RURAL ARITHMETIC
CALFEE
IN MEMORIAM
FLORIAN CAJORI

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RURAL ARITHMETIC

A COURSE IN ARITHMETIC INTENDED TO START CHILDREN TO THINKING AND FIGURING ON HOME AND ITS IMPROVEMENT

BY

JOHN E. CALFEE

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BEREA, KENTUCKY

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814.1

CAJORI

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PREFACE

To a large extent the old-time arithmetics were made and taught with a view to preparing pupils for passing examinations. Expressed or implied, the theory was that the function of the elementary school was to prepare for college. The child who was never to enter college was looked upon as a very unfortunate being; he was reckoned as of little promise. Consequently no definite provision was made for those who must toil and do the world's work by the sweat of the brow; they were set adrift to take up the world's industrial and commercial work with almost no preparation leading to economic and industrial efficiency. As a result the soil has been abused and worn out, much of the timber wasted, and many once fertile farms abandoned.

The purpose of this book is to touch the important phases of farm management. The problems are real and practical, taken from everyday farm life; the information given is reliable and valuable, and can be used to increase the profits in farming. The country boy and girl are taught in terms of their immediate surroundings; they are given a chance to solve problems in which they and their parents are vitally interested. The management of the farm is made an attractive and intelligent subject for conversation around the home fireside during the long winter evenings. A sane, practical business outlook upon the administration of farm affairs will develop in the children a broad view of the unbounded opportunities which the farm offers for the accumulation of wealth and happiness. The farmers' children
are entitled to an education that will give them a fair chance of remaining on the farm as successful farmers, and to this end I submit this book.

The author desires to thank sincerely his students, and also Professors Charles D. Lewis, E. C. Seale, John F. Smith, F. O. Clark, J. A. Burgess (architect and builder), Dr. W. L. Heizer of the Kentucky State Board of Health, and President Frost of Berea College, for their advice and criticism.

J. E. C.
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RURAL ARITHMETIC

FUNDAMENTAL PROCESSES

1. The ability to add, subtract, multiply, and divide, rapidly and accurately, is at the foundation of all satisfactory progress in the study of arithmetic. A large part of the errors in business calculations are caused by illegible figures that are placed in irregular columns for addition. More stress should be placed upon making neat, legible figures of uniform size.

2. Dictation exercises in writing numbers should be given until the pupil can write numbers rapidly, placing units of the same order in the same vertical column.

3. Much practice should be given in reading at a glance numbers consisting of from two to five figures, without naming the individual figures. A good reader takes in a word at a glance, without thinking of the separate letters forming the word; the same standard should be set for reading numbers.

RAPID ADDITION

4. Rapid adding depends largely upon the ability to combine instantly two or more figures into a single number.

ORAL EXERCISE

Practice naming at sight the sums of the following groups from left to right, from right to left, from top to bottom, and from bottom to top, until the sums can be named at the rate of 100 per minute.

1. 1 8 8 7 1 9 7 8 2 2 8 5 9 6 4
   1 9 2 3 3 9 5 8 1 2 4 5 3 1 1

1
Practice naming at sight the sums of the following groups until they can be named at the rate of 60 per minute.

1. 1 4 9 6 4 8 7 2 5 2 4 9 1 1 9
2. 1 7 4 6 3 2 3 4 9 5 3 1 3 2 2
3. 7 9 6 7 8 4 5 9 8 9 6 4 7 6 9
4. 7 1 2 4 6 6 2 6 5 4 6 3 1 5 2
RAPID ADDITION

11. 9 8 4 3 3 8 5 7 9 4 8 6 3 4 6
    9 4 3 1 7 1 5 6 4 5 4 8 4 7 6
    3 8 5 6 1 3 5 7 9 4 9 6 6 9 6

12. 7 3 9 5 6 4 5 3 4 2 4 3 9 9 6
    6 3 4 6 4 2 2 6 3 4 2 5 6 2 3
    3 3 5 7 6 9 8 8 3 7 8 3 3 9 6

13. 3 3 5 6 4 9 3 8 9 .4 7 8 7 5 8
    2 2 4 5 4 2 5 7 7 6 7 3 7 6 7
    9 8 8 8 2 8 9 8 7 8 3 9 5 6 2

14. 5 4 3 2 2 8 2 7 6 6 2 4 5 8 3
    6 4 1 1 8 3 1 2 9 8 9 1 3 5 1
    3 9 3 9 8 5 8 1 8 8 7 4 7 5 5

5. The addition of several numbers arranged in vertical columns can be simplified and rendered much easier by thinking only sums.

Example. 35

46 In adding this column think "17, 24, 30, 35"; 77 and not "9 and 8 are 17, and 7 are 24, and 6 are 68 30, and 5 are 35."

29

ORAL EXERCISE

Speaking only the sums, add the following:

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>385</td>
<td>416</td>
<td>212</td>
<td>297</td>
<td>911</td>
<td>877</td>
<td>288</td>
</tr>
<tr>
<td>276</td>
<td>289</td>
<td>378</td>
<td>578</td>
<td>762</td>
<td>689</td>
<td>999</td>
</tr>
<tr>
<td>425</td>
<td>375</td>
<td>829</td>
<td>879</td>
<td>879</td>
<td>578</td>
<td>878</td>
</tr>
<tr>
<td>738</td>
<td>891</td>
<td>657</td>
<td>683</td>
<td>648</td>
<td>639</td>
<td>657</td>
</tr>
<tr>
<td>897</td>
<td>345</td>
<td>762</td>
<td>479</td>
<td>532</td>
<td>721</td>
<td>894</td>
</tr>
<tr>
<td>365</td>
<td>278</td>
<td>259</td>
<td>178</td>
<td>891</td>
<td>278</td>
<td>335</td>
</tr>
</tbody>
</table>
### EXERCISE

