.6 tons to the acre, while the one at the right having had an application of nitrate of soda produced 7½ tons.

Carriers of phosphoric acid. Acid phosphate is the principal material supplying phosphoric acid alone. It ordinarily carries 14 per cent phosphoric acid.

33. How many pounds of actual phosphoric acid in a ton of acid phosphate?

34. Suppose you desire to apply 35 pounds of actual phosphoric acid to your soil, how many pounds of acid phosphate will it require?

Carriers of potash. Muriate of potash, sulphate of potash, and kainit are commercial forms supplying potash only. The per cent of potash in each is shown in the table following:

Material	*Per cent of Potash*
Muriate of potash,	50
Sulphate of potash,	48
Kainit,	12.5

35. How many pounds of actual potash in a ton of muriate of potash? Sulphate of potash? Kainit?

36. Suppose you desire to apply a mixture of these three materials to your land so as to get 30 pounds of actual potash—ten pounds from each material—how many pounds of each will be necessary?

Carriers of more than one kind of plant food. Leading fertilizing materials and per cent of each element carried is shown in the table below:

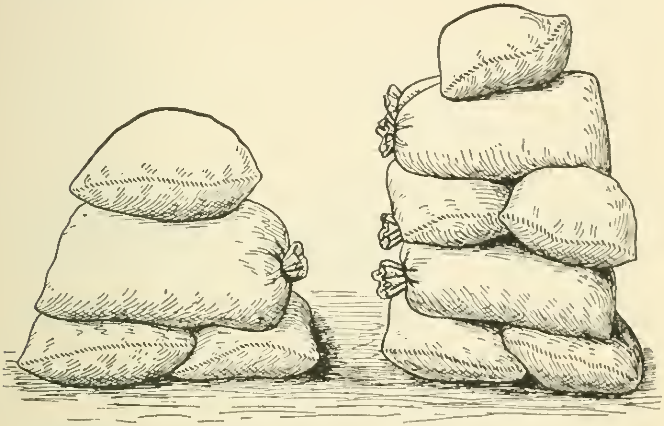
Material	Per cent nitrogen	Per cent phosphoric acid	Per cent potash
Ground bone	3.0	22.0	
Dissolved bone	3.0	15.0	
Cottonseed meal	7.0	2.5	1.5
Tankage	6.0	11.0	
Fish scrap	8.0	7.0	
Wood ashes		1.5	5.0

37. How many pounds of nitrogen, phosphoric acid and potash in a ton of fertilizer made of equal parts of ground bone, cottonseed meal, tankage, fish scrap, and wood ashes?

38. What is the percentage of nitrogen in a ton mixed in this way?

39. Of phosphoric acid?

40. Of potash?

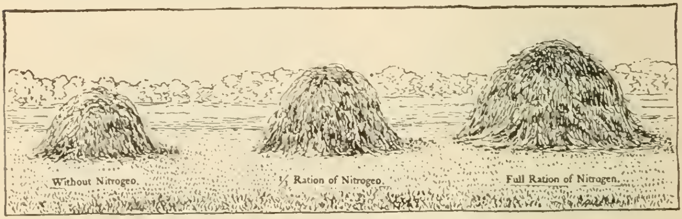


INCREASING THE POTATO YIELD.
Mineral fertilizers were applied, practically doubling the returns.

Important truth. No fertilizing material is wholly plant food. A large part of every fertilizer is inert matter, known as filler. The plant food elements are in general found only in chemical or physical combination with other elements which are not plant foods. Muriate of potash is the most concentrated of the fertilizing materials; yet in one ton of muriate of potash only 1,000 pounds is actual plant food. The remainder is foreign matter, which is of no value to the soil or to the plant. One must always consider the amount of actual plant food present in a commercial fertilizer and must be familiar with the percentage of each food element contained. In order to use such materials wisely and economically one must know something of the nature of the soil in question and of the crop to be grown.

Mixing fertilizing materials. Fertilizing materials may be used singly or in combination. By properly selecting the materials a fertilizer may be made to suit any soil and any crop.

41. A ton of home-mixed fertilizer is made of 1,200 pounds of acid phosphate, 400 pounds of cottonseed meal,



CHANGING THE TIMOTHY RATION.
All three were fertilized alike with muriate of potash and acid phosphate.

and 400 pounds kainit. What will be the quantity of nitrogen, phosphoric acid and potash?

Solution: Turning to page 12 we find that acid phosphate analyzes 14 per cent phosphoric acid; cottonseed meal 7 per cent nitrogen, 2.5 per cent phosphoric acid and 1.5 per cent potash; and kainit 12½ per cent potash.

Acid phosphate.
$1,200 \times .14 = 168$.......... Pounds phosphoric acid.

Cottonseed meal.
$400 \times .07 = 28$.......... Pounds nitrogen,
$400 \times .025 = 10$.......... Pounds phosphoric acid,
$400 \times .015 = 6$.......... Pounds potash.

Kainit.
$400 \times .125 = 50$.......... Pounds of potash.

We now have—

	Phosphoric acid	Nitrogen	Potash
In acid phosphate	168	00	0
In cottonseed meal	10	28	6
In kainit	00	00	50
	178	28	56

42. In a ton of fertilizer mixed in this way what is the percentage of each element of plant food?

Solution: To find this percentage divide the amount of each element by the total amount of the mixture, and multiply by 100. The calculation is as follows:

		Per cent.
Phosphoric acid,	178 ÷ 2,000 × 100 =	8.9
Nitrogen,	28 ÷ 2,000 × 100 =	1.4
Potash,	56 ÷ 2,000 × 100 =	2.8

Note.—This would be designated as a 8.9-1.4-2.8 mixture.

43. How many pounds of nitrogen, phosphoric acid and potash in a ton of fertilizer, containing 1,400 pounds of acid phosphate, 100 pounds of nitrate of soda, 200 pounds of cottonseed meal, 100 pounds of dried blood, and 200 pounds of muriate of potash?

44. What is the percentage of phosphoric acid, nitrogen and potash in the above fertilizer?

45. Suppose, instead of using 1,400 pounds of acid phosphate, we use 1,400 pounds of ground bone; how many pounds of nitrogen, phosphoric acid, and potash will the ton of mixture contain?

46. What is the percentage of phosphoric acid, nitrogen and potash in a ton of the mixture?

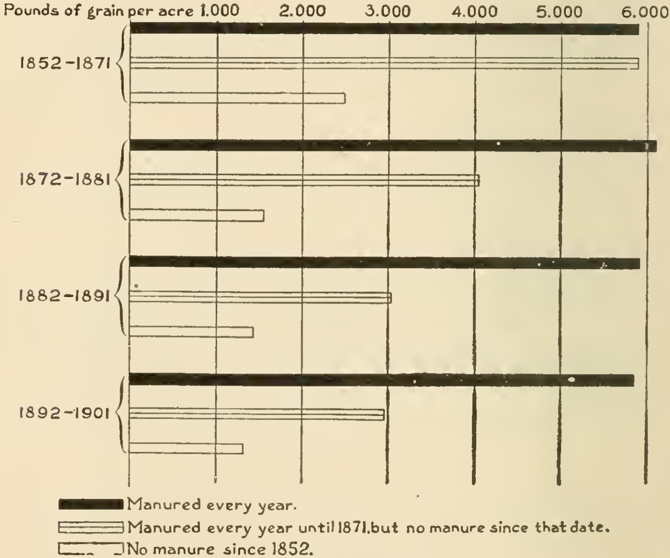
Fertilizer formulæ:

A Widely Used Corn Fertilizer.

Acid phosphate,	875 pounds
Cottonseed meal,	950 pounds
Kainit,	175 pounds
Total,	2,000 pounds

47. What percentages of phosphoric acid, nitrogen and potash are contained in the above fertilizer?

48. When 400 pounds of this fertilizer are used per acre, how many pounds of phosphoric acid, nitrogen and potash are added to the soil?



No Question About Value of Manure.

A Widely Used Cotton Fertilizer.

Acid phosphate,	900 pounds
Cottonseed meal,	800 pounds
Kainit,	300 pounds

49. What percentages of phosphoric acid, nitrogen and potash are contained in above fertilizer?

50. When 200 pounds are used per acre, how many pounds of each element are added to the soil?

51. When 500 pounds are used per acre, how many pounds of each element are added to the soil?

A Widely Used Tobacco Fertilizer.

Acid phosphate,	1,000 pounds
Dried blood,	500 pounds
Nitrate of soda,	100 pounds
Sulphate of potash,	400 pounds
Total,	2,000 pounds

52. What percentages of phosphoric acid, nitrogen, and potash are contained in above fertilizer?

A Widely Used Wheat Fertilizer.

Dissolved bone,	1,200 pounds
Sulphate of ammonia,	500 pounds
Muriate of potash,	300 pounds
Total,	2,000 pounds

53. What percentages of phosphoric acid, nitrogen, and potash are contained in this fertilizer?

54. When 200 pounds are used per acre, how many pounds of potential plant food are added to the soil?

55. When wheat yields 25 bushels of grain and two tons of straw, a total of 94.5 pounds of plant food is removed. What proportion of this amount is furnished when 200 pounds of the above wheat fertilizer is applied to each acre?

Important truth. Even with heavy application of fertilizer only a small part of the plant food used by the crop is furnished by the fertilizer. The soil must always be the chief source of plant food for any growing crop. It is also true that only a part of the fertilizer is taken up by the crop immediately following its application.

Working from percentages. Given the percentages of phosphoric acid, nitrogen, and potash suitable to a crop or to a soil, to mix a fertilizer satisfying the requirement In general this can be done in a great many ways. Usually, however, the materials from which to select are limited in number or are definitely specified.

Let us make a ton of fertilizer analyzing 8-3-3, using for the purpose acid phosphate, sulphate of ammonia and kainit.

Solution: First find the number of pounds of each element in one ton of mixture.

Phosphoric acid,	8 per cent or 160 pounds per ton,
Nitrogen,	3 per cent or 60 pounds per ton,
Potash,	3 per cent or 60 pounds per ton.

Acid phosphate is 14 per cent phosphoric acid.

To get 160 pounds of phosphoric acid we must use 160 ÷ .14 = 1,142 pounds of acid phosphate.

Sulphate of ammonia is 20 per cent nitrogen.

To get 60 pounds of nitrogen we must use 60 ÷ .20 = 300 pounds of sulphate of ammonia.

Kainit, 12.5 per cent potash.

To get 60 pounds of potash we must use 60 ÷ .125 = 480 pounds of kainit.

We now have:

Acid phosphate,	1,143 pounds
Sulphate of ammonia,	300 pounds
Kainit,	480 pounds
	1,923 pounds
Unfurnished,	77 pounds
Total,	2,000 pounds

The remaining 77 pounds is filler and may be supplied in fine sand, road dirt or any similar material. If we wish to make but 100 pounds of 8-3-3 fertilizer, we would take one-twentieth part of each of these amounts.

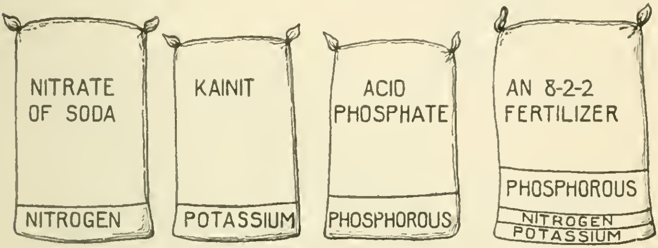
56. How many pounds each of acid phosphate, nitrate of soda, and kainit will be needed to make a ton of an 8-3-3 fertilizer?

57. How many pounds of acid phosphate, cottonseed meal and kainit will be required for a 7-2½-2½ fertilizer?

58. How many pounds of acid phosphate, nitrate of soda, dried blood, and sulphate of potash will be required for a 6-2½-2½ fertilizer?

Note.—Since different quantities of materials may be used as carriers, different answers to these problems will result. The principle is an important one, and should be understood and thoroughly mastered.

Cost of fertilizing materials. The cost of a fertilizer depends upon its constituents. The cost of each element varies from year to year. Unless otherwise indicated in



PLANT FOOD IN BAG OF FERTILIZER.

Not all of the bag contents is plant food. Much of it is dirt or material of no use to plants.

the problem take nitrogen as costing 15 cents a pound, phosphoric acid 5 cents, and potash 5 cents.

59. What is the money value of a ton of fertilizer that analyzes 8 per cent phosphoric acid, 2 per cent nitrogen, and 2 per cent potash (8-2-2)?

Solution:

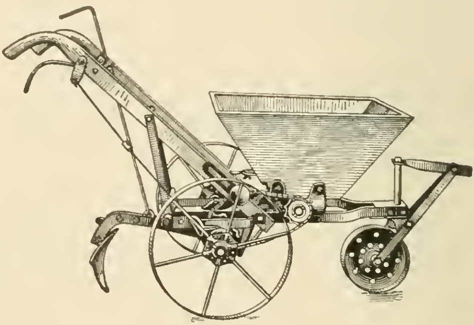
$2{,}000 \times .08 = 160$	160 lb @ 5c = $8.00
$2{,}000 \times .02 = 40$	40 lb @ 15c = 6.00
$2{,}000 \times .02 = 40$	40 lb @ 5c = 2.00
	Total, $16.00

60. What is the money value of a fertilizer that analyzes 7-3-3?

61. What is the money value of a ton of fertilizer composed of 1,600 pounds of acid phosphate and 400 pounds of kainit?

62. When composed of 1,600 pounds of acid phosphate and 400 pounds of muriate of potash?

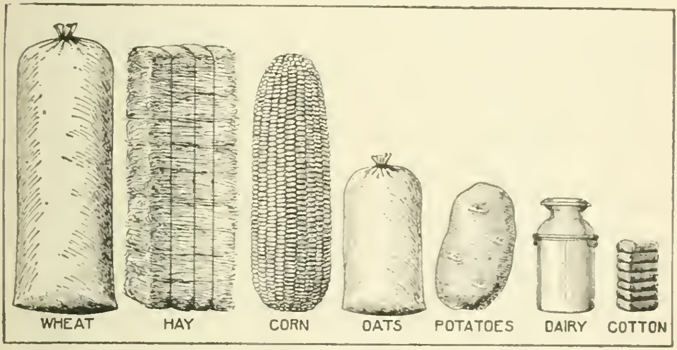
63. When composed of 1,600 pounds of acid phosphate 200 pounds of muriate of potash and 200 pounds of kainit?



FERTILIZER DISTRIBUTOR.

Factory-mixed fertilizers. Commercial fertilizers make up the greater part of purchased chemical manures. They are sold under hundreds of names, but are valuable only in proportion to the amount of plant food they contain. The farmer, therefore, should be guided in buying factory-mixed goods by the guaranteed analysis and not by any high-sounding name or brand.

In computing the relative values of different fertilizers bear in mind that one per cent means one part in a hundred. This is the same as saying one pound in a hundred pounds or 20 pounds in a ton. When a range is given in guaranteed percentages make the calculations on the lowest percentage, since in all probability that most nearly represents the actual composition. By "money value" is here meant the actual market cost of the plant food elements in the fertilizer, not its real value as based on the increased value of the crop due to its use. This latter may be out of all proportion to the actual cost of the fertilizer whether mixed at home or factory made. This latter or real value will depend upon the degree in which the percentages of the different food elements are suited to the given soil and crop.



SEVEN OF OUR LEADING FARM PRODUCTS.

When sold off the farm just so much plant food is sent away. The relative proportions are shown above and apply to nitrogen, phosphorus and potassium in a ton of each product.

64. What is the money value of plant food in a fertilizer containing

Phosphoric acid 7 to 8 per cent,
Nitrogen 1.60 to 2 per cent,
Potash 2 to 2.75 per cent?
Commercial value, $30.

Solution: When the percentages are multiplied by 20 we obtain the number of pounds in a ton, and when this is multiplied by the value per pound we obtain the value on the basis of a ton.

This is shown below:

Nitrogen,	1.6 × 20 = 32	32 lb @ 15c = $4.80
Phosphoric acid,	7 × 20 = 140	140 lb @ 5c = $7.00
Potash,	2 × 20 = 40	40 lb @ 5c = $2.00
	Value of plant food,	$13.80

In this case $13.80 worth of plant food costs $30.

65. What is the value of plant food in a ton of factory-mixed fertilizer containing 9 per cent of phosphoric acid, 2 per cent of nitrogen and 2 per cent of potash?

66. When a ton of such fertilizer sells for $28, what is the money difference between its selling price to the farmer and the money value of the plant food in it?

67. What is the value of plant food in a ton of fertilizer that contains 8 per cent phosphoric acid, 2 per cent nitrogen, and 6 per cent potash?

68. In a ton that contains 8 per cent phosphoric acid, 6 per cent nitrogen, and 2 per cent potash?

69. The value of plant food in a ton of fertilizer is $18. It analyzes 7 per cent phosphoric acid, 3 per cent nitrogen. What per cent of this fertilizer is potash?

70. Two commercial fertilizers are sold on the market. No. 1 analyzes 5 per cent phosphoric acid, 3 per cent nitrogen, and 1½ per cent potash and sells for $26 a ton; No. 2 analyzes 8½ per cent of phosphoric acid, 1 per cent of nitrogen, and 2 per cent of potash and sells for $25 a ton. In which fertilizer do you secure the greater amount of plant food? The better value?

71. If the No. 1 fertilizer rightly sells for $26 a ton, on the same basis of plant food value, what can the farmer afford to pay for No. 2?

Note.—This difference arises from cost of manufacture, agent's profits, and profits to manufacturer. When fertilizers are mixed at home much of this difference can be saved.

72. A fertilizer containing 7 per cent phosphoric acid, 2 per cent nitrogen, and 2 per cent potash sells for $25 a ton. How much phosphoric acid should a ton of a different fertilizer contain, which is also sold at $25, provided it must be 2 per cent nitrogen and 1 per cent potash?

Phosphorus and phosphoric acid. Phosphoric acid means a compound whose composition is expressed by the symbol P_2O_5 and contains 43.79 per cent of phosphorus. To change phosphoric acid into terms of phosphorus it is necessary, therefore, to multiply the number representing phosphoric acid by 0.437, since only 43.7 per cent phosphoric acid is phosphorus.

On many accounts it would be preferable to use the term phosphorus instead of phosphoric acid. The present use is so firmly established that many practical difficulties would be encountered in making the change.

Potash and potassium. Potash is almost universally used in referring to potassium compounds. Strictly speaking, potash means potassium oxide (K_2O). Potassium carbonate (K_2CO_3) or carbonate of potash, contains 56.6 per cent of potassium which is equivalent to 68 per cent of potash (K_2O). Potassium chloride (KCl) contains 52.7 per cent of potassium, which is equivalent to 63.5 per cent of potash. Potassium sulphate (K_2SO_4) contains 45 per cent of potassium, which is equivalent to 54 per cent of potash. Potassium nitrate (KNO_3) contains 38.6 per cent of potassium, which is equivalent to 46.6 per cent of potash.

Ammonia and nitrogen. Ammonia is often substituted for nitrogen in giving the analysis of a fertilizer. This is done simply to increase the size of the figure of the nitrogen content. Nitrogen is the food element, not ammonia, hence ammonia percentage when used must always be changed into nitrogen percentage. This may be done by multiplying the ammonia percentage by .82, since ammonia is 82% nitrogen.

73. What is the percentage of nitrogen in a fertilizer that contains 2 per cent of ammonia?

Solution: $2 \times .824 = 1.6$.

Note.—Ammonia is 14/17 nitrogen, or, in decimals, 0.824.

74. What is the percentage of nitrogen in a fertilizer that analyzes 3 per cent ammonia?

75. A fertilizer contains 2.5 pounds nitrogen in every hundred. What is the percentage of ammonia?

MANURE SPREADER AT WORK.
When the spreader is used manure is applied evenly and uniformly. Then, too, the cost of application is a minimum.

76. In a ton of a certain fertilizer there are 40 pounds of nitrogen. If this were to be expressed in ammonia, how many pounds would there be?

77. If another fertilizer contains 40 pounds of ammonia, how many pounds of nitrogen would it contain?

78. How many pounds of nitrogen in a ton of a fertilizer that analyzes 3 per cent ammonia?

Analyses on tags and sacks. In purchasing a fertilizer it is always necessary to interpret correctly statements and calculations, otherwise the purchaser may be deceived as to its real plant food value. Remember that available phosphoric acid, nitrogen, and potassium are wanted, not high-sounding names or elaborate analyses.

Take the following analysis:

Fertilizer Analysis.

	Per cent
Ammonia,	3 to 4
Phosphoric acid (soluble),	10 to 12
Phosphoric acid (insoluble),	1 to 2
Total phosphoric acid,	11 to 14
Potash (actual),	1.68 to 2.16
Sulphate of potash,	3 to 4

This reduced to its true meaning reads as follows:

Nitrogen,	2.47
Phosphoric acid,	10.0
Potash,	1.62

79. A special potato fertilizer sells for $35 per ton. It analyzes as follows:

	Per cent
Moisture,	10 to 15
Ammonia,	2 to 2.25
Available phosphoric acid.	8 to 9
Equivalent to bone phosphate of lime,	20.74 to 24.01
Insoluble phosphoric acid,	2.25 to 2
Potash,	8 to 8.50
Equivalent to sulphate,	11.80 to 13.72

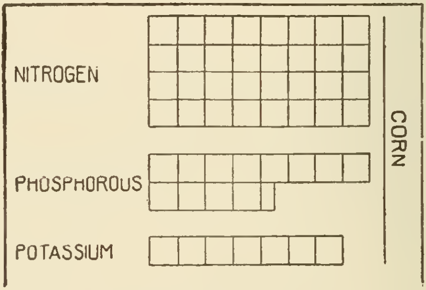
What is the true meaning and what is the plant food value in a ton?

Important truth. In buying fertilizers reduce all fertilizers to terms of nitrogen, available or soluble phosphoric acid and potash. Pay no attention to others, for they are of no value and are deceptive. Use only the lowest percentage for each element, as it more nearly represents the truth.

Remember. Every farmer should study the nature of soil he is farming and the needs of the crop he is growing. He owes it to himself and to humanity to treat the soil in such a way that it will grow richer and richer rather than poorer and poorer.

What Corn Takes From the Soil.

The following problems are intended to serve as a review of the entire subject of plant feeding, and to show what an enormous draft corn, our great king crop, makes



PLANT FOOD IN CORN.
Relative amounts of nitrogen, phosphorus and potassium required by an average corn crop.

each year on the plant food stored in the soil. A similar study could be made with wheat, cotton, hay or the leading crop of any section. The principles involved are the same regardless of the crop, season, or section. As a rule, the soil elements required for the growth of plants are abundantly present in the soil except nitrogen, phosphorus and potassium. These are the principal elements with which the farmer is concerned in feeding his crops. Therefore, fertilizing the land, or feeding the crop, calls for a study of the nitrogen, phosphorus and potassium taken up by the crop and thus removed from the soil.

What corn and stover contain. Dry corn grain, or kernels when removed from the cob, contains of water about 10%, of nitrogen 1.9%, of phosphoric acid 0.7%, of potash 0.4%. This means that in 100 pounds of crib-cured shelled corn of average quality, there are of water 10 pounds, nitrogen 1.9 pounds, phosphoric acid 0.7 of one pound, potash 0.4 of one pound. The corn stalks when thoroughly field-cured, or dried as hay, contain of water about 40%, nitrogen 1%, phosphoric acid 0.3%, potash 1.4%. This means that 100 pounds of field-cured corn fodder of good average quality contain of water 40 pounds, nitrogen 1 pound, phosphoric acid 0.3 of one pound, potash 1.4 pounds.

Average yield an acre. The average yield of corn throughout the United States, one year with another, is about 25 bushels to the acre. This average crop produces about two tons (4,000 pounds) an acre of field-cured corn fodder. Therefore, to produce one bushel of corn requires the growth of stalks and leaves which, when cut and sundried in the field, weigh 160 pounds. As corn weighs 56 pounds to the bushel, one pound of corn is produced by 2.86 pounds of fodder on the average. These proportions vary widely, and so does the composition of grain and fodder, but the above are fair averages. No account is here taken of the cobs which are quite an item.

Questions.

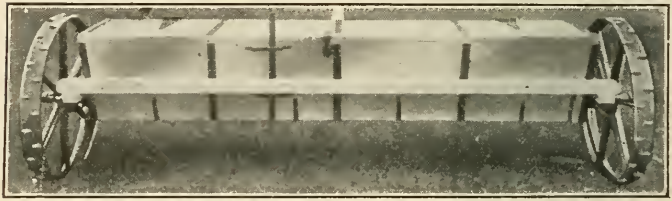
1. How many pounds of nitrogen are removed in 100 pounds of shelled corn, how many pounds of phosphoric acid, how many pounds of potash, and what is the total weight of these three elements in 100 pounds of corn?

2. Determine the same in one bushel (56 pounds) of corn.

3. Determine the same in one ton (2,000 pounds) of shelled corn.

4. When the corn crop yields 25 bushels an acre of shelled corn, how many pounds of nitrogen are required from one acre of soil by the grain? How many of phosphoric acid? How many of potash? What is the total weight of all three elements thus removed?

5. When an acre yielding 25 bushels of corn in the grain produces an average of 4,000 pounds (two tons) of field-cured corn stover, how many pounds of nitrogen are removed from the soil in the stover; that is, by the stalks exclusive of the grain and cob? How many of phosphoric acid? How many of potash? How many pounds of all three of these elements are removed by such a crop of stalks?



HOMEMADE TOOL FOR LIMING THE LAND.

6. What is the total amount of each of the three elements removed from one acre of soil by such a crop of both grain and stalks?

ANSWERS TO ABOVE QUESTIONS.

(1) In 100 pounds of shelled corn of average quality, there are of nitrogen 1.9 pounds or per cent, of phosphoric acid 0.7 pound or per cent, of potash 0.4 pound or per cent. The total weight is 3 pounds.

(2) One bushel of 56 pounds therefore contains 56-100 of the above quantities, which is of nitrogen 1.06 pounds, of phosphoric acid 0.4 pounds, of potash 0.2 pounds, or a total 1.66 pounds of these elements.

(3) One ton of shelled corn contains 20 times the quantity in 100 pounds, or a total of nitrogen 38 pounds, of phosphoric acid 14 pounds, of potash 8 pounds.

(4) A crop of 25 bushels of shelled corn per acre contains of nitrogen 26.5 pounds, phosphoric acid 10 pounds, potash 5 pounds, or a total weight of these three elements of 41.5 pounds.

WHY IS THE DIFFERENCE SO GREAT?

The plot at the right has been in corn for many years, while at the left the corn was rotated with clover and oats. This shows that crop rotation and legume crops improve the land.

(5) Two tons of field-cured corn stover contain of nitrogen 40 pounds, phosphoric acid 12 pounds, potash 56 pounds, a total of 108 pounds.

(6) The 25 bushels of corn and two tons of stover from one acre therefore contain of nitrogen 66.5 pounds,

of phosphoric acid 22 pounds, of potash 61 pounds, or an aggregate of 149.5 pounds of the three.

Plant Food Removed. A certain farm this year will harvest 10 acres of corn yielding an average of 32½ bushels of shelled corn to the acre. Estimate that there are 2.86 pounds of stover for each pound of corn to get the average yield of stover an acre. The average corn crop for the whole United States is computed by the Orange Judd crop reporting bureau of the American Agriculturist as averaging 30 bushels an acre on 100 million acres, making a total of three billion bushels.

You will learn by answering the questions below how much plant food is taken away from the farm, if either the corn or the stover is sold. On the other hand, if the grain or the stover is fed on the farm, and the manure therefrom returned to the soil, only a small part of the plant food in the crop is taken away from the land. This is one reason why it is better to feed a crop on the farm and sell the resulting meat, wool, milk, butter or cheese, than to sell off the whole crop.

Questions.

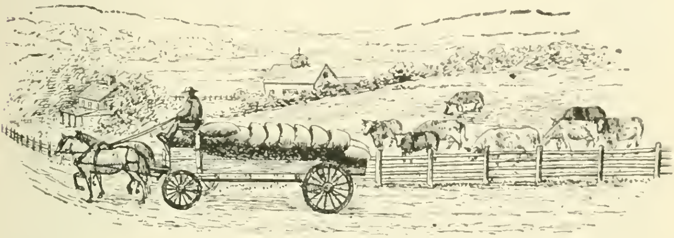
1. Determine the number of pounds of nitrogen, phosphoric acid and potash in the shelled corn, in the stover, and in both together for the 10 acres above referred to.

2. What was the total weight of the United States crop of corn stover in 1912 if all the stalks on every acre were properly field-cured and taken care of?

3. Then calculate the number of pounds of nitrogen, phosphoric acid, and potash, in the grain, and in the stover, and add both quantities together to get the total amount of plant food consumed by a three billion bushel corn crop.

4. Now state in tons the total three billion bushel crop of corn and of corn stover, and the tons of plant food contained in each. How many freight cars, each holding 20 tons, will be required to haul the corn crop? Of such a train how many cars would be required for the total plant food in the corn, were it all separated from the grain?

5. Corn stover is so bulky that 10 tons would make an average carload. How many cars would be required to haul this year's crop of corn stover, and in this train how many cars would be filled with the plant food in the stover, if it all could be separated from the stover?



TWO KINDS OF FARMING.

Grain farming forces plant food from the soil but the dairy cow maintains the fertility of the land.

ANSWERS TO ABOVE QUESTIONS.

1. From the 10-acre piece of corn the yield is 325 bushels of shelled corn, containing of nitrogen 344.5 pounds, of phosphoric acid 130 pounds, of potash 65 pounds. The amount of stover produced is 52,052 pounds, containing of nitrogen 520.5 pounds, of phosphoric acid 156+ pounds, of potash 728.7 pounds. Totals of corn and stover together, nitrogen 865 pounds, phosphoric acid 286 pounds, potash 793.7 pounds.

2. The total weight of an average American crop of corn stover is 480,480,000,000 pounds.

3. In the grain of the entire crop of corn there are of nitrogen 3,192,000,000 pounds; of phosphoric acid, 1,176,000,000 pounds; of potash 672,000,000 pounds; in the stalks, of nitrogen 4,804,800,000 pounds; of phosphoric acid 1,441,440,000 pounds; of potash 6,726,720,000. The total amount of plant food consumed is 18,012,960,000 pounds.

4. In the total United States corn crop the grain will weigh 84,000,000 tons, the fodder 240,240,000 tons. The grain will contain 2,520,000 tons of plant food, and the

FEEDING CATTLE IN THE FIELD.

Hay and grain are placed in racks and troughs and the steers feed at will.

stover 6,486,480 tons; cars, 20 tons each, required for the grain, 4,200,000; for the plant food contained in the grain, 126,000.

5. For the corn stover 24,024,000 cars holding 10 tons each will be required, and for the plant food in it 324,324 cars holding 20 tons each.

Live Stock and the Soil. Having solved these problems, you have discovered what a large amount of expensive plant food is taken from the soil each year by the corn crop. This must be replaced in some way or the land will lose its fertility and become "worn out." If the corn is sold each year, a large amount of fertilizer must be bought. However, suppose the farmer keeps the corn he raises and feeds it to his stock. Let us see what the results are then. The farmer may keep cows and sell the butter, keeping the skim milk to feed calves and to fatten hogs. When butter is sold very little of the elements of the plant food that we have talked about—nitrogen, phosphorus and potassium—is removed. The cows can live upon what is raised on the farm, and most of the elements of plant food in the food consumed by the animals are returned to the soil in the manure. Butter contains only 0.125% of nitrogen, 0.188% of phosphoric acid and 0.031% of potash.

Let us suppose, also, that a number of hogs are kept. They can be fed when young upon the skim milk and fattened with some of the corn that is grown on the farm. With the hogs, as with the cows, a large part of the nitrogen and other elements is returned to the soil in the manure. The carcass of the hog averages about 2% nitrogen, 8.1% phosphoric acid, and 0.16% potash.

Using the percentages given above, work out the following problems, comparing with the results you obtained on the corn problems. Which is the more economical method of farming—to sell the corn or to feed it, selling only the animal products?

QUESTIONS.

1. How many ounces of nitrogen are contained in a pound of butter? How many ounces of phosphoric acid? Of potash?

2. How many pounds each of nitrogen, phosphoric acid and potash are removed from the farm when a ton of butter is sold?

3. How much butter was sold from your place last year, and how many pounds or ounces of the elements of plant food were contained in it?

4. If a farmer sells 20 hogs averaging 150 pounds each, how many pounds of nitrogen are taken away with them? How many pounds of phosphoric acid? Of potash?

5. How many hogs were killed on your farm last year, or sold from it, and what was the total weight of nitrogen in all of them together? Of phosphoric acid? Of potash?

Answers to Above Questions.

1. In one pound of butter there is 0.02 of an ounce of nitrogen, 0.03 of an ounce of phosphoric acid, 0.005 of an ounce of potash.

2. In one ton of butter there are removed of nitrogen, 2.5 pounds; of phosphoric acid, 3.75 pounds; of potash, 0.6 pounds.

4. With the 20 hogs are sold of nitrogen 60 pounds, of phosphoric acid 243 pounds, of potash 4.8 pounds.

The answers to these questions show how much less loss in fertility there is when the corn, or at least a part of it, raised on the farm, is fed to animals at home. If the grain is all sold the needed elements of plant food must, of course, be bought in the form of commercial fertilizer. Let us see how much this amounts to in dollars and cents.

The cost of the three principal elements of plant food varies considerably because there is such a large number of brands of commercial fertilizers. The average cost of each is, for nitrogen 15 to 20 cents a pound, for phosphoric acid 5 cents a pound, and for potash 4 cents a pound. The cost of nitrogen is steadily rising. But let us assume it to be 20 cents a pound. The latest tests of the agricultural college experiment stations show that

TWO CROPS AT THE SAME TIME.

Corn and cowpeas are here growing. The cowpeas were plowed under after the corn was harvested, to add nitrogen and vegetable matter to the soil.

nitrogen is today costing the farmers close to 20 cents a pound when bought in fertilizers. Where mixed farming is practiced the corn stalks can all be used for fodder and for bedding. The stover from an acre of corn is worth almost as much as the hay from an acre of timothy or clover.

QUESTIONS.

1. What is the value of the corn raised on your farm

this year at one cent a pound, or 56 cents a bushel. Of the total (estimated) crop in the United States (3 billion bushels)? Of a 10-acre piece which yields an average of 32½ bushels per acre?

2. Figuring the cost per pound as stated above, how much would it cost to buy the nitrogen contained in the 10-acre piece? Take both the grain and stover into consideration, estimating 2.86 pounds of stover to each pound of grain. What is the value of the phosphoric acid taken from the 10-acre piece? Of the potash? Of the three together? Compare this with the value of the grain.

3. Find the cost of the nitrogen of the phosphoric acid, of the potash, and of all together in the total corn crop of the United States and of your own farm.

Answers to Above Questions.

1. The value of the total United States crop of 3,000,000,000 bushels of corn at 56 cents per bushel is $1,680,000,000. The value of 325 bushels raised on 10 acres is $182.

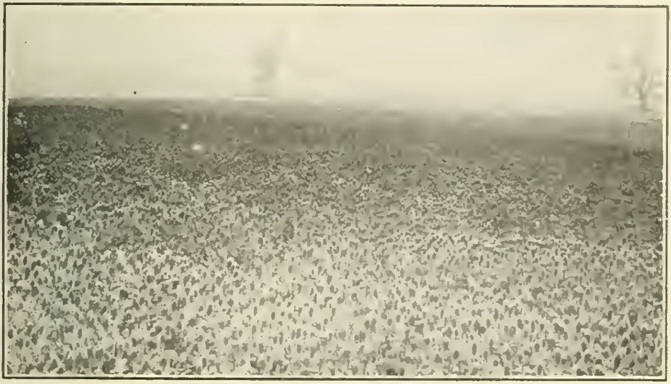
2. The nitrogen in the grain and stalks together at 20 cents a pound would cost $173, the phosphoric acid at 5 cents a pound 14.30, the potash at 4 cents a pound, $31.75; total, $219.05. Now, as a matter of fact, not all of this has to be bought, for corn is able to get most of its food from the soil.

3. Value of the elements in the big total crop of corn in the United States, nitrogen, $1,599,360,000; phosphoric acid, $130,872,000; potash, $295,934,800; total, $2,026,166,800.

The Value of Corn Stover. The stover produced on an acre of corn is worth about as much as the hay from an acre, provided the stover is given the same care in curing. The yield of corn stover averages about two tons (4,000 pounds) an acre.

What is the total yield of field-cured corn fodder on your farm this year, and what is its value at $10 a ton? If you cannot determine the exact weight of the cured corn stalks, compute it as closely as you can.

Now, the total weight of corn stover produced in the United States this year is 480,480,000,000 pounds. Not



CRIMSON CLOVER READY FOR CUTTING.

Every soil is made better by having a legume crop grow in it. Crimson, or scarlet clover, is always prized in those sections to which it is adapted.

all of this is saved, and some of it is not properly taken care of. In figuring out the answers to the questions below remember that 100,000,000 acres of corn were planted in the country this year.

QUESTIONS.

1. What is the value of the corn stover in the United States this year at $10 a ton, assuming that it is all properly harvested and taken care of?

2. What is its value an acre?

3. How much does the waste amount to in dollars if half the stover is lost through poor methods of handling it, or through failure to use it?

4. What is the total value of the grain and stover together in the total United States corn crop?

5. What is the value of the corn, grain, and stover together raised in your vicinity this year? Estimate the acreage and yield per acre in your county or township and base your figures on the cash values at the present day.

Answers to Above Questions.

1. The value of the corn stover grown in the United States this year at $10 per ton is approximately $2,402,-400,000.

2. This gives a value per acre of $24, +.

3. If half the corn stover is wasted, it amounts to a loss of $1,201,200,000 in the whole country.

4. Total value of the United States corn crop, grain and stover together, $4,082,400,000.

Throughout the great corn-growing belt in the middle western states thousands of cattle, sheep and hogs are fattened. The corn thus goes to market "on the hoof," as is sometimes said. The saving in transportation charges is very great. How much more economical it is for the farmer to practice mixed farming and thus get the greater value out of the corn, has been well illustrated by these problems.

Fortunately, also, on many farms where corn growing is not the principal business, due attention is given to this most important cereal, and a wise system of farm management provides for the marketing of animal products rather than grain products.

The value of the manure is no slight item. Let us see what it amounts to in dollars and cents. Barnyard manure varies greatly in composition, as the valuable elements of plant food are easily lost unless proper care is

ON MOST FARMS HOGS HAVE A PLACE.

They furnish the home-meat supply and add many dollars to the farm receipts. They have paid the expenses of many boys through college and paid off thousands of farm mortgages.

taken. It contains on the average about 0.5% of nitrogen, 0.3% phosphoric acid and 0.4% of potash.

QUESTIONS.

1. How many pounds of nitrogen are contained in a load of barnyard manure weighing one ton? How many pounds of phosphoric acid? Of potash?

2. How much are each of these elements in a ton of manure worth on the basis of nitrogen at 20 cents a

pound, phosphoric acid 5 cents a pound, and potash 4 cents a pound? What is the total value of the plant food contained in a ton of manure?

3. If a farmer puts five loads of manure on an acre, how many pounds of plant food is he returning to the land? How many pounds of each of the elements? How do the amounts correspond with the number of pounds of plant food taken from the soil by an acre of corn? (See the answers to questions on page 29.) Can corn get nitrogen from any other source than the manure or fertilizer that has been added to the soil?

Answers to Above Questions.

1. A ton of average barnyard manure contains of nitrogen 10 pounds, of phosphoric acid 6 pounds, of potash 8 pounds; total 24 pounds.

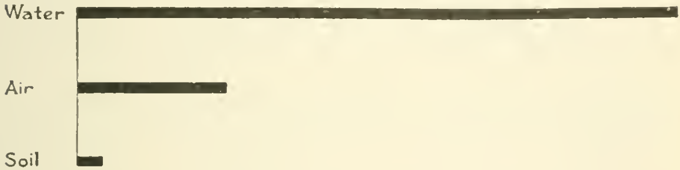
2. Nitrogen $2, phosphoric acid 30 cents, potash 32 cents; total, $2.62.

3. Five loads of manure, weighing a ton each and of average quality, contain 120 pounds of available plant food, consisting of nitrogen 50 pounds, of phosphoric acid 30 pounds, of potash 40 pounds. This is about the same amount of phosphoric acid and potash that is taken from the soil by the grain and stalks of a crop of corn yielding 25 bushels and two tons of stalks per acre.

CHAPTER II.

ANIMAL FEEDING.

Source of food. All animals depend directly or indirectly upon plants for their food. To properly feed domestic animals it is necessary to know their needs and the degree in which each available food will supply these needs. The composition of a given food may be stated in various ways. For the purpose of estimating its food value we should know its analysis in terms of the following substances: (1) *Water,* (2) *ash,* (3) *protein,* (4) *crude fiber,* (5) *starch and sugar* and (6) *oil or fat.* Starch and sugar are usually included in any analysis under the name *nitrogen-free extract.* Sugar, starch and fiber are together known as *carbohydrates.*



Relative amounts of the weight of green plants which are obtained from water, air and soil.

What plants contain. Plants contain in different degrees each of these six more or less complex substances.

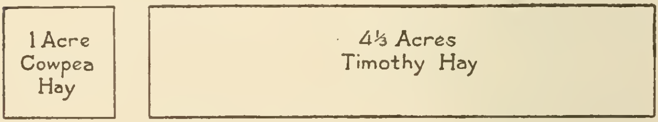
Fresh pasture grass contains:

	Per cent
Water,	75.3
Ash,	2.5
Protein,	4.0
Crude fiber,	5.9
Nitrogen-free extract,	11.4
Fat,	0.9
Total,	100.0

80. In a ton of such grass how many pounds of each substance?

81. Clover hay from the mow contains 6.2 per cent of ash, 12.3 per cent protein, 24.8 per cent of crude fiber, 38.1 per cent of nitrogen-free extract, and 3.3 per cent of fat. What is the percentage of water? How many pounds of water in a ton of such hay?

82. In a ton of corn there are 592 pounds of water, ash, protein, crude fiber, and fat. What is the percentage of nitrogen-free extract?



INCREASING THE FARM PROTEIN SUPPLY.

The two fields will produce the same amount of protein.

83. When corn produces 40 bushels per acre, how many pounds of nitrogen-free extract are contained therein?

84. The percentage of protein in cowpea hay is 16.6; in timothy hay 5.9. What is the difference in number of pounds of protein produced when cowpeas yield 2.1 tons and timothy 1.3 tons per acre?

Digestible nutrients in feeding stuff. Only a part of what is eaten is digested and assimilated. The percentage of a given food that is digested is known as its *coefficient of digestibility*. To know approximately the amount of a given ration that is digestible, it is necessary to make use of the coefficient of digestibility for each constituent in it. These coefficients have been determined by experiment.

85. In 100 pounds of wheat bran there are 15.4 pounds of protein; 79 (coefficient of digestibility) per cent of which, when eaten, is digested. How many pounds of protein are digested?

$$15.4 \times .79 = 12.17$$

86. The composition and coefficients of digestibility of corn stover are as follows:

DIGESTIBILITY OF CORN STOVER.

Nutrient	Per cent composition	Coefficient digestibility
Protein	3.8	45.5
Crude fiber	19.7	67.0
Nitrogen-free extract (starch)	31.5	61.0
Fat	1.1	62.0

How many pounds each of digestible protein, carbohydrates (fiber and starch), and fat in 100 pounds?

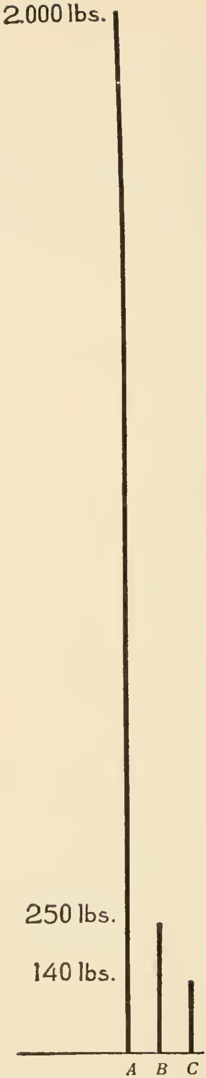
87. In 100 pounds of cottonseed meal there are 42.3 pounds of protein; of this 37.2 are digested. What is the coefficient of digestibility?

88. The number of pounds of digestible protein in a ton of clover hay is 136. When clover hay contains 12.3 per cent of protein, what is the coefficient of digestibility?

89. Wheat bran contains 9 per cent crude fiber of which 22 per cent is digestible, and 53.9 per cent of nitrogen-free extract, of which 69 per cent is digestible. What is the percentage of digestibility of each constituent?

90. In 600 pounds of wheat bran, what is the total digestible quantity of each of these constituents?

The important three compounds. Protein, carbohydrates (nitrogen-free extract and fiber), and fat are the



PROTEIN IN CLOVER HAY.

A represents all nutrients in clover hay; *B*, the protein in one ton; and *C*, the digestible protein in a ton.

three important constituents to be considered in the feeding of animals.

Foods usually contain an amount of ash sufficient to supply all the mineral needs of the body, with the exception of sodium and chlorine. Both of these are supplied in salt.

What they do: 1. Protein (the muscle maker) enters into the formation of the organs of the body, muscle, bone, skin, blood, milk, etc.

2. Carbohydrates (heat and fat producers) are used in the production of heat, fat, and energy.

3. Fat (heat and fat producer) also is used in the production of fat, heat, and energy.

Heat value. Careful calculation has shown that one pound of fat will produce 2.4 times as much heat as one pound of carbohydrates.

91. How many pounds of carbohydrates equal one pound of fat?

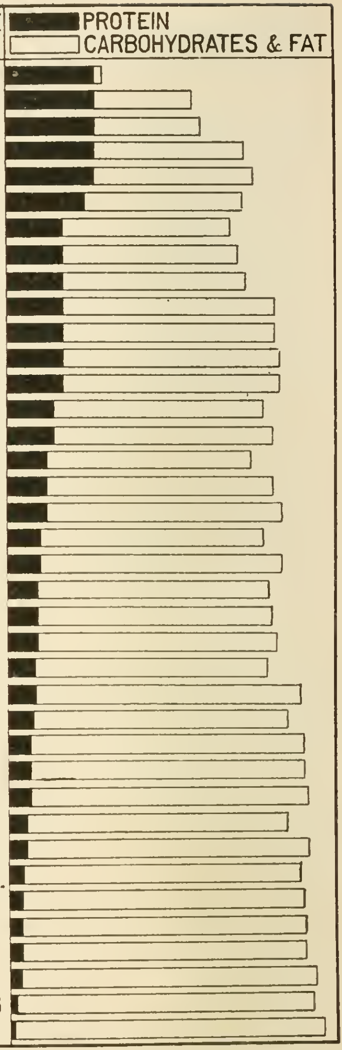
92. Corn contains 4.3 per cent digestible fat. In a ton of corn the fat content is equivalent to how many pounds of carbohydrates?

93. The heat value of carbohydrates and fat in a ton of cottonseed meal is 923.6 pounds. The amount of carbohydrates in 100 pounds cottonseed meal is 16.9 per cent. How many pounds of fat in a ton of cottonseed meal?

Nutritive ratio. Food may be said to do two things: (1) It furnishes the protein for growth, daily waste, blood, etc.; (2) it furnishes the materials for fat, heat, and energy.

The ratio between digestible protein and digestible heat and fat-producing elements (carbohydrates and fat re-

FEEDING STUFF	NUTRITIVE RATIO
DRIED BLOOD	1: 0.1
TANKAGE	1: 1.1
COTTON SEED MEAL	1: 1.2
LINSEED MEAL	1: 1.7
SOY BEANS	1: 1.8
SKIM MILK	1: 2.
GLUTEN FEED	1: 3.
COW PEAS	1: 3.1
DRIED BREWERS' GRAINS	1: 3.2
COWS MILK	1: 3.7
WHEAT BRAN	1: 3.7
ALFALFA	1: 3.8
COW PEA HAY	1: 3.8
PASTURE GRASS	1: 4.5
WHEAT MIDDLINGS	1: 4.7
MANGLES	1: 5.1
RAPE	1: 5.6
RED CLOVER HAY	1: 5.8
OATS	1: 6.2
BUCKWHEAT	1: 6.9
RYE	1: 7.1
WHEAT	1: 7.2
TURNIPS	1: 7.7
KAFIR CORN	1: 8.1
BLUE GRASS	1: 8.6
CORN	1: 9.7
BEET PULP	1: 12.
MILLET HAY	1: 12.
PRAIRIE HAY	1: 12.2
CORN SILAGE	1: 14.
CORN & COB MEAL	1: 15.1
TIMOTHY HAY	1: 16.6
POTATO	1: 18.3
CORN STOVER	1: 20.
KAFIR CORN STOVER	1: 20.
SORGUM HAY	1: 22.
OAT STRAW	1: 33.6
WHEAT STRAW	1: 93.