6. Drill on the following problems until correct results can be obtained rapidly.

<table>
<thead>
<tr>
<th></th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.</td>
<td>3678</td>
<td>8765</td>
<td>4578</td>
<td>2871</td>
<td>7841</td>
<td>1431</td>
</tr>
<tr>
<td>10.</td>
<td>9765</td>
<td>4321</td>
<td>3287</td>
<td>6354</td>
<td>3678</td>
<td>2115</td>
</tr>
<tr>
<td>11.</td>
<td>3146</td>
<td>3456</td>
<td>9976</td>
<td>2789</td>
<td>9765</td>
<td>6312</td>
</tr>
<tr>
<td>12.</td>
<td>8973</td>
<td>7897</td>
<td>4521</td>
<td>3436</td>
<td>4738</td>
<td>2543</td>
</tr>
<tr>
<td>13.</td>
<td>7695</td>
<td>6543</td>
<td>7894</td>
<td>5678</td>
<td>9716</td>
<td>2543</td>
</tr>
<tr>
<td>14.</td>
<td>1878</td>
<td>7896</td>
<td>3786</td>
<td>2143</td>
<td>3789</td>
<td>1635</td>
</tr>
<tr>
<td>15.</td>
<td>6543</td>
<td>8342</td>
<td>7312</td>
<td>1713</td>
<td>9876</td>
<td>1144</td>
</tr>
<tr>
<td>16.</td>
<td>2109</td>
<td>8976</td>
<td>9543</td>
<td>8947</td>
<td>8129</td>
<td>1667</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>7.</th>
<th>8.</th>
<th>9.</th>
<th>10.</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.</td>
<td>24,264,357</td>
<td>34,782,919</td>
<td>27,831,641</td>
<td>11,223,344</td>
</tr>
<tr>
<td>18.</td>
<td>89,361,789</td>
<td>22,438,716</td>
<td>78,897,645</td>
<td>55,668,899</td>
</tr>
<tr>
<td>19.</td>
<td>67,584,932</td>
<td>37,498,562</td>
<td>26,848,973</td>
<td>71,158,734</td>
</tr>
<tr>
<td>20.</td>
<td>11,768,419</td>
<td>11,312,417</td>
<td>31,913,328</td>
<td>25,316,275</td>
</tr>
<tr>
<td>21.</td>
<td>27,834,564</td>
<td>19,638,478</td>
<td>95,654,724</td>
<td>39,423,681</td>
</tr>
<tr>
<td>22.</td>
<td>17,198,137</td>
<td>95,463,821</td>
<td>31,216,317</td>
<td>41,618,755</td>
</tr>
<tr>
<td>23.</td>
<td>99,788,781</td>
<td>67,893,215</td>
<td>13,146,184</td>
<td>27,377,213</td>
</tr>
<tr>
<td>24.</td>
<td>81,291,317</td>
<td>32,123,476</td>
<td>78,945,678</td>
<td>16,428,746</td>
</tr>
</tbody>
</table>
7. The first five minutes of each recitation period for several days, or perhaps weeks, should be spent in drill on these exercises and similar ones prepared by the teacher. The time spent in drill is regained by the pupil in the saving of his time, due to the accuracy and rapidity with which he prepares his lesson.

SUBTRACTION

8. The process of finding the difference between two numbers is made much easier and more rapid if the pupil is able to see at a glance what number added to the smaller of two numbers, of one or two figures each, will produce the larger. Thus, if 13 is to be subtracted from 27, the pupil should think of 14, the number which added to 13 produces 27.
ORAL EXERCISE

Speak the number that, added to the smaller number, makes the larger one in each of the following:

1. \[ 3 \quad 5 \quad 4 \quad 6 \quad 9 \quad 8 \quad 7 \quad 8 \quad 7 \quad 9 \quad 6 \quad 9 \quad 5 \quad 9 \quad 9 \]
   \[ 1 \quad 2 \quad 1 \quad 2 \quad 3 \quad 5 \quad 2 \quad 4 \quad 3 \quad 3 \quad 3 \quad 1 \quad 3 \quad 7 \quad 4 \]

2. \[ 12 \quad 11 \quad 10 \quad 12 \quad 11 \quad 10 \quad 12 \quad 11 \quad 13 \quad 14 \quad 15 \quad 14 \quad 15 \quad 14 \quad 15 \]
   \[ 9 \quad 8 \quad 7 \quad 5 \quad 6 \quad 3 \quad 6 \quad 7 \quad 5 \quad 6 \quad 9 \quad 7 \quad 6 \quad 5 \quad 9 \]

3. \[ 16 \quad 17 \quad 18 \quad 18 \quad 17 \quad 19 \quad 17 \quad 19 \quad 18 \quad 17 \quad 16 \quad 16 \quad 19 \quad 16 \quad 15 \]
   \[ 9 \quad 8 \quad 3 \quad 7 \quad 9 \quad 5 \quad 6 \quad 11 \quad 13 \quad 14 \quad 3 \quad 13 \quad 13 \quad 11 \quad 12 \]

4. \[ 23 \quad 24 \quad 27 \quad 29 \quad 26 \quad 25 \quad 31 \quad 34 \quad 38 \quad 39 \quad 32 \quad 33 \quad 35 \quad 21 \quad 23 \]
   \[ 17 \quad 19 \quad 18 \quad 13 \quad 18 \quad 19 \quad 17 \quad 16 \quad 19 \quad 14 \quad 17 \quad 26 \quad 27 \quad 19 \quad 17 \]

5. \[ 43 \quad 45 \quad 47 \quad 49 \quad 41 \quad 40 \quad 42 \quad 44 \quad 50 \quad 54 \quad 57 \quad 59 \quad 58 \quad 55 \quad 53 \]
   \[ 16 \quad 17 \quad 18 \quad 19 \quad 13 \quad 12 \quad 15 \quad 17 \quad 19 \quad 15 \quad 13 \quad 18 \quad 19 \quad 16 \quad 14 \]

6. \[ 52 \quad 51 \quad 53 \quad 55 \quad 57 \quad 59 \quad 61 \quad 62 \quad 63 \quad 67 \quad 69 \quad 78 \quad 75 \quad 77 \quad 71 \]
   \[ 26 \quad 27 \quad 39 \quad 37 \quad 38 \quad 42 \quad 43 \quad 45 \quad 29 \quad 18 \quad 35 \quad 32 \quad 36 \quad 58 \quad 37 \]

7. \[ $2.00 \quad $5.00 \quad $10.00 \quad $10.00 \quad $5.00 \]
   \[ $1.25 \quad $3.75 \quad $6.75 \quad $3.85 \quad $2.78 \]
   \[ $2.00 \quad $20.00 \quad $20.00 \quad $10.00 \quad $5.00 \]
   \[ $1.19 \quad $7.18 \quad $9.45 \quad $4.85 \quad $1.97 \]

9. In the ordinary business transaction of the store it is important to be able to see at once the amount of change and its denomination. Thus, if a purchase of 18 cents is made and a quarter is handed to the merchant, the customer should be able to think quickly of 7 cents as 2 pennies and 1 nickel, the change and its denomination.
### ORAL EXERCISE

State the amount of change and the denomination in each of the following problems:

<table>
<thead>
<tr>
<th>Article purchased</th>
<th>Amount paid</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 1½ yd. ribbon @ 20¢</td>
<td>$1</td>
</tr>
<tr>
<td>2. 12 yd. prints @ 5¢</td>
<td>$1</td>
</tr>
<tr>
<td>3. 12 yd. prints @ 6¢</td>
<td>$1</td>
</tr>
<tr>
<td>4. 3½ yd. serge @ 50¢</td>
<td>$5</td>
</tr>
<tr>
<td>5. 5 yd. lace @ 3¢</td>
<td>50¢</td>
</tr>
<tr>
<td>6. 1 pair shoes @ $3.75</td>
<td>$10</td>
</tr>
<tr>
<td>7. 1 hat @ $2.25</td>
<td>$5</td>
</tr>
<tr>
<td>8. 1 ax @ 90¢</td>
<td>$10</td>
</tr>
<tr>
<td>9. 1 knife @ 55¢</td>
<td>$2</td>
</tr>
<tr>
<td>10. 7 yd. cotton @ 8¢</td>
<td>$1</td>
</tr>
<tr>
<td>11. 9 lb. rice @ 6¢</td>
<td>$2</td>
</tr>
<tr>
<td>12. 3 pairs hose @ 15¢</td>
<td>$1</td>
</tr>
<tr>
<td>13. 7 bars soap @ 5¢</td>
<td>50¢</td>
</tr>
<tr>
<td>14. 1 bucket @ 69¢</td>
<td>$10</td>
</tr>
<tr>
<td>15. 1 lamp @ 37¢</td>
<td>$2</td>
</tr>
<tr>
<td>16. 1 shovel @ 13¢</td>
<td>25¢</td>
</tr>
<tr>
<td>17. 2 brooms @ 35¢</td>
<td>$5</td>
</tr>
<tr>
<td>18. 1 overcoat @ $11.75</td>
<td>$20</td>
</tr>
<tr>
<td>19. 1 pair gloves @ 87¢</td>
<td>$5</td>
</tr>
<tr>
<td>20. 1 suit @ $7.25</td>
<td>$20</td>
</tr>
<tr>
<td>21. Soap, 15¢; oranges, 20¢</td>
<td>$5</td>
</tr>
<tr>
<td>22. Sugar, 25¢; prunes, 17¢</td>
<td>$2</td>
</tr>
<tr>
<td>23. Lamp, 89¢; oil, 50¢</td>
<td>$5</td>
</tr>
<tr>
<td>24. Meal, 65¢; coffee, 35¢</td>
<td>$10</td>
</tr>
<tr>
<td>25. Nails, 24¢; wire, $3.18</td>
<td>$5</td>
</tr>
</tbody>
</table>
10. There are 72 primary facts of multiplication that must be perfectly memorized before the pupil can become skilled in the process. They are as follows:

2 times 2 = 4
2 times 3 = 6
2 times 4 = 8
2 times 5 = 10
2 times 6 = 12
2 times 7 = 14
2 times 8 = 16
2 times 9 = 18
2 times 10 = 20
3 times 2 = 6
3 times 3 = 9
3 times 4 = 12
3 times 5 = 15
3 times 6 = 18
3 times 7 = 21
3 times 8 = 24
3 times 9 = 27
3 times 10 = 30

4 times 2 = 8
4 times 3 = 12
4 times 4 = 16
4 times 5 = 20
4 times 6 = 24
4 times 7 = 28
4 times 8 = 32
4 times 9 = 36
4 times 10 = 40
5 times 2 = 10
5 times 3 = 15
5 times 4 = 20
5 times 5 = 25
5 times 6 = 30
5 times 7 = 35
5 times 8 = 40
5 times 9 = 45
5 times 10 = 50

6 times 2 = 12
6 times 3 = 18
6 times 4 = 24
6 times 5 = 30
6 times 6 = 36
6 times 7 = 42
6 times 8 = 48
6 times 9 = 54
6 times 10 = 60
7 times 2 = 14
7 times 3 = 21
7 times 4 = 28
7 times 5 = 35
7 times 6 = 42
7 times 7 = 49
7 times 8 = 56
7 times 9 = 63
7 times 10 = 70
### MULTIPLICATION

8 times \(2 = 16\)   
8 times \(3 = 24\)   
8 times \(4 = 32\)   
8 times \(5 = 40\)   
8 times \(6 = 48\)   
8 times \(7 = 56\)   
8 times \(8 = 64\)   
8 times \(9 = 72\)   
8 times \(10 = 80\)   

9 times \(2 = 18\)   
9 times \(3 = 27\)   
9 times \(4 = 36\)   
9 times \(5 = 45\)   
9 times \(6 = 54\)   
9 times \(7 = 63\)   
9 times \(8 = 72\)   
9 times \(9 = 81\)   
9 times \(10 = 90\)   

#### 11. Because of the large number of business transactions in which the price is \(6\frac{1}{4}, 8\frac{1}{3}, 12\frac{1}{2},\) and \(16\frac{2}{3}\) cents per article, yard, or pound, it is very convenient and important to memorize a merchant’s table of multiplication. It is as follows:

<table>
<thead>
<tr>
<th>2 times</th>
<th>6(\frac{1}{4})</th>
<th>12(\frac{1}{2})</th>
<th>2 times</th>
<th>8(\frac{1}{3})</th>
<th>16(\frac{2}{3})</th>
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<td>25</td>
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<tr>
<td>4 times</td>
<td>6(\frac{1}{4})</td>
<td>25</td>
<td>4 times</td>
<td>8(\frac{1}{3})</td>
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<td>5 times</td>
<td>6(\frac{1}{4})</td>
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<td>5 times</td>
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<td>41(\frac{1}{3})</td>
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<tr>
<td>6 times</td>
<td>6(\frac{1}{4})</td>
<td>37(\frac{1}{2})</td>
<td>6 times</td>
<td>8(\frac{1}{3})</td>
<td>50</td>
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<td>6(\frac{1}{4})</td>
<td>43(\frac{3}{4})</td>
<td>7 times</td>
<td>8(\frac{1}{3})</td>
<td>58(\frac{1}{3})</td>
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<tr>
<td>8 times</td>
<td>6(\frac{1}{4})</td>
<td>50</td>
<td>8 times</td>
<td>8(\frac{1}{3})</td>
<td>66(\frac{2}{3})</td>
</tr>
<tr>
<td>9 times</td>
<td>6(\frac{1}{4})</td>
<td>56(\frac{1}{2})</td>
<td>9 times</td>
<td>8(\frac{1}{3})</td>
<td>75</td>
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<td>10 times</td>
<td>6(\frac{1}{4})</td>
<td>62(\frac{1}{2})</td>
<td>10 times</td>
<td>8(\frac{1}{3})</td>
<td>83(\frac{1}{3})</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 times</th>
<th>12(\frac{1}{2})</th>
<th>25</th>
<th>2 times</th>
<th>16(\frac{2}{3})</th>
<th>33(\frac{1}{3})</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 times</td>
<td>12(\frac{1}{2})</td>
<td>37(\frac{1}{2})</td>
<td>3 times</td>
<td>16(\frac{2}{3})</td>
<td>50</td>
</tr>
<tr>
<td>4 times</td>
<td>12(\frac{1}{2})</td>
<td>50</td>
<td>4 times</td>
<td>16(\frac{2}{3})</td>
<td>66(\frac{2}{3})</td>
</tr>
<tr>
<td>5 times</td>
<td>12(\frac{1}{2})</td>
<td>62(\frac{1}{2})</td>
<td>5 times</td>
<td>16(\frac{2}{3})</td>
<td>83(\frac{1}{3})</td>
</tr>
<tr>
<td>6 times</td>
<td>12(\frac{1}{2})</td>
<td>75</td>
<td>6 times</td>
<td>16(\frac{2}{3})</td>
<td>100</td>
</tr>
<tr>
<td>7 times</td>
<td>12(\frac{1}{2})</td>
<td>87(\frac{1}{2})</td>
<td>7 times</td>
<td>16(\frac{2}{3})</td>
<td>116(\frac{2}{3})</td>
</tr>
<tr>
<td>8 times</td>
<td>12(\frac{1}{2})</td>
<td>100</td>
<td>8 times</td>
<td>16(\frac{2}{3})</td>
<td>133(\frac{1}{3})</td>
</tr>
<tr>
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<td>12(\frac{1}{2})</td>
<td>112(\frac{1}{2})</td>
<td>9 times</td>
<td>16(\frac{2}{3})</td>
<td>150</td>
</tr>
<tr>
<td>10 times</td>
<td>12(\frac{1}{2})</td>
<td>125</td>
<td>10 times</td>
<td>16(\frac{2}{3})</td>
<td>166(\frac{2}{3})</td>
</tr>
</tbody>
</table>
EXERCISE