NUTRITIVE RATIO OF SOME COMMON FEEDING STUFFS.

duced to carbohydrate equivalent) for any food or combination of foods is called the *nutritive ratio.* It may be expressed as *wide, medium or narrow,* depending upon its value. Timothy hay, 1 to 16, is wide.

94. What is the nutritive ratio of corn, containing 7.8 per cent of digestible protein, 66.7 per cent digestible carbohydrates, and 4.3 per cent of digestible fat?

Fat will produce 2.4 times as much heat as the same amount of carbohydrates. The carbohydrate equivalent, therefore, of 4.3% of fat is 2.4 × 4.3% or 10.3%, *i. e.*, the heat and fat-producing power of a feed containing 4.3% digestible fat is the same as one containing 10.3% of digestible carbohydrates. The total heat and fat-producing power of corn is, therefore, 66.7% + 10.3% = 77.0%. The nutritive ratio, therefore, is 77.0 ÷ 7.8 = 9.8 This fact is expressed by saying the nutritive ratio of corn is 1 to 9.8.

Process: (1) Reduce the fat to its carbohydrate equivalent, (2) add the carbohydrates and (3) divide this sum by the protein.

TABLE SHOWING DIGESTIBLE NUTRIENTS.

	Dry matter	Digestible nutrients per cents			Nutritive ratio
		Protein	Carbohydrates	Fat	
Corn	89.1	7.9	66.7	4.3	1 to 9.8
Wheat	89.5	10.2	69.2	1.7	1 to 7.2
Oats	89.0	9.2	47.3	4.2	1 to 6.2
Cottonseed	89.7	12.5	30.0	17.3	3 to 1.0
Cottonseed meal	91.8	37.2	16.9	12.2	
Timothy hay	86.8	2.8	43.4	1.4	
Clover hay	84.7	6.8	35.8	1.7	
Alfalfa hay	91.6	11.0	39.6	1.2	

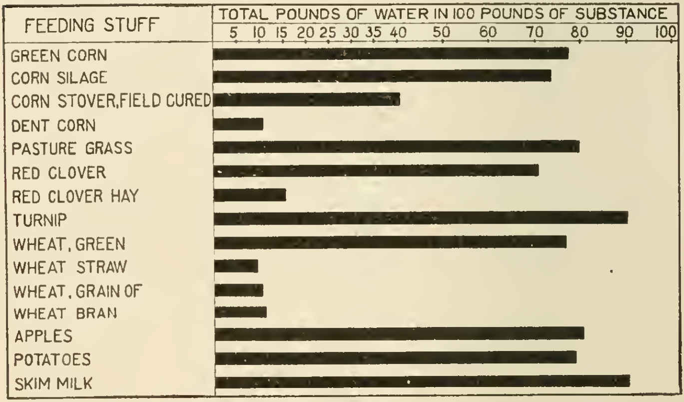
95. Check the nutritive ratios as shown in the last column of the above table.

96. Fill out the remainder of the last column.

97. Name the feeds having a wide nutritive ratio, narrow, medium.

98. In a ton of wheat middlings we find 1,224 pounds of carbohydrates and fat (reduced to carbohydrates). The nutritive ratio is 1 : 4.8. How many pounds of protein in a ton of this food? Ans. 255 pounds.

99. What percentage of wheat middlings is digestible protein?



GROWING PLANTS CONTAIN MUCH WATER.

Several common feeding stuffs are here compared to show the large quantities of water they contain. Note the change when harvested and cured as dry provender.

Important truth. No two feeds have exactly the same nutritive ratio. Some are high in protein; others low. This gives rise to the practice of mixing feeds so as to *balance* the ration in order that the animal may get protein, carbohydrates, and fat in correct proportions and in sufficient quantities to supply the needs of the body.

Feeding standards. Different animals require different nutritive ratios and different quantities of food. The best nutritive ratio and the proper quantity of food are also dependent upon the use to which the animal is put.

A dairy cow to produce a large yield of milk must have a feed rich in protein. Such a cow will lose in quantity of milk and grow fat if given a feed low in protein and high in carbohydrates and fat. A horse at heavy work requires a very different feed from one at light work; a growing pig from one that is being fattened for market. Ignorance of these facts occasions great waste of feed and frequent disappointment in results.

FEEDING STANDARDS PER DAY, 1,000 POUNDS LIVE WEIGHT.

Kind of animal	Dry matter	Digestible nutrients—pounds			Nutritive ratio
		Protein	Carbo-hydrates	Fat	
Ox (at rest)	18.0	0.7	8.0	0.1	1 to 11.8
Calves	30.0	2.5	15.0	0.5	1 to 6.5
Dairy cow					
11 pounds milk daily	25.0	1.6	10.0	0.3	
22 pounds milk daily	30.0	2.5	13.0	0.5	
Horses					
Light work	20.0	1.5	9.5	0.4	
Moderate work	24.0	2.0	11.0	0.6	
Pigs					
Growing	36.0	4.5	25.0	0.7	
Fattening	30.0	4.0	24.0	0.5	

100. What is the nutritive ratio of the feeding standard for the ox at rest?

101. For a young calf?

102. For a dairy cow giving 11 pounds of milk daily?

103. For a dairy cow giving 22 pounds of milk daily?

104. For a horse doing a moderate amount of work?

105. For growing pigs?

106. What would be the amount of dry matter and of each of the three nutrients required to feed a dairy cow weighing 1,000 pounds for one month? Twenty such cows for one year?

Any printed *feeding standard* is simply a rough guide to be used in feeding animals. It gives approximately the amount to be fed per 1,000 pounds of live weight. Even for animals of the same class and weight it should not be regarded as inflexible. It should be varied as experience and careful observation may seem to warrant. Temperaments and individual peculiarities are always to be considered.

Compounding of rations. An animal uses food for at least five different and distinct purposes:

1. To replace the waste of all parts of the body.

2. To produce heat and to keep the body warm.

3. To make growth or increase the body in muscle, fat, flesh, bone, etc.

4. To produce energy so that work may be done.

5. To produce hair, wool, milk, etc.

To meet the demands the food must contain protein, carbohydrates and fat. To obtain a food containing these nutrients in the quantity and proportion required for one or more of the above purposes gives rise to the compounding of feeding rations.

107. For a dairy cow giving 22 pounds of milk daily, how many pounds of each of the following feeding stuffs will be required?

DIGESTIBLE NUTRIENTS IN SOME COMMON FEEDING STUFFS.

	Dry matter	Digestible nutrients in 100 pounds		Fat
		Protein	Carbohydrates	
Corn stover	59.5	1.7	32.4	0.7
Cowpea	89.3	10.8	38.6	1.1
Clover hay	84.7	6.8	35.8	1.7
Cottonseed hulls	88.9	0.3	33.1	1.7
Cottonseed meal	91.8	37.2	16.9	12.2
Wheat bran.	88.1	12.2	39.2	2.7

Process: For a trial ration suppose we decide to take 10 pounds of corn stover, 10 pounds of cowpea hay, 5 pounds of clover hay. The digestible nutrients in these are ascertained as follows:

Corn stover is

59.5 per cent dry matter,
1.7 per cent digestible protein,
32.4 per cent digestible carbohydrates,
0.7 per cent digestible fat.

Therefore in 10 pounds there will be, approximately:

Dry matter,	$.595 \times 10 = 6.0$	Pounds,
Protein,	$.017 \times 10 = 0.2$	Pounds,
Carbohydrates,	$.324 \times 10 = 3.2$	Pounds,
Fat,	$.007 \times 10 = 0.1$	Pounds.

The digestible nutrients of cowpea hay are ascertained in the same way:

Cowpea hay—10 pounds.

Dry matter,	$.893 \times 10 = 8.9$	Pounds,
Protein,	$.108 \times 10 = 1.1$	Pounds,
Carbohydrates,	$.386 \times 10 = 3.9$	Pounds,
Fat,	$.011 \times 10 = 0.1$	Pounds.

Clover hay—5 pounds.

Dry matter,	$.847 \times 5 = 4.2$	Pounds,
Protein,	$.068 \times 5 = 0.3$	Pounds,
Carbohydrates,	$.358 \times 5 = 1.8$	Pounds,
Fat,	$.017 \times 5 = 0.1$	Pounds.

Arranging these for comparison with the feeding standard, to see whether the proportions and quantities of nutrients are correct, we have a trial ration for dairy cow weighing 1,000 pounds and yielding 22 pounds of milk daily:

TRIAL RATION FOR DAIRY COW.

Feeding stuff	Dry matter	Digestible nutrients—pounds		
		Protein	Carbo-hydrates	Fat
10 pounds corn stover	6.0	0.2	3.2	0.1
10 pounds cowpea hay	8.9	1.1	3.9	0.1
5 pounds clover hay	4.2	0.3	1.8	0.1
Trial ration	19.1	1.6	8.9	0.3
Feeding standard	30.0	2.5	13.0	0.5

This trial ration falls considerably below the requirement in every way. It must be increased so as to meet the standard as nearly as possible. To correct these deficiencies and to complete the ration, let us try the effect

PRODUCING MILK UNDER SANITARY CONDITIONS.

of adding 9 pounds of cottonseed hulls, 2 pounds of cottonseed meal and 1 pound of wheat bran.

This second trial is shown in the table below.

SECOND TRIAL RATION FOR DAIRY COW.

Feeding stuff	Dry matter	Digestible nutrients—pounds			Nutritive ratio
		Protein	Carbohydrates	Fat	
Preceding trial ration: 10 pounds corn stover, 10 pounds cowpea hay, 5 pounds clover hay	19.1	1.6	8.9	0.3	
9 pounds cottonseed hulls.....	8.0	0.0	3.0	0.2	
2 pounds cottonseed meal.............	1.8	0.7	0.3	0.2	
1 pound wheat bran..	0.9	0.1	0.4	0.0	
Second trial ration.....	29.8	2.4	12.6	0.7	1 to 6
Feeding standard......	30.0	2.5	13.0	0.5	1 to 5.7

The second trial ration meets the standard approximately both as to quantity and proportions of nutrients. From this we learn that 10 pounds of corn stover, 10 pounds of cowpea hay, 5 pounds of clover hay, 9 pounds of cottonseed hulls, 2 pounds of cottonseed meal and 1 pound of wheat bran make a well-balanced feed and should be a satisfactory ration for a dairy cow weighing 1,000 pounds and yielding about three gallons of milk daily.

Note.—It is not necessary to compound a ration meeting the standard with exactness. A reasonable approach to it is all that is required.

108. What quantities each of five feeding stuffs used at your home may be used in combination so as to furnish an approximately balanced ration for a dairy cow weighing 1,000 pounds and yielding 22 pounds of milk daily?

Note.—For digestible nutrients see appendix.

109. Using for the purpose timothy hay, corn, oats, and bran, how many pounds each will be required for feeding a horse weighing 1,000 pounds and doing light work?

110. When corn stover, clover hay, cottonseed meal, and wheat bran are available, what quantities of each may be fed a cow weighing 1,000 pounds and yielding 11 pounds of milk daily?

Important truth. Animals to do their work efficiently must be properly fed. A feeding stuff is valuable in proportion to the quantity of digestible nutrients

Poor Way to Feed Sheep.

A large amount of fodder is wasted because sheep will not eat it after they have once run over the stalks.

it contains. For this reason rational feeding calls for a variety of materials in order that all nutrients may be furnished in correct proportions and quantities. A ration properly compounded may mean not only better work or more milk or more rapid development, but a saving in cost as well.

Cost of digestible nutrients. That the daily ration fed an animal should be furnished as cheaply as possible there is no question. Since feeding stuffs vary in cost or value as well as in amount of digestible nutrients, it follows that in compounding rations market prices of feeds should always be considered. The farm is a factory for producing carbohydrates and fat. As much protein as possible should be grown also. Usually, however, this cannot be done sufficiently to supply every need; hence it must be purchased. Without it best results cannot follow.

What protein costs. It is possible for the farmer to purchase corn, oats, gluten meal, cottonseed meal, wheat bran, and numerous other grains or feeding stuffs containing protein. In what form shall he purchase it?

111. Corn contains 7.9 per cent digestible protein. When corn sells for $20 a ton what is the cost of a pound of digestible protein?

$7.9 \times 20 = 158$..........Pounds in a ton.
When 158 pounds cost $20,
1 pound will cost 12.7 cents.

112. Cottonseed meal contains 37.2 per cent of digestible protein. When it sells for $32 a ton, what is the cost of each pound of digestible protein?

113. When a pound of digestible protein costs 12.6 cents in corn and 4.3 cents in cottonseed meal, how many times more expensive is it in corn than in cottonseed meal?

114. When gluten meal sells at $25 a ton, a pound of digestible protein costs 4.9 cents. How many pounds of digestible protein in a ton of gluten?

Cost of total digestible nutrients. In purchasing feeding stuffs the number of pounds of digestible nutrients must be considered as well as the cost per ton.

Feeding stuff	Digestible nutrients in 100 pounds				Total digestible nutrients in one ton
	Protein	Carbo-hydrates	Fat	Total	
Corn	7.9	66.7	4.3	78.9	1,578
Oats	9.3	47.3	4.2	60.7	1,214
Cottonseed meal	37.2	16.9	12.2	66.3	1,326
Wheat bran	12.2	39.2	2.7	54.1	1,082

115. In a ton of corn there are 1,578 pounds of nutrients. When corn is $20 a ton what is the cost of a pound of nutrients?

116. At the same value per pound for nutrients what should oats be worth a ton? A bushel?

117. When corn is worth 50 cents a bushel what is the value of a pound of nutrients?

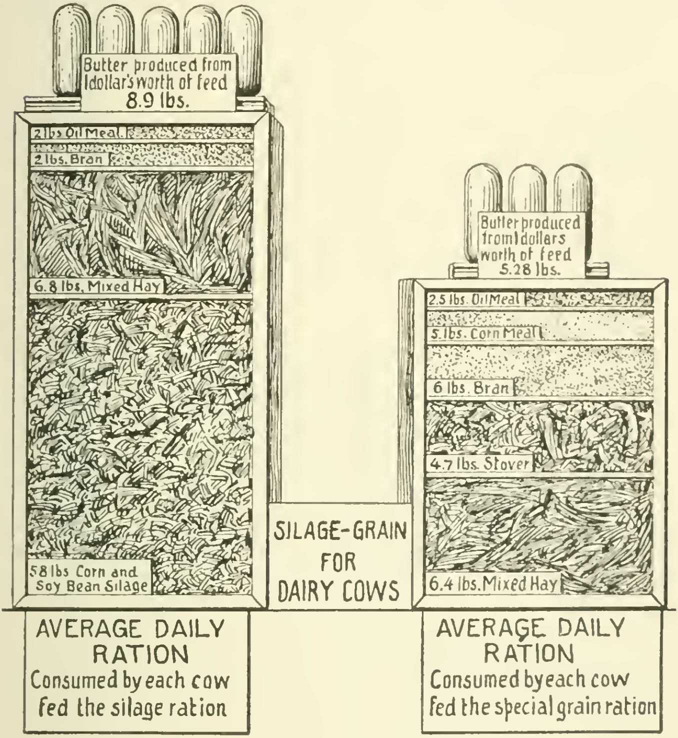
118. At the same value per pound what should be the value of oats a bushel?

119. Wheat bran carries 1,082 pounds of nutrients to the ton. When it sells for $3 per hundred, what is the value of a ton of cottonseed meal on basis of total nutrients?

120. When cottonseed meal is worth $32 a ton what does a pound of digestible nutrients cost?

121. At the same value per pound what is a ton of bran worth?

Important truth. Judgment must be exercised in the selection of a concentrated feeding stuff. As a rule protein is the nutrient that is wanted and for it the purchase is especially made. Even if the cost for a pound of nutrients in bran and cottonseed meal, for instance, were the same, cottonseed meal would be preferable, since it contains over three times as much protein. Since protein is the most difficult nutrient to obtain, and hence the most costly, that feeding stuff supplying it most abundantly and cheaply is always to be selected.



MONEY IS MADE WHERE THE RIGHT FEED IS PROVIDED.

Two rations for dairy cows are compared. From one 8.9 pounds of butter were produced from one dollar's worth of feed, while from the other but 5.28 pounds of butter were obtained. This shows how two rations may cost the same and one may be worth a great deal more for final returns.

Purchase of hay. What has been said with reference to concentrates is also true of roughage feeds. Select those that furnish nutrients at least cost and at the same time contain the highest quantity of protein.

Feeding stuff	Digestible nutrients in 100 pounds				Total digestible nutrients in one ton
	Protein	Carbo-hydrates	Fat	Total	
Timothy hay	2.8	43.4	1.4	47.6	952
Cowpea hay	10.8	38.6	1.1	50.4	1,008
Clover hay	6.8	35.8	1.7	44.3	886
Alfalfa hay	11.0	39.6	1.2	51.8	1,036
Corn stover	1.7	32.4	0.7	34.8	696

122. When timothy hay is worth $20 per ton on basis of total digestible nutrients, what is cowpea hay worth?

123. Clover hay?

124. Alfalfa hay?

125. Corn stover?

126. When timothy hay sells for $20 per ton and clover hay for $10, how much more costly is a pound of nutrients in timothy hay than in clover hay?

127. How many dollars would represent the commercial difference if 100 tons were purchased?

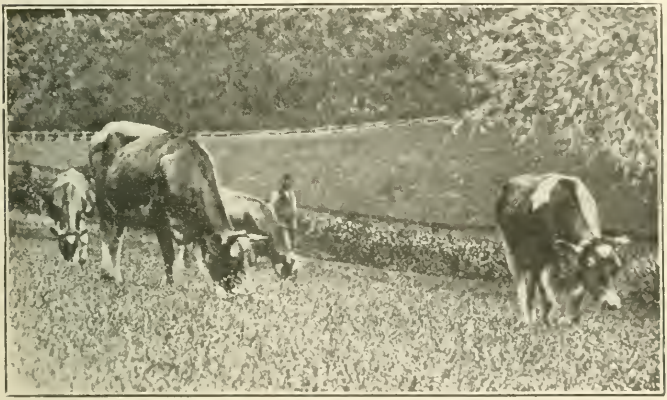
Important truth. Consider the protein content in the sale or purchase of hays just as carefully as you would do with the concentrates. At the same price per ton, cowpea hay and alfalfa hay are to be preferred to timothy because of the greater amount of protein and total digestible nutrients contained. It is wise farming not only to grow all hay and roughage material for feed, but also to select for growing those that are rich in protein—the most costly and most important nutrient.

Compounding Rations with Reference to Cost.

128. Use the following feeding stuffs for compounding a ration for a dairy cow weighing 1,000 pounds and giving 22 pounds of milk daily. Timothy worth $20 per ton, corn stover $5, corn $20, and oats $30. What is the daily cost of the ration?

129. Use the following feeding stuffs for compounding a ration for the same cow: Cowpea hay, worth $10 per ton; clover hay, $10; cottonseed meal, $32; and wheat bran, $24. What is the daily cost of the ration?

130. What is the difference in cents of the daily cost between these two rations? Yearly cost?



PURE-BRED DAIRY CATTLE AT PASTURE.

CHAPTER III.

HUMAN FEEDING.

Man must eat to live. He should apply every known principle of nutrition to his feeding. He should consider his daily ration from the standpoint of its supply of digestible protein, carbohydrates, and fat, as well as of its cost. He can do this wisely and well only in proportion to his knowledge of the subject and the consideration given to it.

Food and food economy. The ingredients of food and their uses in the body may be summarized as follows:

Nutrients in Human Food.

- Food as purchased contains
  - I. Edible—e. g., meat, eggs, bread, vegetables, etc.
    - Water
    - Nutrients
      - Protein
      - Fats
      - Carbohydrates
      - Minerals
  - II. Refuse — bones, shells, etc.

Uses of Nutrients.

- Protein forms tissue—
  - *e. g.*, albumen of the white of egg, casein of milk, lean meat, gluten of grains.
- Fats are stored as fat—
  - *e. g.*, fat of meat, butter, lard, oils, grains, nuts.
- Carbohydrates are formed into fat—
  - *e. g.*, sugar, starch, fiber.
- Mineral (ash) forms bone, assists in digestion—
  - *e. g.*, phosphate of lime, potash, etc.

All serve as fuel to yield energy in forms of heat and muscular power.

NUTRIENTS IN SOME COMMON FOODS.

Kind of food	In 100 pounds or in per cent.		Digestible nutrients in 100 pounds or in per cent.		
	Refuse	Water	Protein	Fat	Carbo-hydrates
Beef loin	13.3	52.5	15.6	16.6	
Beef ribs	20.8	43.8	13.5	20.0	
Dried beef	4.7	53.7	25.6	6.6	
Leg of mutton	18.4	51.2	14.6	14.0	
Pork chops	19.7	41.8	13.0	23.0	
Cured ham	13.6	34.8	13.8	31.7	
Fowl	25.9	47.1	13.3	11.7	
Turkey	22.7	42.4	15.6	17.5	
Fresh mackerel	44.7	40.4	9.9	4.0	
Oysters		88.3	5.8	1.2	3.3
Raw eggs	11.2	65.5	12.7	8.8	
Whole milk		87.0	3.2	3.8	5.0
Skim milk		90.5	3.3	0.3	5.1
Cream		74.0	2.4	17.6	4.5
Butter		11.0	1.0	80.8	
Wheat flour		12.0	9.7	0.9	73.6
Corn meal		12.5	7.8	1.7	73.9
Wheat bread, white		35.3	7.8	1.2	52.0
Cream crackers		6.8	8.2	10.9	68.3
Dried beans		12.6	17.5	1.6	57.8
Cabbage	15.0	77.7	1.2	0.2	4.6
Potatoes, Irish	20.0	62.6	1.5	0.1	14.0
Potatoes, sweet	20.0	55.2	1.2	0.5	20.8
Tomatoes		94.3	0.7	0.5	3.7
Apples	25.0	63.3	0.3	0.3	9.7
Bananas	35.0	48.9	0.7	0.4	12.9
Oranges	27.0	63.4	0.5	0.1	7.7
Strawberries	5.0	85.9	0.8	0.5	6.3

131. In a purchase of ten pounds each of beef loin and ribs, how many pounds more of digestible protein do you secure in the former than in the latter?

Process: Turning to table, we find beef loin contains 15.6 pounds protein and beef ribs 13.5 in 100 of fresh substance.

Loin, $15.6 \div 100 \times 10 = 1.56$
Ribs, $13.5 \div 100 \times 10 = 1.35$

Difference, .21

Note.—We are here preserving an additional figure, since the weighing is much more accurate than in the preceding chapters. The last figure even here, however, has but little significance.

132. What is the difference in amount of fat in these foods when 20 pounds of each are purchased?

133. How many pounds difference of protein and fat in a purchase of 20 pounds each of pork chops and cured ham?

134. What is the percentage of difference?

135. What is the difference of total digestible nutrients (protein, carbohydrates and fat) in 100 pounds of corn meal and 100 pounds of wheat flour?

WHERE PEACE AND SYMPATHY ABOUND.

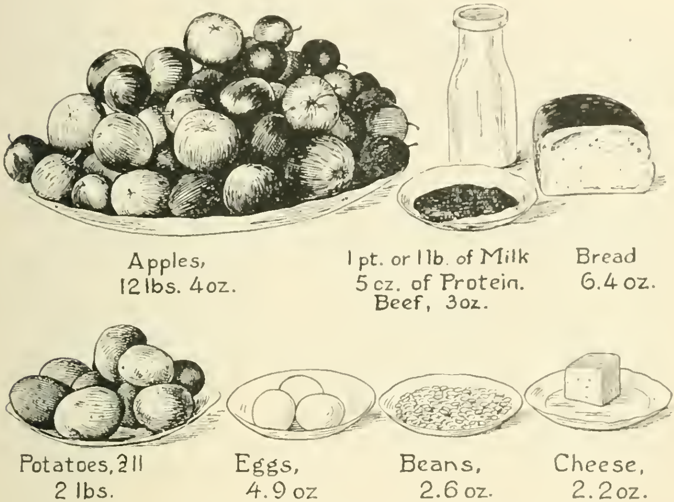
No matter what the future may bring the happy days of childhood in the country never depart from adult memory.

136. A man doing moderate work requires .24 pounds of protein daily. If he eats oysters solely, how many pounds will be required to furnish the needed protein?

137. If he uses crackers as food for the day, how many pounds will be required to furnish the .24 pounds of protein?

138. He requires .12 pounds of fat daily. How nearly does this quantity of crackers meet the fat required?

139. He requires 1.12 pounds of carbohydrates. How nearly does the quantity of crackers meet the carbohydrate requirement?



PROTEIN THE SAME IN ALL.

Here is shown the weight of food required to yield the equivalent of protein in one pound of milk.

140. By using butter, whole milk and beef loin in connection with crackers, how many pounds of each will be necessary for the daily ration of the man doing moderate work when the dietary (feeding) standard calls for .24 pounds of protein, .12 pounds fat and 1.12 pounds carbohydrates?

141. What is the nutritive ratio of this ration?

142. Beef loin is worth 25 cents per pound, butter 25 cents per pound, whole milk 3 cents per pound, and crackers 5 cents per pound. What is the cost of the daily ration?

Note.—For solution of 139, 140, and 141 follow same method as used in compounding rations for animals. Consult table on page 61 for nutrient content.

Quick cooling of milk always retards bacterial growth.

Cost of Nutrients. Cost is a factor of considerable consequence in the selection of food materials. Where different food materials are equally palatable, nutritious, and otherwise suited for nourishment, those furnishing the largest amounts of available nutrients at lowest cost naturally should be selected.

143. When beef loin sells at 25 cents per pound, how many pounds of digestible nutrient may be purchased for $1.00?

Process: Since 1 pound costs $0.25, $1.00 will buy 4 pounds.

Beef loin contains—

	In 100 pounds				In 4 pounds
Protein,	15.6 ÷ 100	×	4	=	.62
Fat,	16.6 ÷ 100	×	4	=	.66
			Total,		1.28

From four pounds of beef loin costing $1.00 the purchaser obtains 1.28 pounds of digestible nutrients.

144. What is the cost of 1 pound of digestible nutrients?

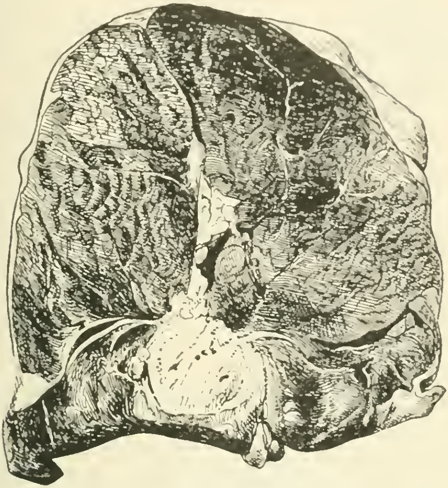
100 ÷ 1.28 = 78.............Cents.

145. When beef loin sells at 12½ cents per pound, what amount of digestible nutrient is obtained for $1.00?

146. What is the cost of each pound of nutrients?

147. When pork chops cost 12 cents per pound, what is the cost of a pound of nutrients?

148. When milk costs 3 cents a pint (1 pound), what is the cost of a pound of nutrients?

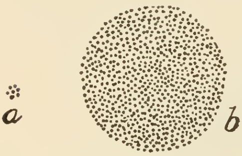


RUMP CUT FROM HIGH-GRADE ANIMAL.

Observe distribution of large and small particles of fat, showing high quality of meat.

149. When potatoes cost 60 cents per bushel, what is the cost of a pound of nutrients?

Comparative cost of nutrients. The market price of food materials is not regulated by the amount and value of the nutrients contained therein. Nutrients contained in one kind of food may be of no greater value than that contained in another, yet it may cost more per pound. Total bulk has but little to do with the problem. Other things being equal, the selection of food materials should take into account the comparative cost of digestible nutrients. It may even happen that the cheapest food from this standpoint is the more appetizing and otherwise desirable when properly prepared.



GROWTH OF BACTERIA.

Showing the growth of bacteria at different temperatures during 24 hours, each dot representing a single bacterium. *A*, at 50 degrees, 7 bacteria; *B*, at 70 degrees, 700 bacteria.

150. When oysters sell for 35 cents per quart, 5.6 pounds are obtained for $1. What amount of digestible nutrients will this quantity contain?

151. If, instead, you spend $1.00 for beef loin, paying 20 cents per pound for it, what quantity of digestible nutrients do you receive?

152. You spend $1.00 for wheat flour, paying three cents per pound for it. How many pounds of digestible nutrients do you get?

153. Finally you make a purchase of beans, the cost of which is 5 cents per pound. What quantity of digestible nutrients do you obtain for $1.00?

DIETARY STANDARDS.

Age and work performed	Digestible nutrients		
	Protein	Carbo-hydrates	Fat
Boy and girl, 10-12.............	0.14	0.67	0.07
Boy and girl, 12-14.............	0.19	0.89	0.09
Girl, 14-16.....................	0.19	0.89	0.09
Boy, 14-16......................	0.22	1.00	0.10
Man, light work.................	0.22	1.00	0.10
Man, moderate work..............	0.24	1.12	0.12

154. What quantity each of wheat flour, butter, eggs, and whole milk will be required for daily food for a boy and girl 14-16 years old?

Note.—Proceed just as you did with the compounding of animal rations. Consult table on page 61 for nutrient content.

155. At the following prices, wheat flour 3 cents a pound, butter 25 cents a pound, eggs 25 cents a dozen, beef loin 25 cents a pound, and milk 3 cents a pound, what is the cost of a day's requirement?

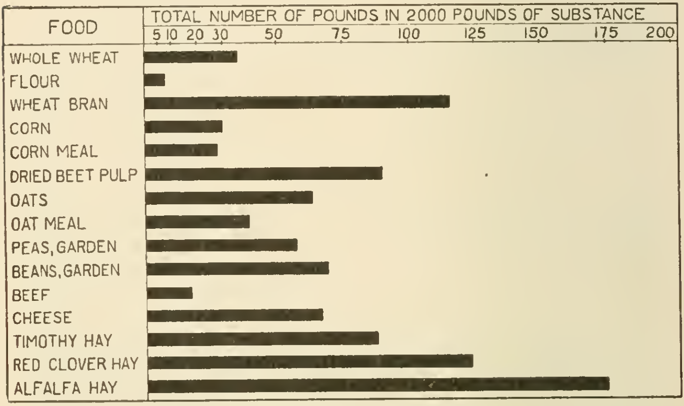
Important truth. For the great majority of people in good health, the ordinary food materials—meats, fish, eggs, milk, butter, cheese, sugar, flour, rice, meal, nuts, fruits, potatoes, and other vegetables—make a fitting diet. The great problem is to supply these foods in such quantities and proportions as is best suited to the actual needs of the body. The problem is of very great importance in the case of growing children and of adults who are not in normal health.

OF FINE FORM AND HIGH QUALITY.

These Angus steers secured championship honors at one of the recent International live stock shows. At the time the picture was taken they were three years old. Right after the show they were slaughtered for beef.

Mineral nutrients. In feeding farm animals little attention is given the question of mineral supply, since hays, roughage material, grains, and their by-products form the bulk of the ration. Mineral nutrients, therefore, are furnished in sufficient quantities.

With man it is different. Wheat is robbed of its bran, meat of its bone, eggs of their shells. These contain much of the mineral salts. They are fed to live stock



MINERAL MATTER IN SOME COMMON FOODS.

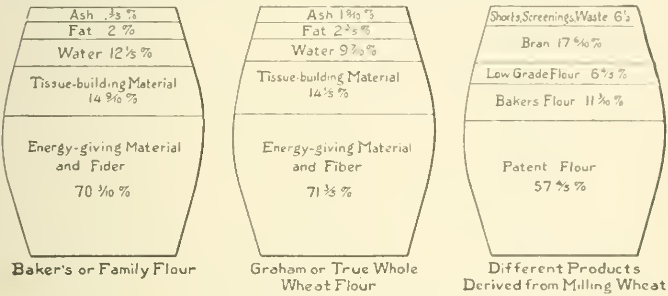
Note the small amount of mineral matter in a ton of wheat flour. Wheat bran on the other hand is abundantly supplied. In our methods of manufacture, farm animals profit at the expense of the human family.

to make bone and teeth and flesh, but occur in the average menu in insufficient quantities for the teeth, bone and flesh of children and men.

156. A ton of wheat contains 36 pounds of mineral salts, of which 27 pounds are digested when eaten. If made into flour but 8 pounds of mineral salts are left for human consumption, of which amount 6 pounds are digested. What is the percentage of digestible mineral salts removed from wheat by the process of manufacture?

157. A farmer grows ten acres of wheat which produces 25 bushels an acre. This wheat analyzes 1.8 pounds of mineral salts to each 100 pounds. How many pounds of mineral salts are produced in the entire crop?

158. If this wheat is eaten, 75 per cent of the mineral salts will be digested. How many pounds will be digested?



DIFFERENT KINDS OF FLOUR COMPARED.

It will be observed that much of the ash materials is removed in the milling process.

159. If this wheat, 30 per cent of which is bran and other by-products, is manufactured into flour, what quantity of flour is made?

160. In 100 pounds of wheat flour there are 0.6 pounds of mineral salts. How many pounds of mineral salts are there in this above quantity of flour?

161. If of this quantity of mineral salts 75 per cent is digested, how many pounds are digested?

162. What is the difference in number of pounds of mineral salts produced from 10 acres of wheat, each acre of which produces 25 bushels, and that finally available for food when manufactured into flour?

Important truth. While the manufacture of cereals may increase their palatability, it is also true that the process removes much of the mineral salts which are essential to the full development of teeth, bone, and tissue.

Digestible Mineral Nutrients.

Average	Per cent, or pounds in 100
Beef,	0.6
Pork,	0.6
Veal,	0.7
Mutton,	0.5
Poultry,	0.5
Milk,	0.5
Butter,	2.3
Eggs,	0.7
Flour,	0.4
Breads,	0.8
Vegetables,	0.6
Legumes—beans, peas, etc.,	2.6
Fruits,	0.3

163. How many pounds of digestible mineral salts in 100 pounds of each of these foods?

164. How many times better are the legumes as mineral producers than beef? Than fruit? Than flour?

165. How many pounds of beef are required to furnish the body with as much mineral salts as would be supplied by a pound of beans?

166. How much flour will be required to do the same?

167. How many pounds of bread will you have to eat to secure the quantity of mineral salts a pound of beans would furnish?

168. How much bread and milk when used in the proportion of 1 to 2 will be required to equal a pound of beans or peas?

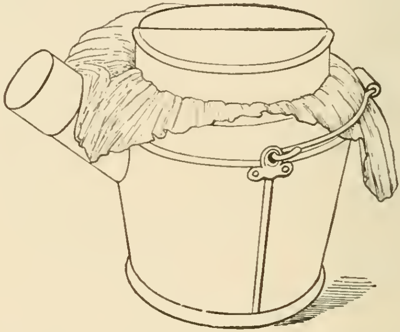
169. How much bread and butter when used in the proportion of 10 to 1?

Important truth. Mineral salts are essential for body growth and good health. They are not harmful, even when taken in excess of the body's actual needs. In planning dietaries, include as frequently and as extensively as possible foods containing considerable quantities of digestible ash. This is neither difficult nor costly, since foods carrying this nutrient are abundant in quantity, reasonable in price, and easily prepared. Many of these foods are appetizing and high in value in the other nutritive substances.

CHAPTER IV.

DAIRY PRODUCTS.

The products of the dairy form an important part of human food. Dairying is the leading animal industry of our country, and must continue so indefinitely. Of all animals the dairy cow is the most economical producer of food for human beings.



MILK PAIL.

A common practice on farms where sanitary milk is produced.

170. A fattening ox, gaining 15 pounds weekly, yields 1.13 pounds of protein (lean meat). A dairy cow during the same time, and yielding 20 pounds of milk daily, yields 7.46 pounds of protein in milk. How many times better is the dairy cow as a protein producer than the fattening ox?

171. During the week a fattening ox stores in his body .22 pounds of mineral matter, while during the same time a dairy cow secretes in her milk a total of 1.35

pounds. The mineral matter secured by the cow is how many times that secured by the fattening ox?

172. During the same time a fattening ox stores in his body 9.53 pounds of fat, and the cow in her milk secretes 6.33 pounds of fat and 8.32 pounds of milk sugar. On basis of heat production, how much more valuable is the product of the cow than that of the fattening ox?

DAIRY COWS AT PASTURE.

173. Supplied with an equal amount of food, a fattening ox will gain 3 pounds in live weight for every pound of butter fat produced by the cow. When fat cattle sell at 7 cents per pound, and butter at 30 cents, how much is the difference in favor of the dairy cow?

Milk. Milk is Nature's first food for mammals. This is because milk is a perfect food for the young; it contains water to slake thirst, ash to make bone, protein to make flesh and muscle, fat and sugar to keep the body warm and to furnish energy and fat. Fat or adipose tissue is Nature's way of storing energy and warmth for future use.

A good dairy cow will yield in one year 6,600 pounds of milk, in which there are:

5,670 pounds of water,
50 pounds of ash,
220 pounds of casein and albumen (protein),
284 pounds of fat,
376 pounds of milk sugar.

These substances are practically all digestible.

174. What is the percentage of water in milk?

175. The percentage of ash?

176. The percentage of protein?

177. The percentage of fat? Compare these values with table on page 61.

178. The percentage of milk sugar?

179. How many pounds of water in a ton of milk?

180. How many of ash?

181. How many of protein?

182. How many of fat?

183. How many of sugar?

184. When a cow yields daily 25 pounds of milk which tests 4.3 per cent butter fat, what quantity of butter fat is produced?

185. A dairyman has 25 dairy cows in his herd. Ten yield 40 pounds each daily; ten, 30 pounds; and five 20 pounds. The milk averages 3.8 per cent butter fat. What is the total quantity of butter fat produced?

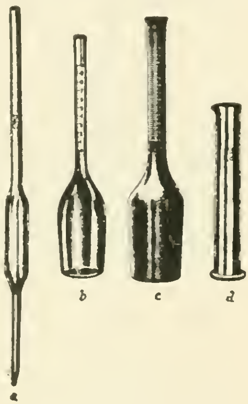
Important truth. Milk varies in composition with cows of different breeds, and with different cows of the same breed. In the same herd the milk from no two cows shows exactly the same percentage of butter fat. The milk first drawn from the udder is very low in fat; the last very high. It follows that cows should be selected not only because of their yield of much milk during the year, but also because of their ability to produce milk with a high per cent of butter fat.

Variation in Test.

186. A dairyman has a herd of 25 cows. Ten of these cows yield 40 pounds each daily; another ten, 30 pounds; the remaining five, 20 pounds. The fat test of the first group is 5.4 per cent; of the second, 4.5 per cent; of the third, 3.8 per cent. What quantity of fat is daily produced by this herd?

187. Suppose the fat test of the first group were 3.8 per cent and of the third 5.4 per cent, the second remaining just the same. What quantity of fat would be produced daily?

188. When butter fat is worth 25 cents per pound, what is the money value of this difference?



BABCOCK TESTER GLASSWARE.

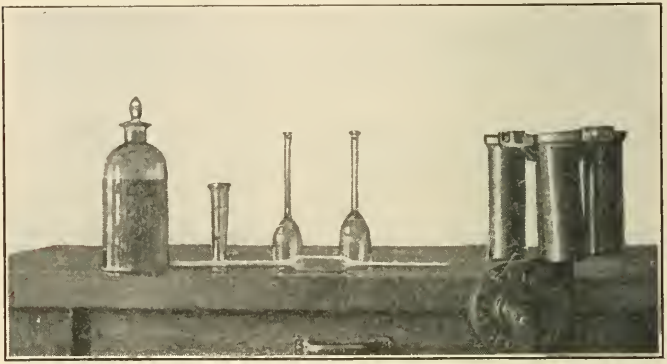
a, milk pipette; *b*, milk bottle; *c*, cream bottle; *d*, graduate glass for the acid.

189. How many cows of the third type would be required to equal in butter production 10 cows of the first type in problem 186?

190. A certain quantity of milk testing 5 per cent contains 45 pounds of fat. What is the quantity?

191. Four cans contain milk as follows: 100 pounds, and tests 5.4 per cent; 80 pounds, 4.3 per cent; 84 pounds, 3.8 per cent; and 180 pounds, 3.1 per cent. What per cent is the mixture?

192. In a can is a certain quantity of milk that tests 5 per cent; in another can is a certain quantity that tests 3 per cent. The amount of butter fat in both cans is 40 pounds, one-fourth of which is in the first can. How much milk is there in each can?



Babcock Milk Tester.

A small tester for four samples. An outfit like this ought to be in every school.

The Babcock Tester. The Babcock test was discovered by Dr. Babcock of Madison. Wisconsin. The test is made as follows: By use of a pipette 17.6 cubic centimeters of milk are put into a test bottle, then sulphuric acid of the correct strength is measured in a graduate, and 17.5 cubic centimeters of it carefully poured down the side of the test bottle into the milk. The acid and the milk should be thoroughly mixed by being gently shaken with a rotary motion. The mixture becomes hot and has a dark color. The bottles are put in the tester, and the machine is rapidly rotated for five or six minutes. Enough warm water is then added to each bottle to bring the fat up into the neck. The bottles are whirled again for two or three minutes, after which they are removed. The amount of fat can be read in per cent on the neck of the bottles.

193. A dairy farmer has in his herd two cows, each producing during the year 6,000 pounds of milk. By using this Babcock tester he finds that the test of one is 3.2 per cent; and of the other 5.8 per cent. What is the difference in fat produced during the year by the two cows?

194. At 25 cents per pound, what is the money value of the butter fat yielded by the first cow. By the second?

195. This same farmer finds that last year one of his cows gave 8,000 pounds of milk, the test of which was 3.2 per cent; another cow gave 5,000 pounds, which tested 5.6 per cent. Which is the more valuable cow? What is the butter fat difference?

Important truth. The value of a cow depends upon her ability to produce a large quantity of milk that shows a high fat test. Neither the quantity nor kind of feed influences the fat per cent. It may influence the quantity produced, but not the quality. The latter is a fixed character with the cow just as color or breed is fixed. The Babcock tester enables the owner to know the quality of the milk for every cow.

Relation of fat to butter. The churn collects fat globules into butter. When thus manufactured the commercial product contains fat, water, salt, milk, sugar, and some casein. Hence the fat when churned produces on an average one-sixth more butter than the fat content of milk or cream.

196. In 50 pounds of butter, how much butter fat? Other matter?

197. A certain cow last year yielded 5,000 pounds of milk that tested 5.4 per cent butter fat. At 25 cents per pound, what was the value of the butter she produced?

Process:

$$5{,}000 \times .054 = 270$$
$$270 \times 1\text{-}6 = 45$$

Butter produced, $270 + 45 = 315$..........Pounds.
315 pounds at 25 cents = $78.75..............Value of butter.

CHURNING IN THE OLDEN DAYS.
Such primitive methods are seldom seen in these days. Modern churns have driven these hand methods largely into oblivion.

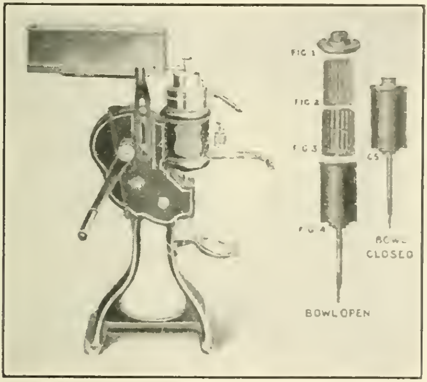
198. The owner of this cow had another that yielded 3,850 pounds of milk, which tested 4.8 per cent fat. What was the value of the butter this one produced at 25 cents per pound?

199. Another cow in this herd yielded 4,300 pounds of milk that tested 3 per cent butter fat. At 25 cents per pound what was the value of the butter produced?

200. The total quantity of butter this herd produced during the year was 5,760 pounds. The average test of the milk for the year was 4.8 per cent. How much milk was produced during the year?

201. The butter at 25 cents per pound averaged $60 for every cow in the herd. How many cows in the herd?

202. The preceding year the milk from this herd averaged 245 pounds for each day of the year, and made an average test of 4.2 per cent. How much butter was made during the year?



MODERN CREAM SEPARATOR.

With this apparatus practically all the cream is obtained from milk. It saves time, labor and waste.

Cream.

There are three methods of creaming:

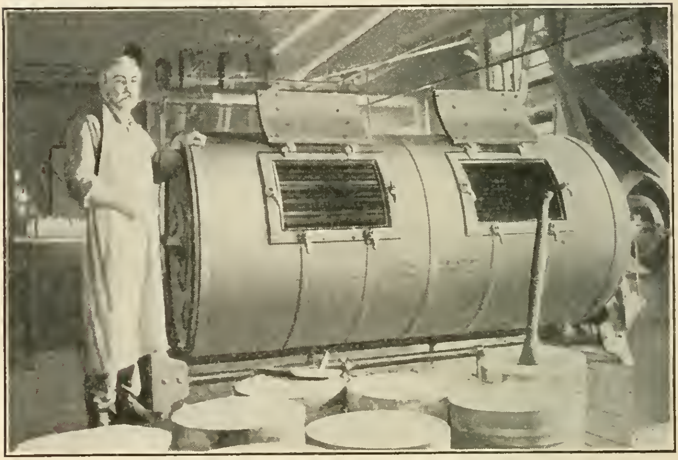
Shallow setting——Skimming cream from shallow pans or crocks
Deep setting——Skimming cream from deep cans.
Centrifugal——Skimming by the separator.

Some fat is left in the skim milk whatever the method employed. This amount is,

Shallow setting,	0.8 per cent.
Deep setting,	0.2 per cent.
Separator,	0.05 per cent.

203. What is the loss of butter fat in 500 pounds of skim milk when shallow setting is followed?

204. When deep setting is followed?



COMBINED CHURN AND BUTTER WORKER.

This is of creamery size and a kind frequently used in large butter factories.

205. When the separator is used?

206. What is the loss of butter during one year when 110 pounds of skim milk is daily produced, the separator being used?

207. When deep setting cans are used?

208. When shallow setting pans or crocks are used?

209. At 25 cents per pound for butter, what is the yearly money loss with shallow pans or crocks?

210. With deep setting cans?

211. With the separator?

212. In 1,610 pounds of skim milk, testing .12 of one per cent, how much fat is lost?

213. How much butter may be made from 460 pounds of cream that tests 33 per cent fat?

214. Cream that tested 22 per cent fat was made into 84 pounds of butter. How much cream was there?

215. How many pounds of 25 per cent cream may be taken from 500 pounds of 4 per cent milk?

Process:

$500 \times .04 = 20$..................Pounds fat.

25 per cent cream means 25 pounds of fat in 100 pounds of cream, or .25 of 1 pound of fat in 1 pound of cream.

$$20 \div .25 = 80$$

Thus 80 pounds of 25 per cent cream may be made from 500 pounds of 4 per cent milk.

216. How many pounds of 20 per cent cream may be taken from 600 pounds of 6 per cent milk? 180.

217. How many pounds of 30 per cent cream may be taken from 600 pounds of 3 per cent milk? 60.

218. A dairyman sent to market 100 pounds of 25 per cent cream. From what quantity of 4 per cent milk was the cream taken? Ans. 625.

219. His neighbor sends with him 100 pounds of 30 per cent cream which had been taken from 625 pounds of milk. What was the per cent of fat in this milk? 4.8. How much 25 per cent cream might have been made? (120 pounds.) How much 20 per cent? (150 pounds.)

Butter.

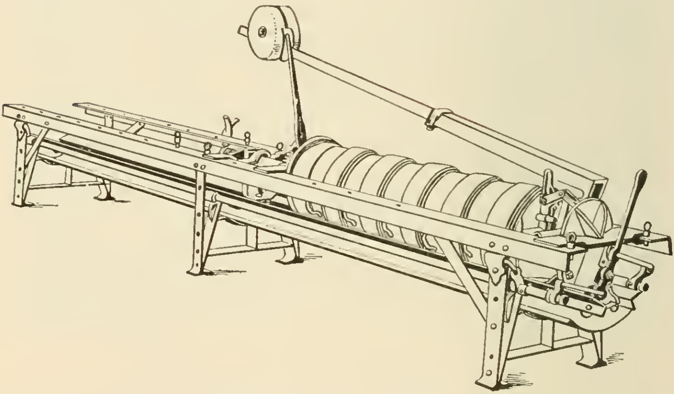
The churn gathers the fat globules together in a mass called butter. The average composition of butter is as follows:

	Per cent.
Water,	13
Fat,	83
Casein (protein),	1
Salt,	3

220. In a ton of butter how many pounds of water?

221. Of fat?

222. Of protein?



ROUNDING OUT THE CHEESE.