1. When gingham sells at \(8\frac{1}{3}\)¢ per yard, what will be the cost of 5 yd.? 7 yd.? 9 yd.? 4 yd.? 10 yd.?

2. When lard sells at 16\frac{2}{3}¢ per pound, what will be the cost of 3 lb.? 5 lb.? 9 lb.?

3. When sugar sells at 6\frac{1}{4}¢ per pound, what will be the cost of 8 lb.? 7 lb.? 6 lb.?

4. When ribbon sells at 12\frac{1}{2}¢ per yard, what will be the cost of 3 yd.? 5 yd.? 8 yd.? 9 yd.?

12. Memorize the following table of important equal parts of 100:

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Decimal</th>
</tr>
</thead>
<tbody>
<tr>
<td>(6\frac{1}{4})</td>
<td>(\frac{1}{16})</td>
</tr>
<tr>
<td>(12\frac{1}{2})</td>
<td>(\frac{1}{8})</td>
</tr>
<tr>
<td>(33\frac{1}{3})</td>
<td>(\frac{1}{3})</td>
</tr>
<tr>
<td>25</td>
<td>(\frac{1}{4})</td>
</tr>
<tr>
<td>(8\frac{3}{4})</td>
<td>(\frac{1}{12})</td>
</tr>
<tr>
<td>(16\frac{2}{3})</td>
<td>(\frac{1}{6})</td>
</tr>
<tr>
<td>20</td>
<td>(\frac{1}{5})</td>
</tr>
<tr>
<td>50</td>
<td>(\frac{1}{2})</td>
</tr>
</tbody>
</table>

13. The following short methods of multiplication are useful.

(1) To multiply any whole number by 10, annex a cipher to the number; if a decimal or mixed number is to be multiplied by 10, move the decimal point in the number one place to the right.

Example. \(368 \times 10 = 3680\).
\(37.56 \times 10 = 375.6\).

ORAL EXERCISE

Name rapidly the products of the following numbers when multiplied by 10; by 100.

1. 89. 6. 285. 11. 87.5. 16. 8.57.
2. 76. 7. 8362. 12. 38.7. 17. .26.
3. 47. 8. 9761. 13. 7.5. 18. .07.
5. 379. 10. 80. 15. .16. 20. 1.02.
(2) To multiply any whole number by $33\frac{1}{3}$, annex two ciphers to the number and divide by 3.

Since $33\frac{1}{3} = \frac{1}{3}$ of 100, to annex two ciphers to any number and divide by 3 is the same as to multiply by $33\frac{1}{3}$.

Example. \[132 \times 33\frac{1}{3} = 13200 + 3 = 4400.\]

EXERCISE

1. Show that to multiply 1728 by $12\frac{1}{4}$ is the same as to multiply by 100 and divide by 8.

2. Show that to multiply 364 by 25 is the same as to multiply by 100 and divide by 4.

3. Show that to multiply 1488 by $8\frac{1}{3}$ is the same as to multiply by 100 and divide by 12.

4. Show that to multiply 1648 by $6\frac{1}{4}$ is the same as to multiply by 100 and divide by 16.

5. Multiply 936 by $8\frac{1}{3}$; by $12\frac{1}{2}$; by $16\frac{2}{3}$; by 25; by $33\frac{1}{3}$.

DIVISION

14. The following short methods of division are useful.

(1) To divide any whole number by 10, point off one decimal place; if a decimal or mixed number is to be divided by 10, move the decimal point in the number one place to the left.

Example. \[867 \div 10 = 86.7.\]
\[36.5 \div 10 = 3.65.\]

ORAL EXERCISE

Name rapidly the quotients of the following numbers when divided by 10; by 100.

1. 87. 3. 273. 5. 638. 7. 1.6.

2. 345. 4. 379. 6. 724. 8. 2780.
ORAL EXERCISE

Name rapidly the quotients of the following numbers when divided by 10.

1. 87.  5. 273.  9. 638.  13. 1.6.
3. 75.  7. 274.  11. 3.7.  15. 8.9.
4. 169.  8. 577.  12. 24.5.  16. 47.5.

(2) To divide any whole number by \(33\frac{1}{3}\), point off two decimal places and multiply by 3; if the number is a decimal or mixed number, move the decimal point two places to the left and multiply by 3.

Since \(33\frac{1}{3} = \frac{1}{3}\) of 100, to move the decimal point two places to the left and multiply by 3 is the same as to divide by \(33\frac{1}{3}\).

Example. \(648 \div 33\frac{1}{3} = 6.48 \times 3 = 19.44\).

(3) To divide any number by \(16\frac{2}{3}\), move the decimal point in the number two places to the left and multiply by 6.

Since \(16\frac{2}{3} = \frac{5}{6}\) of 100, to move the decimal point in the number two places to the left and multiply by 6 is the same as to divide by \(16\frac{2}{3}\).

Example. \(546 \div 16\frac{2}{3} = 5.46 \times 6 = 32.76\).

EXERCISE

1. Show that to divide 484 by 25 is the same as pointing off two decimal places in the dividend and multiplying by 4.

2. Explain a short method for dividing 2567 by 50; by \(12\frac{1}{2}\); by 64.

3. Divide 8976 by \(33\frac{1}{3}\); by \(12\frac{1}{2}\); by \(16\frac{2}{3}\); by 25; by 50.
DECIMALS

15. Skill in the use of decimals in everyday life depends mainly upon the ability to multiply and divide instantly by 10 or some power of 10. This skill may be acquired by practice exercises in multiplying and dividing decimals by 10, by moving the decimal point one place to the right when multiplying, and one place to the left when dividing. Division may be indicated by the sign (÷) or by writing the dividend above the divisor in the form of a common fraction; thus, \( 432 \div 24 \), or \( \frac{432}{24} \).