One of the final steps in cheese making is pressing the cakes. They are now ready for storing and ripening.

223. Of salt?

224. What is the nutritive ratio of butter?

Important truth. In churning the temperature of cream may vary from 50 degrees to 66 degrees. When the temperature is higher than this, more fat is left in the buttermilk and the butter is soft and of inferior quality. Thin cream churns more slowly than thick cream. In making butter, churning should be stopped when the granules are about the size of large grains of wheat.

225. When cream is churned at a temperature of from 50 degrees to 60 degrees, 0.2 per cent of fat is left in the buttermilk; when churned at a temperature of from 75 degrees to 80 degrees the buttermilk tests 0.9 per cent. What is the difference or loss for a herd of cows when 12,640 pounds of buttermilk are made annually?

226. At 25 cents per pound for butter, what is the amount of this yearly loss?

Cheese.

This product of the dairy is made by coagulating milk with rennet, a ferment of the calf's stomach. Milk that is rich in fat makes more and richer cheese than milk that is poor in fat. Full cream cheese contains—

	Per cent.
Water,	37
Fat,	34
Casein,	24
Ash,	5

227. How much water in a ton of cheese?

228. Fat?

229. Casein?

230. Ash?

231. What is the nutritive ratio of cheese?

232. When cheese sells for 15 cents per pound, what is the value of a ton.

233. Ninety-five per cent of the nutrients in cheese is digested. In 100 pounds, how many pounds of digestible nutrients (fat and casein) are there?

234. When cheese sells for 15 cents per pound, what is the cost of 1 pound of digestible nutrients?

235. Beef loin contains 15.6 per cent of digestible protein and 16.6 per cent digestible fat. When sold at 25 cents per pound, what is the cost of a pound of digestible nutrients?

236. How many more pounds of digestible nutrients in a dollar's worth of cheese than in a dollar's worth of beef loin?

IN THE CURING ROOM.
One way of storing cheese during the ripening period.

Important truth. From 9 to 12 pounds of milk are required to make 1 pound of cheese. From 100 pounds of milk, containing 3 per cent fat and 2 per cent casein, 8.8 pounds of cheese may be made; from 100 pounds of milk containing 4.5 per cent fat and 2.7 per cent casein 11.7 pounds of cheese may be made.

Marketing.

Milk may be marketed as milk, butter, cream, or cheese.

The form in which it should be marketed is governed by the distance from market, the relative current prices of the different products, the breed of cows, the inclination of the owner, etc.

237. What is the value of 100 pounds 4.2 per cent milk when sold at 4 cents per pound, *i. e.*, 8 cents per quart?

238. What is the value of cream, testing 30 per cent fat, in 100 pounds of 4.2 per cent milk, when sold at 20 cents per pint (1 pound)?

239. What is the value of the cheese made from 100 pounds of 4.2 per cent milk (nine pounds of this grade of milk makes 1 pound of cheese) when sold at 12 cents per pound?

240. What is the value of the butter made from 100 pounds of 4.2 per cent milk when sold at 25 cents per pound?

Important truth. This comparison does not necessarily mean that milk production is more profitable than butter, cheese, or cream production. It costs more to deliver milk to the consumer than the other products. Then, too, a good deal of fertility is permanently lost from the soil by the sale of milk. When butter is made all skim milk and buttermilk is left on the farm and are available for the feeding of pigs, calves, and poultry—items of great importance in the wise management of a dairy farm.

241. When milk, testing 4 per cent fat, costs $1.60 per hundred pounds, what is the value of 20 per cent cream on basis of fat content?

Process:

In 100 pounds of 4 per cent milk costing $1.60, there are 4 pounds of fat Since 4 pounds of fat cost $1.60, fat costs 40 cents per pound. In 100 pounds of 20 per cent cream there are 20 pounds of fat. Then 20 pounds of fat at 40 cents per pound will cost $20 \times \$.40 = \$8.00$—which is, therefore, the value of 100 pounds of 20 per cent cream.

Note.—A gallon of 30 per cent cream weighs 8 pounds; 20 per cent cream 8.3 pounds; 4 per cent milk 8.55 pounds.

242. When milk, testing 4 per cent fat, costs $1.60 per hundred pounds, what is the value of one gallon of 20 per cent cream on basis of fat content?

243. A dairyman sells his milk, testing 4.5 per cent, at

Bottled Milk Ready for Market.

When milk is bottled immediately after cooling and then kept cool it remains sweet and pure much longer than if marketed in large insanitary cans.

20 cents per gallon. What price should he receive per gallon for 30 per cent cream, so that the value of the fat in this cream may be the same as that it now has in milk?

244. When milk, testing 3 per cent fat, costs 15 cents per gallon, on basis of fat content, what should 4 per cent milk cost? Five per cent milk? Twenty per cent cream?

245. When cream, testing 20 per cent fat, costs $1 a gallon, what should cream testing 30 per cent fat cost a gallon?

Standardized milk. Milk standardized to a certain per cent fat.

246. A dairyman has 322 pounds of milk which test 4.3 per cent fat. He desires to standardize this to 5 per cent fat. How much 5 per cent milk will this quantity make?

Process:

$322 \times 4.3 = 13.8$ ....Pounds fat.
$13.8 \div .05 = 276$ ....Pounds 5 per cent milk.

This means that when 322 pounds of 4.3 per cent milk are standardized to 5 per cent milk, 276 pounds will result.

247. Another dairyman has 322 pounds of milk which tests 3.2 per cent fat. When this is standardized to 5 per cent fat, what quantity will result?

248. A farmer has 660 pounds of milk which tests 3.3 per cent fat. Standardized to 4 per cent fat, what quantity will result?

249. His neighbor averages 240 pounds of milk a day. The milk tests 3 per cent fat. His market calls for 4 per cent fat, at which per cent he standardizes his milk. At 6 cents a quart, what does his milk bring him each day?

CHAPTER V.

SOIL.

That part of the solid surface of the earth in which plants grow is known as the soil. In semi-technical language, the uppermost part is called the soil and the underpart the subsoil.

The soil contains plant food and the moisture in which this food must be dissolved before it can become a factor in the growth of plants; it affords a foothold for plants—a place in which they may grow; it supplies protection, air, agreeable temperature, and other congenial surroundings, that plant roots may be at home in it. "The

Getting Samples of Soil From Fields.

No two soils are just alike. Their water content also varies. By means of simple apparatus as shown in the picture, samples may be obtained from any depth and the amount of water in them determined.

soil is the ultimate employer of all industry—the source of all wealth and the universal banker."—Hill.

250. A sample of soil having a surface area of one square foot and a depth of 12 inches, was dug from a clover field and weighed. The upper 6 inches weighed 60.1 pounds; the lower, 61.4 pounds. These two layers were then dried and weighed, and the following weights were obtained: for the first, 51.1 pounds; for the second, 52.7 pounds. The moisture was what per cent of the dried weight in each layer?

251. What was the per cent of moisture in the 12-inch section of soil?

252. What is the weight of an acre of the upper 6 inches of this soil after being dried?

Process: Multiply number of square feet in an acre by 51.1

253. What is the weight of the water contained in an acre of the upper 6 inches of soil? Of the lower 6 inches?

254. The water in the upper 6-inch layer would have what depth if extracted and spread evenly over the same area?

Process:

1. Divide the weight of water per square foot of surface area by 62.5 (weight of 1 cubic foot of water). This will give the depth in feet. $9 \div 62.5 = 0.14$..................Feet.

2. Multiply quotient by 12 (inches in a foot) to obtain the depth in inches. $0.14 \times 12 = 1.7$..................Inches.

Note.—This is equivalent to dividing by 5.2, since

$$62.5 \div 12 = 5.2$$

255. How many inches depth of water in the second 6 inches of soil?

256. Assuming no loss by evaporation or drainage, to how many inches of rainfall does the water in the 12-inch depth of soil correspond?

257. This soil was analyzed by a chemist who found that it contained in the upper layer 0.162 per cent of nitrogen, 0.249 per cent of phosphoric acid and 0.386 per cent of potash. How many pounds per acre of each of these elements of fertility did this upper layer contain?

258. This chemist also analyzed the second layer and found 0.092 per cent of nitrogen, 0.134 per cent of phosphoric acid, and 0.224 per cent of potash. How many pounds of each did this second layer contain?

GETTING HUMUS INTO THE SOIL.

The rape crop seeded at the last cultivation of the corn is now being plowed under to keep up the humus supply of the land. Cowpeas, rye and crimson clover are other good crops to use for the same purpose.

259. What was the number of pounds each of nitrogen, phosphoric acid, and potash per acre in the 12 inches of soil?

260. A crop of wheat which yields 30 bushels per acre removes from the soil by chemical analysis, as indicated, 48 pounds of nitrogen, 21.1 pounds of phosphoric acid, and 29.8 pounds of potash. When wheat yields at this rate, how many crops will the nitrogen in this soil supply?

261. How many crops will the phosphoric acid supply?

262. How many crops will the potash supply?

263. A crop of oats yielding 60 bushels per acre, requires of nitrogen 73.3 pounds, of phosphoric acid 25.7 pounds, of potash 61.5 pounds. How many crops of such oats will the nitrogen content of this soil supply? Phosphoric acid? Potash?

Important truth. Nature has not stored these elements in the soil in such a form as to be wholly plant food. Only a small percentage of any one is directly available at any time. Available plant food is readily lost by leaching and drainage. Hence, if all the elements had been in an available form originally the soil would have lost its fertility ages ago. Great quantities of plant food are locked up in the soil in such forms that they can be made available only by good tillage, crop rotation, winter-growing crops, humus, stable manure, and legumes. These together form the key which unlocks the door to Nature's richest storehouse.

Moisture of the soil. Water is important to plant growth. It dissolves plant food and carries it to all parts of the plant body. Crops often fail or are greatly injured by an insufficient supply of moisture in the soil. How to keep enough water in the soil during the growing season for all the needs of the growing plant is a very important problem.

Saving moisture by plowing.

264. Samples of soil from a field partially plowed were taken to a depth of 12 inches, two weeks after plowing was done. The sample taken from the plowed land showed 13.87 per cent of water in the soil, while the sam-

Disking the Ground Before Plowing.

A good practice but not generally followed. It helps to make a fine seed bed, saves moisture, makes plowing easier and increases the crop.

ple taken from the unplowed land showed 10.58 per cent. This soil when dried weighed 80 pounds to the cubic foot. How many more tons of water per acre are there in the plowed land than in the unplowed land?

Saving moisture by cultivation. The observed difference in the moisture content of a field of corn for one season was as follows:

CULTIVATION CONTROLS WATER CONTENT.

Kind of cultivation	1st foot per cent.	2d foot per cent.	3d foot per cent.	4th foot per cent.
Cultivated 3 inches deep.....	23.14	23.30	21.94	22.46
Cultivated 1 inch deep.......	22.70	21.08	19.65	19.58
Difference...............	.44	2.22	2.29	2.88

PLOWING LEVEES FOR RICE.

265. How many more tons of water per acre were held in these four feet of soil (dry weight, 80 pounds per cubic foot), by the deeper mulch (cultivated 3 inches), than by the more shallow mulch (cultivated 1 inch)?

266. How many more inches of water in the deep-mulched than the shallow-mulched land?

267. On July 26, 1900, samples of soils were taken from three plats of land on which corn was growing. The observed percentages of moisture content of the soil from these plats were as follows:

	Per cent.
1. No cultivation—weeds allowed to grow,	12.55
2. Ordinary cultivation—some weeds,	18.80
3. Level cultivation—frequent and shallow,	22.64

How many tons of water per acre on land in corn, where no cultivation was given, and weeds were allowed to grow?

268. How many tons where ordinary cultivation was given?

269. How many tons where level, shallow, and frequent cultivation is given?

270. What is the percentage of difference, favorable to ordinary cultivation over no cultivation?

271. The percentage of difference in favor of level cultivation over no cultivation?

Growing crops take water from the soil. Often early spring crops are harvested and the same land is planted in corn or other cultivated crops. Or again a crop of weeds may be permitted to grow on ground to be used later for a cultivated crop. This second crop may suffer on account of the removal of water by the preceding crop. This fact is illustrated in the table below.

PLANTS TAKE WATER FROM THE SOIL.

Nature of land	12 inches	12-18 inches	18-24 inches
	per cent.	per cent.	per cent.
Ground not planted..........	24.53	20.16	17.74
Ground in clover............	10.59	15.66	14.73
	13.94	4.50	3.01

TWO WAYS OF GROWING CORN.

Plot at right received ordinary cultivation, and yielded 64 bushels to the acre. Plot at left received no cultivation and yielded 4 bushels an acre.

272. How many tons of water in the two feet of ground not planted?

273. How many in the ground in clover?

274. On this basis how many tons of water per acre were removed by the growing clover crops?

275. How many more inches of rainfall will be needed on the clover plot than on the other?

Influence of method on producing power of soils. Soils differ in producing power. The same soil often is influenced in productive power by a change in the method of tillage, cultivation, and treatment.

The following results were obtained during three years' growth of crops showing the influence of thorough tillage.

TILLAGE INCREASES CROP YIELDS.

Methods of tillage	Corn, 1899	Barley, 1900	Timothy and clover, 1901
	pounds per acre	pounds per acre	pounds per acre
Ordinary—spring plowed.....	3,300	1,500	1,120
Fall plowed..................	3,800	2,050	1,480
Fall and spring plowed.......	6,900	2,750	2,240

276. How many tons of forage were produced during the three years where spring plowing was done?

277. Where fall plowing was done?

278. Where both spring and fall plowing were done?

279. What is the per cent of increase of fall plowing over spring plowing?

280. What is the per cent of increase of fall and spring plowing over spring plowing only?

281. Twenty acres of land, fall and spring plowed, are the equivalent of how many acres of land spring plowed only? Are there other savings?

Important truth. Thorough tillage is helpful for most soils. Old, dead, wornout lands are especially benefited by deep, effective stirring. Water enters more easily; air more freely; plant food is made available; the soil becomes open and more porous; the roots have larger and better pasture grounds. All these influences contribute to soil activity and soil productivity.

THE PLOW COMES FIRST IN ALL TILLAGE OPERATIONS.

To do good work the plow must turn the furrow slice, cover the grass and vegetable matter and leave the surface pulverized and mellow.

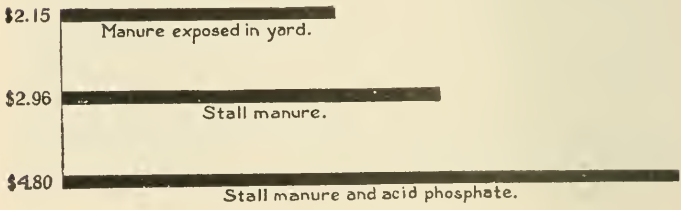
Protected farm manures influence the producing power of soils. An untold quantity of fertility is lost each year because of poor methods in caring for and preserving farm-yard manures. This fact is illustrated by an experiment made at one of our experiment stations, as follows:

UNPROTECTED MANURE VERSUS PROTECTED MANURE.

Method	Pounds green corn
Manure protected from rain and wash	21,520
Manure piled out of doors	14,320

282. How many tons increase in yield of corn from land fertilized with stable manure which has been protected from rain and wash?

283. What is the percentage increase secured by protection of manure from rain and wash?



INCREASING VALUE OF MANURE.

When stable manure is treated with acid phosphate and kept under cover its fertilizing value is increased.

CHAPTER VI.

FIELD CROPS.

The commanding position occupied in the world today by American agriculture, is due in a large measure to the new plants native to this country, and to the old ones which so readily adapt themselves to our soil and climate conditions. This list includes cotton, corn, potatoes, tobacco, wheat, oats, sugar cane, and many grasses and other crops. Without our cotton, corn, wheat, and other agricultural exports the balance of trade would be against us, and the world would be denied its present abundance of cheap clothing and food.

Statistics of Corn.

284. The total production of corn in 1889 was 2,122,000,000 bushels; in 1899, 2,666,000,000 bushels, and in 1909, 2,552,000,000. What was the per cent of increase or decrease during each ten years? The twenty years?

285. The value of the 1899 corn crop was $828,000,000, and of the 1909 crop $1,439,000,000. What was the average price per bushel for each year? Ans. 31 cents in 1899, and 56 cents in 1909.

286. The average yield of corn per acre in 1899 was 28.1 bushels; and in 1909, 25.9 bushels. How many acres were in corn each year? Per cent decrease in yield per acre?

287. A South Carolina farmer in 1899 produced 255 bushels of corn on one acre of land. How many times greater is this yield than the average for the United States for the same year? Than for 1909?

Modern Tools on Large Hay Farm.

288. What would have been the total yield in the United States in 1909, had every acre of corn produced 255 bushels? Its value?

289. What was the average value of corn per acre in 1899? In 1909?

290. The total number of farms in the United States in 1899 was 5,740,000. Corn was grown on 88.6 per cent of these farms. On how many was corn grown that year? Ans. 5,085,640.

291. What was the average production of corn per farm that year?

292. What was the average value of corn per farm that year?

Statistics of Wheat.

293. The total production of wheat in 1899 was 658,-500,000 bushels and in 1909, 683,400,000 bushels. What was the per cent increase? The 1899 crop was an increase of 40.6 per cent over the previous decade. What was the production in bushels in 1889?

294. The value of the 1899 wheat crop was $370,000,-000; the 1909, $657,700,000. What was the average price per bushel in 1899? In 1909?

295. The average yield per acre was 12.5 bushels in 1899, and 15.4 bushels in 1909. How many acres of wheat were grown each year? What was the per cent of increase per acre?

296. It is now claimed by experts that the average yield per acre of corn and wheat can be doubled. What would this have added to the wealth of the country in 1909? In ten years at the same rate?

297. What was the average value of wheat per acre in 1899? In 1909?

298. The total number of farms in the United States in 1899 was 5,740,000. Wheat was grown on 35.8 per cent of these farms. On how many was wheat grown that year?

COTTON READY FOR THE PICKERS.

While the average yield of cotton is about one-third of a bale to the acre, this field yielded at the rate of three bales to the acre. It shows what proper fertilizing, tillage and culture will do.

299. What was the average production of wheat per farm that year?

300. The average value of wheat per farm that year? Per acre?

301. The population of this country in 1910 was 92,000,000; the consumption from the 1909 crop of wheat by this population that year was 596,000,000 bushels. What was the consumption of wheat per capita?

302. It takes 4.77 bushels of wheat to make one barrel of flour. What was the consumption of flour per capita that year?

303. For seed in 1910, 1.4 bushels of wheat were used per acre. What was the consumption for this purpose, assuming the same acreage as in 1909?

304. How many bushels of the 1909 wheat crop were used for food and seed?

305. This consumption equals how many bushels per inhabitant in 1910?

306. How much of the 1909 wheat was available for export?

307. If all of it had been exported, what would have been its value?

Statistics of Cotton.

308. The production of lint cotton in 1899 was 9,435,000 bales of 495 pounds; in 1909, 10,640,000 bales. How many pounds did each crop make?

309. The total acreage in cotton in 1909 was 32,044,000. What was the average production in pounds per acre?

310. The average production in bales per acre?

311. The value of the commercial cotton crop in 1899 was $323,800,000, and in 1909, $703,600,000. What was the average value per bale each year?

312. The average value per pound? Per acre?

313. The total number of farms in the United States in 1909 was 6,362,000, and the total value of all the crops was $5,487,000,000. What was the value per farm? The cotton was what per cent of this total value?

314. What was the production of cottonseed in 1909, estimating 1,000 pounds of seed to each bale of cotton?

315. The cottonseed in 1909 was valued at $121,000,000. What was this per ton? Per pound? Per acre? Total, lint and seed, per acre?

Statistics of Cereal Crops.

Every ten years the census bureau reports on acreage, production, values, and other general facts incidental to farm crops. The following examples may be solved by use of the accompanying table taken from the 1910 census report and showing statistics of the 1909 crops. The corresponding table for 1899 is also given.

SOME CEREAL CROPS GROWN IN THE UNITED STATES IN 1909.

Crop	Acreage	Bushels	Value of crop
Corn	98,382,665	2,552,189,630	$1,438,553,919.00
Wheat	44,262,592	683,379,259	657,656,801.00
Oats	35,159,441	1,007,142,980	414,697,422.00
Barley	7,698,706	173,344,212	92,458,571.00
Rye	2,195,561	29,520,457	20,421,812.00
Buckwheat	878,048	14,849,332	9,330,592.00
Rice	610,175	21,838,580	16,019,607.00

Note.—All figures beyond the first three are of little importance and may be omitted in calculation. 98,382,665 may be taken as 98,400,000, and 2,552,189,630 as 2,550,000,000.

SOME CEREAL CROPS GROWN IN THE UNITED STATES IN 1899.

Crop	Acreage	Bushels	Value of crop
Corn	94,913,673	2,666,440,279	$828,258,326.00
Wheat	52,528,574	658,534,252	369,945,230.00
Oats	29,539,698	943,389,375	217,098,584.00
Barley	4,470,196	119,634,877	41,631,762.00
Rye	2,054,292	25,568,625	12,290,540.00
Buckwheat	807,060	11,235,515	5,747,853.00
Rice	351,344	9,002,886	7,891,613.00

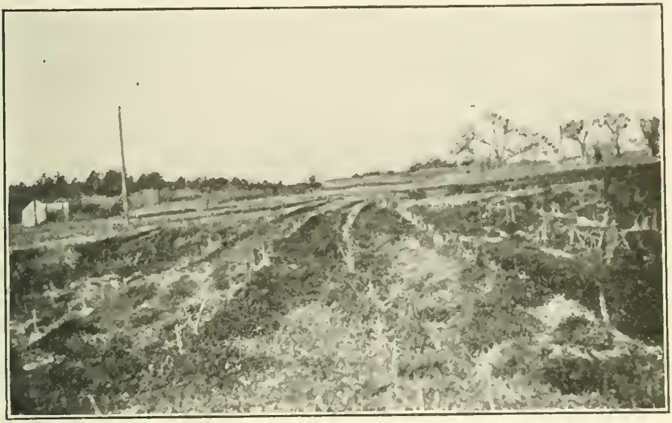
316. In 1909 what was the yield per acre of oats? The value? In 1899?

317. Yield per acre of barley? Value per acre?

318. Yield and value of rye?

319. Yield and value of buckwheat?

320. Yield and value of rice?



CRIMSON CLOVER A FINE COVER CROP.

In this cotton field at last cultivation of cotton crimson clover was seeded. A splendid stand is now in evidence. When plowed under the following spring a great quantity of life-giving vegetable matter will help the soil for future production.

321. What was the average price per bushel of oats in 1909? In 1899?

322. Of barley? Of rye? Of buckwheat?

323. The average price per bushel (45 pounds) of rice? Per pound?

Statistics of hay. For statistics of other kinds of hay and forage crops consult Census Bureau, or United States Department of Agriculture reports. The following table is from the 1900 census report.

CERTAIN HAY CROPS.

Crop	Acreage	Tons	Value per ton
Millet	1,743,887	2,850,959	$5.76
Alfalfa	2,094,011	5,220,671	
Clover	4,103,968	5,167,188	
Timothy and other tame grasses	31,301,689	35,624,395	

324. What was the average yield per acre of millet for 1899?

325. Of alfalfa? Of clover?

326. Of timothy and other tame grasses?

327. What the total value of hay produced in 1899?

328. The combined hay and forage crop acreage in 1899 was 61,691,000. The 1909 acreage shows an increase of 17.2 per cent. What was it? The 1909 crop averaged 1.35 tons per acre. How many tons? The 1909 crop was worth $11.40 per acre. What was this per ton?

Statistics of Potatoes.

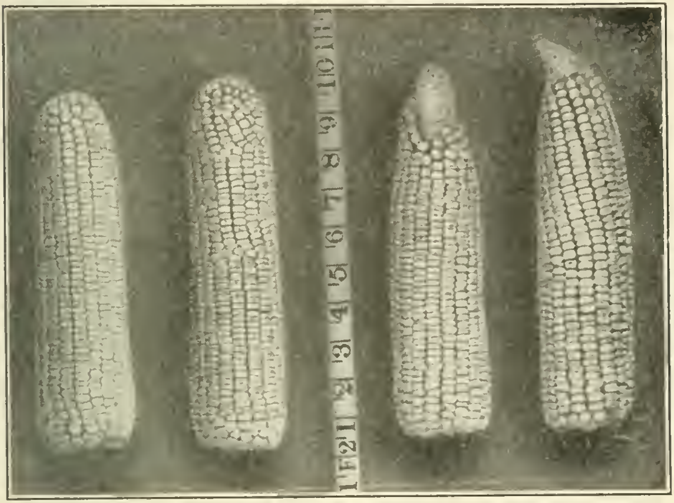
Irish and sweet potatoes enter largely into the diet of all classes of people. The former is also used extensively in the manufacture of starch.

POTATOES IN THE YEAR 1909.

Crop	Acreage	Bushels per acre	Value
Irish potatoes	3,668,855	106.1	$166,423,910.00
Sweet potatoes	641,255	92.4	35,429,176.00

329. How many bushels of Irish potatoes were produced in 1909? Sweet potatoes?

330. The Irish potato acreage in 1899 was 81 per cent of that in 1909. The number of bushels per acre in 1899 was 93.0, and the price per bushel was 36 cents. What was the value of the 1899 crop?



CORN IMPROVED BY SELECTION.

The original stock is shown at the right. By carefully selecting the best ears, the type at the left was obtained.

331. What was the average price per bushel of Irish potatoes in 1909?

332. The average price of sweet potatoes?

333. It has been proved that a more careful selection of wheat for seed purposes will greatly increase the production of each acre. Were this increase but one bushel per acre, how many bushels of increase would there be with the same acreage as in 1909?

334. When sold at 80 cents per bushel what would be the value of the increased production?

335. An ideal country road may be graded and made of stone for a sum not exceeding $3,000 per mile. How many miles of such road could be made annually from the sum represented by one bushel per acre increase in the wheat crop?

336. How many such roads from Boston to San Francisco might thus be built each year?

337. How many years would be required to pay in this way for such a road, whose length is equal to the circumference of the earth?

338. Corn is often calculated on a basis of 120 ears per bushel. What is the weight of each ear?

339. When corn is planted in rows 44 inches apart, how many rows per acre in a field 80 rods long?

340. How many stalks per acre when planted 12 inches apart in the row?

341. When one ear is produced per stalk, what is the yield per acre?

342. If corn is selected and bred to average one and one-half ears per stalk of same weight as above, what is the yield per acre?

343. If corn is bred so as to increase the weight—100 ears to the bushel—what will be the yield per acre, corn being planted 12 inches apart in rows 44 inches wide?

344. If corn is planted 12 inches apart in rows 38 inches apart, what is yield per acre, one ear per stalk and 120 ears per bushel?

345. If on the average one out of five grains fails to germinate, what is the yield per acre? What is the loss per acre at 50 cents per bushel?

346. If corn shrinks 10 per cent in weight between harvest time and the following summer, what is the loss when corn produces 40 bushels per acre, and is worth 50 cents per bushel?

347. What is this loss for the whole country, provided 10 per cent of the corn crop is carried over until the next summer?

348. If it shrinks 12 per cent, what is the annual loss?

349. Fifty-eight samples of seed corn were tested for

SEEDING CORN LAND TO WHEAT.

This custom enables two crops to be grown with one plowing, a saving of time and labor. Corn land is also fairly good preparation for wheat.

vitality. Of that selected from corn in shock, 78 grains out of each 100 germinated; from the crib, 87 grains; of seed selected at harvest time and carefully stored, 94 grains germinated. What was the percentage of germination for each method?

350. What was the per cent difference of germination between well-stored seed corn and that from shocks? From crib?

351. Suppose the seed corn used in the United States in 1914 was 35,000,000 bushels and was of average crib seed, what would be the gain in bushels if well-stored seed were used?

352. If 80 per cent of the 35,000,000 bushels of seed used germinates, and once replanted with the same grade of seed, what will be the stand?

353. It has been estimated that the loss of cotton, when stored under trees and exposed to weather at compresses, farms, and railroad depots is 10 per cent of the value. If 25 per cent of the cotton crop is thus exposed, what was the annual loss to cotton farmers in 1909 in this way?

354. It is estimated that cotton fiber of good length and uniformity is worth two cents more per pound than that of the average now produced. If 25 per cent of the cotton crop were improved so as to secure this additional value, what would have been the increased value of our cotton crop for 1909?

355. It costs on the average $1 per acre to "chop" cotton. If improved cultural methods were secured, that this cost might be reduced one-half, what would have been the saving on the cotton crop of 1909?

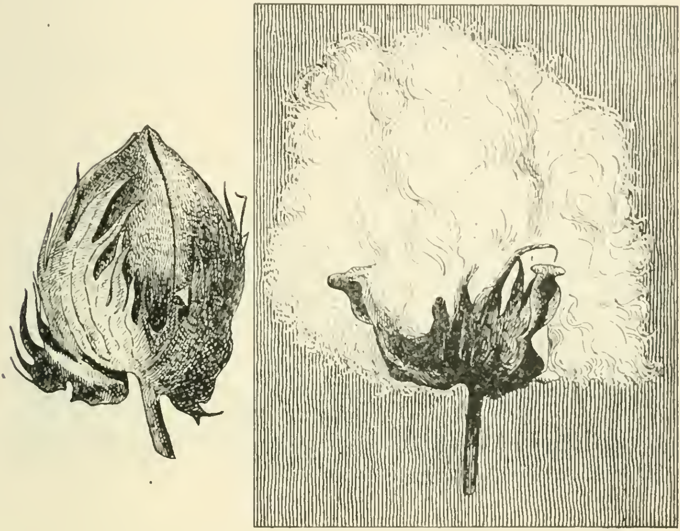
356. It costs 60 cents per hundred to pick cotton. What was the cost for picking the 1909 cotton crop?

357. For every pound of cotton lint produced two pounds of cottonseed are produced. How many tons of seed in the cotton crop of 1909?

358. At 40 cents per bushel (30 pounds), what was the value of the 1909 cottonseed crop?

359. The average price of cotton in 1899 was 7 cents per pound. Since that time cotton has averaged 12 cents per pound. What would be the value of the 1899 crop at this price? The 1909?

360. The value of the commercial cotton crop for 1904 was $633,600,000. That year 13,342,515 bales of cotton were produced. What was the average value of cotton per pound, estimating 495 pounds to the bale?



COTTON BOLLS.

Here are shown a mature unopened and an opened cotton boll.

361. In 1909, 476,849 acres were planted to sugar cane. The value of the crop was $26,415,952. What was the average value per acre?

362. The same year 444,088 acres were devoted to sorghum cane. The value of the crop was $10,174,457. What was the value per acre?

363. The same year 364,093 acres were planted to sugar beets, which produced a crop worth $19,880,724. What was the value per acre? In 1899, 110,170 acres worth $3,323,240. Value per acre? Per cent of increase during the decade?

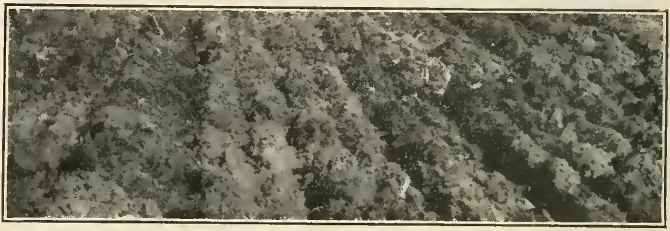
Cost of Production.

364. What is the cost in your locality of plowing an acre of land? Determine this as accurately as you can.

365. Of harrowing?

366. How many acres can be rolled in one day?

367. How many acres can be cultivated in one day?



THIS PLOWING IS IDEAL.
Note how mellow and crumbled the furrow slice has been left.

368. How many acres can be cultivated in a day with a double cultivator?

369. When corn or cotton is cultivated four times during the season, and the labor of a man costs $1.50 a day, what is the average saving during a season through the use of a double cultivator?

370. What is the cost of harvesting an acre of corn?

371. Of wheat? Of cotton?

372. Have these costs increased in your locality or decreased during the last few years? Would these costs and changes in costs have any influence in determining the kind of farming you would do?

373. Determine the cost of producing an acre of the crop in which you are most interested. Include all operations. (1) From plowing to marketing, (2) maintenance of land and tools, (3) interest on the investment. Is the growing of this crop open to any improvements which would make for economy in production?

Important truth. The cost of producing any crop varies with the richness of the land, the time of planting, the effectiveness of the tillage, the cost of labor, the quality and quantity of fertilizer used, the climatic conditions, and the skill and knowledge of the producer. Every farmer should keep an accurate record of every item of expense for each crop grown. He should study these figures and profit by them. He should experiment with a view to discovering what is for him, all things considered, the best practice. He will thus adjust his farming to the local conditions, and will learn many things no book or outside observer can tell him.

CHAPTER VII.

FRUIT AND VEGETABLES.

Millions of dollars' worth of fruits and vegetables are grown and shipped to market every season; and fully as much more is canned, dried, or preserved in some other way for use during the unproductive period of the year. Many people think that the fruits are more important than the vegetables, but this is not true, at least from a money standpoint. In 1909 the value of vegetables produced in the United States was $417,000,000, including $166,000,000 worth of potatoes; that of all other horticultural products amounted to $273,000,000, of which $140,000,000 represented the tree fruits, $30,000,000 small fruits, and $22,000,000 each of grapes and citrus fruits.

374. A farmer in western New York decided to plant apple trees 40 feet apart on 10 acres of his land. How many trees did he set out?

375. He thought that because the trees would hardly begin to bear profitable crops until they were eight or ten years old, he could grow currant bushes between the trees for several years, so he planted them 5 feet apart. How many did he plant?

376. Before the currant bushes were old enough to bear, the four nearest ones to the apple trees began to fail and had to be removed. How many were dug up?

377. As these bushes cost 10 cents each when bought, and as planting and cultivation cost 10 cents more, how much did he lose by buying too many?

378. When the currants began to bear they produced an average of 4 quarts to the bush. The farmer paid boys and girls two cents a quart for picking. How much money did he have to pay for picking all the fruit on this 10 acres?

379. He sold the currants at 10 cents a quart. How much money did he have left after paying for the picking?

CULTIVATING BEANS.

380. In the sixth year the apple trees bore a peck of apples each, and because the farmer handled them properly they doubled in production each year until they were 12 years old. How much did they produce each year?

381. The farmer sold his apples in barrels holding 100 quarts each. How many barrels did he sell in the tenth year from his orchard?

382. He figured that it cost him 90 cents a barrel to grow, pick, grade, pack, and deliver a barrel of fruit. He received $2 a barrel. How much did his orchard pay him in the 12th year?

How Spraying Helps.

Spraying is a very modern farm practice. In a business way it is scarcely more than 25 years old. During these years a very large number of machines have been invented to lighten the labor of spraying, and to do the work better. Nowadays no good farmer who grows fruit or vegetables neglects to practice spraying. He knows that if he does not spray his crops will be neither so large nor so good. Poisons are used for insects that chew their food; and oil, dust, or caustics for those that suck the juices of the plants. Various materials are used to prevent diseases attacking cultivated plants. After the diseases have once gained a foothold there is little use in spraying. With both insects and diseases, therefore, prevention is better than a cure.

383. As an experiment a western New York farmer sprayed part of his potato field six times with bordeaux. At harvest time he found that the unsprayed part of the field yielded 150 bushels and the sprayed part 330 bushels. What was the percentage gain due to spraying?

384. He made two grades of the salable tubers, and found that 60 per cent of the sprayed potatoes could be sold at 40 cents a bushel and the balance at 30 cents, whereas only 40 per cent of the unsprayed salable tubers could be marketed as first grade, the balance being second grade. How much did he get for each lot, and how much of the money was due to the spraying?

385. The same farmer then began potato seed selection. It took him two days (20 hours), worth $4 of his time, to select and to plant according to rules. But the quarter of an acre so planted yielded at the rate of 40 bushels an acre more than his general field average—150 bushels. If he had sold the 10 bushels from his quarter-acre at 40 cents a bushel, would they have paid for his extra time in selecting and planting?

SPRAYING THE ORCHARD.

Spraying is just as important a feature of commercial orcharding as fertilizing, picking, and packing the fruit.

386. When he saw that he came out "just even" he was a little disappointed, but he decided to follow the rules once more, so he used the 400 best hills (the product of 100 best-producing tubers), as his basis of selection and used the next best ones for the "general field" the next year. Selection and planting took him only one day this time, because he had fewer potatoes to handle and plant. At digging time his quarter-acre of selected tubers yielded

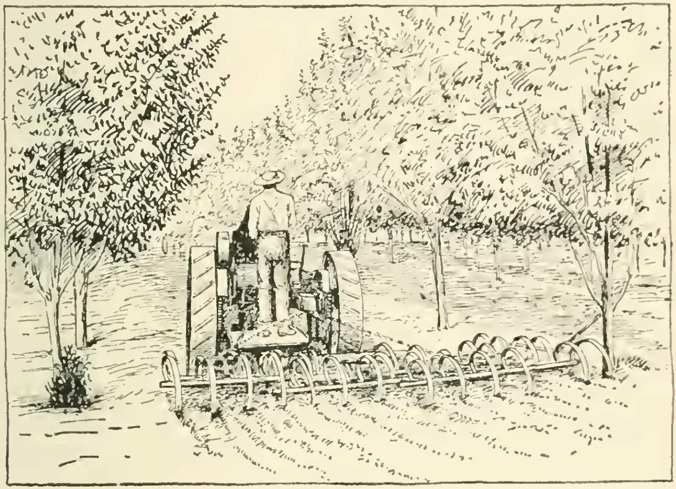
50 per cent more than the first year. If he had sold his crop at 40 cents a bushel, how much would he have made on his expenditure of time in careful selection and planting?

387. He felt encouraged by his results, and tried the plan a third year, this time using the best tubers for his selection plot and the next best for the general field. Imagine his surprise and pleasure at digging time to find that the selected tubers in the general field yielded 30 per cent more salable tubers than unselected seed, which yielded 150 bushels an acre. He sold his crop at 40 cents. How much did he make an acre on the time spent in selecting the seed the first and the second year?

388. A man bought a Maryland farm which had an orchard of 100 mature but neglected trees, that bore scarcely more than a barrel of salable fruit each the first year. Before spring opened the following year he had cut out all the dead wood and as many of the watersprouts as he dared, but was prevented from doing any spraying, fertilizing, or cultivating that season. In the autumn he harvested and sold an average of three barrels of salable apples to the tree at $2 a barrel. He figured that the pruning took him an average of two hours to the tree, and that his time was worth 25 cents an hour. What did he make out of his pruning?

389. The next year he fertilized the whole orchard with stable manure, but could get none of it sprayed and only half of it plowed. This half he kept cultivated until midsummer, when he sowed crimson clover as a cover crop. Plowing and cultivating cost $25. At harvest time he found that the cultivated plot yielded 50 per cent more salable fruit than the uncultivated part. He received $900 for the fruit. How much money did he get from each half, and how much did he make on his outlay for plowing and cultivating?

390. In the spring of the third year he fertilized, plowed, and cultivated the whole orchard and sprayed all but 20 trees, 10 in the part uncultivated the previous year and 10 in the cultivated part. These trees were left as checks. The spraying cost 40 cents a tree. At harvest time he gathered an average of three barrels of salable



ENGINE POWER USED IN ORCHARD.

Gas and oil engines are gradually replacing much of the work formerly done by hand or horse labor.

fruit to the tree from the 10 trees in the part uncultivated the year before, four barrels each from the 10 trees in the cultivated part, six barrels from the sprayed trees cultivated only one year, and seven barrels from the sprayed trees cultivated two years. He figured (1) the difference in yield due to cultivating the orchard two years as against one year; (2) the difference between the check trees, cultivated two seasons and only one season; (3) the difference due to spraying in the once cultivated half of the orchard (check trees with sprayed ones); and (4) a like difference between the 10 trees twice and the 10 trees once cultivated, but not sprayed. What were his answers?

391. A farmer bought a Delaware peach orchard of 200 trees that averaged three pecks of fruit to the tree the year he bought it. He planned to sell the crop in half-peck baskets, and estimated that 15 per cent of the crop would be unsalable. He ordered his baskets on this basis, but when he picked the fruit the trees averaged 10 per cent less than he had estimated, and when graded 20 per cent were unsalable. How many baskets had he left on hand?

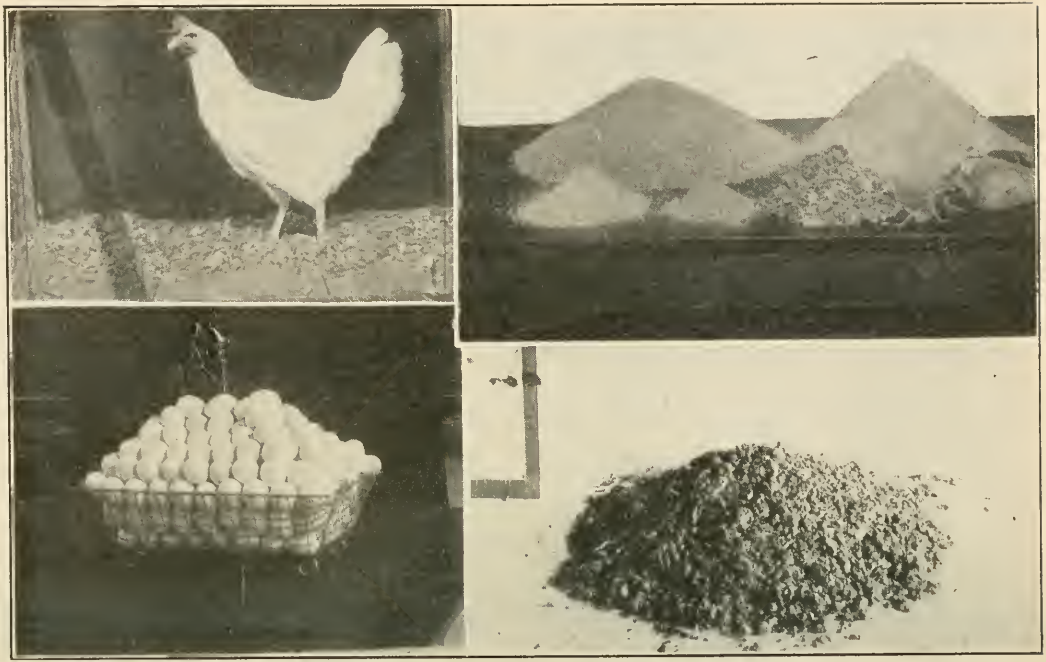
392. The second year he experimented in thinning. After the "June drop" he removed half the fruit from the trees in each alternate row through the orchard. This year he calculated upon three pecks to the tree and 20 per cent as unsalable. But only 10 per cent of the fruit was unsalable, and all of that was on the unthinned trees. As the baskets left over from the previous year were in good condition and could be used, how many baskets did he order, and how many should he have ordered?

393. The salable peaches on the unthinned trees sold for 40 cents a basket, and that from the thinned trees at 50 cents. He calculated the cost of thinning at 15 cents a tree. How much did he make on the operation because of the finer fruit?

394. A Maryland fruit grower uses annually 150 barrels of lime-sulphur spray in his 750-acre orchard. Supposing his trees to be 30 feet apart, and supposing that he can buy the spray material at $4.50 a barrel, how much does the material alone cost an acre?

395. A fruit grower who made lime-sulphur mixture for spraying, found that making the stuff in large quantities cost him 8 cents a gallon, but that his mixture would go only 80 per cent as far as commercial material which cost $4.50 a 50-gallon barrel. Supposing the results upon the crop to be equal, would it be more economical for him to make his own spray or to buy it, and how much money difference would there be?

396. A fruit grower bought 600 pounds of arsenate of lead at $7 a 100 pounds to spray for codling moth larvæ (apple worms). He used only 60 per cent of it and the balance was left over till the following year. Suppose interest to be 5 per cent, how much would he have saved or lost if he had bought the amount he needed each of two years at 8 cents a pound?



Remarkable Leghorn and Her Achievements

This hen weighs 3.2 pounds. In her first year she ate 110 pounds of feed and laid 257 eggs weighing 29.5 pounds. In her second year she laid 200 eggs. This record is due to rational feeding coupled with careful management and thoughtful breeding.

CHAPTER VIII.

FARM ANIMALS.

Farm animals have always been closely identified with prosperity in agriculture. Their high development and large production in this country are due partly to the skill and intelligence of their keepers, and partly to the splendid grasses and other food plants that are grown so successfully. And yet the animal industry is far from what it should be; scrubs and inferior animals must give way to improved stock that products of higher quality may result.

Statistics of Farm Animals.

The total value of the horses, mules, dairy and beef cattle of all kinds, swine, sheep, and goats in the United States in 1910 was $5,296,421,619, of which value neat cattle constituted 29.5 per cent, horses 47.3 per cent, mules 11.0 per cent, swine 7.7 per cent, sheep 4.4 per cent, goats 0.1 per cent.

397. What was the value of neat cattle in the United States for the census year 1910?

398. Of horses? This represents what per cent of the value of the cattle?

399. Of mules? This is what per cent of the value of the horses?

400. Of swine? Of these 2.7 per cent were not on farms; what was their value?

401. Of sheep? These were reported from 617,000 farms, what was the average value per farm?

402. Of goats? In 1900 their value was $2,982,000. What per cent of gain in value?

Value per head for each class. The average value per head in each class for the same census year was as follows: Cattle (neat), $24.50; horses, $108.87; mules, $126; swine, $6.88; sheep, $4.44; and goats, $2.16.

OUT FOR AN AIRING.

The pony and pony cart are childhood sports on many American farms. It is on the farm, in agriculture, and in contact with Mother Nature that are fashioned vigorous bodies, clear brains, steady nerves, self-reliance, character and sympathy.

403. How many cattle of all kinds in the United States in 1910?

404. How many horses? Mules? Swine? Sheep? Goats?

405. In 1900 there were in the United States 69,336,-000 cattle, valued at $1,409,392,000. What was the value per head?

406. In 1900 there were 23,016,000 horses, valued at $49.07 each. What was their total value?

407. In 1900 the average value of swine was $3.69, the total value $226,400,000. What was the number?

408. In 1910 there were 6,361,500 farms. Of these 5,285,000 reported cattle, and 611,000 reported sheep. What per cent had cattle? Sheep? What was the average number of cattle and sheep per farm?

409. Make a table showing these statistics of farm animals as given and calculated.

Horses. Form, quality, action, and purity of breeding largely influence the commercial value of horses. Good horses are always in demand at good prices, while inferior ones are numerous and are expensive at any price. It will pay you to study and observe this animal. When you become the owner of a horse be sure it is a good one and that you give it the best of care.

Oral Exercise.

410. What is the average cost of a good work horse in your community?

411. Of a good roadster?

412. How many hands high is a horse 64 inches high (4 inches = 1 hand)?

413. What differences do you know between the draft type and the roadster type?

Measuring horses. A good horse is well proportioned. Length of head, width between eyes, height at croup, length of body, etc., should bear the correct relations to one another. Expert judges always note these proportions.

The most beautiful horse is the one in which the different parts blend most nicely, and in which the different measurements bear to each other the most nearly correct

PRIZE WINNING SHORTHORN CATTLE.

Note the straight backs, deep sides and blocky character of these animals. They show a form typical of the beef breeds.

proportions. Incorrect proportions give the ungainly, awkward, and poorly esteemed horse; one not pleasing to the eye, and not efficient in its work. Good form, high quality, and pleasing action may be secured only through intelligence in selection and care in breeding.

Some Average Measurements.

1. Width between eyes: Slightly more than one-third length of head.

2. Length of head: Slightly less than three times width between eyes.

3. Height at croup: (1) Two and one-half times length of head, (2) height of horse at withers, (3) length of body from point of shoulder to quarter.

4. Height at withers: (1) Approximately two and one-half times length of head, (2) height at croup. (3) length of body from point of shoulder to quarter.

5. Length of body: (1) Two and one-half times length of head, (2) length at withers, (3) height at croup.

Oral Exercise.

414. A certain horse measures 9 inches wide between his eyes. What should be the length of his head?

415. The head of another horse is 28.5 inches long. What is the length of his body?

416. His height at withers? At croup?

417. What should be the length of a horse's head when the body is 62 inches long?

418. The height at the croup? At the withers?

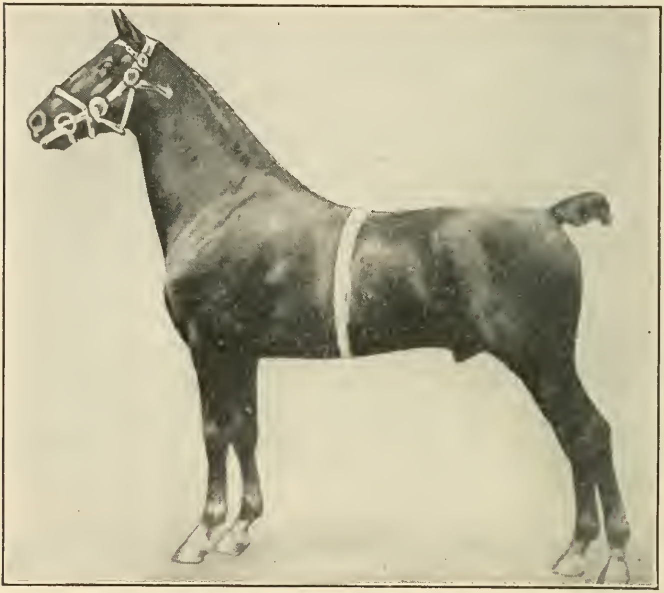
419. A certain horse is 17.5 hands high at the croup. and has exactly the proportions given above, what is his height at his withers?

420. The length of his body?

421. The length of his head?

422. The width between his eyes?

Important truth. While the problems given here are measurements of real horses, not all good horses conform to the standard. Draft horses often are slightly higher at the withers than at the croup; and horses for speed are often higher at the croup than at the withers; also the length of the body may be greater than the height at croup or at withers. This variation is much less, however, than one would suppose. Draft is favored



HACKNEY, TYPICAL OF THE HARNESS CLASS.

when the height at withers is slightly greater (one or two inches) than at croup, while speed is favored when there is a slightly greater height at the croup.

Line of gravitation. The center of gravity in the horse is the point about which all the parts are exactly balanced. If the horse could be supported at this point, the whole body would be at rest in any position whatever. The vertical line through the center of gravity is called the line of gravitation. In draft horses the center of gravity is low, and tends to a forward position; in horses having speed the center of gravity is high, and tends to a rear position.

The point at which the line of gravitation meets the ground may be determined if we know (1) the weight of the horse, (2) weight on fore feet, and (3) length of base of support (distance between fore and hind feet when standing).

423. A horse weighs 978 pounds, of which 565 pounds are on the front feet, and 413 pounds on the hind feet. When the distance between the points of contact with the ground of the front and hind feet is 43 inches, how far in front of point of contact of hind feet does the line of gravitation fall?

Process:

Let F = weight on front feet.
H = weight on hind feet.
D = distance between points of contact (front and hind feet).
X = distance of line of gravitation forward of hind feet.
Y = distance of line of gravitation back of fore feet.

$$X = \frac{F \times D}{F + H} \text{ and } Y = D - X$$

$$X = \frac{565 \times 43}{565 + 413} = 25.7$$

$$Y = 43 - 25.7 = 17.3.$$

Note.—This formula is an expression of the following principle in physics. The line of action of the resultant of two parallel forces divides the distance between them in the inverse ratio of that of the two forces. This formula contains four quantities. It may be used to find any one of them when the remaining three are known.

424. A horse sustains 570 pounds on his fore feet and

430 pounds on his hind feet; the distance between fore and hind feet is 44 inches. What distance in front of the hind feet does the line of gravitation fall? What distance back of the fore feet?

425. A horse weighing 1,200 pounds sustains 680 pounds on his front feet. When he stands, the distance between fore and hind feet is 46 inches. What distance back of the fore feet does the line of gravitation fall?

426. Another horse, weighing 910 pounds, sustains 390 pounds on his hind feet. What is the distance between the fore and hind feet if the line of gravitation falls 24 inches in front of the hind feet? Ans. 42 inches.

Cattle. All farm animals were once called *cattle;* the term now applies only to beef and dairy animals—the so-called neat cattle. Cattle raising is an important feature of American agriculture. Scrub cattle are usually grown with but little profit and frequently at an actual loss. Well-bred and well-tended cattle, whether for beef or for the dairy, bring good returns to the owner.

Gain in Live Weight of Beef Animals.

427. At the Kansas agricultural college 10 steers, in two lots—five in each lot—were fed for 143 days. The grain feed for each steer in both lots was 19.4 pounds of corn and 0.4 pounds of cottonseed meal, daily. In addition to this grain, Lot 1 was fed daily, 12.9 pounds of alfalfa hay, and Lot 2, 10.8 pounds of alfalfa hay, 3.5 pounds of prairie hay, 2.5 pounds of sorghum stover and 1 pound of silage daily. What was the average daily gain of each steer in the two lots, those in Lot 1 having gained 406 pounds for the period, and those in Lot 2, 333 pounds?

428. How many pounds increase of live weight for each 100 pounds of grain consumed by Lot 1? By Lot 2?

429. At the same college some steers were fed in two lots; one a "balanced ration," the other ear corn. The lot fed the balanced ration made an average gain of 406 pounds each, for the period, having consumed 3,055 pounds of grain and 973 pounds of fodder each; the lot receiving ear corn made an average gain of 230 pounds each, having consumed 3,223 pounds of grain and 535 pounds of fodder each. How many pounds of grain were required to make 100 pounds gain for the balanced ration lot? For the ear corn lot?

430. What percentage more grain was necessary to make 100 pounds gain with the ear corn ration than with the balanced ration?

431. When fodder is worth $5.00 per ton, ear corn 40 cents per bushel and grain (composing the balanced ration) $16.00 per ton, what is the cost of producing 100 pounds of grain when the balanced ration is fed? When the ear corn ration is fed?

Gain in Weight at Different Ages.

432. Experiments show that a steer of good breeding will gain live weight as follows:

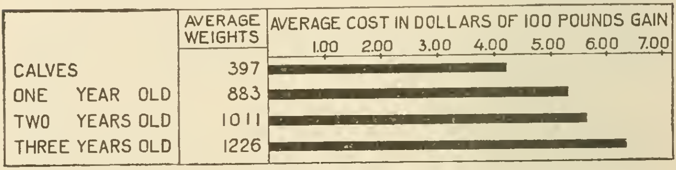
First period, birth to 297th day, 2.63 pounds daily
Second period, 297th to 612th day, 2.18 pounds daily
Third period, 612th to 943d day, 1.74 pounds daily
Fourth period, 943d to 1,283d day, 1.51 pounds daily

What is the total gain in weight of a steer when 1,283 days (3½ years) old? How much more than at birth should its weight be, at the end of the first period? Second? Third?

433. During the first period (1-297 days) the average cost of increase (all items of expense included) is \$4.03 per 100 pounds of gain; the second period (297-612), \$6.00 per 100 pounds of gain; third period (612-943), \$7.98 per 100 pounds of gain; the fourth period (943-1,283), \$12.54 per 100 pounds of gain. What is the total cost of support up to the end of the first period? Second period? Third period? Fourth period?

434. What is the value of such a steer at the end of the first period if he is sold at 5 cents per pound live weight?

Age of Steers with Reference to Cost of 100 Pounds Gain.



Cheapest Gains Are Made with Young Animals.

As animals advance in age the cost of food for maintenance and increase advances also. Compare the four classes of cattle as sketched above.

435. His value at the end of the second period if sold at 6½ cents per pound?

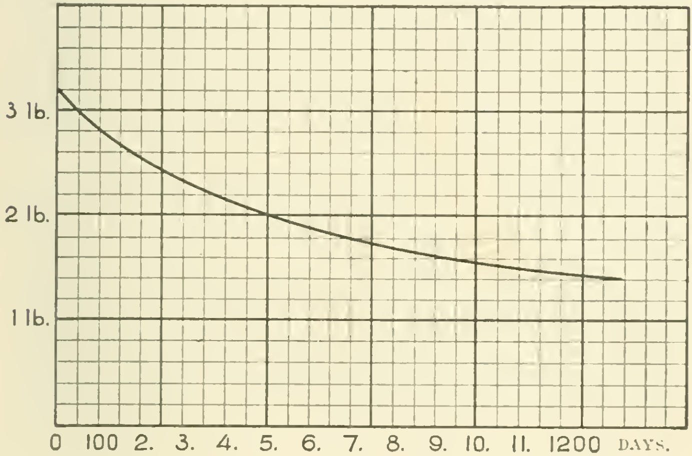
436. His value at the end of the third period if sold at 7 cents per pound?

437. His value at the end of the fourth period (3½ years old), if sold at 8 cents per pound?

438. What is the profit at end of first period? Of second? Of third? Of fourth?

439. At what age should such a steer be sold with market price at 8 cents per pound? At 6½ cents? At 5 cents? At 4 cents? At 3 cents?

The steer maintains a practically uniform rate of gain from birth until two years old. The cost of the gain in the second period is 50 per cent greater than in the first; in the third period twice that in the first; and in the fourth period three times that in the first. These thoroughly established facts should be taken into consideration by the stockman when deciding at what age to market his cattle. Beef cattle are most profitable when marketed between the ages of one year and two and a half years.

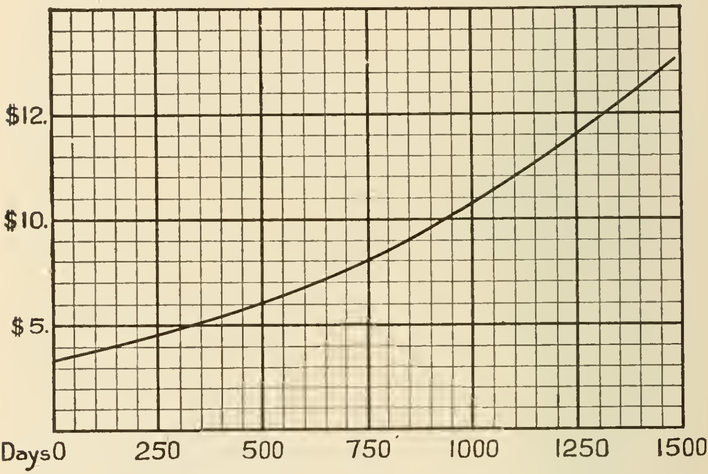


RELATION BETWEEN DAILY GAIN IN WEIGHT AND AGE IN DAYS.

Dairy type versus beef type. The Minnesota Experiment Station has definitely proven that the productive capacity of the cow depends more upon type and conformation than upon size or breed. By testing a large number of cows it was found that those of the beef type produced butter fat at a cost of 17½ cents a pound, while the spare cows having deep bodies produced butter fat at a cost of 12.1 cents a pound.

440. How much greater in cents and in per cent is the cost of producing one pound of butter from the beef type than from the dairy type, when the former produce butter fat at a cost of 17.5 cents per pound and the latter at a cost of 12.1 cents?

441. Suppose two dairymen produce each 4,000 pounds of butter fat annually. One has the beef type of cattle, the other the dairy type. What is the difference



Relation Between Cost Per 100 Pounds of Gain and Age in Days.

in profits when the cost of butter by the beef type is 17.5 cents and by the dairy type 12.1 cents a pound?

442. In the last problem assume the average net selling price of butter to be 25 cents and determine the profits of each dairyman.

Value of Succulent Food.

443. At the New Jersey station a silage ration was compared with a dry fodder ration for dairy cows. Those receiving silage produced 2,276.2 pounds of milk which contained 86.15 pounds of fat, while those fed dry fodder ration produced 2,017.9 pounds of milk which contained 78.02 pounds of fat. What was the per cent of increase of milk of the silage ration over the dry fodder ration? The per cent increase of butter fat of silage over dry fodder ration?

JERSEY COW SHOWING DAIRY TYPE.

444. When this increase is obtained for a herd of 25 cows that average 300 pounds of butter fat per year, what is the value of the increased product, butter being sold at 25 cents per pound?

445. At the Maine Experiment Station 4 cows were fed rations that included (1) hay, (2) hay and silage; the total yields of milk were as follows:

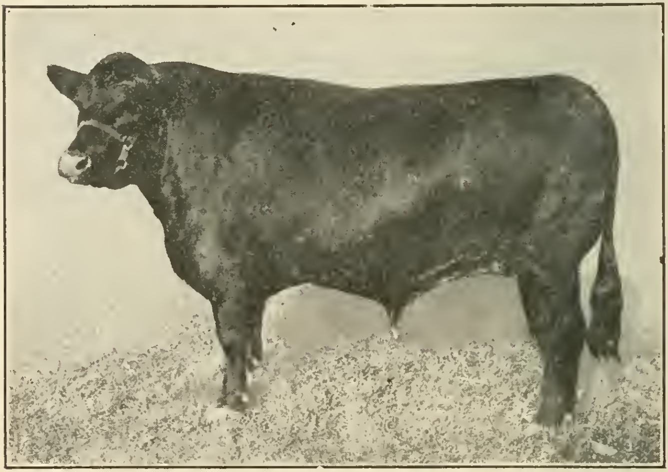
On hay,	1,212 pounds
On silage and hay,	1,294 pounds

What was the per cent increase of milk when the ration was changed from hay to hay and silage?

446. This experiment was continued at the same station, the cows being fed first the silage and hay ration and then changed to the hay ration. The total yields were as follows:

On silage and hay,	1,200 pounds
Changed to hay,	1,100 pounds

What is the per cent of decrease of milk when the ration was changed from silage and hay to hay?



ANGUS STEER SHOWING BEEF TYPE.

Cost of producing butter fat. A herd record that includes cost of feed for each cow and amount of milk and butter fat she produced, enables the owner to estimate the cost of production with exactness.

The results for some cows at the Cornell Station were as follows:

COST OF PRODUCING BUTTER FAT.

No. of cow	Cost of feed consumed during year	Milk produced	Fat produced
No. 1	$44.24	8,028	391.62
No. 2	47.65	9,739	309.19
No. 3	41.24	2,829	159.02
No. 4	52.06	11,165	417.97
No. 5	44.34	5,458	195.31
No. 6	49.08	10,754	439.37

447. At what cost per pound is butter produced by cow No. 1?

448. By cow No. 2?

449. By cow No. 3?

450. By cow No. 4?

451. By cow No. 5?

452. By cow No. 6?

453. When butter sells at 25 cents per pound, what is the profit or loss during the year from cow No. 1?

454. From cow No. 2?

455. From cow No. 3?

456. From cow No. 4?

457. From cow No. 5?

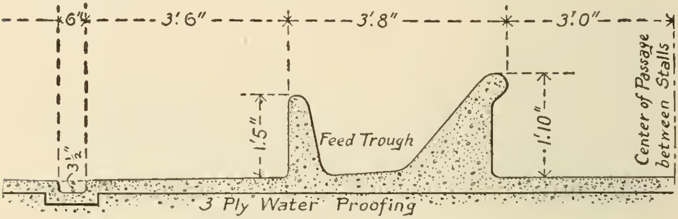
458. From cow No. 6?

Important truth. Some cows are very profitable to their owners; others are kept at a loss. A record must be kept, that unprofitable cows may be eliminated from the herd and their places filled by good ones.

Sheep. The sheep is the plant-scavenger of the farm.

Even when little care and attention are given, some profit is derived from this farm animal. It may be raised for wool or mutton, or for both.

459. Two farmers fed, for 100 days, 240 sheep each. Flock No. 1, because of care and shelter given it, made an average daily gain of 0.3 of a pound for the whole feeding period, while flock No. 2, made an average daily gain of only 0.18 pounds. How much was the total gain of each flock for the entire feeding period?



SECTION OF COW STABLE FLOOR.

460. When purchased the sheep in flock No. 1 had an average weight of 48 pounds each; those of flock No. 2, an average weight of 51 pounds. The cost of sheep in both flocks was 3.5 cents a pound; the selling price for flock No. 1 was 5.5 cents and for flock No. 2, 5 cents a pound. What sum was secured for flock No. 2?

461. The cost of producing the increase in flock No. 1 was $3.80 per hundred. What profit was realized on this flock?

462. The cost of producing the increase in flock No. 2 was $4.40 per hundred. What profit was realized on this flock?

463. How much greater was the profit derived from the flock to which care and attention were given than from the neglected flock?

464. Expressed in per cent, how much greater was the profit on flock No. 1 than on flock No. 2?

Swine. The hog excels all other animals in the cheap production of meat. When allowed to graze on pasture, and when properly fed and cared for otherwise, it will net its owner more profit in proportion to its cost than any other animal on the farm.

SUPPER TIME FOR THE PIGS.

Middlings and corn meal are mixed with water or milk and fed as a slop.

465. A hog, weighing 78 pounds, requires 400 pounds of grain for each 100 pounds gain, while a hog weighing 320 pounds requires 535 pounds of grain for each 100 pounds gain. Expressed in per cent, how much more grain in required for the 320-pound hog?

466. What is the cost of producing 100 pounds of gain when feeding 78-pound hogs with corn costing 42 cents per bushel?

467. When fed to 320-pound hogs?

468. How much profit on every hundred pounds of gain when feeding 42-cent corn to 78-pound hogs, the selling price of hogs being 6 cents per pound live weight.

469. In feeding 42-cent corn to 320-pound hogs?

470. How much profit is made on 100 pounds gain by feeding 56-cent corn to 78-pound hogs, the increase being worth 5½ cents per pound live weight?

471. In feeding 56-cent corn to 320-pound hogs what is the profit on 100 pounds gain?

472. Suppose corn is worth 56 cents per bushel and hogs 6 cents per pound live weight. What is the profit or loss in producing 100 pounds of increase by feeding the 78-pound hog?

473. By feeding the 320-pound hog?

474. The amount of grain required to add a total of 3,000 pounds to the weight of hogs of 320-pound weight would add what weight to hogs of the 78-pound class?

Important truth. Hogs return to their owner the greatest relative profit if sold at an age of from six to nine months. They then weigh between 150 and 200 pounds. Hogs weighing from 300 to 400 pounds are usually sold at a loss. Only when feed is cheap and prices high can heavy hogs be produced at a profit. Feeding beyond the point at which the cost of production equals the selling price always entails an actual loss.

Poultry. Poultry raising is not a specialized industry in the United States. Except in a comparatively few instances it is a side issue of the general farming activities. Nevertheless, it is one of the most important lines of American agriculture, contributing many millions of dollars to its wealth, and, next to the dairy, furnishing the most important and acceptable supply of food.

475. In the year 1909, there were 5,578,525 farms where chickens were raised. On each farm there was an average of 50.3 chickens. How many were there on farms that year in the United States? This is a gain of 20 per cent over 1899. How many in 1899?

TRIO OF LIGHT BRAHMAS.

No farm is complete without its flock of poultry for eggs and meat. In the aggregate the poultry crop adds hundreds of millions of dollars to the annual returns of farming.

476. There was an average in 1909 of about 5.7 dozen eggs laid by each chicken; what was the production of eggs?

477. The average value of chickens on each farm on which they were raised was $25.13 What was the value of each chicken? What was the total value of chickens that year on the farms?

478. In 1909 eggs averaged 19.3 cents per dozen. What was the value of the eggs produced?

479. If the value of chickens sold during the year is taken as $75,000,000, what was the value of the whole chicken crop, including those on farms, those sold, and eggs produced?

Gross earnings of some lines of business. When the gross earnings from poultry are compared with those of other lines of business the extent of the poultry business is more clearly indicated. This is seen below.

GROSS EARNINGS OF SEVERAL INDUSTRIES.

Line of business	Gross earnings
Poultry	$500,000,000.00
Banks	40,151,037.00
Gold	67,806,890.00
Silver	70,074,625.00
Street railways	247,553,999.00
Coal	276,147,056.00

480. About how many times greater were the gross earnings from poultry than from banks in 1909?

481. Than all of the gold mined?

482. Than all the silver mined?

483. Than all the gold and silver combined?

484. Than the gross earnings of the street railway?

485. Than gross earnings of all the coal mines?

CHAPTER IX.

HAND AND MACHINE LABOR.

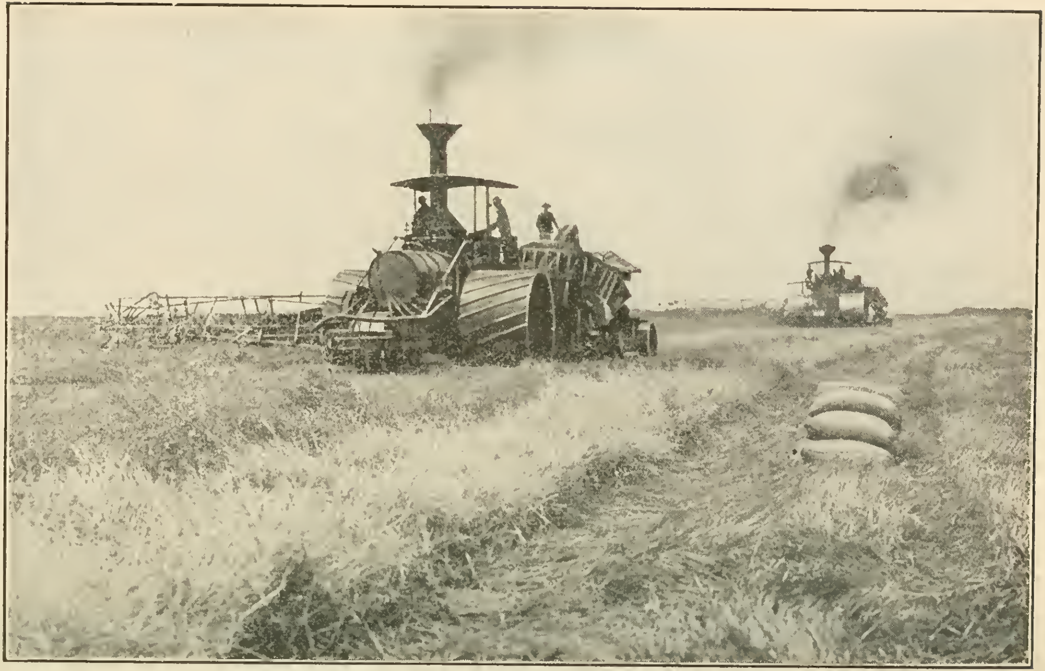
Fifty years ago there were but few farm implements and machines available. Much human labor was then required to produce a crop of any kind. Farmers cradled their wheat and bound it by hand, hauled the sheaves to the barn, and threshed the grain with flails. These operations required for each bushel of wheat harvested the labor of one man for an average time of 183 minutes. One man using the labor-saving machinery now found on the average farm can do the same work in ten minutes. With a combined reaper and thresher operated by steam but four minutes of human labor is required to harvest a bushel of wheat.

Reduction of Human Labor.

486. In 1855 the amount of human labor expended in growing an acre of corn was 183 hours. In 1906 the amount was $27\frac{1}{2}$ hours. The production of corn in both instances was 40 bushels per acre. How much human labor was required to produce one bushel of corn in 1855? In 1906?

487. What is the percentage of decrease in the amount of human labor required for the production of one bushel of corn?

488. In 1830 the amount of human labor expended on an acre of oats was 66 hours; in 1906 the amount was 7.1 hours. The production in both cases was 40 bushels per acre. What was the human labor requirement per bushel in 1830? In 1906?



GIANT HARVESTERS AT WORK.

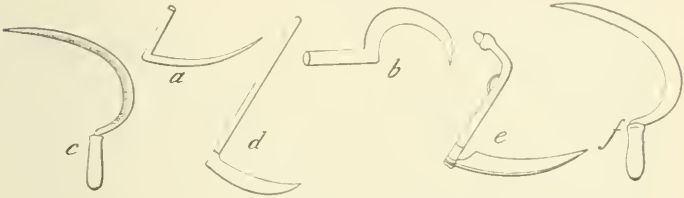
These machines cut the wheat, thresh the grain, and deliver the sacks as shown, at one operation. Contrast this with the davs of the sickle and the flail.

489. How many times as much human labor were required in 1830 as 1906?

490. In 1866, to produce an acre of potatoes, yielding 110 bushels, 55 hours of human labor were required; in 1906 the human labor requirement for producing an acre yielding 220 bushels was but 38 hours. What is the percentage of decrease from 1866 to 1906?

491. What was the human labor requirement per bushel in 1866? In 1906?

492. In 1860 the amount of human labor expended on



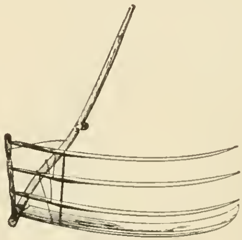
VARIOUS TYPES OF SICKLES.

an acre of cotton was 115.9 hours; in 1911 it was 111.9. The production in both cases was 350 pounds of lint cotton an acre. How many minutes of human labor were required to produce one pound of lint cotton in 1860? In 1906?

493. In 1855 the amount of human labor expended on an acre of sugar cane was 351.3 hours; in 1906 it was 161.5 hours. The production in both cases was 20 tons an acre. What was the human labor requirement per ton in 1855? In 1906?

494. In 1855 the cost of human labor was $14.30 and of animal labor $2.03 for the production of an acre of corn. In 1906 the cost of human labor was $4.23 and animal labor $2.39. The production in both cases was 40 bushels an acre. What was the total cost of labor per bushel in 1855? In 1906?

495. In 1830 the cost of human labor was $3.55 and animal labor $0.28 for the production of an acre of wheat; in 1906 the cost of human labor was 66 cents and animal labor $1.36. The production in both instances was 20 bushels an acre. What was the cost of labor per bushel in 1830? In 1906?



AMERICAN CRADLE.

The tool used for reaping until after the middle of the nineteenth century.

496. In 1830 the cost per acre of oats was for human labor $3.73 and for animal labor $0.12. In 1906, the cost an acre was, human labor $1.07, animal labor $0.53. The production in both instances was 40 bushels an acre. What was the cost of labor per bushel in 1830? In 1906?

497. In 1866, the cost per acre of potatoes, yielding 110 bushels, was for human labor $5.45 and for animal labor $1.15; in 1906 the cost per acre yielding 220 bushels was, for human labor $3.80, and for animal labor $2.17. What was the cost of labor per bushel in 1866? In 1906?

498. In 1855 the cost per acre of cotton was, for human labor $8.79, and for animal labor $1.95; in 1906 the cost per acre was, for human labor $6.61, and for animal labor $1.34. The production in both instances was 350 pounds of lint cotton per acre. What was the cost of labor per pound of lint cotton in 1855? In 1906?

499. In 1855 the cost per acre of sugar cane was, for human labor $37.94, and for animal labor $2.38; in 1906 the cost per acre was, for human labor $11.32, and for animal labor $5.05. The production in both cases was 10 tons per acre. What was the cost of labor per ton in 1855? In 1906?

THRESHING THE WHEAT.
A familiar scene on all grain farms.

Cost and labor requirement of some crops. The table below may be used for further comparisons to show the decrease in the cost of producing crops and in the human effort required, during the last 40 or 50 years.

Crop	Year	Requirement of human labor		Cost of labor		Yield per acre
		Hours	Minutes	Human	Animal	
Rye	1845 1906	66 25	3.8 10.0	$3.30 2.65	$1.43 1.32	25 bushels
Sweet potatoes..	1855 1906	317 122	20.0 9.0	28.23 7.53	6.07 2.76	105 bushels
Tomatoes.......	1870 1906	324 134	20.0 52.5	29.98 12.33	6.23 3.42	150 bushels
Strawberries.....	1872 1906	1,732 675	20.0 21.2	226.64 93.43	4.63 4.48	4,000 quarts
Beets...........	1850 1906	441 202	0.0 35.0	30.45 18.38	1.85 1.63	300 bushels

500. Find differences in human labor requirement and cost per unit of each of the above crops for the years stated.

CHAPTER X.

FARM MECHANICS.

Work. The word *work* is used in various senses. It will here be used in its scientific sense—that of moving against resistance. The mere push or pull of a force is not work; the point of application of the force must move before work can be said to be done. A *foot-pound of work* is done when a force of one pound moves its point of application through a distance of one foot in the direction of the force.

501. How much work is done by a force of 20 pounds when its point of application moves 30 feet in the direction of the force?

Process: 20 × 30 = 600..................Foot-pounds of work.

502. How much work is done when a 160-pound man climbs to the top of a 40-foot windmill?

503. How much work is done when a 120-pound boy walks up one flight of stairs to a second floor which is 10 feet above the first? Ans. 1,200 foot-pounds.

504. How much work does a 1,200-pound horse do in walking up a hill 100 feet high?

505. The draft of (the force required to pull) a certain hand cart is 15 pounds. How much work does a boy do in pushing it a mile?

Process: 5,280 × 15 = 79,200..................Foot-pounds.

506. How much work is done by a team in plowing a furrow 40 rods long when the draft of the plow is 600 pounds?

507. How much work would be done in plowing a headland 60 rods long and 6 rods wide, with a furrow 12 inches wide and draft 500 pounds? Draft 300 pounds?

508. A horse does 396,000 foot pounds of work in drawing a certain wagon one-half mile; what is the draft?

TRACK CONTRIVANCE FOR FEEDING CATTLE.

The grain is prepared and mixed in the barn and later delivered by means of track and cars to the feeding pens. In this way much labor is saved.

509. Two horses draw a load whose draft is 300 pounds, at the rate of three miles per hour. What horsepower is each exerting? A horsepower is 33,000 foot-pounds per minute.

Process:

$3 \times 5{,}280 = 15{,}840$ .... Feet per hour.
$15{,}840 \div 60 = 264$ .... Feet per minute.
$264 \times 300 = 79{,}200$ .... Foot pounds per minute.
$79{,}200 \div 33{,}000 = 2.4$ .... Horsepower.
$2.4 \div 2 = 1.2$ .... Horsepower each.

Note.—Working at this rate, this team should not be required to work full time.

510. At what rate should a horse walk when the draft

is 150 pounds to develop 1 horsepower? Two-thirds of 1 horsepower?

511. What power is necessary, assuming no loss, to raise grain in an elevator to a height of 40 feet at the rate of one-half ton a minute? Five thousand bushels an hour?

512. A farmer desires to fill a water tank 60 feet high. What horsepower engine will be necessary if the water is raised at the rate of 210 gallons a minute? (One gallon of water weighs 8½ pounds.)

RELATIVE COST OF POWER WHEN SUPPLIED BY HORSE AND BY MAN.

513. In the above problem what power will be required if 50 per cent is lost in friction?

To keep a weight of one ton moving vertically upward at a given speed requires 2,000 pounds of force.

To keep a ton moving horizontally at a given speed on an absolutely smooth or frictionless horizontal surface requires no force at all.

To keep a ton moving horizontally on a rough horizontal surface at a given speed, requires just enough force to overcome friction.

To move a ton up a sloping surface requires more force and down a sloping surface less force than along a horizontal surface. By the use of wheels, lubricants, and improved roadbeds, friction may be greatly reduced. On the best level macadam road the total force of friction or traction per ton may be as low as 30 to 50 pounds. The average draft on hard level earth road with an ordinary wagon, carrying a load of one ton, is about 150 pounds. Thus a horse weighing 1,800 pounds may readily pull a wagon and load of one ton horizontally, since this would require a pull of not more than 150 pounds. He can keep this up indefinitely, working ten hours per day and walking at the rate of 2.5 miles an hour. A 1,200-pound horse should be required to do only about two-thirds of this amount of work per day.

514. How much power is a horse developing when walking 2.5 miles an hour, and exerting a steady pull on his traces of 150 pounds?

Process:

$$\frac{150 \times 5{,}280 \times 2.5}{33{,}000 \times 60} = 1 \text{ .... Horsepower.}$$

515. How many horsepower is a horse developing when walking 2.5 miles an hour with a steady pull on his traces of 100 pounds?

516. How many horsepower is a horse developing when walking four miles an hour and pulling 75 pounds? 90 pounds? 165 pounds?

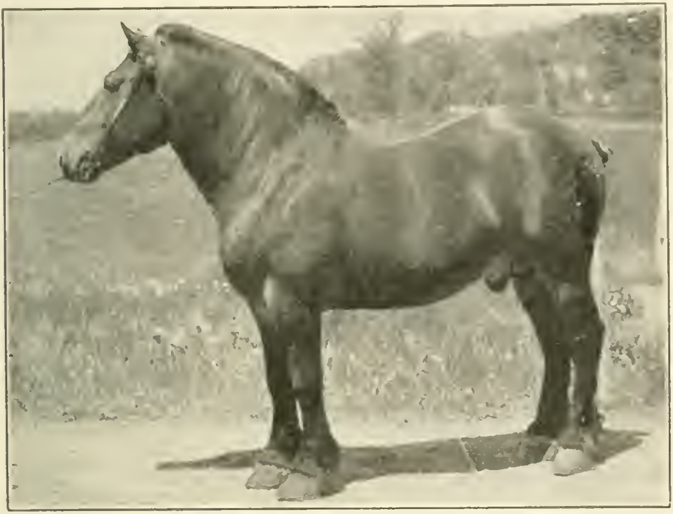
517. A horse is walking 2.5 miles an hour and pulling 100 pounds on his traces. How fast should he walk to develop the same power if his load is increased to a pull of 150 pounds?

518. A certain horse can readily draw 100 pounds when walking 2.5 miles an hour. How rapidly may he travel if he has a pull of but 25 pounds? 50 pounds? 75 pounds? 200 pounds?

519. How rapidly with a pull of 150 pounds, if he is permitted to rest one-half of the time? With a pull of 200 pounds?

Weight of Horse Influences Pulling Power.

Carefully made tests indicate that a horse may safely exert, when walking 2.5 miles an hour and working 10 hours a day, a traction equal to about one-twelfth to one-tenth its weight.



BELGIAN STALLION, SHOWING DRAFT TYPE.

520. How many horsepower is a horse weighing 1,200 pounds capable of developing when walking 2.5 miles an hour and working 10 hours a day? A 1,600-pound horse?

Process:

1/10 of 1,200 = 120..........Pounds the horse is able to pull.

$$\frac{120 \times 5{,}280 \times 2.5}{1{,}980{,}000} = 0.8$$ ....Horsepower.

521. A 1,100-pound horse? 1,000-pound horse? 800-pound horse?

522. A horse weighing 1,600 pounds is worked with another weighing 1,200 pounds. This team walks at a rate of 2.5 miles an hour. What should be the pulling power of the team, working 10 hours each day?

523. The doubletree is adjusted so that each horse shall pull one-half of the weight. This, of course, requires the lighter horse to do more work and the heavier less work than their weights warrant. Measured in horsepower what is the excess for the lighter horse? How much less for the heavier horse than his just share?

524. The doubletree is 4 2-3 feet long. At what point should it be attached to the load so that each horse may pull its just share when the difference in their weights is considered?

Process:

1,600-pound horse = 160 pounds pull.
1,200-pound horse = 120 pounds pull.

Total, 280

$160 \div 280 = .57$ .... Part of load 1,600-pound horse pulls.
$120 \div 280 = .43$ .... Part of load 1,200-pound horse pulls.
4 2/3 feet = 56 inches, length of doubletree.
$.57 \times 56 = 32$ .... Inches
$.43 \times 56 = 24$ .... Inches

Total 56 .... Inches
Check, $160 \times 24 = 120 \times 32$.

The heavier horse should, of course, be hitched to the shorter arm of the doubletree and the lighter horse to the longer arm. When so hitched the amounts of work they will do will be proportionate to their weights.

525. On account of a difference in weight, the owner of a two-horse team desires to give the lighter less work than the heavier. He adjusts a 4-foot doubletree so that one horse shall pull 60 per cent and the other 40 per cent of the load. What is the length of each arm? Ans. 19 and 29 inches.

526. A farmer adjusts a 45-inch doubletree so that a colt which he is breaking may pull but one-half as much as the older horse. What is the length of the colt's end of the doubletree?

Effect of Speed on Pulling.

The standard quantities are:

1. Rate, 2.5 miles an hour.
2. Size of horse, 1,200 pounds.
3. Pull, 120 pounds.
4. Days work, 10 hours.
5. Rate of work, 4-5 of a horsepower.

If speed is increased a horse is able to pull less during 10 hours; if diminished he is able to pull more. Experience indicates that speed between three-fourths of a mile and four miles an hour, when continued for 10 hours, may be estimated by the following relation:

Standard speed × standard pull = changed speed × changed pull.

527. A 1,200-pound horse works for 10 hours, walking at the rate of two miles an hour. How many pounds pull may be expected of him?

Process:

$2.5 \times 120 = 2 \times$ pull to be determined.

$300 \div 2 = 150$..............Pounds pulling force.

528. A 1,200-pound horse walks three miles an hour for 10 hours. What pull may he exert?

529. A 1,600-pound horse walks four miles an hour for 10 hours. What pull may he exert?

530. A 1,600-pound horse walks two miles an hour for 10 hours. What pull may be expected?

531. A 1,500-pound horse is exerting a pull of 200 pounds while working 10 hours a day. How fast should he walk? How fast if pull is 150 pounds? If 100 pounds?

532. Two horses, one weighing 1,600 pounds and the other 1,000 pounds, are walking at a rate of three miles an hour. What pull are they exerting, provided that they are doing a full day's work (10 hours) and that the doubletree is properly adjusted?

533. At what rate should these horses walk if the pull is increased to a total of 520 pounds?

Effect of Duration of Work on Pulling Power.

The standard day's work is 10 hours. If, however, the working hours be decreased more may be required of the horse either in speed, or load, or both. Experiments indicate that between five and 10 hours, speed remaining the same, the pull may be increased in the same ratio as the hours are decreased. This may be shown as follows:

Standard hours a day × standard pull = changed hours a day × changed pull.

534. A 1,200-pound horse walking 2.5 miles an hour works for five hours. How many pounds pull may be expected of him?

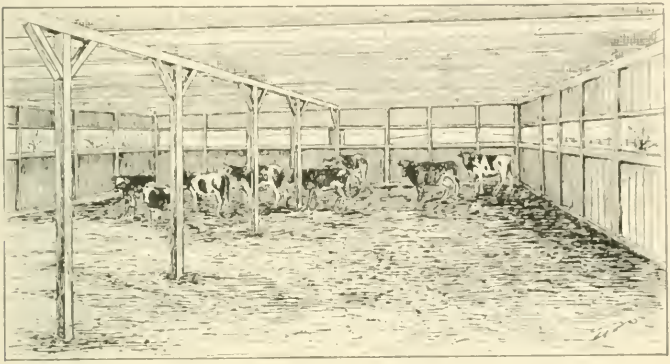
Process:

$10 \times 120 = 5 \times$ pull to be determined.
$1{,}200 \div 5 = 240$..................Pounds pulling force.

535. If this horse exerts a pull of 180 pounds, how many hours should he work? 200 pounds? 120 pounds?

536. A 1,200-pound horse walking 2.5 miles an hour works six hours. How many pounds pull may be expected of him?

537. An 800-pound horse, walking 2.5 miles per hour, works nine hours. How many pounds pull may be expected of him?



COVERED BARNYARD OF SMALL COST.

Cattle are protected and the manure is preserved.

538. A 1,000-pound horse working 10 hours each day walks at the rate of 2.5 miles an hour. What pull may be expected?

539. A 1,000-pound horse, working five hours each day, is walking at the rate of 2.5 miles an hour. What pull may be expected?

540. A 1,200-pound horse working 10 hours each day, walks one mile an hour. What pull may be expected?

541. Another 1,200-pound horse working but five hours each day, walks four miles an hour. What pull may be expected?

542. A 1,600-pound horse, working five hours each day, walks at the rate of four miles an hour. What pull may be expected?

543. An 800-pound horse working 10 hours each day walks at the rate of one mile an hour. What pull may be expected?

Draft of Farm Implements.

Draft is the amount of force required to move a thing. The subject of draft should be given the fullest consideration in the purchase and use of farm tools and implements. Draft is always at the expense of energy, either motor, horse, or human, and should in general be reduced to the minimum.

This may be accomplished only by using implements of the best design and construction, properly cared for, sharpened, lubricated, and adjusted. An immense amount of labor may be saved and much time gained in this way.

Draft of Plows.

The draft of a plow is the force required to pull it. This force varies with the character and condition of the soil and the type and condition of the plow. Many tests have been made with different plows in different soils, and under different conditions. The following problems are constructed from some of these tests:

544. What is the draft per square inch of a plow throwing a furrow 9 inches wide and 5 inches deep of blue clay, the total draft of which is 661 pounds?

Process:

$9 \times 5 = 45$..................Number of square inches in cross-section of furrow.

$661 \div 45 = 14.7$..................Draft per square inch.

545. What is the draft per square inch for a plow throwing a furrow 9 inches by 5 inches of clay loam, the total draft being 227 pounds?

546. At the New Hampshire Agricultural College an old-fashioned type of walking plow was used for plowing a rich loam soil. The furrow slice was 13 inches wide, by 8 inches deep. The total draft was 673.3 pounds. What was the draft of each square inch of furrow?

547. How much power is required when such a plow is used, horses walking 1 2-3 miles an hour?

548. When three horses are used for pulling this plow, what may be their weight, provided they walk at rate of 1 2-3 mile an hour and work for 10 hours each day?

549. At the same college a modern type of walking plow was used at the same time for plowing this land. The furrow slice was also 13 inches wide and 8 inches deep, draft being 400 pounds. What was the draft per square inch of furrow when this plow was used?

550. Using this modern plow and the three horses found in problem 548, at what rate should they walk if working 10 hours each day?

551. What per cent of time is saved by the modern plow over the older type when the same horsepower is used in both cases? How much time in a job requiring 120 hours with the older plow?

552. How many horsepower are required when this modern plow is used, the horses walking 2.5 miles an hour?

553. How many 1,600-pound horses are necessary for this plow, when they are made to walk at a rate of 2.5 miles an hour and work for 10 hours each day?

554. How many such horses as the three found in problem 548 should be used with this plow when they walk at the rate of 1 2-3 miles an hour and work for 10 hours each day?

Important truth. These problems illustrate the value of modern and improved farm implements and tools.

This experiment shows that less work is required to accomplish a given result, with modern tools than with the older tools. That is, to do a given piece of work in a given time, requires less horsepower, and to do a given piece of work with a given horsepower requires less time.

Plowing Sod Land With and Without Wheel Coulter.

The table below shows the draft of a sod plow when used with and without the wheel coulter.

WITH AND WITHOUT THE COULTER.

Method of plowing	Size of furrow	Total draft
Sod plow with wheel coulter....	5.5 inches by 15 inches	296.0
Sod plow without coulter	5.5 inches by 15 inches	348.0

555. What is the draft per square inch when the coulter is used?

556. What is the draft per square inch when the coulter is not used?

557. When a plow with the coulter is used, two 1,500-pound horses walking at the rate of 2.5 miles an hour and working 10 hours daily are able to do the work. When the same plow is used without the coulter what weight is necessary for the team, walking at the same rate, and working the same number of hours daily?

558. A stubble plow is used with and without the coulter. The total draft with the coulter was 300 pounds; without it 410 pounds. A two-horse team walking at the rate of 2.5 miles an hour for 10 hours daily pulled the plow with ease when the coulter was used. But a third horse was necessary without it. What was the minimum allowable weight of the third horse?

Draft of furrows. The following tests were made where the soil was a clay loam and shortly before had been sod.

DRAFT OF DISK HARROW.

Grade	How set	Draft
1-8	At full angle up grade, man riding	676
1-8	At full angle, up grade, no load	555
1-8	At full angle, down grade, man riding	555
1-8	At ordinary angle, down grade, man riding	398
1-8	At ordinary angle, down grade, no load	386
None	At straight angle, level, man riding	314
None	At straight angle, level, no load	266

559. How many pounds draft are added to the pull of a disk harrow up grade when the driver rides? What is the percentage of increase?

560. What is the difference in draft of the disk harrow, set at full angle, when operated up and down hill? What is the percentage greater when operated up grade?

561. How many per cent greater is the draft of a disk harrow operated down grade when the driver rides than when he walks?

562. When operated on level ground?

Important truth. It should be remembered that when the driver rides on the disk harrow, more useful work is done, since more soil is moved. Thus while draft is increased, the work is not necessarily uneconomically done.

Oral Problems on Draft of Disk Harrows.

563. When the disk harrow is set at full angle about how many horses are necessary? About what weight should they be? Should they be worked continuously and at rapid gait? About how fast should they walk?

564. When set at angle as ordinarily used, how many horses may be used? Their weight? How rapid gait?

565. How does the draft of the disk harrow compare with the draft of the plow?

Spring-Tooth Harrow.

566. When the spring-tooth harrow is set so as to cut 4 inches deep the total draft is 451.3 pounds. How many 1,200-pound horses are needed when they are expected to work steadily all day and walk two miles each hour?

Corn Binder.

The following shows the draft of the corn binder.

Implement	Trial condition	Draft
Corn binder	Heavy corn, clay lands, soil dry and mellow Light corn, clay lands, soil dry and mellow	568.0 302.0

567. How many pounds more of draft are required by heavy corn than by light?

568. What is the percentage of difference?

569. How many 1,600-pound horses walking four miles an hour, should be used in cutting heavy corn, if the binder is used only five hours daily?

570. How many horses, and of what weight, will pull this binder in light corn, walking slightly more than 2.5 miles each hour for 10 hours daily?

Farm Wagons.

The draft required for a 2,000-pound net load and wagon, has been estimated for high and low wheels with 6-inch tires, from the trials made at Missouri Experiment Station, as follows:

DRAFT OF WAGON ON DIFFERENT KINDS OF ROADS.

Hauled over	Condition	Kind of wheels	Draft total	Draft per ton
Earth road loam..	Dry and hard	High, 44 and 56 inch Low, 24 and 28 inch	130 182	69 108
Gravel road.......	Dry, 1 inch sand	High Low	159 185	85 110
Earth road loam..	Thawing, ½ inch mud	High Low	189 234	
Sod land..........	Wet and spongy	High Low	325 473	
Plowed ground....	Freshly plowed	High Low	475 628	

571. Given that the high and low-wheeled wagons weighed 1,760 and 1,350 pounds, respectively, check the figures in the last column and complete the column.

572. Find per cent of increase in total draft on the gravel road if high wheels be changed to low.

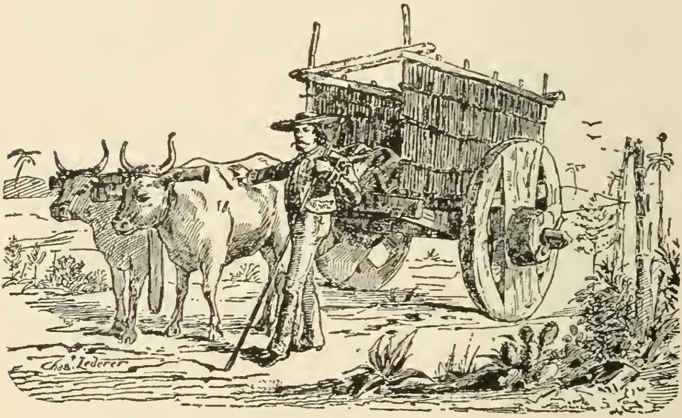
573. When used on the thawing dirt road?

574. When used on the dry dirt road in good condition?

575. When used on sod land that is wet and spongy?

576. When used on freshly plowed land?

577. How much more draft is required for hauling one ton net over freshly plowed ground than over wet,



BEFORE THE COMING OF MODERN WAGONS.

spongy land when high wheels are used? Percentage difference?

578. Assuming the draft per ton to be the same when the loads are greater than those used in the experiment, find draft for net load of two tons on high and low-wheeled wagons on dry earth road. On wet sod.

579. How much more draft is required for hauling a load weighing one ton over dry gravel road than over dry dirt road? Percentage difference?

580. At what average rate should two 1,500-pound horses walk with two tons of hay on an 1,800-pound high wheel wagon in wet sod? Low-wheel wagon?

The width of tire. On good roads wide tires give less draft than narrow tires. They are also better for the road. Experiments conducted by the Missouri Experiment Station resulted as follows:

DRAFT IN POUNDS PER TON OF TOTAL WEIGHT.

Kind of surface	Condition	Width of tire and draft	
		1½ in.	6 in.
Broken stone	Hard, smooth	121	98
Gravel	Hard, smooth	182	134
Gravel	Wet, very sandy	246	254
Earth road loam	Dry, hard	149	109
Earth road loam	Stiff mud	497	307
Plowed ground	Compact, smooth	466	323

581. What per cent of power is saved by the use of a 6-inch tire rather than a 1½-inch tire on a hard, smooth road of broken stone?

582. What per cent of the power is wasted when a 1½-inch tire is used on a hard, smooth gravel road?

583. What is the draft of an 1,800-pound wagon with 6-inch tires, carrying a load of two tons over plowed ground? What draft with 1½-inch tires?

584. At what rate should two 1,200-pound horses working full time pull a 1,500-pound wagon loaded with three-fourths ton, and having 6-inch tires, when the road is a stiff loam mud? With 1½-inch tires?

585. Greasing the Axle. Experiments made at the

Michigan Agricultural College show that when the axles of a wagon were greased the draft was 188 pounds per ton; when ungreased the draft was 230 pounds. What is the percentage of difference?

586. When a 230-pound pull is required to haul one ton, the axles being ungreased, how many tons may be hauled with the same expenditure of power when the axles are greased?

The position of the load. The position of the load with reference to the four wheels of a wagon may influence the draft, as the following table shows.