ORAL EXERCISE

1. Multiply 387.96 by 10; by 100; by 1000.
2. Multiply .0167 by 10; by 100; by 1000.
3. Divide 379.4 by 10; by 100.
4. Divide 753.21 by 10; by 100; by 1000.
5. Divide .8 by 10; by 100.
6. Divide .25 by 10; by 100.
7. Multiply both dividend and divisor in \( \frac{43.2}{24} \) by 10.
8. Multiply both dividend and divisor in \( \frac{36.78}{12.4} \) by 10; by 100.
9. Multiply both dividend and divisor in \( \frac{1.728}{.12} \) by 10; by 100.
10. Multiply both dividend and divisor in \( \frac{6.2575}{.275} \) by 10; by 100; by 1000.
11. State the effect on the quotient when both the dividend and the divisor are multiplied by the same number.
16. Division of decimals is made easier by making the divisor a whole number.

**EXERCISE**

1. \$75 \div 15 \text{ will give dollars in the quotient. How many?}
2. \( 75 \text{ bu.} \div 15 \text{ will give bushels in the quotient. How many?} \\
3. \( 75 \text{ yd.} \div 15 \text{ will give yards in the quotient. How many?} \\
4. \( 75 \text{ gal.} \div 15 \text{ will give gallons in the quotient. How many?} \\
5. \( .75 \div 15 \text{ will give hundredths in the quotient. How many?} \\
6. \( .075 \div 15 \text{ will give thousandths in the quotient. How many?} \\
7. \( .0075 \div 15 \text{ will give ten-thousandths in the quotient. How many?} \\

The divisor is an abstract and whole number, and the quotient in each case takes its name from the dividend. Making use of this principle in the division of decimals, always make the divisor a whole number by multiplying both the dividend and divisor by such a number as will make the divisor a whole number.

**Example.**

\[
.1875 \div .25 = .75. \\
25)18.75(75 \\
175 \\
\underline{125} \\
\underline{125}
\]

The divisor is made an integer by moving the decimal point two places to the right in both dividend and divisor. The quotient is hundredths, the same as the dividend.
EXERCISE

Divide:
1. 10.36 by .2.
2. .0032 by .16.
3. .0625 by 2.5.
4. 1728 by .11.
5. 14.4 by .36.
6. .0044 by 22.
7. 100 by .01.
8. .01 by 20.
9. .2 by 200.
10. .04 by 40.

17. The term "per cent" means hundredths. Hence,
.12 = 12 per cent. .00\(\frac{1}{4}\) = \(\frac{1}{4}\) per cent.
.07 = 7 per cent. 1.25 = 125 per cent.
.09\(\frac{1}{3}\) = 9\(\frac{1}{3}\) per cent. .007 = .7 of a hundredth = .7 per cent.

The sign for per cent is %. Therefore,
\(\frac{1}{10}\) = 13\%. \(\frac{1}{8}\) = \(\frac{1}{8}\)\%.
1.69 = 169\%.

Express the following by using the per-cent sign:
1. .18. 3. .01. 5. .006. 7. .003. 9. .00\(\frac{1}{4}\),
2. .89. 4. .00\(\frac{1}{4}\). 6. .0025. 8. 1.67. 10. .001.

18. Any number written as a per cent may be changed to a decimal by dropping the per-cent sign and multiplying the number by .01; thus,
27\% = 27 \times .01 = .27.
137\% = 137 \times .01 = 1.37.
.25\% = .25 \times .01 = .0025.

Express the following as decimals:
1. 9\%.
2. 8\(\frac{1}{3}\)%.
3. 139\%.
4. .7\%.
5. .18\%.
6. \(\frac{1}{2}\)%.
7. 1.9\%.
8. 2.25\%.
9. 8.3\%. 
19. **Rule.** To find a number when a certain number of hundredths of it is given, divide the given part by the given hundredths.

**Example.**

56 is .16 of what number?

\[ 56 \div .16 = 350. \]

**Proof.**

.16 of 350 = 56.

**EXERCISE**

1. 35 is .12 of what number?

2. The product of a certain number multiplied by .24 is 39.6. What is the number?

3. The product of a certain number multiplied by .17 is 36.55. What is the number?

4. Multiply 75 by .7. The product must be divided by what number to give 75 as quotient?

5. If .16 of a hired man's monthly wages is $4.80, what are his wages?

6. If $11.70 is .14 of the wages a man received for 3 mo., what did he receive?

7. A farmer sold 280 head of cattle, which was .35 of his herd. How many had he in the herd?

8. In a snowstorm .2 of a flock of sheep froze to death. If 13 died, how many were there in the flock?

9. If a bank loaned .24 of its deposits, which was $10,400, what was the total deposit?

10. If 10 A. are .8 of a potato field, how many acres are there in the field?

20. A very generally used method of computing interest is known as the One Dollar Six Per Cent Method. The skillful use of this method depends upon the ability to take readily a fractional part of a decimal.
21. **Rule.** To take a fractional part of a decimal, multiply the decimal by the numerator of the common fraction and divide by the denominator.

**Example.** Find the value of $\frac{5}{6}$ of .041$\frac{3}{8}$.

\[
.041\frac{3}{8} \times 5 = .208\frac{1}{3},
\]

\[
.208\frac{1}{3} \div 6 = .034\frac{13}{18}.
\]

**EXERCISE**

Find:

1. $\frac{3}{4}$ of .18.
2. $\frac{7}{8}$ of .246.
3. $\frac{7}{6}$ of .8.
4. $\frac{4}{3}$ of .0111.
5. $\frac{2}{3}$ of .1.
6. $\frac{5}{6}$ of .01.
7. $\frac{3}{4}$ of .0$\frac{1}{2}$.
8. $\frac{3}{5}$ of .00$\frac{1}{3}$.
9. $\frac{3}{5}$ of .135.
10. $\frac{3}{4}$ of .126.
11. $\frac{3}{4}$ of .123.
12. $\frac{7}{6}$ of .186.
13. $\frac{4}{3}$ of .087.
14. $\frac{3}{2}$ of .105.
15. $\frac{7}{6}$ of .023.
16. $\frac{5}{3}$ of $.018\frac{1}{3}$.
17. $\frac{5}{6}$ of $.093\frac{1}{3}$.
18. $\frac{5}{6}$ of $.08\frac{1}{3}$.
19. $\frac{3}{4}$ of $.008$.
20. $\frac{4}{5}$ of $.004$.
21. $\frac{7}{6}$ of $.002$.
22. $\frac{7}{6}$ of $.01\frac{1}{3}$.
23. $\frac{4}{3}$ of $.071$.
24. $\frac{5}{3}$ of $.031$.
25. $\frac{5}{3}$ of $.18$.
26. $\frac{7}{6}$ of $.241$.
27. $\frac{7}{6}$ of $.001$. 

EDUCATION AND THRIFT

EDUCATED LABOR

22. A business man who has studied the productive power of intelligent labor in New York reports that the man with a common-school education is able to produce one and one-half times as much wealth as the illiterate man, the high-school man two times as much, and the college man four times as much.

EXERCISE

1. The farm hand who is scarcely able to read and write is able to earn $16 a month. If he had a common-school education, how much more should he earn in a period of 30 yr.?

2. If a laborer who signs his name with a mark is able to accumulate $3000 in 20 yr., with a common-school education how much more should he have accumulated in the same time?

3. If a farmer by reading farm papers and books on farming 30 min. daily for a year can grow 2 bu. more of grain per acre, at the present price of corn, wheat, and oats how much does he profit from his reading in growing 20 A. of corn, 10 A. of oats, and 20 A. of wheat? Counting 10 hr. a day’s work, what does he receive for a day’s reading? If this is 50% of the entire gain from the reading, what is the total for a year?

4. The average salary of the man who has completed a college course is about $1000 per year, and the average wages of the man who has completed the common-school studies
are about $450. What will be the difference in the earnings of the two men at the end of a work period of 40 yr.? If it takes 1440 days to complete a high-school and college course, what is the average value of each day spent in taking such a course? (The college-trained man spends 8 yr. of the work period in school at an annual expense of $250.)

5. Two classmates leave the country school, one to work for 75¢ a day with board; the other borrows $250 and goes away 3 yr. to a trade school and learns a trade which pays him $1.75 a day with board. Counting each able to average 285 work days a year, at the end of 10 yr. from the time they leave the district school which will have earned the more money?

TRAINING FOR HEAD AND HAND

23. Manual training is an incentive for study. The pupil is able to see his own thoughts given expression in woodwork, and thus is made conscious of the process of being educated. The result is more personal efficiency, economy, and a higher regard for education.

EXERCISE

1. A seventh-grade boy made and sold in his first 36 one-hour lessons in woodwork the following: a hatrack for $1, a bookshelf for 50¢, a checkerboard for 25¢, two picture frames for 25¢ each, a footstool for 50¢, two coat hooks for 20¢ each, a handkerchief box for 30¢, a singletree for 10¢, and two hammer handles for 10¢ each. How much did he earn while reciting his 36 lessons?

2. A boy working at odd times during a school term of 6 months made a bookcase for which he received $15. How much did he earn each month besides learning geography, history, grammar, and arithmetic?
3. Estimating the value of training a boy how to handle and care for tools at 5¢ for each work day he lives, what is this training worth to a man in the course of 40 yr.?

4. It is estimated by a teacher of carpentry that the boy without training in the use of tools wastes 2 in. on the length of a board for each cut he makes with the saw. Estimate the loss on 100 cuts of 6-inch lumber selling at $3 per hundred.

5. If a boy who has been trained in the use of tools saves $15 a year in the repairs and convenient articles made for the home, what is the saving in 50 yr.?
24. Idleness, carelessness, and waste of machinery can be estimated in dollars. Thus, if a man idles away a day when he can earn $1.50 per day at work, he has lost this money as completely as though it had fallen through a hole in his pocket.

**EXERCISE**

1. How much does a man lose who idles away 140 work days each year, when wages are 75¢ a day with board?

2. In a family of 5 children of school age only one attends school. How much of the state's school fund does the family lose when the state pays $4.40 per year for the education of each child?

3. A self-binder that cost a merchant $100 was left out in the open for 2 yr. and then sold for $50. Money being worth 6%, estimate the cost of this carelessness.
4. A farm wagon with ordinary usage, and kept under shelter when not in use, will last about 15 yr.; when not sheltered it will last about half as long. What is the average loss per year on a $65 wagon that stands out in the open?

5. If a hired hand while cultivating young corn covers up 10 hills to the acre, what is the value of the corn destroyed, counting 2 ears to the hill and 100 ears to the bushel, at 60¢ per bushel?

6. If the hired hand in problem 5 cultivates $\frac{3}{4}$ A. per day, what is the actual cost to the farmer for a day's work when the man is paid 75¢ per day?
7. Read in some good book for 30 min. and count the words read. How many would this make per hour?

8. Calling 400 pages with 400 words to the page an average-sized book, how many good books could you read each year at your present rate of reading by devoting 1 hr. each day to them?

9. How many books have you read? Counting 400 pages to the book, how many hours have you spent reading good books?

10. A kitchen that is poorly arranged requires the mother to take 100 more steps each day in preparing the meals than she would in a well-arranged kitchen. How many unnecessary steps does she take in a year? How many miles is this? (Allow 20 in. to a step.)

11. If a kitchen cabinet saves a mother 50 twenty-inch steps daily, how many miles is she saved in 20 yr.?

PRODUCE, GRAIN, AND STOCK MARKET

25. The teacher should assist and encourage his pupils to make a weekly produce and grain chart of the local and city market prices of all the farm products of his school district. Any good daily or weekly paper will give the city market prices, while the county paper will give the local or home prices. This chart should be tacked on the wall of the schoolroom, in a place where all the pupils can read it. Once a week a new one should be made, the pupils reporting the market prices.

The child who grows up to be a farmer, not accustomed to read and study the markets, will never be in a position to command the highest prices for his products. He must know the markets in order to know how to buy and sell intelligently.
EXERCISE

1. Make a produce-, grain-, and stock-market chart for the week beginning September 8, 1913, as follows:

<table>
<thead>
<tr>
<th>Name of article</th>
<th>Local market price</th>
<th>City market price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butter, per lb.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs, per doz.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hens, per lb.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hogs, per cwt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steers, fat, per cwt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steers, feeders, per cwt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yearlings, per cwt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heifers, per cwt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cows, per cwt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat, per bu.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oats, per bu.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn, per bu.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Find the amount of:

   3 doz. eggs @ 18¢
   5 lb. butter @ 20¢
   10 lb. honey @ 12½¢

3. Find the sum due a person who sells:

   6 doz. eggs @ 12¢
   30 lb. chickens @ 8¢
   35 lb. dried fruit @ 4½¢

and buys:

   3 lb. coffee @ 20¢
   1 gal. sirup @ 60¢
   2 gal. oil @ 15¢
   8 lb. rice @ 6¢
   10 yd. gingham @ 8½¢
The Department of Agriculture has just completed an inquiry into the causes for bad and addled eggs. It reports that farmers could save several million dollars a year in the egg industry by observing the following rules: give the hens clean nests; gather the eggs at least once daily; keep the eggs in a cool, dry place; market the eggs at least twice a week; sell all mature roosters as soon as the hatching season closes.

**EXERCISE**

1. A flock of 30 hens that have a barnyard for a run are fed daily 2 lb. of wheat worth 90¢ a bushel. If the hens average 80 eggs a year each, when eggs are worth 18¢ per dozen, what is the profit on the flock?

2. Keep a strict account of the feed given a flock of chickens for a month and the number of eggs laid. At the local price of feed and eggs, determine the profit or the loss on the flock for the period.
3. One dozen Barred Plymouth Rock eggs weighed 22 oz. and one dozen Leghorn eggs weighed 16 oz. How many Leghorn eggs will it take to equal in weight 22 doz. Barred Plymouth Rock eggs?

4. From problem 3, find out what a laboring man can afford to pay per dozen for Barred Plymouth Rock eggs when Leghorn eggs are selling at 11¢ per dozen. Why should eggs be sold by weight?