DRAFT WITH LOADS DIFFERENTLY PLACED.

Where load was put	Pasture field	Dry meadow
Equally on four wheels..................	109	194
Heaviest on one side....................	121	208
Heaviest on front wheels................	130	235
Heaviest on hind wheels.................	102	186

587. Where should the load be placed to secure the least draft? The greatest?

588. How much less draft when load is on hind wheels than when on front wheels in pasture field? In a dry meadow? What per cent less?

589. What per cent less when load is on hind wheels than on one side in pasture field? In dry meadow?

590. What per cent less when load is on the hind wheels than when distributed equally on four wheels in pasture field? In dry meadow?

591. If 2,000 pounds may be hauled with an expenditure of 130 pounds of draft when the load is placed on

front wheels, how many pounds may be hauled with the same draft when the load is placed on hind wheels?

592. If 2,000 pounds may be hauled with an expenditure of 109 pounds of draft when load is distributed equally on the four wheels, how many pounds may be hauled with the same draft when the load is placed on the hind wheels?

DRAFT OF SOME OTHER FARM IMPLEMENTS.

Implements	Condition	Draft
Subsoil..............	10 inches deep	504
Mowing machine........	5 foot cut	246
Sod plow with coulter...	Soil dry and hard and furrow 10 inches by 6 inches	516
Sod plow with coulter...	Soil in best condition and furrow 10 inches by 6 inches	212
Sod plow without coulter	Soil hard and dry and furrow 10 inches by 6 inches	648
Sod plow without coulter	Soil in best condition	267
Farm cart...............	Level road, slightly muddy, load 1,000 pounds	352

Oral Problems.

593. How many horses would be used in each instance as suggested by draft? Consider weight of horse, and rate he should walk per hour when working 10 hours per day? Make estimate only in round numbers and approximately.

The effect of grades. A grade may be ascending or descending. If ascending the draft is increased; if descending, it is decreased. The amount of increase or decrease does not depend upon the amount of draft on the level, but only upon the total weight of the load and the slope of the grade. The slope of a grade is the ratio of the rise to the horizontal distance. A rise of 2 feet in 40 feet gives a slope of one-twentieth or a grade of 1 to 20.

594. What is the grade or slope of a hill having a rise of 3 feet in 90 feet? Six inches in 8 feet?

FATTENING STEERS.

595. How much rise in going ¼ mile up a slope of 2 to 50? How much fall in going down such a slope a distance of 300 feet?

A grade is frequently expressed as a per cent instead of as a ratio. The per cent of a grade is the per cent of the rise as compared with the horizontal distance. A rise of 2 feet in 50 feet, *i. e.*, of 4 feet in a hundred feet, is called a 4 per cent grade; 7½ feet in a hundred would be a 7½ per cent grade. A grade may also be expressed in degrees—*i. e.*, the angle it makes with the horizontal.

596. What per cent is a grade having a rise of 2½ feet in 80 feet? Of 53 feet in a mile? Two inches in 2 feet?

597. In a 3 per cent grade what is the rise in 800 feet? What distance down the grade would give a fall of 15 feet?

For grades less than 20 per cent a very good approximate rule for calculating the draft is the following:

The draft up a grade whose per cent is known is equal to the draft on the level, increased by a quantity which is equal to the grade per cent of the total weight of the load. The draft down a grade is equal to the draft on the level decreased by this quantity.

598. The draft of a total load of 3,000 pounds on a certain level road is 200 pounds. What is the draft on a 4 per cent grade on the same road?

Process:

$3{,}000 \times .04 = 120$

$200 + 120 = 320$..................Pounds draft up grade.

$200 - 120 = 80$..................Pounds draft down grade.

599. In the above problem suppose the grade to be 10 per cent, find the draft up grade. What would be the draft in going down this grade?

600. A total load of 4,500 pounds has a draft on a certain level road of 100 pounds per ton. What is the draft up a 3 per cent grade? Down a 5 per cent grade? Up a 12 per cent grade? Down a 12 per cent grade?

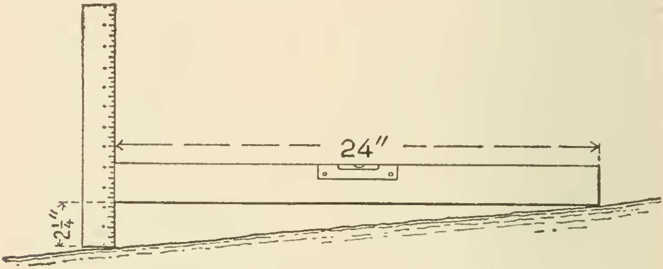
601. If a 2,500-pound load is found to have 150 pounds draft on a certain level road, what is the per cent grade down which the draft will be zero? What will be the draft up this grade?

602. At what rate may a team of 1,500-pound horses draw a load, including the wagon, of two tons on a level road when the total draft is 160 pounds per ton? At what rate up a 5 per cent grade? Down a 5 per cent grade? Down a 10 per cent grade?

603. If in the preceding problem the team is required to walk at the rate of 2½ miles an hour up a 5 per cent grade, what portion of the time should it be allowed to rest?

Measuring a Grade.

The slope of a grade may be easily determined by means of a level and a rule. A board resting along the grade will facilitate the measurement. The level should



How to Measure Grade with Level and Rule.

be placed in horizontal position, with one end resting on the board or ground and the other pointing in the direction of the slope. With the rule measure the vertical distance between the lower edge of other end of the level and the board or ground. The ratio of this distance to the length of the level is the slope of the grade. If the slope be multiplied by 100 the per cent of the grade is obtained.

604. In the above figure the level is 24 inches long and the vertical distance is 2¼ inches. What is the per cent grade? Slope?

605. Determine approximately some of the grades on the roads in your vicinity. What is the steepest grade over which you must haul in going to market?

CHAPTER XI.

FARM BUILDINGS.

The total value of permanent buildings on farms in 1910 was over $16,000,000,000. Of this amount over $3,500,000,000 were invested in farm buildings. When a farmer wishes to build a house or a barn, he plans it according to his wishes and needs, and engages a carpenter, who prepares a bill of materials and an estimate of the cost of the building.

Bills of materials. An itemized statement of the lumber and other supplies necessary for a building is called a *bill of materials.* Lumber is sold at so much "per M," meaning per 1,000 feet board measure. One foot board measure (B. M.) is a piece of lumber having an area of one square foot on one surface, and a thickness of not more than 1 inch. The sign "x" means "by"; the sign " ′ " means "feet," and the sign " ″ " means "inches."

606. How many feet B. M. in 9 boards 8′ x 2′ and 1″ thick?

607. In a ⅞-inch board 6′ x 10″ ? 6′ x 8″? 6′ x 16″? 10′ x 18″?

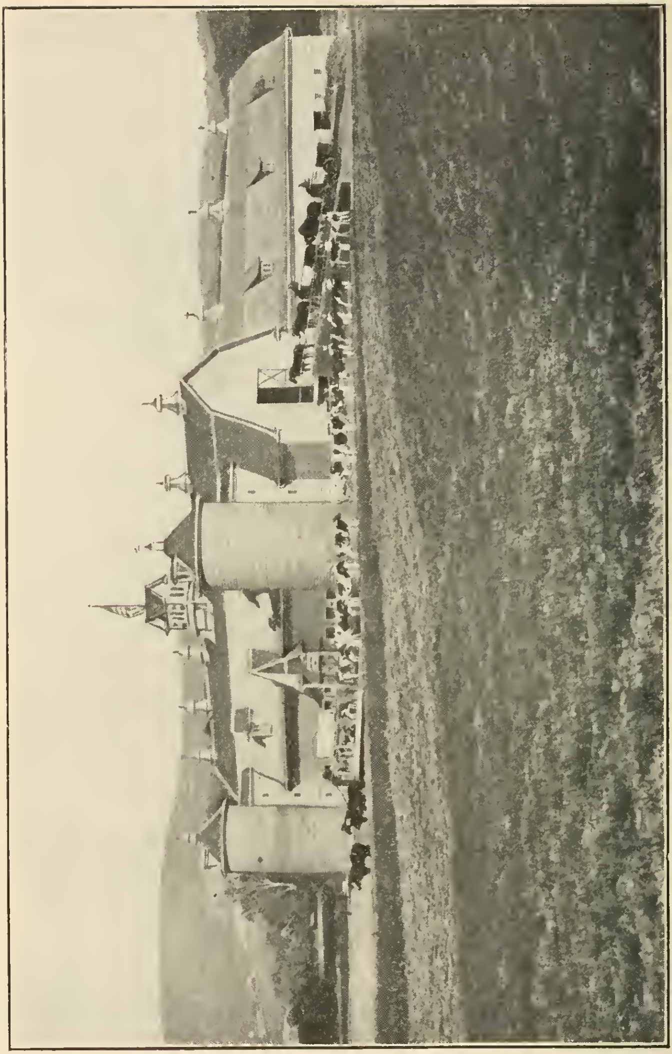
608. In a board or plank 24′ x 18″ x 3½″?

Process:

18 inches = 1½ feet; 3½ inches must be taken as 4 inches.
$24 \times 1\frac{1}{2} \times 4 = 144$. Ans. 144 feet B. M.

609. 8′ x 12″ x 4″? 16′ x 8″ x 2″? 24′ x 6″ x 4½″?

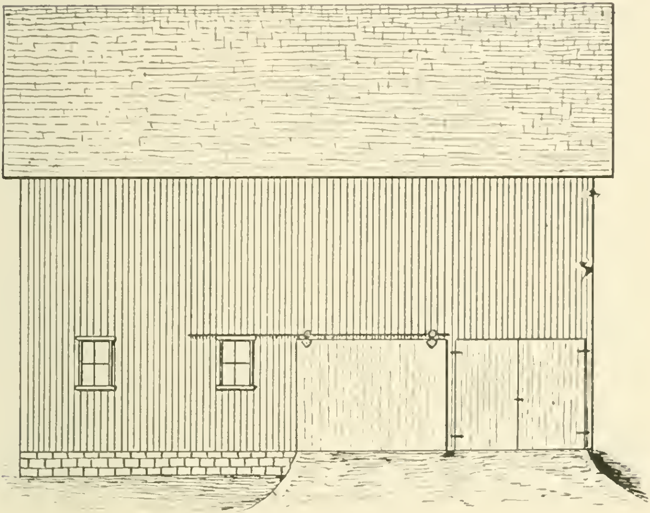
610. 8′ x 8″ x 8″? 16″ x 8″ x 10″? 20′ x 6½″ x 8½″?



Dairy Barn Up to Date and Fully Equipped.

611. Find the number of feet B. M. in each of the following items:

12 pieces, 2 in. x 6 in. x 18 ft.
8 pieces, 2 in. x 6 in. x 16 ft.
54 pieces, 2 in. x 6 in. x 14 ft.
44 pieces, 2 in. x 6 in. x 12 ft.
90 pieces, 2 in. x 6 in. x 10 ft.
4 pieces, 4 in. x 6 in. x 20 ft.
32 pieces, 2 in. x 4 in. x 10 ft.
30 pieces, 2 in. x 4 in. x 8 ft.



SMALL BARN, 36 BY 40 FEET.

Width three spans, 12 feet plus 12 feet plus 12 feet equals 36 feet. Length four spans, 10 feet plus 10 feet plus 10 feet plus 10 feet equals 40 feet. Height, 20 feet. Gables, 12 feet. Loft, 20 feet. Gable roof, one-third pitch. Vertical siding, shingle roof.

612. What is the total number of feet (B. M.) in this bill of materials?

613. At $45 per M, how much did this lumber cost?

614. How many feet (B. M.) in the following bill of rough timber?

300 lineal feet bridging, 1 in. x 2 in.,
1,440 square feet loft boards, and
2,000 square feet roof boards.

615. At $28 per M, how much did this lumber cost?

Building a Barn.

For the barn shown in the cut on page 173 the following bill of materials is required:

Heavy timbers:

27	pieces	2 in. x	10 in. x	12 ft.
3	pieces	2 in. x	10 in. x	18 ft.
6	pieces	2 in. x	10 in. x	6 ft.
6	pieces	2 in. x	8 in. x	23 ft.
46	pieces	2 in. x	8 in. x	20 ft.
8	pieces	2 in. x	8 in. x	18 ft.
6	pieces	2 in. x	8 in. x	16 ft.
22	pieces	2 in. x	8 in. x	12 ft.
170	pieces	2 in. x	8 in. x	10 ft.
30	pieces	2 in. x	8 in. x	8 ft.
16	pieces	2 in. x	6 in. x	22 ft.

Siding and facing:

3,600 square feet of siding.
186 square feet facing, ⅞ x 5 inches.

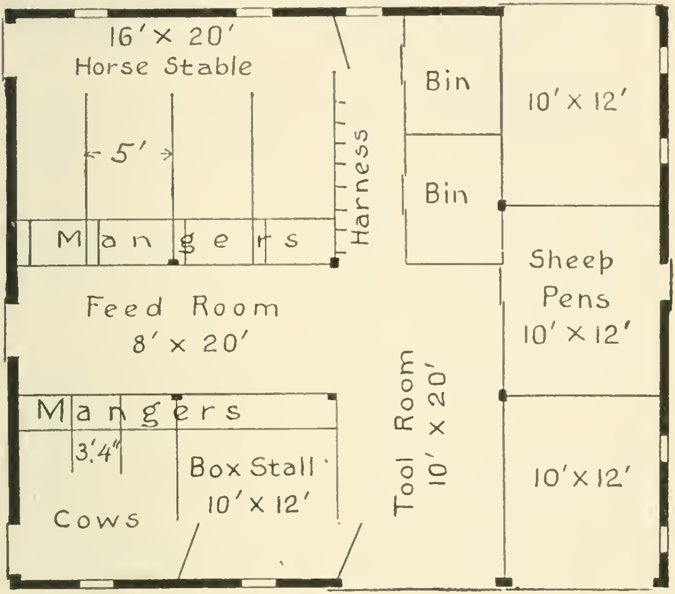
616. How many feet (B. M.) does this part of the bill of materials include?

617. At $30 per M how much did this lumber cost?

618. There were 16 000 shingles for the roof at $4.75 per M; 100 pounds of 60d spikes, 100 pounds 40d spikes, 300 pounds 20d spikes, 100 pounds 8d nails, 70 pounds 4d nails, all of which are purchased at a cost of 5 cents per pound. What will these materials cost?

619. There were also used two tracks 20 feet long at 10 cents per foot; two pair hangers at 75 cents each; eight pair coop hinges at 50 cents each; eight windows, 24″ x 36″, at $2 each. What is the total cost of these items?

620. To complete the building there were used the following: 21 foundation posts at 25 cents each; painting, $40; tin work, $12; the work of one carpenter for 30 days



FLOOR PLAN OF SMALL BARN.

at $3.50 a day; the work of a helper for 30 days at $2 a day. What is the cost of these items?

621. Allowing $25 for extras, what was the total cost of the barn?

Roofing. An area containing 100 square feet and called a *square* is the unit of measure for roofing.

Shingles are 16 inches long and average usually 4 inches wide. When laid $4\frac{1}{2}$ inches to the weather, each average shingle will cover $4 \times 4\frac{1}{2}$ or 18 square inches. Eight average shingles will, therefore, cover 1 square foot and 800 shingles will cover a square. On account of waste, it is better in making an estimate to allow 900 or 1,000 shingles per square. The pitch of the roof should never be less than one-sixth; that is, in a building 60 feet wide, the comb or peak of the roof should be at least one-sixth of 60 feet or 10 feet higher than the plates on which the rafters rest. A pitch of one-fourth or more gives a much better protection from rain and melting snow, and makes a more durable roof.

622. Allowing 800 shingles per square, how many thousand would be required for the roof of a house 35 feet long, the length of the rafters on each side of the roof being 14 feet?

623. How many average shingles are required per square if laid 4 inches to the weather? 3 inches?

624. Allowing 900 shingles per square, how many thousand are required for a house 40 feet long, if the rafters are 16 feet long?

Length of rafters. If the width of a building and the pitch of the roof be known, the length of the rafters may be calculated by the following rule:

Square each of the two legs of the right-angled triangle of which the rafter is the hypothenuse, add these squares and extract the square root of the sum. The result is the length of the rafter. These lengths may include the overhang, as in the following problem.

625. How long are the rafters of a barn 30 feet wide, when the pitch is three-tenths and the overhang is 1 foot?

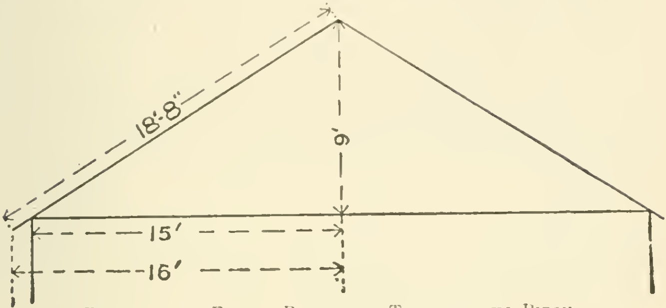
Process:

30 feet + 2 feet = 32 feet.

Three-tenths of 32 feet = 9.6 feet.

$$
\begin{aligned}
16 \times 16 &= 256.0 \\
9.6 \times 9.6 &= 92.2 \\
\hline
&\ 348.2
\end{aligned}
$$

$\sqrt{348.2} = 18.7$ (nearly)..................Length of rafter in feet.



ELEVATION OF END OF ROOF WITH THREE-TENTHS PITCH.

626. How many shingles will be required if the barn in the preceding problem is 40 feet long and the roof projects 1 foot at each end?

627. How many shingles will be required for a building 36 feet by 52 feet, if the roof has a pitch of one-fourth and overhangs 18 inches on the sides and 12 inches on the ends?

628. If the length of the rafter, exclusive of the overhang, is 15 feet, and the width of the building 24 feet, what is the height of the ridge above the plate? What is the pitch?

Laths. One hundred laths are tied in each bundle. This number will cover 5 square yards.

629. How many bundles of laths will be required for one side of a room 15 feet long and 9 feet high.

Process:

$15 \times 9 = 135$..................Square feet.
$135 \div 9 = 15$..................Square yards.
$15 \div 5 = 3$..................Bundles.

630. How many bundles of laths will be required for the sides and ceiling of a room 20 feet long, 15 feet wide, and 9 feet high, allowing for two windows 3′ 6″ x 5′, one door 3′ 6″ x 7′?

631. A certain house contains eight rooms, four of which are 20′ x 15′ x 9′, and four 15′ x 15′ x 9′. How many bundles of laths will be required for all walls and ceilings, allowing 190 square yards for doors, windows, baseboards, and fireplaces?

Plastering. The unit for measuring plastering is the *square yard.*

The following materials are required for 100 square yards of plastering, two coats:

3½ barrels of lime,
1½ bushels of hair or fiber,
1¼ cubic yards of good sand.

632. How many barrels of lime are needed for plastering the walls and ceiling of a room 17′ 4″ x 15′ 8″ x 10′?

633. How many bushels of hair or fiber?

634. How many cubic yards of sand?

635. A farm house just built has the following rooms, walls and ceilings of which are to be plastered: On the first floor: hall, 8′ x 35′; dining room, 15′ x 20′; kitchen, 15′ x 15′ and a living room, 20′ x 35′; on the second floor are the same number of rooms, including the hall and bathroom, and of the same size as on first floor. The height from the floor to the ceiling is 9′ for the first floor, and 8′ for the second floor. How many square yards of surface for the entire house?

636. There are 24 windows, each 3′ 6″ x 5′, in the house. How many square yards are taken up by windows?

637. There are three folding doors, each 6′ x 7′; a front door, 5′ x 7′; ten doors, 3′ x 7′, one of which is an outside door. How many square yards are taken up by door space?

638. Deducting door space and window space, how many square yards are left to be plastered?

639. How many barrels of lime will be needed for two coats of plaster for this house?

640. How many bushels of hair or fiber?

641. How many yards of sand?

CHAPTER XII.

ROADS.

Farmers suffer great inconvenience and great money loss on account of bad roads. Good roads, on the other hand, make country life almost ideal. Good roads economize time and energy in transportation; reduce wear and tear on horses, harnesses and vehicles; increase the value of farm land. Good roads denote progressiveness and prosperity. Bad roads denote indifference and thriftlessness.

Losses Due to Bad Roads.

642. The estimated cost of hauling wheat over bad roads a distance of 10 miles is 6 cents a bushel; over good roads, 3 cents. What is the loss to a farmer 10 miles from market who annually sells 1,000 bushels of wheat? If five miles from market?

643. Not more than four bales of cotton can be hauled with a pair of 1,200-pound horses over bad roads, while eight bales may be hauled with the same horses over good roads. If it now costs 75 cents a bale to market cotton over bad roads, what is the saving to a farmer who annually markets 100 bales over good roads?

644. Carefully made estimates show that the annual loss to a farmer because of bad roads is 76 cents an acre. What is the loss to a farmer who owns 50 acres? 160 acres? 420 acres?

645. Carefully made estimates show that good roads increase the value of land $6.48 an acre. How much is this increase for a farm of 50 acres? 80 acres? 640 acres?

646. Good roads increase the appraisement for taxation by an average amount of $4 an acre and the average tax rate is 1¼ per cent. What is the average annual increase of taxes an acre. How much is this increase for a farm of 50 acres? 160 acres? A township six miles square?

647. If the average saving in the marketing of wheat is 3 cents a bushel, how many bushels of wheat on a farm of 50 acres will pay the entire increase in taxes?

MAKING THE OLD ROADS BETTER.

This roadbed was smoothed and slightly rounded with road scraper, and then oiled. After each rain, it is gone over with a road drag to keep it smooth and in good condition.

648. Carefully made estimates show that the average annual loss per 100 acres, because of bad roads, is $76.28. What is the annual loss for the whole country, the number of acres of improved farming lands being 478,452,000?

649. The estimated average cost of converting the common public roads of the United States into improved highways is $1,146 a mile. How many miles of such roads might be made at a cost of a single battleship, costing $10,000,000?

650. The annual expenditures in our War and Navy Departments are $160,000,000. If these were reduced one-half how many miles of roads might be made into improved highways annually with the saving?

WHY GOOD ROADS PAY.

They save horse flesh and time. Many times larger loads may be hauled over good roads than over poor ones.

651. The little city of Haslar, in the Hartz Mountains, owns a spruce forest of 7,000 acres, which by careful management permits an annual cut of 7,300,000 square feet of wood per annum. The city macadamized the roads leading through the forest at an expense of $25,000. The average cost of hauling 1,000 feet B. M. on the old roads was $2.70. On the new roads the cost is $1.70. What is the income on the investment in new roads from the saving in hauling alone?

Draft in pounds required to draw one ton over roads composed of different materials.

Various Road Surfaces.

Loose sand road,	448
Loose gravel (4 inches) road,	222
Common gravel road,	147
Good gravel road,	88
Ordinary dirt road,	224
Hard clay road,	112
Hard dry dirt road,	89
Common macadam road,	64
Hard and smooth macadam road,	46
Asphalt street,	17
Iron railway,	8

652. If a team of horses can draw one ton on a loose sand road, how much can it draw on a common macadam road?

653. Four bales of cotton are hauled over a common gravel road. How many bales may be hauled over a common macadam road with the same force?

654. A load of 35 bushels of wheat is hauled over an ordinary dirt road. How many bushels may be hauled over a common macadam road, using the same force?

CHAPTER XIII.

FARM DRAINAGE.

Soil drainage consists in the removal of the surplus water from the soil. Some lands are naturally drained, while others must be drained artificially. The most economical and durable artificial drain is the earthen tile. To be productive a soil must contain enough water to dissolve the nutrient which plants require. More than this amount of moisture is not beneficial to the soil or to the growing plant. The surplus water fills the pores of the soil, thus excluding the air, and suffocating the plant.

Value of Drainage.

655. A farmer in northern Ohio continually failed in raising crops because his land was wet. He was induced to tile-drain 13 acres, which was done at a cost of $23 an acre. What was the total cost of draining the field?

656. After the field was drained this farmer sowed it in wheat, and on 10 acres harvested 46½ bushels an acre, which was sold for $1 a bushel. What sum was realized for this wheat?

657. He claims this result was due to his investment in tile drains. What amount an acre was realized on this wheat crop after paying the total cost of draining the 13 acres?

658. Encouraged by the results of drainage, this farmer tile-drained a part of his young orchard. On land where tile drains had been partially laid 25 trees out of a total of 175 died. What was the percentage of trees that died?

659. On land that had not been tiled 49 trees out of 91 died. What was the percentage of trees that died?

660. This same farmer reports that the trees on the tiled land yielded 50 per cent more fruit than those on the untiled land. If 30 trees were growing on each acre, what is the difference when there is a yield of 10 bushels a tree where no tiling was done?

OLD LAND REMADE BY DRAINAGE.

This land was formerly hardly worth the taxes. It was reclaimed by drainage. Note the excellent crop of beans in the foreground and corn in the background.

661. What is the money gain an acre by tiling when apples are worth 50 cents a bushel?

662. Suppose five acres, 30 trees per acre of apple trees, are planted on tiled land, and five acres, 30 trees per acre, planted on untiled land. On the tiled land 14 per cent of the trees die, while on the untiled land 54 per cent die. For 20 years the average annual production of apples per living tree on untiled land is eight bushels, and on the tiled land 50 per cent more. What is the production of apples in bushels for each five acres during 20 years' time?

663. If the selling price of apples averaged during that time 50 cents a bushel, what was the total value of the crop on the undrained five acres?

664. The total value on the tiled five acres?

665. What is the percentage difference between the tiled and untiled areas for the period of 20 years?

Size of tiles. The size of the tile to be used in a main will depend on the fall, the area to be drained, and the water delivered by sub-mains and laterals. To determine the number of acres that a tile main of given size and grade will drain, multiply the discharge in cubic feet per second for a tile of the given size when laid on a one per cent grade, by the square root of the per cent of the grade in question, and this product by the proper constant. This constant is 24 when it is desired that the main shall be able to carry off in 24 hours an amount of water equal to a depth of one inch over the area drained; 48, if one-half inch; 96, if one-fourth inch. This constant is known as the *standard*. For most of the open soils the one-fourth inch standard is used in practice, and is found to be satisfactory.

TABLE I.

Discharge of Tiles	Grade 1-100 (Elliott)
Diameter of tile in inches	Discharge in cubic feet per second
4	0.16
6	0.49
8	1.11
10	2.05
12	3.40
15	6.29
20	13.85

TABLE II.

Grades and square roots		
Fall per 100 feet		Square root of grade
In inches	In feet	
1	0.09	0.30
2	0.16	0.40
3	0.25	0.50
6	0.50	0.70
9	0.75	0.87
12	1.00	1.00

666. How many acres will a 10-inch main drain when laid upon a grade of 2 inches per 100 feet, using the half-inch standard?

Process:

D = discharge of the tile (Table I).
R = square root of grade (Table II).
S = standard.
A = area in acres to be drained.
$A = D \times R \times S$.
$A = 2.05 \times .40 \times 48 = 39$ Acres.

667. How many acres will a 10-inch main drain when laid upon a grade of 3 inches per 100 feet, using the half-inch standard? The quarter-inch standard?

668. How many acres will a 6-inch main drain when laid on a grade of 3 inches per 100 feet, using the quarter-inch standard? The half-inch?

669. How many acres will a 6-inch main drain when laid on a grade of 6 inches per 100 feet using the quarter-inch standard? The half-inch?

670. How many acres will a 6-inch main drain when laid on a grade of 9 inches per 100 feet, using the half-inch standard? The inch?

671. How many acres will a 6-inch main drain when laid on a grade of 12 inches per 100 feet, using the half-inch standard? The quarter-inch?

672. How many acres will a 4-inch main drain when laid on a grade of 6 inches per 100 feet, using the half-inch standard? The quarter-inch? The inch?

673. How large a main should be used on a grade of 6 inches per 100 feet to drain 230 acres, using the quarter-inch standard? The inch?

674. How large a main should be used laid on a grade of 2 inches per 100 feet to drain six acres, using the quarter-inch standard? 60 acres?

Important truth. In addition to a careful calculation of the size of drains good judgment must be used in the application of the results. A tract of land may have such surface conditions that the underdrains will be called upon to take care of a much larger area than at first apparent. It is also important to take into account the facilities for natural drainage. Too large a tile may involve an expense greater than the returns would warrant, while too small a tile may entail loss that will soon greatly exceed the saving in first cost.

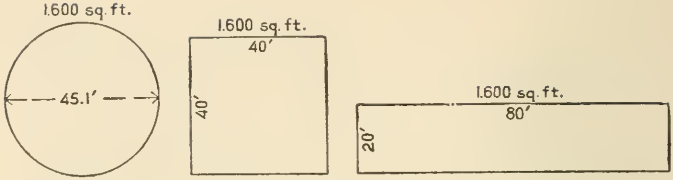
CHAPTER XIV.

SILOS.

Animals do best when feeding upon green and succulent pastures. In the greater part of the country, however, these are not available during the winter season. The silo is a very satisfactory substitute, since it is a very effective method of preserving green forage. Silos do for live stock what the canning of fruit and vegetables does for man. Forage for live stock when left in the field deteriorates and decays or matures and becomes dry and less palatable; when put into a silo it holds its succulence and freshness and remains soft and appetizing. It is thus available as a choice food for all classes of live stock at a time when most needed. A silo enables the farmer to preserve a larger quantity of food material than is possible by any other system; it furnishes a feed of known and uniform quality; it provides the most economical form of storage; it removes much of the drudgery and hardship incidental to live stock feeding.

Form of construction. A good silo is so constructed as to be practically air-tight, thus excluding the bacteria that cause deterioration. A silo may be round, square, or rectilineal in form. The round is the most popular. It contains less waste space, presents much greater strength, and for a given capacity requires less lumber than any other form. The advantage of the circular form over the square is not so great for smaller silos, particularly when simplicity of construction is taken into account, as for larger.

The relation of the form of construction to capacity is illustrated by the three following types:



THE AREA IS JUST THE SAME.

If each were a silo, and you bought the lumber, would there be any difference in quantity required?

675. What is the distance around (the perimeter of) a circular silo 20 feet in diameter?

Process: Multiply the diameter by 3.1416.

Note.—The number 3.14 as multiplier is sufficiently accurate for most farm work.

$20 \times 3.14 = 62.8$ ....Feet.

676. What is the base area of a circular silo 20 feet in diameter?

Process: Multiply the square of the diameter by 0.7854 or the square of the radius by 3.1416 or 3.14.

$20 \times 20 \times 0.7854 = 314$ ....Square feet.

677. What is the area of a circular silo 12 feet in diameter? 25 feet? 32 feet? 40 feet? What is the perimeter in each case?

678. What is the diameter of a circular silo having a base or surface area of 1,600 square feet?

Process: Divide the area by 0.7854 and take square root of the result.

$1,600 \div 0.7854 = 2,024$ $\sqrt{2,024} = 45.1$ ....Feet, diameter.

679. What is the circumference or distance around the inside wall of a silo having a surface area of 1,600 square feet?

680. What is the distance around a square silo containing a surface area of 1,600 square feet?

681. What is the distance around a rectangular silo, 20 feet wide and 80 feet long, that also contains an area of 1,600 square feet?

682. Since the round silo incloses the greatest space in proportion to the length of the wall inclosing it, what is the percentage of saving in lumber for a silo having a surface area of 1,600 square feet when the round form is adopted rather than the rectangular?

683. What is the percentage of saving when the round form is adopted rather than the square?

684. A farmer has built a silo 30 feet square and 30 feet high. How many feet (B. M.) of lumber were required for the walls, plank lumber 3 inches thick being used?

685. His neighbor at the same time built a round silo having the same height and an equal capacity. He also used plank lumber 3 inches thick. How many feet (B. M.) were required for the wall?

686. Lumber was purchased at $22 per M (B. M.); what was the cost of that used in the wall of the square silo? Round silo? What was the difference in cost?

Proper diameter of silo. Silage of all kinds readily spoils unless it be fed regularly, evenly, and at a sufficient rate. Experience has taught that a feeding surface of at least 2 inches depth should be removed daily. Where 5 or 6 inches are daily fed, there is but little waste of food materials. It is necessary so to build the silo that its diameter may be in keeping with the number of cattle to be fed. If made too large less than 2 inches will be fed daily, hence there will be waste and loss. Experiments show that to secure most satisfactory results, a horizontal feeding surface of 5 square feet per cow should be provided.

687. For a herd of 30 cows, how many square feet of feed surface are required in the silo?

688. What is the diameter of the round silo, that provides a horizontal feeding surface of 5 square feet daily for 25 cows?

Process: $25 \times 5 = 125$ square feet area of feeding surface required.

$$125 \div .7854 = 159.15$$

$\sqrt{159.15} = 12.6$. ....Diameter of silo.

Dairy Herd and Barns.

Note the silo in the center. The silo is indispensable if dairy products are to be secured at the greatest economy.

689. What diameter of silo is required for a herd of 20 cows, each cow to have 5 square feet of feeding space?

690. What diameter of silo is required for a herd of 30 cows when a feeding surface of 5 square feet is given each cow?

691. For a herd of 35 cows? Fifty cows?

Quantity of silage needed. In planning a silo the quantity necessary for the year's supply must be estimated. The quantity of silage depends upon (1) the amount fed daily to each animal, (2) number of animals to be fed, (3) the length of silage feeding period.

692. How many tons of silage will be required for a dairy herd of 25 cows when an average of 40 pounds is fed daily to each animal for 180 days?

Process:

$25 \times 40 \times 180 = 180{,}000$ .... Pounds.
$180{,}000 \div 2{,}000 = 90$ .... Tons.

693. How many tons of silage will be required for a dairy herd of 30 cows, the average feed of 40 pounds being given?

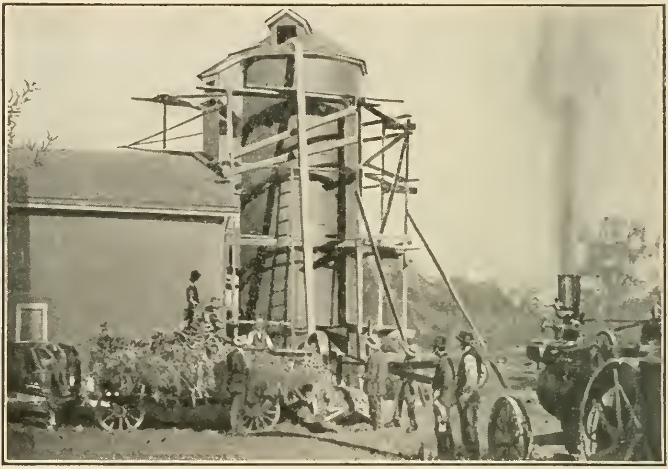
694. A farmer, calculating the amount of silage necessary for his cattle, plans to feed 20 cows, each 50 pounds daily; 15 cows, each 40 pounds daily; 10 cows, each 30 pounds daily; and 25 calves, each an average of 15 pounds daily. How many tons of silage will be required for nine months (270 days) feeding?

695. His neighbor plans to feed 20 cows, each 50 pounds daily for 90 days, then 40 pounds daily for the next 90 days, and 30 pounds daily for the following 75 days. He also plans to feed 15 other cows each 40 pounds for 150 days, and 25 pounds each for the following 100 days; and also 30 calves an average of 15 pounds each for 180 days. How many tons of silage will be required?

Capacity of silos. Corn silage weighs from 25 pounds to 50 pounds per cubic foot according to the depth in the silo from which it is taken, and the amount of moisture it contains. Where a silo is constructed and filled properly, the average weight of the contents will average about 40 pounds to the cubic foot. This means 50 cubic feet to every ton. The capacity of a silo depends on its depth and diameter. The number of cattle to be fed will control, in a large measure, the diameter of the silo, while the quantity demanded will influence the height of the silo.

696. How many cubic feet in a silo having an inside base area of 352 square feet and a height of 24 feet?

Process: Multiply the area of the base by the height.
$352 \times 24 = 8{,}448$..................Cubic feet.



FILLING THE SILO.

The cut green corn is blown into the silo at the top. Silage makes one of the best farm feeds.

697. How many pounds of silage will the above silo store? How many tons?

698. What must be the height of a silo to hold 20,000 cubic feet, if the area of the base is 600 square feet? To hold 350 tons?

699. What should be the size of a silo for a herd of 25 cows, that are to be fed 40 pounds each daily for 180 days?

Process:

1st part. $25 \times 40 \times 180 \div 2{,}000 = 90$..........Tons required.
25×5 sq. ft. $= 125$ sq. ft..........Horizontal feeding surface.
$125 \div .7854 = 159.15$
$\sqrt{159.15} = 12.6$..........Diameter of the silo in feet.

2nd part. 1 ton occupies 50 cubic feet.
90 tons occupy 4,500 cubic feet.
$4{,}500 \div 125 = 36$..........Feet, height of silo.

700. What should be the diameter and height of a round silo for a herd of 25 cows that are to be fed 30 pounds each daily for 150 days?

701. What should be the diameter and height of a round silo for a herd of 25 cows that are to be fed 40 pounds each daily for 90 days and 30 pounds each for 80 days?

702. What should be the diameter and height of a silo for a herd of 40 cows that are to be fed 40 pounds each daily for 160 days?

703. What should be the size of a silo for a herd of 60 cows that are to be fed 35 pounds each daily for 175 days?

704. A round silo has a diameter of 20 feet and a height of 35 feet; how many tons of silage will it hold?

Process:

$20 \times 20 \times 0.7854 = 314$..........Area of base.
$314 \times 35 = 11{,}000$..........Cubic feet.
$11{,}000 \div 50 = 220$..........Tons, capacity of silo.

705. How many tons of silage will a silo hold that has a diameter of 15 feet and a height of 28 feet?

706. What is the capacity of a round silo 24 feet high and 16 feet in diameter?

707. What is the difference in capacity between two silos, one a round silo 15 feet in diameter and 28 feet high, and the other a square silo 15 feet square and 28 feet high?

708. A round silo 20 feet in diameter and 30 feet high holds a certain quantity of silage. What shall be the diameter of another silo of same height, that will hold twice the quantity of silage?

709. What should be the diameter, that three times the quantity may be held?

Staves required for round stave silo. Staves used in silo construction vary in length, width, and thickness. The best length of stave is the height of the silo. If this is not possible, two lengths, one long and one short, may be used. The break should be distributed at different heights. The best widths are 6 or 8 inches; the best thickness, 2 inches, although 3 inches is often used.

710. A silo 16 feet in diameter and 26 feet high is wanted. How many staves, 2 x 6 inches, will be needed?

Process: Divide the circumference by the width of stave.

Circumference of a circle = diameter × 3.1416.
16 × 3.1416 = 50.26..................Feet, circumference.
6 inches = ½..................Foot, width.
50.26 ÷ ½ = 100.52..................Staves.

711. A silo 20 feet in diameter and 24 feet high is wanted; how many staves, 2 x 6 inches, will be needed?

712. A silo 20 feet in diameter and 26 feet high is wanted; how many staves, 3 x 8 inches, will be needed?

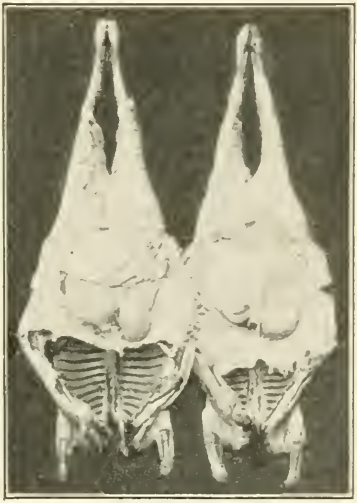
713. A silo 18 feet in diameter and 36 feet high is wanted. Because of the height it is necessary to set the staves in two lengths. How many staves, 3 x 8 inches and 20 feet long, will be required, provided all the pieces are used in building the silo?

CHAPTER XV.

MEAT PRODUCTS.

Farm animals when sold for meat are usually sold on foot at a given price per pound live weight. When they are slaughtered first, they are sold at a given price per pound dressed weight.

More than one-half of our commercial meat products are now prepared in Chicago and a few other large cities. Thousands of animals are shipped each day from all parts of the United States to these great slaughtering houses. The farmer may consign his shipment of fattened animals to a live stock commission merchant, who in turn sells to buyers who are constantly purchasing for butchers and packing houses; or he may sell to a local buyer who makes the shipment and profits or loses according to his judgment; or he may slaughter his animals at home, selling the meat to local consumers.

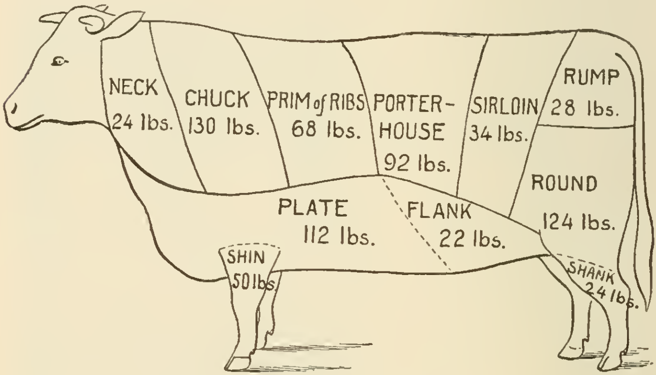


READY FOR MARKET.

Mutton carcasses showing manner of dressing ready for shipment.

Cattle. Those that possess the highest percentage of valuable and high-priced cuts, with a correspondingly low percentage of offal, waste, and cheap cuts, are the most profitable to both farmer and butcher.

A high-grade steer is one whose meat possesses fine quality, and one which is abundant in profitable parts and small in waste and offal. When slaughtered, such an animal will dress from 65 to 69 per cent of its live weight. A low-grade or coarse steer, when slaughtered, will dress no more than 40 to 50 per cent of its live weight, and yield meat of poorer quality and of lower value when sold on the butcher's block.



RETAIL BEEF CUTS AND WEIGHT.

Chicago Retail Dealers' Method of Cutting Beef.

A good 1,200-pound steer dresses about 800 pounds, and of this 708 pounds is marketable meat. All of the high-priced cuts are taken from the ribs, loins, and hind quarters, and the best cuts coming principally from the ribs and loins. These valuable cuts together weigh 346 pounds. The less valuable cuts from the fore-quarters, belly, and flank weigh 362 pounds.

Oral Problems.

Ascertain of your local butcher the prices he charges for the different cuts.

714. What is the value of the neck? Chuck? Prime of rib?

715. What is the value of the porterhouse? Sirloin? Rump? Round?

716. What is the value of the plate? Shin? Shank? Flank?

717. What is the total quantity of dressed beef?

718. What percentage is this of the live weight?

719. What is the total value of prime or ribs, porterhouse, sirloin, rump, and round?

720. What is the value of all other parts of the carcass?

721. What percentage of the value of a good average steer is found in the ribs, loins, and hind quarters?

Important truth. Since the high-priced cuts are found in the region of the back, loins, and hind quarters, it follows that animals should be bred and fattened with this fact in mind. A large head, long neck, long legs, big abdomen and heavy flank are worth little to the butcher, hence these parts should be small as compared with the back, loins, and hind quarters.

722. "Blackrock" the great champion fat steer at a recent international live stock exposition, weighed, just before he was slaughtered, 1,640 pounds. When slaughtered his carcass yielded 69.25 per cent of his live weight. What was his dressed weight?

723. A 2,200 steer was sold for 9 cents per pound live weight. When slaughtered the carcass yielded 68.9 per cent of the live weight. Had he been sold on basis of dressed weight what price per pound would have been required to make the selling price equal?

724. Two cattle weighing 1,200 pounds each were sold. The dressed weight of one was 69 per cent of its live weight, and of the other 48 per cent of its live weight. If both had been sold at 11 cents per pound dressed weight, how many dollars more would the better animal have brought?

725. On account of quality, the steer that dressed highest sold at 11 cents per pound dressed weight, while the other brought but 6 cents per pound. What was the difference in value?

Sheep. The ideal sheep is one that carries a large proportion of flesh or lean meat with but a limited quantity of fat. In live sheep this is indicated by a firm, even covering over the meat parts of the body. In lambs the dressed weight varies from 50 per cent to 60 per cent of the live weight.

Leg,	22.2 pounds
Loin,	17.5 pounds
Rib,	14.5 pounds
Neck,	3.0 pounds
Shoulder,	4.5 pounds
Breast,	7.5 pounds
Shank,	4.8 pounds

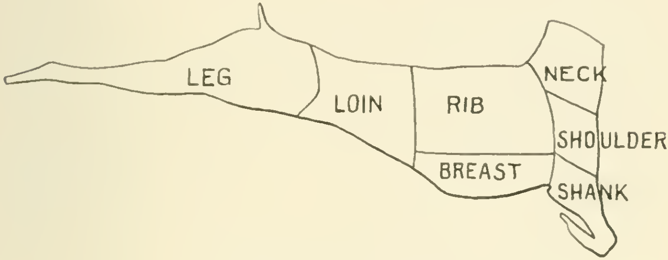
Location of Cuts in a Mutton Carcass.

726. What is the percentage of the leg cuts to the whole carcass?

727. What is the percentage of value of leg cuts to the value of the whole carcass?

728. What is the percentage of leg, loin, and rib cuts to the whole carcass?

729. What is the percentage of the value of these cuts —leg, rib, and loin—to the value of the whole carcass?



RETAIL CUTS OF MUTTON.

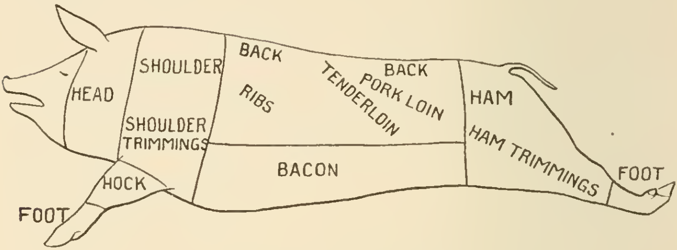
Hogs. Some markets demand the bacon hog, so called because of its long sides; while others prefer the fat hog because of the demand for hams, shoulders, and the broad, fat back. Scrubs and other hogs poor in form make small gains when fed and give smaller quantities of dressed meat in proportion to live weight than well-bred hogs of good form and quality. Good hogs dress from 78 to 82 per cent of their live weight.

Carcass of a Fat Hog, Showing the Division Commonly Made.

730. The average weight of a bunch of ten-month hogs when sold was 243 pounds live weight. When slaughtered the average dressed weight was 206 pounds. What was the percentage of dressed meat of live weight?

731. The average weight of a bunch of nine-month hogs was 246 pounds live weight when sold. The slaughtered carcasses averaged 81.6 per cent of the live weight. What was the average dressed weight for each hog?

732. This latter bunch of hogs brought 6.5 cents per pound. Had they been slaughtered before being sold, what should have been the price per pound dressed weight?



RETAIL CUTS OF PORK.

733. Hogs that are worth $6.60 per hundred and weigh 280 pounds, are worth how much per pound, providing they dress 81 per cent of their live weight?

Curing Meats on the Farm.

Plain salt pork. Rub each piece of meat with fine common salt and pack closely in a barrel. Let stand overnight. The next day weigh out ten pounds of salt, and two ounces of saltpeter to each 100 pounds of meat and dissolve in four gallons of water. Pour this brine over the meat when cold, cover and weight down to keep it under brine until used.

Oral Problems.

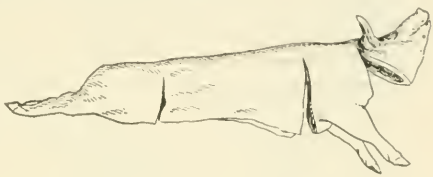
734. How many pounds of salt and saltpeter will be required for curing 400 pounds of plain salt pork?

735. How much water should be used for this quantity of salt and saltpeter?

736. How many pounds each of saltpeter, salt, and water will be required for 75 pounds of salt pork?

737. In what proportion are salt and saltpeter used in curing plain pork?

Sugar-cured hams and bacon. When the meat is cooled, rub each piece with salt and allow it to drain overnight. Then pack it in a barrel with the hams and shoulders in the bottom, using the strips of bacon to fill in between or to put on top. Weigh out for each 100 pounds of meat eight pounds of salt, two pounds of brown sugar, and two ounces of saltpeter. Dissolve all in four gallons of water, and cover the meat with the brine. Bacon strips should remain in this brine from four to six weeks; hams and shoulders from six to eight weeks. After this smoke carefully and the meat will be sweet, palatable, and of good flavor.



HOG CARCASS IN FOUR PARTS.
Showing way of cutting head, shoulders, middle and hams.

Oral Problems.