5. Capons in the market are worth more than hens. What is the profit on 36 capons weighing 8 lb. each, worth 8½¢ per pound, when as roosters they would bring only 4½¢ per pound?

6. What is the difference in the value of two hens, one laying 192 eggs a year and the other 90 eggs a year, if the average price of eggs is 15¢ per dozen?

7. A flock of 50 hens averages 93 eggs a year each. If the average price of eggs is 15¢ per dozen, what is the value of the eggs?

8. If it takes $15 worth of feed to keep this flock for 1 yr., what is the profit over and above the cost of feed?

9. A poultry journal estimates that hens on the farm average 80 eggs a year each, and that by selecting the best layers and breeding from them, an average of 135 eggs a year each could be obtained. What would this difference amount to for a year with a flock of 75 hens, when eggs are worth 16¢ per dozen?

10. The Eastern egg buyers have discovered by years of experience that one out of every five eggs coming from a certain state during the summer is bad, and they make the price to the local egg buyers accordingly. When the local egg buyer pays 12¢ per dozen, what is the actual value per dozen of good eggs? What is the loss on the sale of 144 doz. of good eggs?
SPRAYING

27. Blight, rot, and scab are fungous diseases of orchards which decrease the yield and quality of the fruit grown. Bordeaux mixture is used for killing fungous growths, such as black rot and scab of apples. To make a solution for spraying, dissolve 4 lb. of freshly slaked lime and 4 lb. of copper sulphate in 50 gal. of water. If chewing insects that destroy plants by eating the leaves are also to be destroyed, add $\frac{1}{4}$ lb. of Paris green or 3 lb. of arsenate of lead paste to the Bordeaux mixture. A sufficient amount to spray one tree is $2\frac{1}{2}$ gal.

28. A Paris-green solution, consisting of $\frac{1}{4}$ lb. of Paris green mixed with 50 gal. of water, is used to destroy insects that chew the leaves of potatoes.

EXERCISE

1. In the spring of 1910 the Kentucky Experiment Station took as a subject for demonstration an orchard in Hardin County which had never been sprayed. A single row of trees extending through the orchard was sprayed twice with Bordeaux mixture, once immediately following the blooming period, and again 12 da. later. One sprayed Maiden Blush tree yielded 7 bu. of apples, 4$\frac{1}{2}$ bu. of which graded "firsts," the remainder "seconds." One unsprayed tree of the same variety in the next row yielded 4 bu. of apples, $\frac{1}{2}$ bu. of which graded firsts. When firsts were selling at 80¢ a bushel and seconds at 40¢, what was the difference in the market value of the fruit grown on the two trees?

2. When the yield and the quality of the fruit in the above problem is an average for sprayed and unsprayed trees, what will be the difference in yield in two orchards
of 150 trees each, one sprayed twice, the other unsprayed? What will be the difference in their value, firsts selling at 50¢ per bushel, seconds at 25¢ per bushel?

3. With lime at 1¢ per pound, copper sulphate at 10¢ per pound, and arsenate of lead paste at 20¢ per pound, averaging 2 gal. of the mixture to a tree for a single spray, what would be the cost of spraying 100 apple trees twice?

4. If the orchard in problem 1 is a square consisting of 10 A., with the trees set in rows 30 ft. apart and the trees in the row the same distance apart, what would be the cost of the material for spraying the orchard twice? What would be the value of the increased yield when apples of the first grade sell for 60¢ per bushel, and of the second grade for 30¢ per bushel?

5. What would be the cost of the material required to spray an orchard of 50 trees twice?

6. To destroy blight, rot, and insects, a farmer sprayed half of a 2-acre field of potatoes three times with Bordeaux mixture containing Paris green. The expense was as follows: 24 lb. of lime at 1½¢ per pound; 24 lb. of copper sulphate at 24¢ per pound; 1½ lb. of Paris green at 30¢ per pound; $4.25 for labor. The sprayed acre yielded 165 bu. of potatoes, for which the farmer received 60¢ per bushel. The unsprayed acre yielded 57 bu., for which he received 60¢ per bushel. What was the value to the farmer of the spraying of the 1 A.?

7. What is the cost of materials required for spraying a 10-acre field of potatoes three times for insects, if Paris green is 30¢ a pound and 300 gal. of the solution are used to the acre? What is the profit for spraying if the labor cost $22.50 and the increased yield is worth $75?
The Value of Birds to Farmers

29. Mr. Beal, of the United States Biological Survey, once estimated that the tree sparrow in a single season in the state of Iowa ate 1,750,000 lb. of weed seed.

Mr. Chester A. Reed, of Massachusetts, estimates that on an average each bird will eat daily for about five months in the year, from May to September inclusive, 100 harmful insects. He also estimates 120,000 insects to the bushel.

Exercise

1. If 15 lb. of weed seed will sow 1 A., how many acres of weeds would the seed eaten by the tree sparrow in Iowa alone have sown? At 65¢ an acre for cutting, raking, and burning the weeds, what would it have cost the farmers of Iowa to destroy the weeds?

2. Counting 5 insect-eating birds to the acre, how many bushels of harmful insects will the birds on an average-sized farm in your community destroy during 5 mo.?

3. How many cutworms, grubs, and harmful insects will be destroyed by a flock of 50 birds that follow the plow daily for 2 wk.?

4. If 2 out of every 100 insects and worms destroyed are either cutworms or grubs (these are the destroyers of young corn), and if both the grubworm and the cutworm destroy on an average 3 corn plants daily, what is the value of the 50 birds following the plow for 2 wk., when corn is 50¢ per bushel? (Allow one good ear to each plant destroyed.)

5. If a quail, in the course of a year, eats 25¢ worth of grain, and destroys $2 worth of harmful insects and weed seed, how much has a farmer injured himself by killing 3 pairs of quails if a pair raise a brood of 12 each year?
PRACTICAL MEASUREMENTS

JUDGING DISTANCE AND SURFACE

30. Every one should be so familiar with the units of measure that he can measure distance, surface, and volume fairly accurately with the eye.

EXERCISE

1. Lay off a square yard on the wall or blackboard with colored crayon. Put it in a conspicuous place and do not erase.

2. In one corner of the square yard lay off a square foot.

3. Make an estimate of the number of square yards in the schoolroom floor; then measure and determine the exact number.

4. Make an estimate of the number of square feet in the blackboard; then measure and determine the exact number.

5. How many square feet in the top of your desk?

6. How many square feet in the floor?

7. How many square yards in the wall?

8. Measure a rod on the school yard and mark with two firmly set stones or stakes.

9. Lay off 300 ft. by accurate measurement, set up stakes at each end, and walk this distance several times, counting the number of steps taken each time. From this determine the length in inches of your average step.

10. By stepping, estimate a quarter of a mile.
LUMBER MEASURE

31. A board foot is the unit in measuring lumber. It is a board 1 ft. square and 1 in. or less thick. It contains 144 sq. in.