738. What quantities each of salt, brown sugar, and saltpeter are required for 600 pounds of meat?

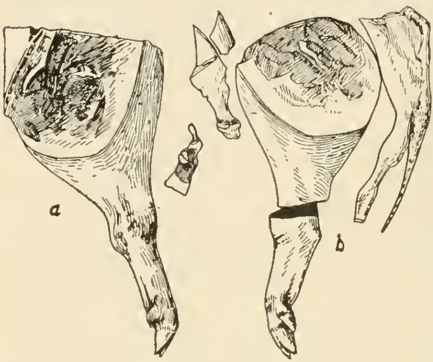
739. In how much water should these materials be dissolved?

740. In what proportions are these materials used for sugar-cured hams and bacon?

741. A farmer has 18 hams averaging 12 pounds each, 18 shoulders averaging 10 pounds each, and 16 pounds of bacon, which he desires to sugar-cure. How many pounds of salt, brown sugar, and saltpeter will be required?

742. How much water will be required for curing this quantity of meat?

Dry-cured pork. For each 100 pounds of meat weigh out five pounds of salt, two pounds of granulated sugar, and two ounces of saltpeter, and mix them thoroughly. Rub the meat well every three days with a third of the mixture. Pack in a barrel or tight box. For convenience it is advisable to have two barrels and to transfer the meat from one to the other each time it is rubbed. After the third rubbing the meat should remain in the barrel for a week or ten days, when it will be cured and ready to smoke.



HAMS TRIMMED AND UNTRIMMED.

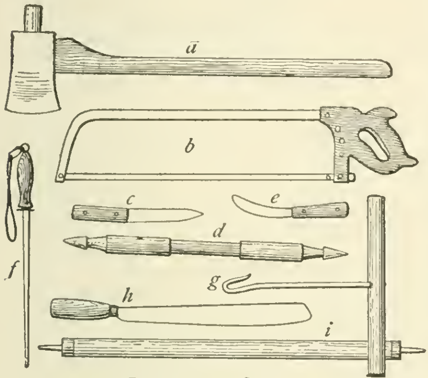
Oral Problems.

743. A farmer desires to dry cure 300 pounds of pork. How much each of salt, granulated sugar, and saltpeter will be needed? How many pounds of the mixture will be required for each rubbing?

744. If this farmer should decide to dry-cure one-half of this meat and sugar-cure the other half, what materials would be required and how much of each?

745. A farmer on finishing his butchering finds that he has 540 pounds of meat to cure. He decides that he wishes 140 pounds of this to be plain salt pork, and one-half of the remainder to be sugar-cured and one-half dry-cured. What materials will be required for all and what quantity of each?

Sausage. To each three pounds of fresh, lean, pork add one pound of fat. Mix the fat and lean together in chopping. When thoroughly mixed, season with a mixture made of one ounce pure fine salt, one-half ounce of ground black pepper, and one-half ounce of pure leaf sage for each four pounds of meat. This done the sausage may be packed away in stone jars or stuffed into casings.



BUTCHERING OUTFIT.
Some of the smaller tools of much help in cutting up the farm meat supply.

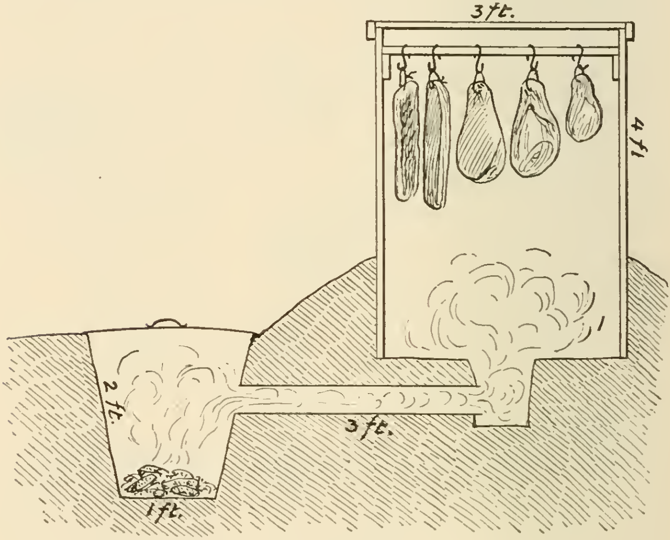
Oral Problems.

746. A farmer after mixing his sausage finds he has 75 pounds. How much each of salt, black pepper and sage leaf will be required for proper seasoning?

747. A farmer slaughters 15 hogs. He finds that after properly trimming the dressed carcasses he has an average of 10 pounds of sausage meat from each. What materials and what quantity of each will be required for seasoning the sausage?

Note.—Sausage may be made by using two pounds of lean pork, one pound of fat pork, and one pound of lean beef. Chop together until fine and season the same as pork sausage.

Bologna sausage. To each 10 pounds of lean beef use one pound of fat pork, or bacon if preferred. Chop fine and season with one ounce of salt to each four pounds of meat, one ounce of best black pepper (ground fine) to each six pounds of meat, and a pinch of ground coriander.



SMOKING MEAT.

A simple contrivance for use when but a small amount of meat is cured.

Stuff into casings. Smoke for 10 to 12 hours. Cook in boiling water until the sausage floats. Dry on clean hay or straw, and hang away in a cool place until wanted.

Oral Problems.

748. How many ounces each of salt and black pepper will be required for 100 pounds of bologna sausage meat?

749. How many ounces of each of the seasoning materials for bologna sausage when 10 pounds of fat pork has been used. the proper quantity of lean beef having been mixed with it?

Smoking meats. A smoke house, 6 by 8 feet, will be large enough for ordinary farm use. Ample ventilation should be provided to carry off the warm air, to prevent overheating of meat. The best fuel is green hickory or maple wood smothered with sawdust of the same material. Hard wood of any kind is preferable to soft wood. Corn cobs are a good substitute for hard wood.

Remove meat from the brine two or three days before smoking. If coated with salt wash the meat in tepid water and clean with brush. A slow fire should be started, warming up the meat gradually. When the fire is kept going steadily 24 to 36 hours will be required to finish one lot of meat. After being smoked cover the meat with muslin, paper, or burlap, keep at even temperature and away from insects. Coat the covering with a yellow wash made as follows:

For 10 pounds of hams or bacon take three pounds of barytes (barium sulphate), one ounce of glue, one and one-half ounces of chrome yellow (lead chromate), and six and one-half ounces of flour. Fill a pail half full of water and mix in the flour, dissolving all lumps thoroughly. Dissolve the chrome in a quart of water in a separate vessel, and add the solution and the glue to the flour; bring the whole to the boiling point and add the barytes slowly, stirring constantly. Make the wash the day before it is required. Apply with a brush.

Oral Problems.

750. How many pounds of barytes are required for preserving 150 pounds of hams or bacon? Glue? Chrome yellow? Flour?

Grove of Young Black Walnut Trees.

CHAPTER XVI.

FORESTRY.

The forests of the United States constitute, next to its agricultural lands, its greatest natural source of wealth. In wood alone they yield an annual product exceeded in value only by the output of our farms and mines. In the order of their importance. our leading productive industries are, farming, mining, grazing, and lumbering; but this makes no account of the vast amount of wood grown and used locally for fuel, fencing, building, and other purposes. Again, lumbering stands fourth in the list of our manufacturing industries, being surpassed only by the iron and steel, the textile, and the meat-packing industries. The value of the forests in promoting our national welfare is much greater even than these facts indicate. Wood is directly or indirectly essential to all of our industries. Mining requires timber for shores and props. Transportation, vital to all industries, demands that our forests be preserved; for trains run on wooden ties, and rivers and canals are made navigable by the water which forests store. Manufacturers and merchants require wood for their wares and for boxes and crates. The wage earner needs it that he may be cheaply housed.

The farmer is no less benefited by forests. He draws on the forest for fencing, firewood and building materials. He may add to his income by the sale of material from his woodlot, which furnishes him with work at a time of year when he can do little else that is profitable. In many regions he may protect his family, his stock, and his crops by planting forest trees as windbreaks, protecting from the blizzards of winter and the hot winds of summer.

The forests have a very important influence upon the rainfall and floods.

Forestry means the science and art of making the best permanent use of the forest. If a forest is cut in such a way that no new forest growth of value follows, its usefulness is permanently destroyed. If it is so cut that it afterwards produces less timber than in its natural state, or timber of inferior quality, its usefulness is impaired. Few farmers give sufficient thought to the cultivation of their forests, or even know whether the treatment which they are receiving will make them better or worse. This is bad farming. With proper care a forest can be made to grow more and better timber in a given time than it would if left to itself. Use should cause a forest to improve and not to deteriorate.

The farmers of the United States own approximately three hundred million acres of woodland. This is a tremendously productive resource. Most of this woodland, however, is in a run-down condition. The difference between what it now produces and what it might produce with intelligent care is a great loss which the country suffers on account of careless, wasteful, and shortsighted methods. The difference between what the farmer now gets and what he should get is a loss for which he is himself responsible.

751. A long leaf pine tree produces three logs, containing 10, 24, and 44 cubic feet respectively. Assuming that from each cubic foot seven board feet are secured, and that long leaf pine lumber is worth $6 a thousand on the stump, how much is the tree worth?

752. A farmer wishes to build a fence around a square farm of 160 acres. The posts are to be 16½ feet apart. How many posts will it take?

753. If the supply of posts was obtained by cutting locust trees which would make two posts each, and were planted 8 by 12 feet apart, how much land would have to be cut over?

754. The ordinary life of a chestnut telephone pole is 12 years. If the poles are treated with a preserving fluid, they will last 10 years longer. The average cost of an untreated pole is $5.04 and of a treated pole $5.72. If treated poles are used, what will be the saving in 25 years per mile, 40 posts being used for each mile?

755. A farmer wishes to build a fence one-half mile long, with the posts 16½ feet apart. If he used untreated posts at a cost of 15 cents each, he would have to renew them after eight years; if he used those which had been preserved against decay at a cost of 6 cents per post, he would not have to renew his fence for 16 years. The cost of setting the posts in either case is 5 cents each. What would he save by using the treated instead of the untreated posts?

756. A farmer owns 200 acres of loblolly pine, which, if cut now, would yield 10,000 board feet of lumber an acre worth $2 per thousand feet. If in 5 years the price of loblolly pine will be $3 per thousand feet, and if the cost of taxes and protection is 2 cents per acre per annum, what rate of simple interest would the farmer realize if he held his timber instead of cutting it?

757. A cattle raiser owns three adjoining sections of land, which he has to keep fenced with wire fence in which the posts are set two rods apart. The posts now set are expected to last 15 years, but the owner wants to provide for renewals. He knows that by planting cedar 6 by 6 feet he can get a quantity of single post trees in from 15 to 20 years, and by thinning the stand to 12 by

12, can have three hundred two-post trees an acre in 30 years. If the thinnings are assumed to provide for the necessary renewals for 30 years, how many acres of forests must be planted and maintained to furnish the needed posts?

758. A farmer owns 30 acres on which he wishes to plant European larch, set 4 feet apart in rows 6 feet apart. How many seedlings must he plant?

GROWING TIMBER AS FARM CROP.

These are hardy catalpas. One season's growth, second year from planting out, and cut to ground in spring after planting.

759. A farmer had a woodlot of hickory and oak in equal proportions, from which he sold half the wood, 50 cords, for firewood at $6 a cord. Afterwards a furniture maker offered him $100 per thousand board feet for the remaining oak, and a wagon maker offered him $50 per thousand board feet for the remaining hickory. He found that he could cut half as many thousand board feet as he had cut cords. How much did he receive for the rest of his wood lot, and how much more would he have made had he sold the cordwood to the furniture maker and the wagon maker?

760. A farmer in New England planted 60 acres of white pine. The cost of land, of planting, and of expenses incidental to all the work per acre was as follows: Cost of land, $4; cost of seed and growing young trees, $2.42; cost of planting, $2.42. What was the cost of 60 acres?

761. If this money had been placed in a savings bank and had drawn 3 per cent compound interest for 40 years, what would be the total amount of interest?

762. But this money was invested in a forest instead. What was the total amount invested per acre, including the actual cost and compound interest accumulating during the 40 years?

763. At the end of the 40 years the forest farm yielded 40 cords of wood per acre. The wood contained in each cord was valued at $4. What was the value of wood on each acre?

764. After deducting the initial cost of the forest and interest that might have accumulated at 3 per cent compound interest in a savings bank for 40 years, what is the profit for each acre?

765. What is the average annual profit per acre?

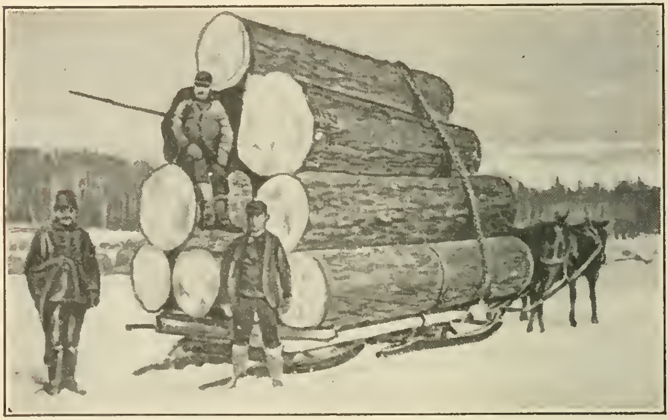
766. What is the average annual profit for the 60 acres?

767. What is the total profit of the 60 acres at the end of 40 years, after allowing for initial cost and accumulated interest?

768. A European larch grove planted in western Minnesota 17 years ago, now contains post material worth

$484 per acre. What is the total cost per acre, including the initial cost of $64.45 per acre for the land, labor, and cost of trees, and compound interest at 3 per cent during the entire period?

769. Measurements made by the Bureau of Forestry have shown that the loss from cutting high stumps in a tract of 100,000 acres in the Adirondacks is a total of



HEAVY LOGS EN ROUTE TO MARKET.
In this load are 5,540 feet.

30,000 standards. When a standard is worth 50 cents what is the loss for the tract of land?

770. The average number of ties to each mile of railroad track in the United States is 3,000. How many ties are in use now, the railroad trackage being 250,000 miles?

771. The average life of railroad ties is six years. What number of ties must be replaced each year?

772. The average cost of a railroad tie is 30 cents.

What is the amount of the annual expenditure for railroad ties?

773. From an average tree three railroad ties may be cut. How many trees are annually required to furnish the needs of the railroads for replacing the old ties, the average life of a tie being six years?

774. A certain railroad uses annually 3,840,000 railroad ties. If three ties may be cut from a locust tree 30 years old, how many acres will be required to be planted each year, 400 trees being planted per acre, to furnish the supply?

775. What is the total number of acres in trees required to supply the needs of this railroad?

776. How many trees, from one to 30 years old, must be growing to keep the needs constantly supplied?

777. How much is an acre of locust trees worth, three ties to each tree, 400 trees to an acre, when sold at 30 cents a tie?

778. A farmer wishes to renew the sills of his barn, and finds that he must have 12 pieces, 10 inches by 6 inches, white oak timber and 25 feet long. How many board feet is this equivalent to (a board foot is equivalent to a piece of 12 x 12 x 1 inch), and what will be the cost at 4 cents a board foot?

779. If 60 board feet of sawed lumber, also worth 4 cents per board foot, can be obtained from a tree in addition to one sill, and a half cord of firewood, worth $4 a cord, what is the total value of the tree's product?

780. If an acre contains ten such trees, and in addition 40 other trees fit for cord wood with an average product of one-fourth of a cord, what is the acre worth before deducting the expense of marketing?

781. If, in consequence of recurring ground fires and lack of care, an adjoining wood lot has deteriorated so that it bears only a partial stock of inferior trees which when cut yield ten cords per acre of firewood, salable for only $3 per cord, what is the loss due to the fire?

Strength of woods used in building. Timber is not often used in tension. It is used in compression, as in the uprights in buildings and in posts or columns supporting loads. It is also used in beams, as the joists in buildings. The two cases we will consider are: (1) Posts or short columns—compression and tension, and (2) beams —bending.

782. What is the safe working load that may be supported by a 4-inch by 4-inch white pine post or column that is too short to bend?

Process: Multiply the area of the cross section in square inches by the safe working strength, per square inch, of the timber to be used. For white pine this may be taken as 500 pounds per square inch.

$4 \times 4 \times 500 = 8{,}000$..................Pounds in total safe load.

Safe Working Tensile and Compressive Strengths of Some Common Woods.

	Pounds per square inch.
White ash,	750
Yellow birch,	850
Hickory,	800
Soft maple,	750
Yellow pine,	700
White pine,	500
Poplar,	550
White oak,	850
Red oak,	800
Hemlock,	450

783. What is the safe working load that may be supported for an indefinite time by a 10" × 12" block of white oak? Red oak? Yellow pine? Poplar?

784. What should be the area of the cross section of a yellow pine post which is to carry indefinitely a load of 18,000 pounds? What would be the length of a side if this is a square post? What is the diameter if circular?

785. What should be the side of a square hickory post which is to carry an 18,000-pound load?

(2) Beams—bending. When used as a beam the amount of the safe working load will depend upon the way in which the beam is supported and the way in which the load is applied as well as upon the dimensions of the beam and the safe working strength of the wood.

786. What is the safe working load that may be placed at the middle point of a yellow pine joist which is supported at the ends and which is 20 feet long, 2 inches broad, and 10 inches deep?

Process: Multiply the square of the depth in inches by the breadth in inches and this product by the safe working strength, as given in the table above, and divide by 18 times the length in feet; *i. e.*,

$$P = \frac{d^2 \times b \times s}{18 \times L}$$

$$\frac{10 \times 10 \times 2 \times 700}{18 \times 20} = 390 \text{.........Pounds}$$

787. What would be the load under the same conditions as in the preceding problem, except that the depth is 12 inches? 8 inches? How many times stronger is the 12-inch than the 8-inch?

788. Show that the beam in problem 786 would have a safe working load of less than 100 pounds if placed on the side with the 2-inch side vertical.

Note.—A man could walk over this beam, however, without breaking it, since the ultimate or breaking load is estimated as at least ten times and frequently twenty times the safe working load.

789. What is the safe working load that may be placed at the middle point of a white pine scantling, 4″ x 4″ x 8′, when supported at the ends?

790. On a white oak beam, 6″ x 6″ x 10′? Red oak?

SLEDDING TIME.

Logs are hauled out of a large forest to the saw mill.

791. On a hemlock beam 2″ x 10″ x 16′?

Note.—The safe working load, when the load is uniformly distributed throughout the length of the beam, is twice as great as when concentrated at the middle point.

792. In problem 786 what would be the safe working load if uniformly distributed along the beam?

Process: $390 \times 2 = 780$..............Pounds.

793. A joist of yellow pine, 2″ x 12″ x 14′, will support what distributed load? If 2″ x 8″ x 14′?

794. A beam of yellow pine, 10 feet long and 12 inches deep is to carry two tons at the middle point, what must be the breadth? How might this beam be built up if 2″ x 12″ x 10′ planks be used?

795. What is the safe working distributed load that may be applied to a beam of hickory 2″ x 2″ x 10′?

796. Of soft maple 2″ x 2″ x 10′?

797. Of yellow pine 2″ x 2″ x 10′? 2″ x 4″ x 10′? 2″ x 6″ x 10′?

798. Of white oak 2″ x 2″ x 10′? Red oak? Yellow birch?

799. A piece of yellow pine, 2″ x 2″ x 20′, supports from its middle point a certain weight. What should be the length of a piece of hickory of the same breadth and thickness, that the same weight may be supported?

800. A red oak beam, 8″ x 8″ x 20′, supports a weight equal to its safe working load. If a yellow pine timber of same length is substituted, what breadth will be required, that the same weight may be carried?

801. In planning a barn yellow pine timbers 12 inches broad and 20 feet long are to be used as beams, each timber being called upon to sustain 1.5 tons at the middle point. What depth of timbers will be required?

CHAPTER XVII.

RULES AND MEASURES.

To measure wood. Multiply together the length, width, and height in feet and divide the product by 128. The result is the number of cords.

802. How many cords in a pile of wood 30 feet long, 4 feet wide, and 8 feet high?

803. How many cords in a pile of wood 84 feet long, 10 feet wide, and 6 feet and 4 inches high?

To ascertain the circumference of a tree required to hew a square stick. Multiply the given side of the square by 4.44, *i. e.*, by $3.1416 \sqrt{2}$. The quotient is the circumference required. To find the diameter multiply the given side by 1.414. Allowance, of course, must be made for the tapering, irregularities, and bark.

804. A farmer needs a timber 9 inches square. A tree of what circumference in the clear will furnish it?

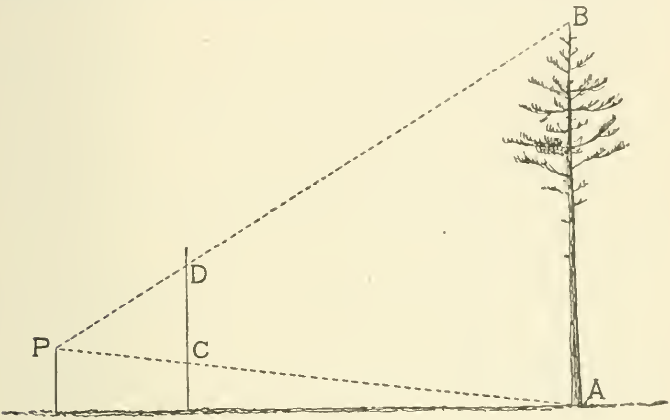
Process: $9 \times 4.44 = 40$..................Inches in circumference.

805. He also needs a timber 12 inches square. What is the circumference required?

806. A tree of what circumference will furnish a piece of timber 14 inches square?

To determine the height of a tree. The easiest method to determine the height of a tree is to remember that when the length of the shadow of a vertical pole is equal to the length of the pole, the length of the shadow of a tree is equal to the height of the tree, or that in general the height of a tree is in the same ratio to the length of its shadow as the height of a pole is to the length of its shadow.

A more general method is to set up two poles in line with the tree. From some point, P, in the farther pole (as the top) sight across the second pole to the base, A, of the tree and mark the point C, in which this line cuts the second pole. Do the same for the top of the tree, thus determining the point D. Then measure the distances, P A, P C, and C D. Now the height of the tree



USING POLES TO GET HEIGHT OF TREE.

is in the same ratio to the distance P A as the distance C D is to the distance P C. Therefore, the height of the tree,

$$AB = \frac{CD \times PA}{PC}$$

This method may be used to determine the vertical distance between any two points on the trunk of a tree by finding the difference of their distance from the base.

807. What is the height of a tree when C D = 6 feet, P A = 30 feet, and P C = 4 feet? Answer, 45 feet.

808. What is the height from the ground to the first limb, B, of a tree when the measurements are as follows: C D = 3′ 4″, P A = 102′ 6″ and P C = 7′ 2″?

To find the number of gallons in a tank or cistern. For a rectangular cistern: Multiply together the length, width, and depth in feet and multiply the product by 7.5, the number of gallons in a cubic foot. This will give the contents in gallons.

809. How many gallons of water in a square cistern 4 feet long, 3 feet wide and 8½ feet deep?

Process: $4 \times 3 \times 8\frac{1}{2} \times 7\frac{1}{2} = 750$..................Gallons.

For a circular cistern: Multiply the square of the diameter in feet by the depth in feet, and this product by 5.9. This will give the contents in gallons.

810. How many gallons of water in a round cistern, the diameter of which is 10 feet and the depth 10 feet?

Process:

$10 \times 10 \times 10 \times 5.9 = 5{,}900$..................Gallons.

811. How many gallons of water in a cistern 6 feet long, 6 feet wide, and 6 feet deep?

812. How many gallons of water in a circular tank 8 feet in diameter and 8 feet deep?

813. A farmer wishes to place a square tank 4 feet high in the attic of his house. It must hold 800 gallons. What is the length of the side?

814. If the above tank is circular, what must be the diameter?

The number of bushels in a bin. For a rectangular bin: Multiply together the length, breadth, and depth, each in feet and multiply this product by 0.8, the number of bushels in a cubic foot. The result is the number of bushels.

815. What is the capacity, in bushels, of a bin 6′ x 8′ x 3′?

816. How high must a bin be to hold 200 bushels if the length is 10 feet and the width is 5 feet?

For a circular bin: Multiply the square of the diameter by the depth, all in feet, and multiply this product by 5/8. The result is the number of bushels.

817. How many bushels in a bin whose diameter is 42 inches and whose depth is 4 feet?

818. What is the depth of a circular bin holding 85 bushels and having a diameter of 4 feet?

819. What is the diameter of a circular bin holding 180 bushels and having a depth of 5 feet?

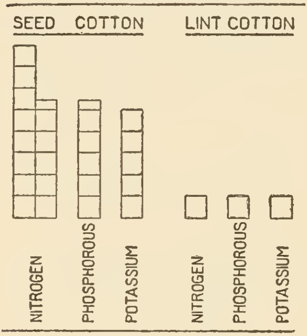
To measure corn in the crib. Multiply together the height, width and length in feet and multiply this product by .45 for old dry corn, and by .4 for new fresh corn. The final product will approximate the number of bushels of corn in the crib.

820. What is the approximate number of bushels of corn in a crib 20 feet long, 4 feet wide, and 10 feet high, corn new and fresh?

821. What is the approximate amount of corn in a crib 30 feet long, 4 feet wide, and 12 feet high, the corn being thoroughly dry?

To measure hay in the mow. Multiply together the height, length, and width in yards and divide by 15 if the hay be well packed. If the mow be shallow and the hay recently placed therein, divide by 18, or by any number from 15 to 18, depending upon the character of the packing. This gives approximately the number of tons.

822. How many tons of hay in a mow 42 feet long, 21 feet wide, and 15 feet high, the hay being well packed?



PLANT FOOD IN COTTON.

Most of the plant food withdrawn from the soil in cotton raising is stored in the seed. If all seed were fed to cattle and the resulting manure returned to the land cotton would be the least exhaustive of all crops grown.

823. How many tons in a mow 46 feet long, 35 feet wide, and 18 feet high, the hay being just put in?

To measure hay in the rick. (Approximately.) Multiply the length of the base in yards by the width in yards, and that by half the height in yards and divide the product by 15 to 18.

824 How many tons of old hay in a rick 15 feet long, 9 feet wide, and 12 feet high?

825. How many tons of newly made hay in a rick 24 feet long, 12 feet wide, and 12 feet high?

Important truth. The only exact method of measuring hay or grain is to weigh it, but the rules given above will be found sufficient for ordinary practical purposes. In measuring hay the rules apply to timothy as the standard. In the case of clover, alfalfa, and cowpea hay, which do not pack so completely, one-fourth should be taken from the approximate measure in tons as determined by the above rules.

To exchange cottonseed for cottonseed meal. In the cotton states a great deal of cottonseed is exchanged for cottonseed meal. The basis of exchange must rest on the commercial value of the feeding and fertilizing elements contained in each. Since both of these materials are used in great quantities as carriers of commercial plant food, the fertilizing value primarily governs the selling prices. and also becomes the *basis of exchange* of seed for meal at the oil mill.

Determining Basis of Exchange.

One ton cottonseed contains:	
Ammonia, 75 pounds at 16 cents,	$12.00
Phosphoric acid, 26 pounds at 5 cents,	1.30
Potash, 24 pounds at 5.4 cents,	1.30
Fertilizing value,	$14.60
One ton cottonseed meal contains:	
Ammonia, 170 pounds at 16 cents,	$27.20
Phosphoric acid, 56 pounds at 5 cents,	2.80
Potash, 36 pounds at 5.4 cents,	1.94
Fertilizing value,	$31.94

$$31.94 \div 14.60 = 2.19$$

Which means that, at the prices assumed, cottonseed meal contains 2.19 times as much fertilizing materials as cottonseed.

Cost of transfer. The seed must be hauled to the oil mill and the meal must be hauled back to the farm. From the standpoint of fertilizing values an exchange of 2,000 pounds of seed for 913 (2,000 ÷ 2.19) pounds of meal would be equitable. The farmer should receive an additional quantity of meal sufficient to cover the expense and trouble of hauling or he will lose by the transaction.

826. A farmer exchanges one ton of seed for meal at the oil mill. He finds it costs him $2 for the time and labor. How many pounds of meal will be required in exchange for the ton of seed after allowing for the expense of the trip?

Process: He should receive 933 pounds of meal for the ton, and in addition $2 worth of meal. Since meal is worth about $30 per ton, he should receive 2/30 of a ton, or 133+ pounds, or a total of 1,083 pounds.

It costs another farmer $3 to haul a ton of seed to the mill, and the meal back home. On a basis of even exchange, how many pounds of meal should he receive?

SEED COTTON READY TO BE GINNED.

The raw cotton is weighed, sucked automatically from the wagons under the shed at the right of picture. Without being touched by hand it is ginned—lint separated from seed—the lint put in bales seen at left of the picture and the seed blown into a box car ready for shipment.

827. At a certain oil mill farmers are given 1,400 pounds of meal for each ton of seed. How much does each farmer receive per ton for the trouble and expense of hauling to and from the mill?

828. On basis of even exchange based upon the prices assumed on page 225, what is cottonseed worth per bushel (30 pounds) when cottonseed meal is worth $25 per ton?

Suggestion: Note that cotton meal is worth 2.19 times as much as cottonseed and that there are 66 2/3 bushels of seed in a ton.

829. On basis of even exchange, when cottonseed meal is worth $30 a ton, what is seed worth a bushel?

830. When cottonseed meal is worth $28 a ton, what is seed worth at the mill if the cost of hauling is 2 cents a bushel?

831. When cottonseed meal is worth $30 a ton, what should the farmer receive for seed per bushel at the mill if the cost of hauling is $3 a ton?

832. When cottonseed is bought at the mill for 40 cents a bushel, what should cottonseed meal be worth per ton, providing the oil extracted pays for cost of manufacture?

833. When cottonseed is bought for 25 cents per bushel, what is the value of the meal per ton?

To measure land. 1. For a square or rectilinear field: Multiply the length in rods by width in rods and divide by 160, the number of square of rods in an acre. The result is the number of acres in the field.

2. For a triangular field: From half the sum of the three sides in rods subtract each side separately. Find the continued product of the half sum, and the three remainders. Divide the square root of the product by 160. The result is the number of acres. If the field is a right-angled triangle, *i. e.*, one having two sides that are perpendicular to each other, take one-half of the product of these two sides in rods and divide by 160. The result is the number of acres.

3. For a field irregular in shape: Divide up into tri-

angles and rectangles by means of straight lines and proceed as in No. 2 and No. 1.

4. For a circular field: Multiply the square of the diameter in rods by .7854 and divide by 160.

834. I. Find the area of a field 100 rods long by 48 rods wide?

$$\text{Process: } \frac{100 \times 48}{160} = 30 \text{.................Acres.}$$

835. II. Find the area of a triangular field the sides of which are 20, 30, and 40 rods respectively.

$$\frac{20 + 30 + 40}{2} = 45$$

$$45 - 20 = 25$$

$$45 - 30 = 15$$

$$45 - 40 = 5$$

$$45 \times 25 \times 15 \times 5 = 84,375$$

$$\sqrt{84,375} = 290.5$$

$290.5 \div 160 = 1.81.$ Answer, 1.81 acres.

836. III. Find the area of a circular field, the diameter of which is 20 rods?

837. How many acres in a farm 400 rods long and 320 rods wide?

838. How many acres in a triangular field the sides of which are 20, 40, and 50 rods?

839. How many acres in a circular field the diameter of which is 26 rods?

Given the plot of a farm as shown on page 229, to find its acreage.

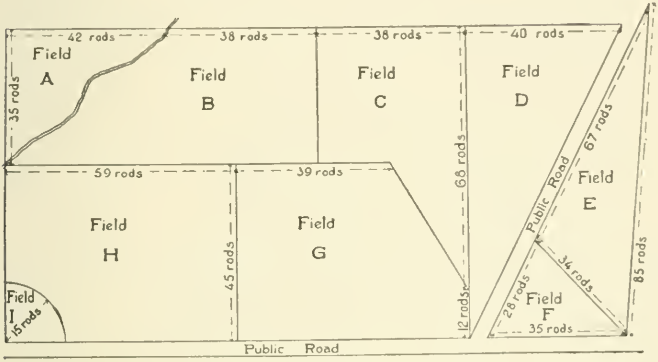
840. How many acres in the fields A and B together?

841. How many acres in the field A, assuming it to be a right-angled triangle?

842. How many acres in field B?

843. Find the number of acres in field C by dividing it into a rectangle and a triangle.

844. How many acres in field D?



LAYOUT OF FARM, SHOWING FIELDS.
The acreage of each field is to be determined.

845. How many acres in field E?

846. How many acres in field F?

847. How many acres in field G?

848. Find the number of acres in field I by considering it the quarter of a circle?

849. Find the number of acres in field H by first finding the area of I and H together.

850. How many acres in the farm?

CHAPTER XVIII.

CONCRETE CONSTRUCTION.

Concrete, or artificial stone, is a mixture of gravel or crushed stone, sand, and Portland cement. When properly executed concrete forms a permanent and comparatively inexpensive material for the construction of foundations, steps, sidewalks, cellar and farm building floors, feeding areas, cisterns, watering and feeding troughs, fence and hitching posts, horse blocks, piers, culverts, building blocks, building walls, etc.

The crushed stone or gravel and sand should be reasonably free from clay and loam. The sand should not be too fine. Except for the most unimportant work the cement should be of the best grade. Cement may be purchased in sacks of one-fourth barrel each, weighing a little less than 100 pounds. Walks and floors should be subdrained and should have a slope of 1 inch in 4 feet for surface drainage. Where freezing will occur walks should be underlaid with from 4 inches to 12 inches of cinders, gravel, or broken stone, well wetted and very thoroughly tamped. Foundations, piers, etc., should extend well below the frost line.

851. How many cubic yards of concrete are required in the construction of a cellar floor 12 feet by 20 feet and 4 inches thick? Three inches thick?

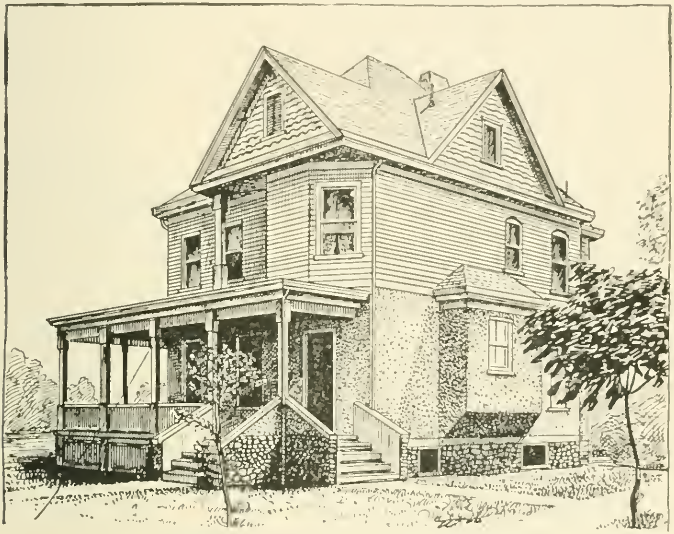
Process:

$12 \times 20 = 240$..........Square feet in area of floor.
$240 \times 1/3 = 80$..........Cubic feet in volume of concrete.
$80 \div 27 = 3$..........Cubic yards in the 4-inch floor.

852. How many cubic yards would be required for three 3-inch floors, 8 feet by 12 feet, 16 feet by 32 feet, and 10 feet by 14 feet, respectively?

853. A sidewalk 60 feet long, 4 feet wide and 4 inches thick is to be constructed. Calculate the number of cubic yards of cinders, required to make a 12-inch foundation? Six-inch foundation?

854. How many cubic yards of concrete are required for the sidewalk in the preceding problem? How much finish is required for a finishing coat 1 inch thick?



CONSTRUCTED OF CONCRETE THROUGHOUT.

Not only the foundations, but the floors, walls and other parts of this house are made of concrete. Even the clapboard effect on the second story was made by placing mortar over the concrete and lining it off to represent wood. The interior of the house, also, is concrete.

855. How much concrete required to build a watering trough having its walls 4 inches thick and the inside dimensions as follows: Length 8 feet, width 18 inches, depth 12 inches.

856. How much concrete is required to make 50 posts

$6\frac{1}{2}$ feet long and 6 inches square at the bottom and $3\frac{1}{2}$ inches square at the top?

Process: A solid of this shape is called a frustum of a pyramid. It may be regarded as the solid that is left when a pyramid having a base 6″ x 6″ has a pyramid having a base $3\frac{1}{2}$″ x $3\frac{1}{2}$″ removed from its top. If the height of the smaller pyramid in inches be represented by X, then we must have the relation: X inches (the altitude of the smaller pyramid) is to $3\frac{1}{2}$ inches (the side of its base) as X + 78 inches (the altitude of the larger pyramid) is to 6 inches (the side of its base).

Therefore, $\frac{X}{3\frac{1}{2}} = \frac{X + 78}{6}$

" $6X = 3\frac{1}{2}X + 3\frac{1}{2} \times 78$

" $6X - 3\frac{1}{2}X = 3\frac{1}{2} \times 78$

" $2\frac{1}{2}X = 3\frac{1}{2} \times 78$

" $5X = 7 \times 78 = 546$

" $X = 109.2$ ....Inches, altitude smaller pyramid.

$X + 78 = 187.2$ ....Inches, altitude larger pyramid.

The volume of a pyramid is equal one-third the area of the base multiplied by the altitude.

The volume of the larger pyramid is
$1/3 \times 6 \times 6 \times 187.2 = 2{,}246.4$ ....Cubic inches.

The volume of the smaller pyramid is
$1/3 \times 3.5 \times 3.5 \times 109.2 = 445.9$ ....Cubic inches.

Volume of post = 2,246.4—445.9 = 1,800.5 ....Cubic inches.

∴ volume of post = 1,800.5 ÷ 1,728 = 1.04 ....Cubic feet.

Volume of 50 posts = $50 \times 1.04 = 52$ ....Cubic feet, or approximately 2 cubic yards.

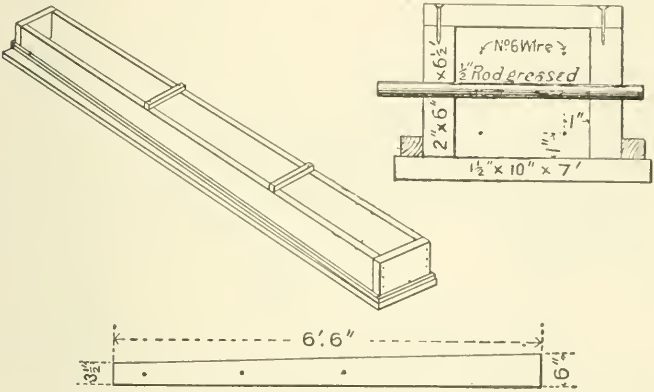
857. If the above posts were the same size at the top as at the bottom, how many cubic yards would be required? If 10″ x 10″ at bottom and 6″ x 6″ at top—*i. e.*, corner-post size?

858. How much No. 6 wire is required to reinforce the 50 posts in the above problem if each post contains four strands running the entire length?

859. How much concrete is required to build a root cellar 10 feet by 14 feet and $7\frac{1}{2}$ feet high, omitting roof and entrance way, if the side walls are 8 inches thick and the floor 4 inches thick?

860. About how much concrete will be required to construct a semi-cylindrical roof 3 inches thick, the two ends, and an entrance way, for the root cellar in the last problem?

861. How much concrete was required for the two circular silos, 20 feet diameter, 32 feet high, 12-inch walls, and 8-inch floors, now in use at the U. S. Soldiers' Home, Washington, D. C.?



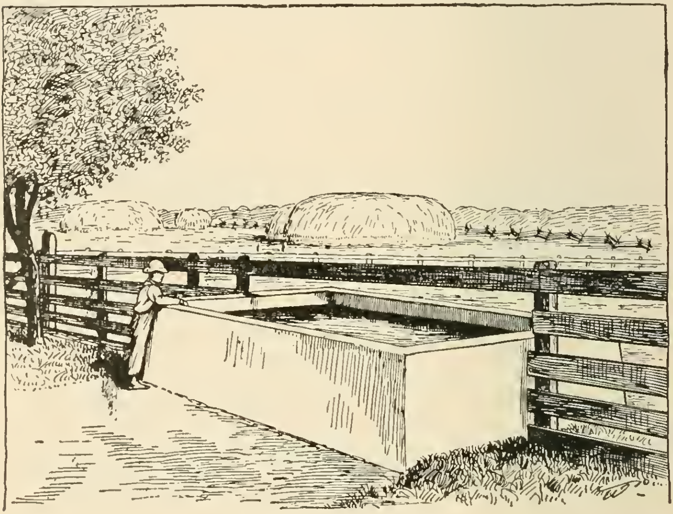
CONCRETE FENCE POSTS.

At the bottom is shown the face of the post. At the top at the left the form for making, and at the top at the right is shown enlarged section of post.

862. How much concrete is required to make ten V-shaped and ten round-bottom hog troughs, length 6 feet, with cross sections as shown in the cuts on page 235?

Concrete formula. A formula is used to indicate the relative amounts by volume of each of the three ingredients. A 1-2-4 concrete is one composed of one part of cement, two parts of sand, and four parts of gravel or crushed stone. It is richer in cement than is ordinarily required. For walks, cellar floors, building walls, etc. A 1-2½-5 mixture is amply sufficient. For heavier work the proportions may be 1-3-6 and for massive and unimportant work 1-4-8.

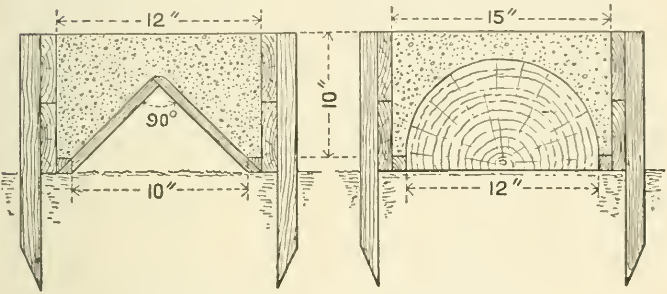
Mixing. On a level watertight platform spread out the measured quantity of dry sand and on top of this the



CONCRETE WATER TANK.

cement. Turn dry with shovel until thoroughly mixed—at least three times. Add the gravel or stone (thoroughly wet) and again turn at least three times, adding water slowly, from a sprinkler, after the first time. Add only enough water to make a thick mush, so that when lightly tamped into place the water will just flush to the surface. Mix small batches, one or two bags of cement at a time, and, to avoid deterioration, place in the forms without delay. The total amount of concrete obtained is only slightly greater in volume than that of the gravel or crushed stone used. The following table shows approximately, for four standard formulæ, the number of barrels of each material required to make one cubic yard (7.1 barrels) of concrete.

Formula		Barrels cement		Barrels sand		Barrels gravel		Cubic yards concrete
1-2-4	-	1.6	-	3.2	-	6.4	-	1
1-2½-5	-	1.3	-	3.3	-	6.6	-	1
1-3-6	-	1.1	-	3.3	-	6.6	-	1
1-4-8	-	0.9	-	3.4	-	6.8	-	1



FORMS FOR MAKING CONCRETE HOG TROUGHS.

863. How many sacks of cement will be required to make 3.5 cubic yards of 1-2½-5 concrete? How much sand? Gravel or crushed stone?

Process: The table indicates 1.3 barrels per cubic yard.

$4 \times 1.3 = 5.2$ ......Sacks per cubic yard.
$3.5 \times 5.2 = 18.2$ ......Sacks, cement.

864. What amount of materials would be required in the last problem if the 1-3-6 formulæ were used? The 1-4-8?

865. What would be the cost, exclusive of labor, of the concrete in problem 863 with cement at $1.80 per barrel, sand at $1.50 per cubic yard, and gravel $1.00 per cubic yard?

866. What would be the cost of the materials used in the sidewalk in problem 854, if cinders are free for the hauling, other costs are as in 865, a 1-2½-5 concrete is used, and the surfacing is omitted?

867. The materials used in the silo in problem 861 were, "one part best Portland cement, two parts clean coarse sand, three parts clean fine gravel, and four parts clean broken stone, brick or terra cotta." Assuming that this was approximately a 1-3-6 concrete, determine the quantity of cement used.

868. If the surface finish in problem 854 be a 1-2-0 mixture and the volume after adding the cement to the sand be the same as that of the sand, what is the amount of cement required for the finishing coat?

CHAPTER XIX.

FARM ACCOUNTS.

No farmer can know just where he stands financially unless he keeps an accurate account of his daily, weekly, monthly, and yearly business transactions. A farm account book is a matter of economy and satisfaction. It is a protection in case of dispute or death. It assists a farmer to become quick and accurate in figures and increases his knowledge of business methods. It gives him positive knowledge, and consequently his opinions have greater weight than the opinions of those who merely guess.

Farm inventory. An inventory is a detailed account or schedule of the farm and what is on it. This includes land, stock, machinery, tools, hay and grain, household goods, notes, cash, accounts against others, and all property having money value.

869. A certain farm consisting of 75 acres of land is worth $125 an acre. The other assets are as follows: Two horses, worth $185 each; two horses, worth $130 each; six cows, average value $60; three brood sows, $20 each; 30 sheep, $8 each; 150 hens, $1 each; corn in crib, 400 bushels at 60 cents a bushel; 320 bushels of wheat, $1 a bushel; 16 tons of hay at $10 a ton; one two-horse wagon, $75; one wheat harvester, $100; one corn planter, $30; one buggy, $60; 2 plows, $8 each; 4 single cultivators, $4 each; other farm machines and tools, $550. Arrange the inventory by schedule and indicate the total assets.

How to arrange inventory:

INVENTORY, JANUARY 1, 1914.

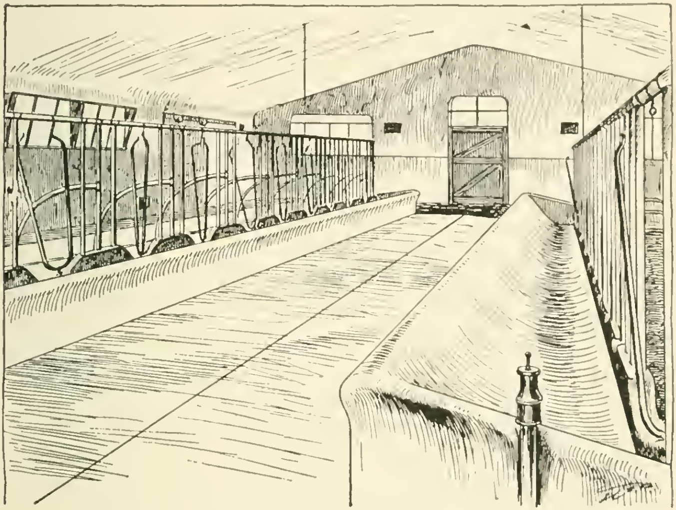
75 acres with improvements, $125.00 an acre	$9,375.00
2 horses, $185.00 each	370.00
2 horses, $130.00 each	260.00
6 cows, $60.00 each	360.00
3 brood sows, $20.00 each	60.00
30 sheep, $8.00 each	240.00
150 hens, $1.00 each	150.00
400 bushels corn, $0.60 a bushel	240.00
320 bushels wheat, $1.00 a bushel	320.00
16 tons hay, $10.00 a ton	160.00
1 two-horse wagon	75.00
1 wheat harvester	100.00
1 corn planter	30.00
1 buggy	60.00
2 plows, $8.00 each	16.00
4 cultivators, $4.00 each	16.00
Other farm machines and tools	550.00
	Total $12,382.00

Liabilities. The liabilities or debts—that which is owed on mortgages, notes, accounts, etc.—should also be listed. The difference between one's assets and liabilities is what he is worth. A new inventory should be made out each year. By comparing these inventories year by year one can tell whether his property is increasing or decreasing in value—whether he is accumulating wealth or is running behind.

870. Make out an inventory as indicated in problem 869, itemizing the assets of your father's farm or some other farm in your community.

Keeping a record of receipts and disbursements. Provide a ruled blank book of reasonable size. Use the first pages for the inventory. Where this leaves off turn a page, marking at the top, the word "Receipts"; and on the opposite page at the right the word, "Expenditures." As money is paid out or received in cash, enter it on the book by date and amount. Do this to the end of the month, and then balance the account.

Now turn to next two pages and write "Receipts" and "Expenditures" as before. In case there is a balance on hand after closing the account of the previous month, enter the same under "Receipts" as "Balance brought forward." In case there is a deficit, enter this under "Expenditures" as "Deficit brought forward." By so doing from month to month, you have a definite statement showing whether you are making or losing money.



INTERIOR OF COW BARN, SHOWING CONCRETE CONSTRUCTION.

871. Suppose on January 1, 1914, a farmer has on hand $40 in cash. He starts his account book. On January 4, he pays out for labor to John Smith, $36; on January 6, he pays $24 for a ton of wheat bran; on January 7, he is paid $16 for a calf; on January 9 he is paid $42 for corn; on January 16 he sells his wheat and gets $1.04 a bushel for 350 bushels. On January 17, he pays $16 for three shotes. Other receipts are as follows: Four tons hay at $14 a ton on January 21; 1 colt on January 26, $75; and on January 31, a trio of sheep, $20. Indicate the transactions for the month, and amount of balance on hand or deficit to be carried forward:

Left-hand page.

RECEIPTS.

1914		
Jan. 1	Cash on hand	$ 40.00
Jan. 7	1 calf	16.00
Jan. 9	Corn	42.00
Jan. 16	350 bushels wheat at $1.04	364.00
Jan. 21	4 tons hay at $14.00	56.00
Jan. 26	1 colt	75.00
Jan. 31	3 sheep	20.00
	Total	$613.00

Right-hand page.

EXPENDITURES.

1914		
Jan. 4	John Smith for labor	$ 36.00
Jan. 6	1 ton wheat bran	24.00
Jan. 17	3 shotes	16.00
	By Balance	537.00
	Total	$613.00

Note.—Starting the month of February, the $537 would be entered on page devoted to "Receipts" under date of February 1, as *balance brought forward.* Other items of "Receipts" would be entered in order under this from day to day as received. The same would apply to "Expenditures." Both "Receipts" and "Expenditures" are to be carried right on through the year, month by month. At the end of the year, if there is any surplus on hand, it will go into the inventory of the next year as an asset. If there is a deficit due to loss or purchase the amount will be carried over as a liability.

Detailed accounts. Only one book is necessary for farm accounts. Of course, one or more may be provided, using one for live stock, another for poultry, another for grain crops, another for farm hands, etc., in addition to the inventory and current "Receipts and

Expenditures" book. Whether one or more books are used, the pages should be regularly numbered, and when an account is carried forward the number of the page from which it is brought should be written at the top of the new page, and the number of the page to which it is carried should be written at the bottom of the page from which it is taken.

Grain crops. When but a single grain crop is raised, but one account need be opened for any one year. When more than one crop is raised, a different account should be opened for each crop. The same book may be used, with separate accounts opened on different pages. The following will indicate the account with wheat:

1912		Dr.	Cr.
Aug. 30	To man and team, 10 days plowing, 15 acres	$ 30.00	
Sept. 15	Preparing land, 5 days	15.00	
Oct. 1	20 bushels seed wheat at $1.50	30.00	
Oct. 3	3 days drilling	6.00	
1913			
June 30	6 men and 2 days cutting..	15.00	
July 20	Threshing 400 bushels	16.00	
July 20	10 men, threshing, 1 day	15.00	
July 24	Hauling wheat to market	5.00	
July 26	Received for 300 bushels		$300.00
Sept. 1	Sold 100 bushels for seed at $150.00		150.00
	Totals	$132.00	$450.00
	Profit		$318.00

Note.—The account with corn, oats, fruit, dairy, hay, poultry, and every kind of stock or produce may be kept in exactly the same way. The profit, of course, ought to exceed the sum of the interest on the investment in land, teams, and machinery, the cost of the labor, fertilizers, etc., and the deterioration in values.

872. Itemize the cost of producing 20 acres of wheat, giving all details as performed in your section from plowing to marketing. If the yield is 22 bushels an acre, what is the profit if the wheat brings $1.04 a bushel?

873. Arrange these items as illustrated above for this wheat crop.

874. Itemize the cost of producing 20 acres of corn, giving all details as performed in your section from plowing the land to cribbing the corn. Value the corn at current price and determine the profit on the 20 acres.

To the Teacher: Require each pupil to estimate cost of producing a ten-acre crop of each of the principal farm crops raised in the community. Then require the pupils to estimate the average yield an acre that is necessary in order to meet the cost of production.

CHAPTER XX.

MISCELLANEOUS PROBLEMS.

Note.—The data involved in the following problems are contained in the statements given on other pages of this book. Pupils will find it necessary to refer back to the tables in order to get the needed facts and figures. The purpose of these problems is to acquaint each pupil with such work, because this is just what he will need to do later when he carries on agricultural operations for himself. Much interest is centered in these problems also because of the reasoning exercised in their solution.

Nature of the problem. A man owns a farm containing 75 acres. He keeps 4 horses, 12 cows, 6 brood sows; raises each year 80 fat hogs, and 10 calves which he sells; he also sells 400 bushels of wheat, 500 bushels of potatoes and various other farm products. He has a two-acre orchard and an acre garden from which he gets fruit and vegetables for himself and family. His farm is equipped with a silo, necessary barns and sheds, and farm tools and implements. The milk obtained from the cows is made into butter and sold to private trade, each pound bringing 30 cents the year round. The horses are used for driving and the farm work. Most of the corn, hay, and other grain raised is fed to live stock.

1. How many pounds of nitrogen, phosphoric acid, and potash are sent away from this farm each year if 400 bushels of wheat are annually sent to market?

2. How many pounds of these three elements are annually removed from the soil by the average wheat crop of the whole of your county?

3. If every pound were returned to the land in fertilizer, what would be the cost if nitrogen is worth 20 cents

a pound, phosphoric acid 5 cents a pound, and potash 5 cents a pound?

4. A certain soil contains 4,800 pounds of nitrogen, 6,700 pounds of phosphoric acid, and 16,400 pounds of potash in the first 8 inches. How many crops of wheat would the nitrogen in this soil supply, supposing that none of the nitrogen is withdrawn in any other crop or is lost, and no additional nitrogen is added to the soil? How many years would the phosphoric acid hold out? How many the potash?

5. If the wheat straw, two tons an acre, is annually restored to this land, how many years will it take to entirely exhaust the soil of these three elements of plant food?

6. This farmer does not permit his land to run down. He uses a wheat fertilizer on his wheat consisting of 1,200 pounds of dissolved bone, 500 pounds of sulphate of ammonia, and 300 pounds of muriate of potash. He uses 250 pounds of this mixture an acre. State the percentages of nitrogen, phosphoric acid, and potash in this mixture.

7. If 300 pounds of this mixture were used on each acre, how many pounds of potential plant food would be added to the soil?

8. When 22 bushels of wheat and one ton of straw are removed how many pounds of plant food will be drawn out of the soil?

9. How many pounds of the fertilizer mixture mentioned in Problem 6 will be required to equal the draft of the wheat crop mentioned in Problem 8?

10. The farmer decides to try a new fertilizer he finds advertised. This fertilizer analysis is known as an 8-3-3,

or one analyzing 8 per cent phosphoric acid, 3 per cent nitrogen, and 3 per cent potash. The ingredients used are acid phosphate, sulphate of ammonia, and kainit. How many pounds of each of these will be needed to make a ton of the mixture that is to be an 8-3-3 fertilizer?

11. What is the value of this fertilizer mentioned in Problem 10, on basis of plant food if nitrogen costs 20 cents, phosphoric acid 5 cents, and potash 5 cents each a pound?

12. What is the money value of a fertilizer that analyzes 7-3-4?

13. What is the money value of a ton of fertilizer composed of 1,600 pounds of acid phosphate and 400 pounds of kainit?

14. Of another fertilizer that contains 1,600 pounds of acid phosphate and 400 pounds of muriate of potash?

15. Of another one that contains 1,600 pounds of acid phosphate, 200 pounds of kainit, and 200 pounds of muriate of potash?

16. A fertilizer agent tries to induce this farmer to purchase a new fertilizer analyzing 2.4 per cent of ammonia, 9 per cent of phosphoric acid, and 2 per cent of potash. What is this fertilizer worth a ton?

17. A neighbor farmer has been using a fertilizer containing 8½ per cent of phosphoric acid, 1 per cent of nitrogen, and 2 per cent of potash. The cost is $25 a ton. Another neighbor uses a fertilizer that costs $26 a ton but analyzes 5 per cent phosphoric acid, 3 per cent nitrogen, and 1½ per cent potash. In which fertilizer is the more plant food secured?

18. If the price of the fertilizer that sells for $25 a

ton is right, at what price a ton should the fertilizer bought by the neighbor be sold by the ton?

19. What is the nutritive ratio of corn, clover hay, and alfalfa hay?

20. On this farm there are available for feeding the dairy cows corn silage, clover hay, cottonseed meal, and wheat bran. The cows weigh 1,000 pounds and average 22 pounds of milk a day. Using these feeding stuffs, compound a ration containing these feeds that will approximate the standard for such animals.

21. What is the daily cost per cow for feeding the above ration when corn silage is worth $2 a ton, clover hay $12, cottonseed meal $32, and wheat bran $28?

22. A neighbor has a herd of similar cows. He feeds timothy hay, corn stover, corn meal, wheat bran, and oats. How many pounds daily of each of these foods should be fed in order to approximate the standard, the cows yielding 22 pounds daily?

23. What is the daily cost of the ration provided in Problem 22, when timothy is worth $18 a ton, corn stover $6, corn meal $30, wheat bran $28, and oats 50 cents a bushel?

24. This farmer feeds his work horses a ration consisting of corn, oats, wheat bran, and timothy hay. How many pounds of each feed may he give each horse per day, the horses weighing approximately 1,000 pounds each and doing moderate or medium work?

25. If each horse is fed the above ration throughout the year, what will be the cost of the food consumed when corn at the farm is worth 65 cents a bushel, oats 56 cents, wheat bran $28 a ton, and timothy hay $18 a ton.

26. A neighbor feeds his horses of the same weight 10 pounds of hay and 14 pounds of oats each day. What does his horse feed cost per day per horse if hay is worth $18 a ton and oats 56 cents a bushel?

27. Another neighbor, with similar horses, uses 10 pounds of hay, 9 pounds of corn, and 2 pounds of oil meal. If corn is worth 65 cents a bushel and oil meal $30 a ton, what is the cost per day for feeding a horse on this neighbor's farm?

28. Compare the digestible nutrients of the two rations suggested in Problems 26 and 27. Which is the cheaper ration and what is the difference in cents?

29. Suppose 10 horses are kept on a farm, what is the difference in dollars between the two rations?

30. Two neighbors are dairy farmers. Each has 40 cows in his herd. Dairyman A feeds daily 8 months the following ration to his cows: 58 pounds of silage, 6.8 pounds of mixed hay, 2 pounds of oil meal, and 2 pounds of wheat bran. Dairyman B feeds the following ration: 4.7 pounds of corn stover, 6.4 pounds of mixed hay, 2.5 pounds of oil meal, 5 pounds of corn meal, and 6 pounds of bran. The feeds are worth at each farm the following prices: Corn silage, $2 a ton; corn stover, $6 a ton; mixed hay, $12; linseed oil, $34; wheat bran, $34; and corn, $30. Determine the daily cost of the two rations. The difference in dollars for 40 cows covering the 8 months or 240-day feeding period.

31. The 10 cows on this farm are known as good butter cows. The average per cent of butter fat for the entire herd is 5.2 per cent. They yield 220 pounds of milk on an average each day of the year. What is the average daily production of butter fat in pounds? This is equivalent to how many pounds of butter?

32. A neighbor has 25 cows. Ten of them yield 40 pounds each, daily; another ten, 32 pounds; the other five, 20 pounds a day. The fat test of the first group is 3.8 per cent, of the second group 4.5 per cent, and of the third group 5.2 per cent. What quantity of fat is daily produced by this herd?

33. Suppose the fat test of the first group to be 5.2 per cent and of the third group 3.8 per cent, the second group remaining just the same. What quantity of fat would be produced daily?

34. In a can is a certain quantity of milk that tests 4.8 per cent; in another can is a certain quantity that tests 2.8 per cent. The amount of butter fat in both cans is 40 pounds, one-fourth of which is in the first can. How much milk in each can?

35. In the herd on this farm there is one cow that yields 12,000 pounds of milk that tests 3.2 per cent butter fat. How does her butter fat production compare with another cow that yields 9,400 pounds of milk that tests 5.8 per cent butter fat? At 40 cents per pound for butter how much in dollars does this difference amount to?

36. Compare the amount of plant food—nitrogen, phosphoric acid, and potash—removed in 400 bushels of wheat and in 400 bushels of potatoes.

37. With nitrogen worth 20 cents, phosphoric acid 5 cents, and potash 5 cents, what is the plant food worth that is removed in the wheat? In the potatoes?

38. How many tons of silage should be stored for the use of 10 cows, the intention being to feed each cow 40 pounds a day for 5 months, then 30 pounds a day for 2 months, then 20 pounds a day for 2 months?

39. If 14 tons of silage is grown to an acre, how many acres will be necessary to grow the supply required for this 10-cow herd?

40. It is advisable to feed not less than 2 inches of silage out of the silo each day to insure that it does not spoil on top. If a minimum of 300 pounds is fed a day, what should be the diameter in feet of the silo?

41. A neighbor desires to build a silo? He has 40 cows in his herd. At times he expects to feed as little as 800 pounds of silage a day. What should be the diameter in feet of his silo?

42. He expects to feed his cows for 240 days, averaging for this period 35 pounds of silage a day for each of the 40 cows in his herd. With the diameter selected in Problem 41, what height of silo will be required in order to store the full amount of silage wanted?

43. How many staves will be required for a round silo that is to be 16 feet in diameter and 34 feet high, the staves being 6 inches wide and 2 inches thick?

44. How many staves and how much lumber will be required to build the silo of the dimensions called for in Problem 42, the staves being 3 inches thick and 8 inches wide?

45. The farm under discussion contains 75 acres in the form of a square. What is the length of each of the four sides? The diagonal?

46. A neighbor's farm contains 80 acres, rectangular in shape. The length is just twice the width. What is the length of the side? Of the end?

47. On this farm is a circular cistern 7 feet in diameter and 7 feet deep. How many gallons will it hold when full?

48. When disposing of his calves the farmer is paid $50 each for 4 pure breds, $25 each for 4 grade yearlings, and $6 each for two calves. He sells 80 hogs, 60 of them in the summer. They average 226 pounds, and he is paid $7.35 per hundred. He sells 12 hogs during the winter at $8.15 per hundred, the twelve averaging 195 pounds each. The other 8 he slaughters at home. They "dress out" 84 per cent, and bring 12 cents a pound. What was the total sum received for the 10 calves and the 80 hogs?

49. If these transactions were entered in an account, show how the facts in Problem 48 could be entered so as to give all the information and show the total receipts.

50. Prepare an inventory of a 75-acre farm, placing in it the land and animals as mentioned, with valuations as typical of your community, and include all other tools, implements, and appliances that would be customarily used in your section on such a farm, and that would be expected if the work were properly done. Make an estimate of the respective values of these tools and implements.

ANSWERS TO PROBLEMS

CHAPTER I

2. 130; 1,870. 3. 94; 152. 4. 691.5. 5. 70.5 + 304 = 374.5. 8. 138; 54; 36. 9. 44.2; 17.3; 11.5; 73; 884; 346; 230. 10. 33.6; 12.8; 9.6. 11. 0.74; 0.25; 0.99; 52; 20; 36; 12; 6; 18. 12. 243.4; 89.7; 51.2. 13. Wheat 19.3; 7.6; 5.0; oats 19.2; 7.3; 5.5; cotton 0.50; 0.17; 0.66; corn 31.3; 11.5; 6.6; timothy 28.6; 11.0; 19.8; potatoes 10.2; 5.1; 15.3. 15. 71.3; 23.5; 62.6. 16. 10.7; 4.5; 4.6. 17. 33.6; 12.1; 34.3. 20. 452. 21. 105; 469; 1,255. 22. 158; 555; 3,263. 23. 42.8; 179.5; 260.6. 24. 97.5; 367; 2,472. 25. 285; 937 3,547. 26. 6,168; 25,570; 24,723. 28. 400. 29. 280. 31. 18. 32. 86. 33. 280. 34. 250. 35. 1,000; 960; 250. 36. 20; 21; 80. 37. 96; 176; 26. 38. 4.8. 39. 8.8. 40. 1.3. 43. 44; 201; 103. 44. 17.4. 45. 86; 313; 103. 46. 25. 47. 7.3; 3.3; 1.8. 48. 29.2; 13.3; 7.2. 49. 7.3; 2.8; 2.5. 50. 14.6; 5.6; 5.0. 51. 36.5; 14.0; 12.4. 52. 7.0; 4.3; 9.6. 53. 9.0; 6.8; 7.5. 54. 46.6. 55. 49.3. 56. 1,142; 375; 480. 57. 872; 714; 392. 58. 857; 0; 357; 104: or 857; 312.5; 0; 104: or 857: 156; 179; 104: or etc. 60. $19 per ton. 61. $13.70. 62. $21.20. 63. $17.45. 65. $17. 66. $11. 67. $20. 68. $28. 69. 2. 70. No. 2; No. 1. 71. $22.65. 72. 8 per cent. 74. 2.5 per cent. 75. 3 per cent. 76. 48.5. 77. 33. 78. 49.4. 79. Nitrogen 1.6; phosphoric acid 8; potash 8; $20.80.

CHAPTER II

80. 1,506; 50; 80; 118; 228; 18. 81. 15.3; 306. 82. 70.4. 83. 1,577. 84. 543.8. 86. 1.72; 32.4; 0.68. 87. 88. 88. 55.3. 89. 1.98; 37.2. 90. 12 pounds; 223 pounds. 91. 2.4. 92. 206. 93. 244. 96. 1 to 1.3; 1 to 16.1; 1 to 5.9; 1 to 3.9; 97. Wide are timothy hay, corn; Medium are wheat, oats, clover hay, alfalfa hay; Narrow are cottonseed, cottonseed meal. 99. 12.5. 102. 6.8. 103. 4.1. 104. 6.2. 105. 5.9. 106. For 11 pounds milk daily, feed for each cow per month in pounds, 750, 48, 300, 9; feed for 20 cows per year in tons, 91, 6, 36, 5, 1. For 22 pounds milk corresponding quantities are 900, 105, 390, 15 and 110, 13, 48, 2. 109. 14; 1; 1; 6; 1 to 7.5. 112. 4.3 cents. 113. 2.9. 114. 510. 115. 1.27 cents. 116. $15.42; 24.7 cents. 117. 1.13 cents. 118. 28.3 cents. 119. $3.68. 120. 2.41. 121. $26.08. 122. $21.18. 123. $18.61. 124. $21.76. 125. $14.62. 126. 0.97 cents or 86 per cent. 127. $1,000 per 100 tons of hay, or $1,940 per 100 tons of nutrients, or $925 too much for 100 tons of timothy hay

which should cost but $10.75 per ton. **128-129.** No exact answers can be obtained when limited to the feeds named.

CHAPTER III

132. 0.68 pounds more in ribs. **133.** 0.16; 1.74 more in ham. **134.** 6.2; 37.9. **135.** 0.8 pounds more in wheat flour, or 0.3 pounds more in corn meal if fat be reduced to carbohydrate equivalent. **136.** 4.1. **137.** 2.9. **138.** 2.6 times that needed. **139.** 1.8 times that needed. **140.** As in 128 and 129 the standard can be only approximated. The standard itself is only an average. The requirement for a given individual may differ greatly from this average. **145.** 2.58 pounds. **146.** 39 cents. **147.** 33 1-3 cents. **148.** 25 cents. **149.** 6.4 cents. **150.** 0.58 pounds. **151.** 1.61 pounds. **152.** 28.1. **153.** 15.4 pounds. **154.** Depends; try to make balanced ration. **155.** Depends on food used. **156.** 78. **157.** 270. **158.** 202.5. **159.** 10,500 pounds. **160.** 63. **161.** 47.3. **162.** 222.8. **164.** 4.3; 8.7; 6.5. **165.** 4.3. **166.** 6.5. **167.** 3.3. **168.** 4.3. **169.** 2.8.

CHAPTER IV

170. 6.6. **171.** 6.0. **172.** 1.03. **173.** 42.8 per cent. **174.** 85.9. **175.** 0.76. **176.** 3.3. **177.** 4.3 **178.** 5.7. **179.** 1,718. **180.** 15.2 **181.** 66. **182.** 86. **183.** 114. **184.** 1.08 pounds. **185.** 30.4 pounds. **186.** 38.9 pounds. **187.** 34.1. **188.** $1.20. **189.** 28.4. **190.** 900 pounds. **191.** 4. **192.** 200 pounds; 1,000 pounds. **193.** 156 pounds. **194.** $48; $87. **195.** The second; 24 pounds. **196.** 42.86 pounds; 7.1 pounds. **198.** $53.90. **199.** $37.63. **200.** 10,285.7 pounds. **201.** 24. **202.** 4,381. **203.** 4 pounds. **204.** 1 pound. **205.** ¼ pound. **206.** 23.4 pounds. **207.** 93.6 pounds. **208.** 374.73 pounds. **209.** $93.68. **210.** $23.42. **211.** $5.85. **212.** 1.9 pounds. **213.** 177 pounds. **214.** 327.3. **220.** 260. **221.** 1,660. **222.** 20. **223.** 60. **224.** 1 to 199. **225.** 88.5 pounds fat or 103.3 pounds butter. **226.** $25.82. **227.** 740 pounds. **228.** 680 pounds. **229.** 480 pounds. **230.** 100 pounds. **231.** 1 to 3.4. **232.** $300. **233.** 55.1. **234.** 26 cents ash not included. **235.** 78 cents. **236.** 2.58. **237.** $4. **238.** $2.80. **239.** $1.33. **240.** $1.23. **242.** 66.4 cents. **243.** $1.25. **244.** 20 cents; 25 cents; 97 cents. **245.** $1.45. **247.** 206 pounds. **248.** 544.5 pounds. **249.** $5.40.

CHAPTER V

250. 17.6; 16.5. **251.** 17.1. **252.** 1,113 tons. **253.** 196 tons; 189.5 tons. **255.** 1 2-3. **256.** 3.4. **257.** 3,606; 5,543; 8,592. **258.** 2,111.9; 3,076; 5,142. **259.** 5,718; 8,619; 13,734. **260.** 119. **261.** 408. **262.** 460.9. **263.** 78; 335.3; 223.3. **264.** 57.3. **265.** 136. **266.** 1.2. **267.** 219 in upper one foot if dry soil weighs 80 pounds. **268.** 328. **269.** 394. **270.** 49.8%. **271.** 80.49. **272.**

1,088. **273.** 714. **274.** 374. **275.** 3.3. **276.** 2.96. **277.** 3.67. **278.** 5.95. **279.** 23.5. **280.** 101. **281.** 40. **282.** 3.6. **283.** 50.

CHAPTER VI

284. 25.6 increase; 4.3 decrease; 20.3 increase. **286.** 94,875,444.8; 98.532,818.5; 8.5 per cent. decrease. **287.** 9.07; 9.84. **288.** 25,111,680,000 bushels; $13,862,540,800. **289.** $8.71; $14.50. **291.** 524.2 bushels. **292.** $162.50. **293.** 3.76 per cent; 391,149,000. **294.** 56.2 cents; 96.2 cents. **295.** 52,680,000; 44,376,623; 23.2. **296.** $2,096,700,000; $20,967,000,000. **297.** $7.03; $14.81. **298.** 2,054,920. **299.** 320.4. **300.** $180. **301.** 6.5. **302.** 1.36 barrels. **303.** 62,127,272 bushels. **304.** 658,127,272. **305.** 7.2. **306.** 25,272,728 bushels. **307.** $24,342,364. **308.** 4,670,325,000; 5,266,800,000. **309.** 164.4. **310.** 0.33. **311.** $34.32; $66.13. **312.** 6.9 cents; 13.4 cents; $22.03 in 1909. **313.** $860.89; 12.8 per cent. **314.** 10,640,000,000. **315.** $22.74; 1.14 cents; $3.76; $25.79. **316.** 28.4 bushels; $11.79; 31.4 bushels; $7.34. **317.** 22.5 bushels; $12.01; 26.8 bushels; $9.30. **318.** 13.4 bushels; $9.27; 12.5 bushels; $6. **319.** 16.9 bushels; $10.65; 13.9 bushels; $6.13. **320.** 35.8 bushels; $26.28; 25.6 bushels; $22.45. **321.** 41.5 cents; 23 cents. **322.** 53 cents; 35 cents; 69 cents; 48 cents; 63 cents; 51 cents. **323.** 73 cents; 88 cents; 1.6 cents; 2.0 cents. **324.** 1.6. **325.** 2.5 tons; 1.3 tons. **326.** 1.1 tons. **327.** $281,318,400. **328.** 72,301,852; 97,607,500; $8.44. **329.** 389,387,000; 59,228,400. **330.** 99,525,996. **331.** 43 cents. **332.** 60 cents. **333.** 44,262,592. **334.** $35,410,074. **335.** 11,803. **336.** 3.33. **337.** 2.1. **338.** 0.47 pounds. **339.** 9. **340.** 11,880. **341.** 99 bushels. **342.** 148.5 bushels. **343.** 118.8 bushels if one ear to stalk; 178.2 bushels if one and one-half ears to stalk. **344.** 114.6 bushels. **345.** 91.7 bushels; $11.46. **346.** $2 per acre. **347.** $127,609,481. **348.** $153,131,378. **349.** 78; 87; 94. **350.** 20.5 per cent better; 8.97 per cent. better. **351.** 3,139,500. **352.** 96 per cent. **353.** 266,000 bales or $17,590,000. **354.** $26,334,000. **355.** $16,022,000. **356.** $31,600,800. **357.** 5,266,800. **358.** $140,448,000. **359.** $560,-439,000; $632,016,000. **360.** 9.5. **361.** $55.19. **362.** $22.92. **363.** $54.60; $30.16; 230.5 per cent. in acreage; 498.2 per cent. in total value; and 81.0 per cent. in value per acre.

CHAPTER VII

374. 272. **375.** 17,152. **376.** 1,088. **377.** $217.60. **378.** $1,285.12. **379.** $5,140.58. **380.** 2 pecks; 1 bushel; 2 bushels; 4 bushels; 8 bushels; 16 bushels. **381.** 348. **382.** $1,531.20. **383.** 120. **384.** $118.80; $51; $67.80. **385.** Yes. **386.** 11.50 on the ¼ acre. **387.** $18. **388.** $350. **389.** $360; $540; $180. **390.** 18.5 per cent.; 33 1-3 per cent; 100 per cent. increase per tree; 33 1-3 per cent. 391. 156. 392. 804; 924. 393. $69. 394. 90 cents. 395. Commercial is 50 cents cheaper per barrel. 396. Lost $5.34.

CHAPTER VIII

397. $1,562,444,378. 398. $2,505,207,426; 160.3. 399. $582,606,378; 23.3. 400. $407,824,465; $11,011,261. 401. $233,042,551; $377.70. 402. $5,296,422; 77.6. 403. 63,773,239. 404. 23,010,998; 4,623,860; 59,291,344; 52,487,062; 2,452,047. 405. $20.33. 406. $1,129,195,120. 407. 61,355,014. 408. 83.7; 9.6; 12.1; 85.9. 412. 16. 414. Slightly less than 27 inches. 415. 71.25 inches. 416. 71.25 inches; 71.25 inches. 417. 24.8 inches. 418. 62 inches; 62 inches. 419. 17.5 hands or 70 inches. 420. 70 inches. 421. 28 inches. 422. Slightly more than 9.33 inches. 424. 25.08 inches; 18.92 inches. 425. 19.84 inches. 427. 2.84 pounds; 2.33 pounds. 428. 6.9; 8.5. 429. 752.4; 1,401.3. 430. 86.2. 431. $6.62; $10.60. 432. 2,557.15 pounds; 781.11 pounds; 1,467.81 pounds; 2,043.75 pounds. 433. $31.48; $72.68; $118.64; $183.02. 434. $39.06. 435. $95.41. 436. $143.06. 437. $204.57. 438. $7.58; $22.73; $24.42; $21.55. 439. About 26 months (middle third period); About 18 months; About 10 months; About 5 months; At the earliest possible date. Note: The average cost of any period is reached at about the middle of the period. 440. 5.4 cents; 44.6 per cent. 441. $216. 442. $300; $516. 443. 12.8 per cent.; 10.4 per cent. 444. $227.50. 445. 6.8. 446. 8.3. 447. 9.68 cents. 448. 13.21 cents. 449. 22.23 cents 450. 11 cents. 451. 19.46 cents. 452. 9.57 cents. 453. $70. 454. $42.53. 455. $5.14. 456. $68.27. 457. $12.62. 458. $79.09. 459. 7,200 pounds; 4,320 pounds. 460. $828. 461. $332.80. 462. $209.52. 463. $123.28. 464. 58.8. 465. 33.75. 466. $3. 467. $4.01. 468. $3. 469. $1.99. 470. $1.50. 471. 15 cents. 472. $2 profit. 473. 65 cents. 474. 4,012.5. 475. 280,599,808; 224,479,846. 476. 1,599,418,906 dozen. 477. 49.63 cents; $140,188,333.25. 478. $308,687,848. 479. $523,876,182.11. 480. 12.4. 481. 7.4. 482. 7.1. 483. 3.6. 484. 2. 485. 1.9.

CHAPTER IX

486. 4.6 hours; 41 minutes. 487. 85. 488. 1.65 hours; 0.18 hours. 489. 9.2. 490. 65. 491. 30 minutes; 10.4 minutes. 492. 19.9; 19.2. 493. 17.6 hours; 8.1 hours. 494. 40.8 cents; 16.5 cents. 495. 19 cents; 10 cents. 496. 9.6 cents; 4.0 cents. 497. 6.0 cents; 2.7 cents. 498. 3.1 cents; 2.3 cents. 499. $4.03; $1.64. 500. Rye 2.64 hours; 1.01 hours; 18.9 cents; 15.9 cents. Sweet potatoes 3.02 hours; 1.16 hours; 32.7 cents; 9.8 cents. Tomatoes 2.16 hours; 0.9 hours; 24.1 cents; 10.5 cents. Strawberries 26 minutes; 10 minutes; 5.8 cents; 2.4 cents. Beets 1.47 hours; 40.5 minutes; 10.8 cents; 6.7 cents.

CHAPTER X

502. 6,400 foot-pounds. **503.** 1,200 foot-pounds. **504.** 120,000 foot-pounds. **506.** 396,000. **507.** 49,005,000 foot-pounds; 29,403,000 foot-pounds. **508.** 150 pounds. **510.** 2½ miles per hour; 1 2-3 miles per hour. **511.** 1.2 horse-power. **512.** 3.25. **513.** 3.25 horsepower. **515.** 2-3. **516.** 0.8; 0.96; 1.76. **517.** 1.7 miles per hour. **518.** 10 miles per hour; 5 miles per hour; 3.3 miles per hour; 1.25 miles per hour. **519.** 3.3 miles per hour; 2.5 miles per hour. **520.** 1.1. **521.** 0.93; 0.67; 0.53. **522** 280 pounds. **523.** 2-15; 2-15. **526.** 30 inches. **528.** 100 pounds. **529.** 100 pounds. **530.** 200 pounds. **531.** 1⅞ miles per hour; 2.5 miles per hour; 3¾ miles per hour. **532.** 133 pounds; 83 pounds. **533.** 1¼ miles per hour. **535.** 6 2-3 per day; 6 per day; 10 per day. **536.** 200. **537.** 89. **538.** 100 pounds. **539.** 200 pounds. **540.** 300 pounds. **541.** 150 pounds. **542.** 200 pounds. **543.** 200 pounds. **545.** 5.04 pounds. **546.** 6.47 pounds. **547.** 3 horsepower. **548.** 4,500 pounds. **549.** 3.85 pounds. **550.** 2.8 miles per hour. **551.** 40; 48 hours or 4.8 days. **552.** 2.7. **553.** 2½. **554.** 1.78 (*i.e.,* two are more than sufficient). **555.** 3.59 pounds. **556.** 4.22 pounds. **557.** 3,527.36 pounds. **558.** 1,100 pounds. **559.** 121; 22. **560.** 121; 22. **561.** 3. **562.** 18. **566.** 3. **567.** 266. **568.** 88. **569.** 2.84 (*i.e.,* three will do it easily). **570.** 2. **571.** 101; 139; 173; 282; 253; 374. **572.** 16 per cent. **573.** 24 per cent. **574.** 40 per cent. **575.** 46 per cent. **576.** 32 per cent. **577.** 150 pounds; 46 per cent. **578.** 199; 290; 498; 755. **579.** High 29 pounds, low 3 pounds; High 22 per cent, low 2 per cent. **580.** 1½ miles per hour; .9 mile per hour. **581.** 23. **582.** 36. **583.** 937 pounds; 1,351 pounds. **584.** 1 1-3 miles per hour; 4-5 mile per hour. **585.** 22.4. **586.** 1.22. **588.** 28 pounds; 49 pounds; 21.5; 20.9. **589.** 15.7; 8.4. **590.** 6.4; 4.1. **591.** 2,549. **592.** 2,140. **594.** 1 to 30; 1 to 16. **595.** 52.8 feet; 12 feet. **596.** 3.2; 1; 8.30. **597.** 24 feet; 500 feet. **599.** 500 pounds;—100 pounds (*i.e.,* the team or the brakes must hold back with a force of 100 pounds). **600.** 235 pounds;—125 pounds; 640 pounds;—440 pounds. **601.** 6; 300 pounds. **602.** 2 1-3 miles per hour; 1.4 miles per hour (weight of horses not included, otherwise 1.1 miles per hour). The rule gives over 6 miles per hour, which, of course, is too high; As fast as safety will permit. **603.** More than one-half of the time. **604.** 9.4; 3 to 32 or about 1 to 11.

CHAPTER XI

606. 144. **607.** 5; 4; 8; 15. **609.** 32; 21.3; 60. **610.** 43; 9; 98. **611.** 216; 128; 756; 528; 900; 160; 213; 160. **612.** 3,061. **613.** \$137.75. **614.** 3,490. **615.** \$97.72. **616.** 5,712. **617.** \$171.36. **618.** \$109.50. **619.** \$25.50. **620.** \$222.25. **621.** \$553.61. **622.** 7,840. **623.** 900; 1,200. **624.** 11,520. **626.** 12,600 at 800 per square.

627. 19,000 at 800 per square. 628. 9 feet; ¾. 630. 20. 631. 113. 632. 3.22. 633. 1.4. 634. 1.4. 635. 954. 636. 47. 637. 41. 638. 831. 639. 29.4. 640. 12½. 641. 10½.

CHAPTER XII

642. $30; $15. 643. $37.50. 644. $38; $121.60; $319.20. 645. $324; $518; $4,147.20. 646. 5 cents; $2.50; $8; $1,152. 647. 83 1-3. 648. $364,963,185. 649. 8,726. 650. 69,808. 651. 7,300. 652. 7 tons. 653. 9.2. 654. 122½.

CHAPTER XIII

655. $299. 656. $465. 657. $12.77. 658. 14.3. 659. 53.8. 660. 150 bushels per acre. 661. $75. 662. 30,960 bushels; 11,040 bushels. 663. $5,520. 664. 15,480. 665. 180 per cent. more in the tiled. 667. 49; 98. 668. 24; 12. 669. 33; 16.5. 670. 20.2; 10. 671. 24; 48. 672. 5.4; 10.8; 2.7. 673. 12-inch; 20-inch. 674. 4-inch; 9-inch.

CHAPTER XIV

677. 113 square feet; 491 square feet; 804 square feet; 1,257 square feet; 37.7 feet; 78.5 feet; 100.5 feet; 125.7 feet. 679. 141.8 feet. 680. 160 feet. 681. 200 feet. 682. 29.1 feet. 683. 11.4. 684. 10,800. 685. 9,570. 686. $237.60; $210.54; $27.06. 687. 150. 689. 11.3 feet. 690. 13.8 feet. 691. 14.9 feet; 17.8 feet. 693. 108 tons in 180 days. 694. 307. 695. 208. 697. 337,920; 169. 698. 33.3 feet; 30 feet. 700. Use 4 square feet per cow. Diameter 11.3 feet; height 28 feet. 701. Account of 30-pound feeding use 4 square feet per cow. Diameter 11.3 feet; Height 37½ feet. Better build two, each 20 or more feet high. 702. Diameter 16 feet; Height 32 feet. 703. Diameter 18 feet; Height 36 feet. Or two, diameter 16 feet; Height 25 feet. 705. 100. 706. 96. 707. 13 tons more in square. 708. 28.3 feet. 709. 34.6 feet. 711. 126. 712. 95. 713. 153.

CHAPTER XV

722. 1,136 pounds. 723. 13.1 cents. 724. $27.72. 725. $56.52. 730. 84.8. 731. 201 pounds. 732. 8 cents. 733. 8 1-7 cents.

CHAPTER XVI

751. $3.28. 752. 640. 753. 0.7 acre. 754. $160 or 38 per cent. 755. $22.40 and interest every 16 years. 756. 9.9 per cent. 757. 2 2-15 acres. 758. 54,450. 759. $1,875; $1,575. 760. $530.40. 761. $1,200. 762. $28.84. 763. $160. 764. $131.16. 765. $3.28.

766. $196.74. 767. $7,870. 768. $106.54. 769. $15,000. 770. 750,000,000. 771. 125,000,000. 772. $37,500,000. 773. 41,666,-666.6. 774. 3,200. 775. 96,000. 776. 38,400,000. 777. $360. 778. 1,500; $60. 779. $9.40. 780. $134. 781. $102. 783. 102,000 pounds; 96,000 pounds; 84,000 pounds; 66,000 pounds. 784. 25.71 square inches; 5.1 inches; 5¾ inches. 785. 4.75 inches. 787. 560 pounds; 248.8 pounds; 2¼ times as strong. 788. 77.8 pounds. 789. 222 pounds. 790. 1,020 pounds; 960 pounds. 791. 312.5 pounds. 793. 1,600 pounds; 710 pounds. 794. 7.14 inches; 4 planks bolted together. 795. 71 pounds. It would, of course, stand many times this weight. 796. 67 pounds. 797. 62 pounds; 250 pounds; 560 pounds. 798. 76 pounds; 64 pounds; 76 pounds. 799. 23.2 feet. 800. 9.1 inches. 801. 12 inches, if yellow pine, to carry 1.5 tons.

CHAPTER XVII

802. 7½. 803. 41½. 805. 53 1-3. 808. 47 feet, 8 inches. 811. 1,620. 812. 3,020.8. 813. 5 feet 2 inches. 814. 5 feet 10 inches. 815. 115. 816. 5 feet. 817. 30.6. 818. 5.83 feet. 819. 7 feet 6 inches. 820. 200. 821. 288. 822. 32.7. 823. 59.6. 824. 2. 825. 3½. 826. 1,113. 827. $7.80. 828. 17 cents. 829. 20.4 cents. 830. 21 cents. 831. 24.9 cents. 832. $58.40. 833. $36.50. 836. 1.96 acres. 837. 800. 838. 2.38. 839. 3.32. 840. $17.50. 841. 4.59. 842. 12.91. 843. 10.37. 844. 10.00. 845. 6.68. 846. 2.76. 847. 14.54. 848. 1.10. 849. 15.49. 850. 78.44.

CHAPTER XVIII

851. 2.2. 852. 6.9. 853. 9; 4.5 when tamped. 854. 2.96; 0.74 cubic yards. 855. 0.5 cubic yards. 857. 3; 5.5. 858. 1,300 feet. 859. 10.2 cubic yards exclusive of foundation. 860. 2.8 cubic yards for roof and ends. 861. 154 cubic yards. 862. With 6 inch ends added—1.8 cubic yards; 1.8 cubic yards. 864. 15.4 sacks; 1.6 cubic yards; 3.3 cubic yards; 12.6 sacks; 1.7 cubic yards; 3.4 cubic yards. 865. $13.89. 866. $11.76. 867. 680 sacks. 868. 11.4 sacks.

APPENDIX

APPENDIX

Table I. Feeding Standards for Farm Animals.

The Wolff-Lehman Standards for feeding farm animals are shown in the table below. They indicate the amount of food required daily per 1,000 pounds live weight.

Animal	Digestible nutrients					
	Dry matter	Crude protein	Carbohydrates	Fat	Sum of nutrients	Nutritive ratio
1. Oxen	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	1 :
At rest in stall......	18.0	0.7	8.0	0.1	7.5	11.8
At light work.......	22.0	1.4	10.0	0.3	9.7	7.7
At medium work....	25.0	2.0	11.5	0.5	12.0	6.5
At heavy work......	28.0	2.8	13.0	0.8	15.0	5.3
2. Fattening cattle						
First period.........	30.0	2.5	15.0	0.5	15.6	6.5
Second period.......	30.0	3.0	14.5	0.7	17.0	5.4
Third period........	26.0	2.7	15.0	0.7	17.2	6.2
3. Milch cows						
When yielding daily:						
11.0 pounds of milk	25.0	1.6	10.0	0.3	10.2	6.7
16.6 pounds of milk	27.0	2.0	11.0	0.4	12.2	6.0
22.0 pounds of milk	29.0	2.5	13.0	0.5	14.4	5.7
27.5 pounds of milk	32.0	3.3	13.0	0.8	16.0	4.5
4. Sheep						
Coarse wool.........	20.0	1.2	10.5	0.2	9.1	9.1
Fine wool...........	23.0	1.5	12.0	0.3	10.5	8.5
5. Breeding ewes.........						
With lambs.........	25.0	2.9	15.0	0.5	16.3	5.6
6. Fattening sheep						
First period.........	30.0	3.0	15.0	0.5	16.5	5.4
Second period.......	28.0	3.5	14.5	0.6	16.9	4.5
7. Horses						
Light work..........	20.0	1.5	9.5	0.4	10.0	7.0
Medium work.........	24.0	2.0	11.0	0.6	12.8	6.2
Heavy work.........	26.0	2.5	13.3	0.8	15.5	6.0
8. Brood sows	22.0	2.5	15.5	0.4	19.0	6.6
9. Fattening swine						
First period.........	36.0	4.5	25.0	0.7	31.2	5.9
Second period.......	32.0	4.0	24.0	0.5	29.2	6.3
Third period........	25.0	2.7	18.0	0.4	22.0	7.0

TABLE I. FEEDING STANDARDS FOR GROWING ANIMALS—*Continued.*

Animal	Per day per 1,000 lbs. live weight					
		Digestible nutrients				
	Dry matter	Crude protein	Carbohydrates	Fat	Sum of nutrients	Nutritive ratio
10. Growing cattle Dairy breeds Age in months / Average live weight per head, lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	1:
2- 3..........150......	23.0	4.0	13.0	2.0	21.0	4.5
3- 6..........300......	24.0	3.0	12.8	1.0	17.0	5.1
6-12..........500......	27.0	2.0	12.5	0.5	13.7	6.8
12-18..........700......	26.0	1.8	12.5	0.4	12.8	7.5
18-24..........900......	26.0	1.5	12.0	0.3	11.8	8.5
11. Growing cattle Beef breeds						
2- 3..........160......	23.0	4.2	13.0	2.0	21.5	4.2
3- 6..........330......	24.0	3.5	12.8	1.5	19.0	4.7
6-12..........550......	25.0	2.5	13.2	0.7	15.8	6.0
12-18..........750......	24.0	2.0	12.5	0.5	13.9	6.8
18-24..........950......	24.0	1.8	12.0	0.4	13.2	7.2
12. Growing sheep Wool breeds						
4- 6.......... 60......	25.0	3.4	15.4	0.7	18.4	5.0
6- 8.......... 75......	25.0	2.8	13.8	0.6	15.8	5.4
8-11.......... 80......	23.0	2.1	11.5	0.5	12.8	6.0
11-15.......... 90......	22.0	1.8	11.2	0.4	12.0	7.0
15-20..........100......	22.0	1.5	10.8	0.3	11.0	7.7
13. Growing sheep Mutton breeds						
4- 6.......... 60......	26.0	4.4	15.5	0.9	20.9	4.0
6- 8.......... 80......	26.0	3.5	15.0	0.7	17.8	4.8
8-11..........100......	24.0	3.0	14.3	0.5	16.3	5.2
11-15..........120......	23.0	2.2	12.6	0.5	13.8	6.3
15-20..........150......	22.0	2.0	12.0	0.4	12.8	6.5
14. Growing swine Breeding stock						
2- 3.......... 50......	44.0	7.6	28.0	1.0	38.0	4.0
3- 5..........100......	35.0	4.8	22.5	0.7	29.0	5.0
5- 6..........120......	32.0	3.7	21.3	0.4	26.0	6.0
6- 8..........200......	28.0	2.8	18.7	0.3	22.2	7.0
8-12..........250......	25.0	2.1	15.3	0.2	17.9	7.5
15. Growing, fatten'g swine						
2- 3.......... 50......	44.0	7.6	28.0	1.0	38.0	4.0
3- 5..........100......	35.0	5.0	23.1	0.8	30.0	5.0
5- 6..........150......	33.0	4.3	22.3	0.6	28.0	5.5
6- 8..........200......	30.0	3.6	20.5	0.4	25.1	6.0
9-12..........300....	26.0	3.0	18.3	0.3	22.0	6.4

Table II. Nutrients and Fertilizer Constituents of Common Feeding Stuffs.

The tables giving the average digestible nutrients and the fertilizing constituents in the following American feeding stuffs have been adapted from Henry's "Feeds and Feeding."

Name of feed	Total dry matter in 100 lbs	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude Protein	Carbo-hydrates	Fat	Nitrogen	Phosphoric acid	Potash
Grains, seeds and their parts	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Dent corn	89.4	7.8	66.8	4.3	16.5	7.1	5.7
Flint corn	88.7	8.0	66.2	4.3	16.8	7.1	5.7
Sweet corn	91.2	8.8	63.7	7.0	18.6	7.1	5.7
Corn meal	85.0	6.1	64.3	3.5	14.7	6.3	4.7
Corn cob	89.3	0.5	44.8	—	3.9	0.6	6.0
Corn-and-cob meal	84.9	4.4	60.0	2.9	13.6	5.7	4.7
Gluten meal	90.5	29.7	42.5	6.1	54.8	3.3	0.5
Gluten feed	90.8	21.3	52.8	2.9	40.0	3.7	0.4
Feed chop	90.4	6.8	60.5	7.4	16.8	9.8	4.9
Germ oil meal	91.4	15.8	38.8	10.8	34.7	3.9	2.1
Corn bran	90.6	6.0	52.5	4.8	17.9	10.1	6.2
Wheat	89.5	8.8	67.5	1.5	19.0	5.5	8.7
High-grade flour	87.6	10.6	65.1	1.0	19.2	5.7	5.4
Red dog flour	90.1	16.2	57.0	3.4	29.4	—	—
Flour wheat middlings	90.0	16.9	53.6	4.1	30.7	12.2	9.6
Wheat middlings	88.8	13.0	45.7	4.5	27.0	26.3	15.3
Wheat bran (all analyses)	88.1	11.9	42.0	2.5	24.6	26.9	15.2
Wheat feed	89.1	12.7	47.1	4.0	26.1	20.4	5.4
Wheat screenings	88.4	9.6	48.2	1.9	20.0	11.7	8.4
Rye	91.3	9.5	69.4	1.2	18.1	8.6	5.8
Rye flour	86.9	5.6	72.2	0.5	10.7	8.2	6.5
Rye middlings	88.2	11.0	52.9	2.6	22.9	12.3	9.6
Rye bran	88.4	11.2	46.8	1.8	23.3	22.8	14.0
Rye feed	87.6	12.6	56.6	2.8	25.1	7.7	4.7
Barley	89.2	8.4	65.3	1.6	19.2	7.9	4.8
Emmer (speltz)	92.0	10.0	70.3	2.0	18.4	7.6	5.7
Oats	89.6	8.8	49.2	4.3	18.2	7.8	4.8
Ground oats	88.0	10.1	52.5	3.7	19.7	7.6	5.0
Oat middlings	91.2	13.1	57.7	6.5	25.9	22.5	15.3
Oat feed	93.0	5.2	30.1	2.6	12.8	6.1	7.2
Oat hulls	92.6	1.3	38.5	0.6	5.3	1.6	4.9
Buckwheat	86.6	8.1	48.2	2.4	17.3	6.9	3.0
Buckwheat flour	85.4	5.9	63.0	1.2	11.0	6.8	3.4
Buckwheat middlings	87.2	22.7	37.5	6.1	42.7	12.3	11.4
Buckwheat bran	91.8	5.9	34.0	2.0	20.2	4.2	12.7
Buckwheat feed	88.4	15.6	38.2	4.4	29.3	15.8	10.5
Buckwheat hulls	86.8	1.2	28.6	0.5	7.3	4.3	14.7
Rice	87.6	6.4	79.2	0.4	11.8	1.8	0.9
Rice polish	89.2	7.9	58.6	5.3	19.0	26.7	7.1
Rice bran	90.3	7.6	38.8	7.3	19.0	2.9	2.4
Rice hulls	91.2	0.3	19.9	0.7	5.1	1.7	1.4
Canada field pea	85.0	19.7	49.3	0.4	37.9	8.4	10.1

TABLE II. NUTRIENTS AND FERTILIZER CONSTITUENTS OF COMMON FEEDING STUFFS.—*Continued.*

Name of feed	Total dry matter in 100 lbs	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude protein	Carbohydrates	Fat	Nitrogen	Phosphoric acid	Potash
Grains, seeds & their parts—Cont.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Canada field pea meal	89.5	16.8	51.7	0.7	32.3	8.2	9.9
Canada field pea bran	89.0	7.7	41.6	0.6	16.0	3.1	10.3
Bean meal	89.1	20.2	42.3	1.3	37.1	12.0	12.9
Cowpea	85.4	16.8	54.9	1.1	32.8	10.1	12.0
Soy bean	88.3	29.1	23.3	14.6	53.6	10.4	12.6
Horse bean	88.7	23.1	49.8	0.8	42.6	12.0	12.9
Kafir corn	90.1	5.2	44.3	1.4	17.9	—	—
Sorghum seed	87.2	4.5	61.1	2.8	14.6	8.4	3.4
Broom corn seed	87.2	4.6	42.2	1.5	15.8	7.2	5.2
Millet seed	87.9	7.1	48.5	2.5	17.4	6.5	3.3
Hungarian grass seed	90.5	6.4	48.8	3.3	15.8	4.7	3.8
Flaxseed	90.8	20.6	17.1	29.0	36.2	13.9	10.3
Linseed meal (old process)	90.2	30.2	32.0	6.9	54.2	16.6	13.7
Linseed meal (new process)	91.0	31.5	35.7	2.4	60.0	17.4	13.4
Cottonseed	89.7	12.5	30.0	17.3	29.4	10.5	10.9
Cottonseed meal	93.0	37.6	21.4	9.6	72.5	30.4	15.8
Cottonseed hulls	88.9	0.3	33.2	1.7	6.7	4.3	10.4
Palm-nut cake	89.6	16.0	52.6	9.0	26.9	11.0	5.0
Cocoanut cake	89.7	15.4	41.2	10.7	31.5	16.0	24.0
Sunflower seed	91.4	14.8	29.7	18.2	26.1	12.2	5.6
Sunflower seed cake	89.2	29.5	23.3	8.0	52.5	21.5	11.7
Peanut kernels (without hulls)	92.5	25.1	13.7	35.6	44.6	12.4	12.7
Peanut cake	89.3	42.8	20.4	7.2	76.2	20.0	15.0
Rapeseed cake	90.0	25.3	23.7	7.6	49.9	20.0	13.0
Factory by-products							
Dried brewers' grains	91.3	20.0	32.2	6.0	40.0	16.1	2.0
Wet brewers' grains	23.0	4.9	9.4	1.7	10.7	4.2	0.5
Malt sprouts	90.5	20.3	46.0	1.4	42.1	17.4	19.9
Dried distillers' grains	92.4	22.8	39.7	11.6	49.9	6.0	1.7
Apple pomace	17.0	0.6	13.1	0.5	1.6	0.1	0.3
Cassava starch refuse	88.0	0.4	74.0	0.6	1.2	0.6	2.8
Starch refuse	88.0	2.4	70.6	1.1	7.6	2.9	1.5
Wet starch feed	31.2	3.7	12.4	2.6	8.0	0.5	0.2
Potato pomace	7.3	0.4	6.8	0.1	0.9	0.2	0.9
Wet beet pulp	10.2	0.5	7.7	—	1.4	0.3	11.4
Dried beet pulp	91.6	4.1	64.9	—	12.9	2.2	3.1
Sugar beet molasses	79.2	4.7	54.1	—	14.5	0.5	56.3
Porto Rico molasses	74.1	1.4	59.2	—	4.3	1.2	36.8
Dried molasses beet pulp	92.0	6.1	68.7	—	15.4	1.5	18.1
Molasses grains	89.6	10.8	48.0	2.2	27.4	8.5	21.1
Cow's milk	12.8	3.4	4.8	3.7	5.8	1.9	1.7

TABLE II. NUTRIENTS AND FERTILIZER CONSTITUENTS OF COMMON FEEDING STUFFS.—*Continued.*

Name of feed	Total dry matter in 100 lbs	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude protein	Carbo-hydrates	Fat	Nitrogen	Phosphoric acid	Potash
Factory by-products—Continued	Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Cow's milk (colostrom)........	25.4	17.6	2.7	3.6	28.2	6.6	1.1
Skim milk....................	9.4	2.9	5.3	0.3	5.0	2.1	2.0
Buttermilk...................	9.9	3.8	3.9	1.0	6.4	1.7	1.6
Whey.........................	6.2	0.6	5.0	0.2	1.0	1.1	2.0
Meat scrap...................	89.3	66.2	—	13.4	114.0	81.1	—
Meat and bone meal...........	94.0	36.7	5.5	10.6	63.2	146.8	—
Dried blood..................	91.5	70.9	—	2.5	135.0	13.5	7.7
Tankage......................	93.0	50.1	—	11.6	86.2	139.0	3.0
Dried fish...................	89.2	45.0	—	11.4	77.4	140.0	3.0
Dried roughage							
Fodder corn (ears, if any, remaining).................	57.8	2.5	34.6	1.2	7.2	5.4	8.9
Corn stover (ears removed)...	59.5	1.4	31.2	0.7	6.1	3.8	10.9
English hay..................	86.0	4.5	44.0	1.2	12.6	3.2	16.1
Hay for mixed grasses........	84.7	4.2	42.0	1.3	11.9	2.7	15.5
Timothy (all analyses).......	86.8	2.8	42.4	1.3	9.4	3.3	14.2
Timothy (cut in full bloom)....	85.0	3.4	43.3	1.4	9.6	5.0	14.1
Timothy (cut soon after bloom)	85.8	2.5	39.2	1.5	9.1	—	—
Timothy (cut nearly ripe).....	85.9	2.1	40.1	1.1	8.0	—	—
Meadow foxtail...............	93.4	5.3	41.0	1.3	14.9	—	—
Orchard grass................	90.1	4.9	42.4	1.4	12.9	3.7	16.9
Red top......................	91.1	4.8	46.9	1.0	12.6	3.6	10.2
White top....................	86.0	6.8	40.6	1.5	17.9	—	—
Meadow fescue................	80.0	4.2	36.9	1.5	11.2	4.0	21.0
Kentucky blue grass..........	86.0	4.4	40.2	0.7	12.5	4.0	15.7
Tall oat.....................	86.0	3.3	41.4	1.1	10.3	—	—
Italian rye grass............	91.5	4.5	43.4	0.9	12.0	7.6	24.6
Perennial rye grass..........	86.0	6.1	37.8	1.2	16.2	7.4	24.1
Rowen hay....................	86.0	7.9	42.2	1.4	18.2	4.3	14.9
Bermuda grass................	92.9	6.4	44.9	1.6	17.1	—	—
Johnson grass................	89.8	2.9	45.6	0.8	11.5	—	—
Macaroni wheat...............	93.0	4.4	48.7	0.8	10.9	—	—
Barley.......................	85.0	5.7	43.6	1.0	14.1	—	—
Oat..........................	86.0	4.7	36.7	1.7	14.2	6.7	25.4
Emmer (speltz)...............	93.4	7.0	43.9	0.6	17.1	—	—
Barnyard millet..............	86.0	5.2	38.6	0.8	16.9	4.3	28.8
Hungarian grass..............	86.0	5.0	46.9	1.1	12.1	4.3	15.4
Wild oat grass...............	85.7	2.9	48.7	1.7	8.0	—	—
Prairie grass................	90.8	3.0	42.9	1.6	9.9	—	—
Buffalo grass................	85.0	3.0	42.0	1.6	7.1	—	—
Gama grass...................	85.7	4.2	39.9	0.9	11.8	—	—
Texas blue grass.............	85.7	5.1	36.3	1.4	14.6	—	—
Salt marsh grass.............	89.6	3.1	39.7	0.9	8.8	2.5	7.2
Ox-eye daisy.................	89.7	3.7	41.0	1.7	12.3	4.4	12.5
Australian salt bush.........	93.0	3.8	28.8	0.7	18.6	5.9	21.3

TABLE II. NUTRIENTS AND FERTILIZER CONSTITUENTS OF COMMON FEEDING STUFFS.—*Continued.*

Name of feed	Total dry matter in 100 lbs	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude protein	Carbo-hydrates	Fat	Nitrogen	Phosphoric acid	Potash
Dried roughage—Continued	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Red clover	84.7	7.1	37.8	1.8	19.7	5.5	18.7
Red clover in bloom	79.2	7.7	34.0	2.8	19.9	—	—
Mammoth red clover	78.8	6.2	34.7	2.1	17.1	5.2	11.6
Alsike clover	90.3	8.4	39.7	1.1	20.5	5.0	13.9
White clover	90.3	11.5	42.2	1.5	25.1	7.8	13.2
Crimson clover	90.4	10.5	34.9	1.2	24.3	4.0	13.1
Japan clover	89.0	9.1	37.7	1.4	22.1	—	—
Sweet clover	92.1	11.9	36.7	0.5	28.8	5.6	18.3
Soy bean	88.2	10.6	40.9	1.2	23.8	—	—
Cowpea	89.5	9.2	39.3	1.3	14.3	5.2	14.7
Alfalfa	91.9	10.5	40.5	0.9	23.4	6.1	17.9
Alfalfa leaves	95.1	16.8	35.9	1.3	37.3	—	—
Bur clover	91.0	8.2	39.0	2.1	21.8	—	—
Hairy (winter) vetch	88.7	11.9	40.7	1.6	27.2	9.7	24.4
Peanut vine	92.4	6.7	42.2	3.0	17.1	3.2	11.6
Velvet bean	90.0	9.6	52.5	1.4	22.4	—	—
Beggar weed	90.8	6.8	42.8	1.6	18.9	—	—
Sanfoin	85.0	10.4	36.5	2.0	23.7	5.0	14.7
Wheat and vetch	85.0	10.6	36.8	1.2	23.2	—	—
Oat and pea	89.5	7.6	41.5	1.5	16.5	6.1	18.1
Oat and vetch	85.0	8.3	35.8	1.3	20.5	6.0	12.7
Mixed grasses and clover	87.1	5.8	41.8	1.3	16.2	—	—
Mixed rowen	83.4	8.0	40.1	1.5	18.6	—	—
Straw and chaff							
Wheat	90.4	0.8	35.2	0.4	5.0	2.2	6.3
Rye	92.9	0.7	39.6	0.4	5.0	2.5	8.6
Oat	90.8	1.3	39.5	0.8	5.8	3.0	17.7
Barley	85.8	0.9	40.1	0.6	7.0	2.0	10.6
Millet	85.0	0.9	34.3	0.6	6.5	1.8	17.3
Buckwheat	90.1	1.2	37.4	0.5	8.0	1.3	11.4
Field bean	95.0	3.6	39.7	—	—	—	—
Soy bean	89.9	2.3	40.1	1.0	6.8	2.5	10.4
Wheat chaff	85.7	1.2	25.4	0.6	7.2	3.8	8.2
Oat chaff	85.7	1.5	33.0	0.7	6.4	1.4	4.5
Fresh green roughage							
Fodder corn (all varieties)	20.7	1.0	11.9	0.4	2.9	1.1	3.9
Dent varieties	21.0	0.9	12.2	0.4	2.7	—	—
Dent (kernels glazed)	26.6	1.1	15.0	0.7	3.2	—	—
Flint varieties	20.2	1.1	11.4	0.5	3.2	1.3	3.1
Flint (kernels glazed)	22.9	1.5	13.2	0.6	4.3	—	—
Sweet varieties	20.9	1.2	12.6	0.4	3.4	1.4	3.8
Sweet corn (without ears)	20.0	0.7	11.6	0.4	2.2	—	—
Red kafir corn	18.4	0.8	9.7	0.4	2.9	1.3	4.5
White kafir corn	16.6	0.9	8.3	0.5	3.0	1.2	5.0
Teosinte	9.9	0.9	4.9	0.2	2.2	0.6	9.2
Yellow milo maize	16.8	1.1	9.3	0.3	2.7	1.1	5.7

TABLE II. NUTRIENTS AND FERTILIZER CONSTITUENTS OF COMMON FEEDING STUFFS.—*Continued.*

Name of feed	Total dry matter in 100 lbs	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude protein	Carbo-hydrates	Fat	Nitrogen	Phosphoric acid	Potash
Fresh green roughage—Cont.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Sorghum fodder	20.6	0.6	11.6	0.3	2.1	0.7	3.4
Sugar cane	15.8	0.5	9.5	0.3	1.9	0.9	4.4
Fresh green hay							
Pasture grass	20.0	2.5	10.1	0.5	5.6	2.6	7.4
Kentucky blue grass	34.9	2.8	19.7	0.8	6.6	—	—
Timothy	38.4	1.5	19.9	0.6	5.0	2.6	7.6
Orchard grass	27.0	1.2	13.4	0.5	4.2	1.6	7.6
Red top (in bloom)	34.7	1.9	21.3	0.5	4.5	—	—
Wheat forage	22.7	1.7	12.0	0.4	3.8	1.6	6.0
Rye forage	23.4	2.1	14.1	0.4	4.2	2.5	7.1
Oat forage (in milk)	37.8	2.5	18.2	1.0	5.4	1.3	3.8
Oat forage (in bloom)	25.0	1.1	12.4	0.5	2.6	—	—
Barley forage	21.0	1.9	10.4	0.3	4.3	—	—
Meadow fescue	30.1	1.6	18.6	0.5	3.8	—	—
Italian rye grass	26.8	1.5	12.6	0.7	5.0	2.9	11.4
Tall oat grass	30.5	1.2	15.7	0.5	3.8	—	—
Johnson grass	25.0	0.6	13.7	0.2	1.9	—	—
Bermuda grass	28.3	1.3	13.4	0.4	3.5	—	—
Hungarian grass	28.9	2.0	15.9	0.4	5.0	1.2	4.2
Japanese millet	25.0	1.1	13.6	0.3	3.4	2.0	3.4
Barnyard millet	25.0	1.6	14.4	0.3	3.8	1.1	5.8
Pearl millet	18.5	0.6	10.0	0.2	1.9	1.5	7.1
Common millet	20.0	0.8	11.0	0.2	2.4	0.7	4.7
Red clover	29.2	2.9	13.6	0.7	7.0	1.5	4.8
Mammoth red clover	20.0	2.0	9.1	0.2	4.8	—	—
Alsike clover	25.2	2.6	11.4	0.5	6.2	1.1	2.0
Crimson clover	19.1	2.4	9.1	0.5	5.0	1.2	4.0
Sweet clover	20.0	2.5	8.4	0.4	6.1	2.4	6.7
Alfalfa	28.2	3.6	12.1	0.4	7.7	1.3	5.6
Spring vetch	15.0	1.9	6.6	0.2	4.3	1.0	4.5
Cowpea	16.4	1.8	8.7	0.2	3.8	1.3	4.6
Hairy vetch (winter)	15.0	2.8	6.4	0.3	5.8	1.4	5.2
Hairy vetch (in bloom)	18.0	3.5	7.7	0.3	6.7	—	—
Soy bean	24.9	3.1	11.0	0.5	6.4	1.4	5.6
Velvet bean	17.8	2.7	8.4	0.4	5.6	—	—
Canada field pea	15.3	1.8	6.9	0.3	4.5	1.6	5.0
Canada field pea (in bud)	15.0	2.6	6.8	0.3	5.0	1.1	4.4
Canada field pea (in bloom)	13.0	2.3	5.3	0.2	4.5	1.1	3.2
Canada field pea (in pod)	15.0	1.9	7.0	0.2	3.7	1.3	3.7
Barley and vetch	20.0	2.1	6.5	0.3	4.5	2.0	5.7
Barley and peas	20.0	2.1	9.1	0.4	4.5	—	—
Oats and peas	20.3	1.8	10.2	0.4	3.8	1.5	5.0

TABLE II. NUTRIENTS AND FERTILIZER CONSTITUENTS OF COMMON FEEDING STUFFS.—*Continued.*

Name of feed	Total dry matter in 100 lbs	Digestible nutrients in 100 pounds			Fertilizing constituents in 1,000 pounds		
		Crude protein	Carbo-hydrates	Fat	Nitrogen	Phosphoric acid	Potash
Fresh green hay—Continued	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Oats and vetch	20.0	2.3	10.0	0.2	4.8	1.4	3.0
Wheat and vetch	20.0	2.6	10.3	0.3	5.4	—	—
Mixed grasses and clover	25.0	2.3	14.6	0.5	4.6	—	—
Roots and tubers							
Potato	20.9	1.1	15.7	0.1	3.4	1.6	5.8
Common beet	11.5	1.2	7.9	0.1	2.4	0.8	4.8
Mangel	9.1	1.0	5.5	0.2	2.2	0.9	3.8
Sugar beet	13.5	1.3	9.8	0.1	2.9	0.9	3.7
Flat turnip	9.9	0.9	6.4	0.1	2.1	0.9	3.4
Carrot	11.4	0.8	7.7	0.3	1.8	0.9	2.6
Rutabaga	11.4	1.0	8.1	0.2	1.9	1.2	4.9
Parsnip	11.7	1.1	10.1	0.2	2.6	2.0	4.4
Artichoke	20.5	1.3	14.7	0.2	4.2	1.4	4.7
Sweet potato	28.9	0.8	22.9	0.3	2.4	0.8	3.7
Chufa	20.5	0.6	9.1	5.6	—	—	—
Cassava	34.0	0.8	28.9	0.2	2.0	1.0	4.0
Miscellaneous							
Apples	22.2	0.8	16.5	0.2	1.2	0.1	1.7
Dwarf essex rape	14.3	2.0	8.2	0.2	3.5	1.2	3.5
Cabbage	10.0	2.3	5.9	0.1	4.2	1.1	4.3
Sugar beet leaves	12.0	1.9	5.0	0.2	4.2	1.5	6.2
Field pumpkin	9.1	1 0	5.8	0.2	2.1	—	—
Garden pumpkin	19.2	1.4	8.3	0.4	2.9	1.6	0.9
Silage							
Corn (early analyses)	20.9	0.9	11.4	0.6	2.7	1.1	3.7
Corn (recent analyses)	26.4	1.4	14.2	0.7	4.3	1.1	3.7
Corn (ears removed)	26.3	1.1	14.9	0.7	3.5	—	—
Sorghum	23.9	0.1	13.5	0.2	1.3	1.5	1.9
Millet	26.0	0.2	13.1	0.6	2.7	1.4	6.2
Rye	19.2	0.7	9.0	0.2	3.8	—	—
Red clover	28.0	1.5	9.2	0.5	6.7	—	—
Canada field pea	49.9	3.4	25.5	1.0	9.4	—	—
Soy bean	25.8	2.7	9.6	1.3	6.6	1.6	7.5
Cowpea vine	20.7	1.5	8.6	0.9	4.3	1.5	4.6
Brewers' grains	29.7	4.6	11.5	1.8	10.1	4.2	0.5
Apple pomace	15.0	0.7	9.6	0.5	1.9	1.5	4.0
Corn cannery refuse (husk)	16.2	0.4	10.1	0.4	2.2	—	—
Corn cannery refuse (cobs)	25.9	0.3	13.7	0.9	2.4	—	—
Pea cannery refuse	23.2	2.1	13.1	0.8	4.5	—	—
Cowpea and soy bean	30.2	2.2	12.9	0.8	6.1	—	—
Corn and soy bean	24.0	1.6	13.2	0.7	4.0	1.5	3.6
Barnyard millet and soy bean	21.0	1.6	9.2	0.7	4.5	1.1	4.4

INSECTICIDES AND FUNGICIDES

(From Government Reports.)

Standard Bordeaux Mixture.

Copper sulphate (bluestone)	6 pounds
Lime	4 pounds
Water to make	50 gallons

This mixture often injures the foliage of the peach and the Japanese plum, and sometimes russets the fruits of apples and pears.

The 5-5-50 Bordeaux Mixture Formula.

Copper sulphate	5 pounds
Lime	5 pounds
Water to make	50 gallons

When this mixture is used there is less danger of scorching or russeting the fruit than when the "Standard Mixture" is used.

Peach Bordeaux Mixture.

Copper sulphate	3 pounds
Lime	9 pounds
Water to make	50 gallons

This form of bordeaux mixture is more harmless to the foliage on account of the excess of lime.

Dust Bordeaux Mixture.

(1) Dissolve 4 pounds of copper sulphate in 4 gallons of water.

(2) Dissolve 4 pounds of lime in 4 gallons of water.

(3) Prepare 60 pounds of slaked lime dust. The lime dust is best prepared by slowly sprinkling a small quantity of water over a heap of quicklime, using barely enough water to cause the lime to crumble into a dust.

The first two solutions should be poured together into a tub. Allow the resulting precipitate to settle, decant off the liquid, pour the wet mass of material into a double flour sack, and squeeze out as much water as possible. Spread out the doughlike mass in the sun to dry. Then crumble the material into a powder, and screen the powder through a sieve of brass wire having 80 meshes to the inch. Finally mix the powder with the slaked lime dust.

COPPER SULPHATE SOLUTION.

Copper sulphate	3 pounds
Water	50 gallons

The manner of making this solution is the same as for the bordeaux mixture, except that lime is not added. This solution is very injurious to plants in foliage; therefore it should be applied only during the dormant period.

COPPER ACETATE SOLUTION.

Dibasic acetate of copper	6 ounces
Water	50 gallons

Add the acetate of copper to the water and stir thoroughly. Although this mixture is much inferior to the bordeaux mixture as a fungicide, it can be applied to ripening fruit without the staining effect of the latter. The copper acetate solution is injurious to the foliage.

AMMONIACAL COPPER CARBONATE.

Copper carbonate	5 ounces
Strong ammonia (26° Baume)	2 to 3 pints
Water to make	50 gallons

(1) Dilute the ammonia with about two gallons of water in order to increase the solvent action of the ammonia upon the copper carbonate.
(2) Add water to the carbonate to make a thin paste.
(3) Pour on about half of the diluted ammonia, stir vigorously for several minutes, allow it to settle, pour off the liquid, leaving the undissolved copper salt behind. Repeat the operation until all the salt is dissolved.
(4) Add the remainder of the water to make 50 gallons.

This mixture is inferior to the bordeaux mixture as a fungicide. It is used as a substitute for bordeaux mixture when stains upon ornamental plants and maturing fruits are objectionable. Plants susceptible to injury from the bordeaux mixture are also likely to be injured by the ammoniacal copper carbonate solution.

EAU CELESTE (MODIFIED).

Copper sulphate	4 pounds
Ammonia	3 pints
Sal soda	5 pounds
Water to make	45 gallons

Dissolve the copper sulphate in 10 or 12 gallons of water, add the ammonia and dilute to 45 gallons; then add the sal soda and stir until dissolved. Eau celeste is an effective dormant spray for the peach leaf curl and other similar diseases, but it is unsafe to use on the foliage of most plants.

LIME-SULPHUR WASH

The following formula may be used:

Unslaked lime	20 pounds
Flowers of sulphur	15 pounds
Water to make	45 to 50 gallons

The lime should be slaked in a small quantity of water. The sulphur should be mixed into a stiff paste and added to the lime which has been slaked. The mixture should then be boiled for an hour, after which the full amount of cold water can be added, The mixture should be strained and used at once. This mixture, which is much used for scale insects, should be applied just before the buds open.

SELF-BOILED LIME-SULPHUR MIXTURE

Sulphur	10 pounds
Lime	10 pounds
Water	50 gallons

Place the lime in a barrel and add enough water to start it slaking and to keep the sulphur off the bottom of the barrel. Add the sulphur, which should first be worked through a sieve to break up the lumps, and finally add enough water to slake the lime into a paste. Considerable stirring is necessary to prevent caking at the bottom. After the violent boiling which accompanies the slaking of the lime is over, the mixture should be diluted ready for spraying, or at least enough cold water added to stop the cooking. The mixture should then be strained to remove the coarse particles of lime, but all of the sulphur should be worked through the sieve.

This mixture is not injurious to peach foliage.

SULPHUR AND RESIN SOLUTION.

Sulphur (flowers or flour)	16 pounds
Resin (finely powdered)	½ pound
Caustic soda (powdered)	10 pounds
Water to make	6 gallons

(1) Place the sulphur and the resin, thoroughly mixed, in a barrel and make a thick paste by adding about 3 quarts of water.

(2) Stir in the caustic soda. After several minutes the mass will boil, turning a reddish brown, and should be stirred thoroughly.

(3) After boiling has ceased add about 2 gallons of water and pour off the liquid into another vessel. Then add water to make 6 gallons. This form of stock solution should be used at the rate of 1 gallon to 50 of water for spraying most plants and for soaking seeds.

POTASSIUM SULPHID.

Potassium sulphid	1 ounce
Water	3 gallons

Dissolve the potassium sulphid in the required amount of water and use immediately. This mixture is effective for surface mildews.

CORROSIVE SUBLIMATE.

Corrosive sublimate	1 part
Water	1000 parts

This solution is used to disinfect tools used in cutting out pear blight.

PARIS GREEN.

For general purposes:

Paris green	1 pound
Water	50 to 100 gallons

For pome fruits and grapes:

Paris green	1 pound
Water	150 to 200 gallons

Milk of lime from slaking three pounds of lime for each 50 gallons of spray should be added.

Paris green may be added to bordeaux mixture. In that case no lime will need to be added, as the bordeaux mixture contains lime.

ARSENATE OF LEAD.

Arsenate of lead may be applied at the rate of 2, 3, or 4 pounds for every 50 gallons of water or bordeaux mixture. It is advisable to add lime water when the arsenate of lead is used with water.

SCHEELE'S GREEN.

Scheele's green is used the same as Paris green.

HELLEBORE.

Hellebore may be applied dry, diluted with from 5 to 10 parts of flour, or with water at the rate of one ounce to the gallon.

Hellebore acts as an internal poison to insects, but is harmless to man in the quantities recommended.

WHALE-OIL SOAP WASH.

For aphides and pear psylla: Dissolve 1 pound of soap in 3 or 4 gallons of water.

For scale insects: Dissolve 2 gallons of soap in 1 gallon of water, and apply when the trees are dormant.

MISCIBLE OILS.

Step 1. Preparation of the emulsifier—In preparing the emulsifier an iron kettle provided with a board cover and a thermometer should be used. The formula for the emulsifier is as follows:

Menhaden oil	10 gallons
Carbolic acid	8 gallons
Caustic potash	15 pounds

This is heated to 290° or 300° F. and then the following are added:

Kerosene	2 gallons
Water	2 gallons

The kerosene is added while the mixture is at the high temperature, but the water must not be added until the mixture has cooled below the boiling point.

Step 2. Mixing the emulsifier and the oils—No heat is required in the mixing of the emulsifier with petroleum or other oils. The emulsifier may be used with kerosene or with crude petroleum, with or without the addition of resin or other oils. The following is easily made and is efficient as a spray while trees are dormant:

Emulsifier	3 2-3 gallons
Paraffin oil	40 gallons
Resin oil	6 gallons

Sufficient water to give a ready emulsion.

From 3 to 5 gallons of the miscible oil are used to make 50 gallons of spray.

TOBACCO SOLUTION.

Tobacco solutions must be strong in order to make an effective spray. One pound of tobacco should be steeped in each gallon of water. This solution is effective as a spray against aphides and thrips.

LIME-SULPHUR SPRAY CALENDAR FOR APPLES.

The first spraying for San Jose scale and other pests should be made while the buds are dormant with full strength lime-sulphur wash (1 part to 9); the second when the leaf buds unfold but with dilute wash (1 to 33). Subsequent sprayings the same as with bordeaux mixture. All sprayings of the foliage should be with dilute wash.

TABLE 3. BORDEAUX SPRAY CALENDAR FOR APPLES.

Number of application	Material	Time of application
First	Bordeaux mixture and arsenical	After leaf buds unfold and before flower buds open
Second	Bordeaux mixture and arsenical	Just after petals fall
Third	Bordeaux mixture and arsenical	7 or 8 days later (This may be omitted in dry seasons and in dry states.)
Fourth	Half-strength bordeaux mixture and full-strength arsenical	3 weeks later

TABLE 4. STATUTORY WEIGHTS OF THE BUSHEL.

State or territory	Wheat	Rye	Oats	Barley	Buckwheat	Shelled corn	Corn on cob	Bran	Potatoes, Irish	Potatoes, sweet	Onions	Beans	Peas	Apples	Timothy seed	Blue grass seed	Clover seed
United States	60	56	32	48	42	—	—	—	60	—	—	—	60	—	—	—	—
Alabama	60	56	32	47	—	56	70	—	60	55	—	60	60	—	—	—	—
Alaska	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Arizona	60	56	32	45	—	—	—	—	—	—	—	55	—	—	—	—	—
Arkansas	60	56	32	48	52	56	70	20	60	50	57	60	60	50	60	14	60
California	60	54	32	50	40	—	—	—	—	—	—	—	—	—	—	—	—
Colorado	60	56	32	48	52	—	70	—	60	—	57	60	—	—	45	14	60
Connecticut	60	56	32	48	48	—	—	20	60	54	52	60	60	48	—	—	60
Delaware	60	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
District of Columbia	60	—	—	—	—	—	—	—	60	—	—	—	—	—	—	—	—
Florida	60	56	32	48	—	56	70	20	60	60	56	60	—	48	—	—	—
Georgia	60	56	32	47	52	56	70	20	60	55	57	60	60	—	45	14	60
Hawaii	60	56	32	43	—	—	—	—	—	—	—	—	—	—	—	—	—
Idaho	60	56	36	48	42	—	—	—	60	—	—	—	—	45	—	—	60
Illinois	60	56	32	48	52	56	70	20	60	50	57	60	—	—	45	14	60
Indiana	60	56	32	48	50	56	68	—	60	55	48	60	—	—	45	14	60
Iowa	60	56	32	43	52	56	70	20	60	46	57	60	—	48	45	14	60
Kansas	60	56	32	48	50	—	70	20	60	50	57	60	—	48	45	14	60
Kentucky	60	56	32	47	56	56	70	20	60	55	57	60	60	—	45	14	60
Louisiana	60	56	—	48	—	—		—	—	—	—	—	—	—	—	—	—
Maine	60	50	32	48	48	—		—	60	—	52	60	60	44	—	—	—
Maryland	—	—	26	—	—	—			56	—	—	—	—	—	—	—	—
Massachusetts	60	56	32	48	48	50		20	60	54	52	60	60	48	45	—	60
Michigan	60	56	32	48	48	56	70		60	56	54	60	60	48	45	14	60
Minnesota	60	56	32	43	50	56	70		60	55	52	60	60	50	45	14	60
Mississippi	60	56	32	48	48	56	72	20	60	60	57	60	60	—	45	14	60
Missouri	60	56	32	48	52	56	70	20	60	56	57	60	60	48	45	14	60
Montana	60	56	32	48	52	56	70	20	60	—	57	60	60	45	45	14	60
Nebraska	60	56	32	48	52	56	70	20	60	50	57	60	60	—	45	14	60
Nevada	—	—	—	—	—						—	60	—	—	—	—	—
New Hampshire	60	56	32	—	—	—			60		—	62	60	—	—	—	—
New Jersey	60	56	30	48	50	—			60	54	57	60	60	50	—	—	64
New Mexico	—	—	—	—		—					—	—	—	—	—	—	—
New York	60	56	32	48	48			20	60	54	57	60	60	48	45	—	60
North Carolina	60	56	32	48	50	—					—	—	60	—	—	—	60
North Dakota	60	56	32	48	42	56	70	20	60	46	52	60	60	50	45	—	60
Ohio	60	56	32	48	50	56	68		60	50	55	60	60	50	45	—	60
Oklahoma	60	56	32	48	42	56	70	20	60	46	52	60	60	—	42	—	60
Oregon	60	56	32	46	42	—	—	—	60	—	—	—	—	45	—	—	60
Pennsylvania	60	56	32	47	48	—	—	—	56	—	50	—	—	—	—	—	60
Rhode Island	60	56	32	48	48	56	70	20	60	54	50	60	60	48	45	—	60
South Carolina	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
South Dakota	60	56	32	48	42	56	70	20	60	46	52	60	60	—	42	—	60
Tennessee	60	56	32	48	50	56	70	20	60	50	56	60	60	50	45	14	60
Texas	60	56	32	48	42	56	70	20	60	55	57	60	—	45	45	—	60
Utah	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vermont	60	56	32	48	48	56	—	—	60	—	52	62	60	46	45	—	60
Virginia	60	56	30	48	52	56	70	—	56	56	57	60	60	—	45	14	60
Washington	60	56	32	48	42	—	—	—	60	—	—	—	—	45	—	—	60
West Virginia	60	56	32	48	52	—	—	—	60	—	—	60	—	—	45	—	60
Wisconsin	60	56	32	48	50	—	—	20	60	54	57	60	60	50	45	—	60
Wyoming	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE 5. AVERAGE COMPOSITION OF FARM MANURES.

Kind of manure	Pounds per hundred				
	Water	Nitrogen	Phosphoric Acid	Potash	Lime
Cow manure (fresh)...	85.3	0.38	0.16	0.40	0.31
Horse manure (fresh)...	71.3	0.58	0.28	0.53	0.21
Sheep manure (fresh)..	64.6	0.83	0.23	0.67	0.33
Hog manure (fresh)...	72.4	0.45	0.19	0.60	0.08
Hen manure (fresh)...	56.0	1.63	1.54	0.85	0.24
Mixed stable manure..	75.0	0.50	0.26	0.63	0.70

TABLE 6. DIGESTIBLE NUTRIENTS OF CEREALS.

Kind of food	Protein	Fat	Carbo-hydrates	Ash
Oat preparations:	Per cent.	Per cent.	Per cent.	Per cent.
Oats, whole grain......	—	—	—	—
Oatmeal, raw.........	12.5	6.5	65.5	1.4
Rolled, steam-cooked..	12.5	6.7	64.5	1.4
Wheat:				
Whole grain..........	—	—	—	—
Cracked wheat........	8.1	1.5	68.7	1.2
Rolled, steam-cooked..	8.5	1.6	70.7	1.1
Shredded wheat.......	7.7	1.3	71.1	1.4
Crumbed and malted..	9.1	0.9	73.7	1.4
Farina...............	8.9	1.3	72.9	0.3
Rye:				
Whole grain..........	—	—	—	—
Flaked, to be eaten raw	7.8	1.3	71.1	1.3
Barley:				
Whole grain..........	—	—	—	—
Pearled barley........	6.6	1.0	73.0	0.8
Buckwheat:				
Flour................	5.0	1.1	73.1	0.7
Corn:				
Whole grain..........	—	—	—	—
Corn meal, unbolted...	6.2	4.2	73.2	1.0
Corn meal, bolted.....	6.8	1.7	74.6	0.8
Hominy...............	6.4	0.5	78.7	0.2
Pop corn, popped......	7.9	4.5	77.8	1.0
Hulled corn...........	1.7	0.8	21.8	0.4
Rice:				
Whole rice, polished...	5.8	0.3	78.4	0.4
Puffed rice...........	5.1	0.5	84.0	0.3
Crackers...............	9.1	7.9	70.5	1.4
Macaroni...............	11.6	0.8	72.2	1.0

TABLE 7. COMPOSITION OF BEVERAGES.

Kind of beverage	Water	Protein	Fat	Carbo-hydrates	Fuel value per pound
	Per cent.	Per cent.	Per cent.	Per cent.	Calories
Commercial cereal coffee (0.5 ounce to 1 pint water)	98.2	0.2	—	1.4	30
Parched corn coffee (1.6 ounces to 1 pint water)	99.5	0.2	—	0.5	13
Oatmeal water (1 ounce to 1 pint water)	99.7	0.3	—	0.3	11
Coffee (1 ounce to 1 pint water)	98.9	0.2	—	0.7	16
Tea (0.5 ounce to 1 pint water)	99.5	0.2	—	0.6	15
Cocoa (0.5 ounce to 1 pint milk)	84.5	3.8	4.7	6.0	365
Cocoa (0.5 ounces to 1 pint water)	97.1	0.6	0.9	1.1	65
Skimmed milk	90.5	3.4	0.3	5.1	170

TABLE 8. AVERAGE COMPOSITION OF COMMON HUMAN FOOD PRODUCTS.

Food materials (as purchased)	Refuse	Water	Protein	Fat	Carbohydrates	Ash
ANIMAL FOOD	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Beef, fresh:						
Chuck ribs	16.3	52.6	15.5	15.0	—	0.8
Flank	10.2	54.0	17.0	19.0	—	0.7
Loin	13.3	52.5	16.1	17.5	—	0.9
Porterhouse steak	12.7	52.4	19.1	17.9	—	0.8
Sirloin steak	12.8	54.0	16.5	16.1	—	0.9
Neck	27.6	45.9	14.5	11.9	—	0.7
Ribs	20.8	43.8	13.9	21.2	—	0.7
Rib rolls	—	63.9	19.3	16.7	—	0.9
Round	7.2	60.7	19.0	12.8	—	1.0
Rump	20.7	45.0	13.8	20.2	—	0.7
Shank, fore	36.9	42.9	12.8	7.3	—	0.6
Shoulder and clod	16.4	56.8	16.4	9.8	—	0.9
Fore quarter	18.7	49.1	14.5	17.5	—	0.7
Hind quarter	15.7	50.4	15.4	18.3	—	0.7
Beef, corned, canned, pickled, dried:						
Corned beef	8.4	49.2	14.3	23.8	—	4.6
Tongue, pickled	6.0	58.9	11.9	19.2	—	4.3
Dried, salted and smoked	4.7	53.7	26.4	6.9	—	8.9
Canned boiled beef	—	51.8	25.5	22.5	—	1.3
Canned corned beef	—	51.8	26.3	18.7	—	4.0
Veal:						
Breast	21.3	52.0	15.4	11.0	—	0.8
Leg	14.2	60.1	15.5	7.9	—	0.9
Leg cutlets	3.4	68.3	20.1	7.5	—	1.0
Fore quarter	24.5	54.2	15.1	6.0	—	0.7
Hind quarter	20.7	56.2	16.2	6.6	—	0.8
Mutton:						
Flank	9.9	39.0	13.8	36.9	—	0.6
Leg, hind	18.4	51.2	15.1	14.7	—	0.8
Loin chops	16.0	42.0	13.5	28.3	—	0.7
Fore quarter	21.2	41.6	12.3	24.5	—	0.7
Hind quarter, without tallow	17.2	45.4	13.8	23.2	—	0.7
Lamb:						
Breast	19.1	45.5	15.4	19.1	—	0.8
Leg, hind	17.4	52.9	15.9	13.6	—	0.9
Pork, fresh:						
Ham	10.7	48.0	13.5	25.9	—	0.8
Loin chops	19.7	41.8	13.4	24.2	—	0.8
Shoulder	12.4	44.9	12.0	29.8	—	0.7
Tenderloin	—	66.5	18.9	13.0	—	1.0
Pork, salted, cured, pickled:						
Ham, smoked	13.6	34.8	14.2	33.4	—	4.2
Shoulder, smoked	18.2	36.8	13.0	26.6	—	5.5
Salt pork	—	7.9	1.9	86.2	—	3.9
Bacon, smoked	7.7	17.4	9.1	62.2	—	4.1
Sausage:						
Bologna	3.3	55.2	18.2	19.7	—	3.8
Pork	—	39.8	13.0	44.2	1.1	2.2
Frankfort	—	57.2	19.6	18.6	1.1	3.4
Soups:						
Celery, cream of	—	88.6	2.1	2.8	5.0	1.5

Table 8. Average Composition of Common Human Food Products.—*Continued.*

Food materials (as purchased)	Refuse	Water	Protein	Fat	Carbohydrates	Ash
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Soups—(continued)						
Beef	—	92.9	4.4	0.4	1.1	1.2
Meat stew	—	84.5	4.6	4.3	5.5	1.1
Tomato	—	90.0	1.8	1.1	5.6	1.5
Poultry:						
Chicken, broilers	41.6	43.7	12.8	1.4	—	0.7
Fowls	25.9	47.1	13.7	12.3	—	0.7
Goose	17.6	38.5	13.4	29.8	—	0.7
Turkey	22.7	42.4	16.1	18.4	—	0.8
Fish:						
Cod, dressed	29.9	58.5	11.1	0.2	—	0.8
Halibut, steaks or sections	17.7	61.9	15.3	4.4	—	0.9
Mackerel, whole	44.7	40.4	10.2	4.2	—	0.7
Perch, yellow, dressed	35.1	50.7	12.8	0.7	—	0.9
Shad, whole	50.1	35.2	9.4	4.8	—	0.7
Shad, roe	—	71.2	20.9	3.8	2.6	1.5
Fish, preserved:						
Cod, salt	24.9	40.2	16.0	0.4	—	18.5
Herring, smoked	44.4	19.2	20.5	8.8	—	7.4
Fish, canned:						
Salmon	—	63.5	21.8	12.1	—	2.6
Sardines	5.0	53.6	23.7	12.1	—	5.3
Shellfish:						
Oysters, solids	—	88.3	6.0	1.3	3.3	1.1
Clams	—	80.8	10.6	1.1	5.2	2.3
Crabs	52.4	36.7	7.9	0.9	0.6	1.5
Lobsters	61.7	30.7	5.9	0.7	0.2	0.8
Eggs: Hen's eggs	11.2	65.5	13.1	9.3	—	0.9
Dairy products, etc.:						
Butter	—	11.0	1.0	85.0	—	3.0
Whole milk	—	87.0	3.3	4.0	5.0	0.7
Skim milk	—	90.5	3.4	0.3	5.1	0.7
Buttermilk	—	91.0	3.0	0.5	4.8	0.7
Condensed milk	—	26.9	8.8	8.3	54.1	1.9
Cream	—	74.0	2.5	18.5	4.5	0.5
Cheese, Cheddar	—	27.4	27.7	36.8	4.1	4.0
Cheese, full cream	—	34.2	25.9	33.7	2.4	3.8
VEGETABLE FOOD						
Flour, meal, etc.:						
Entire wheat flour	—	11.4	13.8	1.9	71.9	1.0
Graham flour	—	11.3	13.3	2.2	71.4	1.8
Wheat flour, patent roller process						
High-grade and medium	—	12.0	11.4	1.0	75.1	0.5
Low grade	—	12.0	14.0	1.9	71.2	0.9
Macaroni, vermicelli, etc	—	10.3	13.4	0.9	74.1	1.3
Wheat breakfast food	—	9.6	12.1	1.8	75.2	1.3
Buckwheat flour	—	13.6	6.4	1.2	77.9	0.9
Rye flour	—	12.9	6.8	0.9	78.7	0.7
Corn meal	—	12.5	9.2	1.9	75.4	1.0
Oat breakfast food	—	7.7	16.7	7.3	66.2	2.1
Rice	—	12.3	8.0	0.3	79.0	0.4
Tapioca	—	11.4	0.4	0.1	88.0	0.1
Starch	—	—	—	—	90.0	—

TABLE 8. AVERAGE COMPOSITION OF COMMON HUMAN FOOD PRODUCTS.—*Continued.*

Food materials (as purchased)	Refuse	Water	Protein	Fat	Carbohydrates	Ash
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Bread, pastry, etc:						
White bread	—	35.3	9.2	1.3	53.1	1.1
Brown bread	—	43.6	5.4	1.8	47.1	2.1
Graham bread	—	35.7	8.9	1.8	52.1	1.5
Whole wheat bread	—	38.4	9.7	0.9	49.7	1.3
Rye bread	—	35.7	9.0	0.6	53.2	1.5
Cake	—	19.9	6.3	9.0	63.3	1.5
Cream crackers	—	6.8	9.7	12.1	69.7	1.7
Oyster crackers	—	4.8	11.3	10.5	70.5	2.9
Soda crackers	—	5.9	9.8	9.1	73.1	2.1
Sugars, etc:						
Molasses	—	—	—	—	70.0	—
Candy	—	—	—	—	96.0	—
Honey	—	—	—	—	81.0	—
Sugar, granulated	—	—	—	—	100.0	—
Maple syrup	—	—	—	—	71.4	—
Vegetables:						
Beans, dried	—	12.6	22.5	1.8	59.6	3.5
Beans, Lima, shelled	—	68.5	7.1	0.7	22.0	1.7
Beans, string	7.0	83.0	2.1	0.3	6.9	0.7
Beets	20.0	70.0	1.3	0.1	7.7	0.9
Cabbage	15.0	77.7	1.4	0.2	4.8	0.9
Celery	20.0	75.6	0.9	0.1	2.6	0.8
Corn, green (sweet) edible portion	—	75.4	3.1	1.1	19.7	0.7
Cucumbers	15.0	81.1	0.7	0.2	2.6	0.4
Lettuce	15.0	80.5	1.0	0.2	2.5	0.8
Mushrooms	—	88.1	3.5	0.4	6.8	1.2
Onions	10.0	78.9	1.4	0.3	8.9	0.5
Parsnips	20.0	66.4	1.3	0.4	10.8	1.1
Peas (Pisum sativum), dried	—	9.5	24.6	1.0	62.0	2.9
Peas (Pisum sativum), shelled	—	74.6	7.0	0.5	16.9	1.0
Cowpeas, dried	—	13.0	21.4	1.4	60.8	3.4
Potatoes	20.0	62.6	1.8	0.1	14.7	0.8
Vegetables:						
Rhubarb	40.0	56.6	0.4	0.4	2.2	0.4
Sweet potatoes	20.0	55.2	1.4	0.6	21.9	0.9
Spinach	—	92.3	2.1	0.3	3.2	2.1
Squash	50.0	44.2	0.7	0.2	4.5	0.4
Tomatoes	—	94.3	0.9	0.4	3.9	0.5
Turnips	30.0	62.7	0.9	0.1	5.7	0.6
Vegetables, canned:						
Baked beans	—	68.9	6.9	2.5	19.6	2.1
Peas (pisum sativum), green	—	85.3	3.6	0.2	9.8	1.1
Corn, green	—	76.1	2.8	1.2	19.0	0.9
Succotash	—	75.9	3.6	1.0	18.6	0.9
Tomatoes	—	94.0	1.2	0.2	4.0	0.6
Fruits, berries, etc., fresh:						
Apples	25.0	63.3	0.3	0.3	10.8	0.3
Bananas	35.0	48.9	0.8	0.4	14.3	0.6
Grapes	25.0	58.0	1.0	1.2	14.4	0.4
Lemons	30.0	62.5	0.7	0.5	5.9	0.4
Muskmelons	50.0	44.8	0.3	—	4.6	0.3

TABLE 8. AVERAGE COMPOSITION OF COMMON HUMAN FOOD PRODUCTS.—*Continued.*

Food materials (as purchased)	Refuse	Water	Protein	Fat	Carbohy-drates	Ash
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Fruits, berries, etc., fresh—Cont.						
Oranges	27.0	63.4	0.6	0.1	8.5	0.4
Pears	10.0	76.0	0.5	0.4	12.7	0.4
Persimmons, edible portion	—	66.1	0.8	0.7	31.5	0.9
Raspberries	—	85.8	1.0	—	12.6	0.6
Strawberries	5.0	85.9	0.9	0.6	7.0	0.6
Watermelons	59.4	37.5	0.2	0.1	2.7	0.1
Fruits, dried:						
Apples	—	28.1	1.6	2.2	66.1	2.0
Apricots	—	29.4	4.7	1.0	62.5	2.4
Dates	10.0	13.8	1.9	2.5	70.6	1.2
Figs	—	18.8	4.3	0.3	74.2	2.4
Raisins	10.0	13.1	2.3	3.0	68.5	3.1
Nuts:						
Almonds	45.0	2.7	11.5	30.2	9.5	1.1
Brazil nuts	49.6	2.6	8.6	33.7	3.5	2.0
Butternuts	86.4	0.6	3.8	8.3	0.5	0.4
Chestnuts, fresh	16.0	37.8	5.2	4.5	35.4	1.1
Chestnuts, dried	24.0	4.5	8.1	5.3	56.4	1.7
Cocoanuts	48.8	7.2	2.9	25.9	14.3	0.9
Cocoanut, prepared	—	3.5	6.3	57.4	31.5	1.3
Filberts	52.1	1.8	7.5	31.3	6.2	1.1
Hickory nuts	62.2	1.4	5.8	25.5	4.3	0.8
Pecans, polished	53.2	1.4	5.2	33.3	6.2	0.7
Peanuts	24.5	6.9	19.5	29.1	18.5	1.5
Pinon (Pinus edulis)	40.6	2.0	8.7	36.8	10.2	1.7
Walnuts, black	74.1	0.6	7.2	14.6	3.0	0.5
Walnuts, English	58.1	1.0	6.9	26.6	6.8	0.6
Miscellaneous:						
Chocolate	—	5.9	12.9	48.7	30.3	2.2
Cocoa, powdered	—	4.6	21.6	28.9	37.7	7.2
Cereal coffee, infusion (1 part boiled in 20 parts water)	—	98.2	0.2	—	1.4	0.2

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