Lumber dealers usually speak of board feet as feet.

EXERCISE

1. On a board 6 in. wide, mark the length of a board that will contain 144 sq. in. (a board foot).

2. On a board 8 in. wide, mark the length of a board that will contain a board foot.

3. On a board 4 in. wide, mark the length of a board that will contain a board foot.

4. On a board 10 in. wide, mark off a board foot.

32. In billing lumber, the number of pieces are entered first, then the thickness and width in inches, then the length in feet. In recording 5 pieces, 6 in. thick by 8 in. wide and 16 ft. long, the form would be thus,

5 pc. $6'' \times 8'' \times 16'$;

and would be read off by a lumberman, "5 six-by-eight 16 ft." Lumbermen use the sign (" for inches and (') for feet, instead of writing inches and feet.
33. Rule. To find the number of board feet in a piece of lumber, divide by 12 the product of its length in feet by its width and thickness in inches.

The work may usually be shortened by arranging it in the form for cancellation. Thus,
\[
\frac{18 \times 8 \times 1}{2} = 12 \text{ ft.}
\]

34. Rule. To find the cost of a bill of lumber, divide the number of board feet by 100 by pointing off two decimal places, then multiply by the price per hundred feet.

EXERCISE

1. Read the following bill of lumber:
   23 pc. 4" × 6" × 12',
   7 pc. 4" × 6" × 16',
   15 pc. 2" × 8" × 20',
   16 pc. 2" × 6" × 20'.

2. Determine the number of board feet of lumber in
   10 pc. 2" × 4" × 12',
   12 pc. 3" × 8" × 16',
   16 pc. 3" × 6" × 18',
   80 pc. 3" × 8" × 20'.

3. At $1.75 per hundred, find the cost of
   7 pc. 2" × 10" × 18',
   75 pc. 1" × 8" × 14',
   30 pc. 2" × 4" × 12'.

4. Find the cost of the following:
   20 pc. 2" × 4" × 16' at $1.50 per 100,
   60 pc. 1" × 6" × 14' at $1.75 per 100,
   100 pc. 1" × 4" × 12' at $2.25 per 100.
5. Determine the cost, at $1.75 per hundred, of the lumber required to build a yard fence 168 ft. long and 6 boards high, the boards used being 12 ft. long, 4 in. wide, and 1 in. thick.

6. At $2 per hundred, what will be the cost of the lumber required to inclose a field 20 rd. square with a board fence 6 boards high, if the boards are 10 ft. long, 4 in. wide, and 1 in. thick?

MEASURING LUMBER IN THE LOG

35. A widely used rule for measuring lumber in the log is the following, known as Doyle's Rule:

36. Rule. Subtract 4 in. from the smallest diameter, multiply the remainder by one half itself, then by the length of the log in feet, and divide by 8.

Example. How many feet of lumber in a log 12 ft. long and 32 in. in diameter?

\[
\frac{7 \times 3}{\frac{28 \times 14 \times 12}{8}} = 588 \text{ ft.}
\]

EXERCISE

1. Determine the number of board feet in the following: 3 logs 14 ft. long, 36 in. in diameter; 2 logs 16 ft. long, 24 in. in diameter.

2. At 50¢ per hundred for sawing, what will it cost to have sawed 10 logs, 16 ft. long and 18 in. in diameter?

3. An oak tree 11 in. in diameter contains about 40 ft. of lumber. After a growth of 8 yr. it contains 120 ft. At $1
per hundred, what is the value of the growth of the oak in 50 A. of forest, averaging 30 oaks to the acre?

4. A poplar tree 10 in. in diameter contains about 46 ft. of lumber. After a growth of 10 yr. it contains 200 ft. At $1.75 per hundred, what is the value of the growth on 400 trees?

5. Estimating one railroad tie to a tree 11 in. in diameter, which is the better business: to cut 800 tie trees when ties are selling at 55¢ apiece, delivered, or to take the growth on them for 12 yr., at which time the trees will average 170 ft. and will be worth $1.50 per hundred standing?

6. If a cubic foot of oak weighs 64 lb., what is the weight upon a wagon loaded with 10 oak ties 8 1/2 ft. long, 9 in. wide, and 7 in. thick?

7. How many railroad ties 9 in. wide, placed 15 in. apart, are required for 1 mi. of track?

CORDWOOD, STOVE WOOD, AND COAL

37. Cordwood is 4 ft. long. A cord of wood is a pile 8 ft. long and 4 ft. high. A cord of stove wood is a pile of wood 8 ft. long, 4 ft. high, and of any length that will fit a stove.

38. Rule. To find the number of cords of wood in a pile, multiply the length of the pile by the height in feet, and divide by 32.

EXERCISE

1. If a cord of wood for cooking purposes lasts a family 3 wk., how much does the family pay out in the course of a year for cook-stove wood when wood is $2 per cord? when wood is $3 per cord?

2. How many cords of wood are there in a pile 18 ft. long and 4 ft. high?

3. How many cords of oak bark are there in a pile 24 ft. long and 10 ft. high?
4. At $6 per cord, what is the value of a pile of oak cordwood 40 ft. long and 6 ft. high?

5. How many cords of wood can a man have on a frame 12 ft. long and 4 ft. high?

6. Which is cheaper for a man living in town: to buy stove wood 16 in. long at $3 per cord, or to pay $6 per cord for cordwood and give a man $2 to saw and split it into stove wood?

7. Is it cheaper for a man to buy stove wood 16 in. long at $1.50 per cord, or to pay $2 per cord for cordwood and give a man $1.50 to saw and split it into stove wood?

8. Make an estimate of the number of cords of wood in the fallen trees that are wasting on your father's farm. What is the value of this wood at $2 per cord?

9. How many cords of wood 16 in. long can be placed crosswise in a wagon bed 10 ft. long, 3 ft. wide, and 14 in. deep?

10. How long must a pile of wood 10 ft. high be to contain 18 cords?

EXERCISE

1. How many bushels of coal are there in a wagon bed 9 ft. long, 3 ft. wide, and 15 in. deep?

2. How many tons of coal will a coal shed 12 ft. long, 8 ft. wide, and 7 ft. high hold?

3. Measure the thickness of a vein of coal in your neighborhood and estimate the number of tons under an acre of land. What is it worth at 10¢ per ton?

4. How many tons of coal can be placed in a car 36 ft long, 8 ft. wide, and 5 ft. deep?

LIQUID MEASURE

40. The liquid gallon contains 231 cu. in. and the barrel 31\frac{1}{2} gal. A cubic foot contains 1728 cu. in. For practical purposes count 7\frac{1}{2} gal. to every cubic foot of water.

EXERCISE

1. Make a box whose inside measurements are 11 in. by 7 in. by 3 in. Fill the box level full of sand, then pour the sand into a bucket and mark its depth. This may be used as a gallon measure.

2. Using your marked bucket as a measure, find the capacity of several different vessels.

3. Saw a 1-inch cube from a board 1 in. thick.

4. Saw a square foot from a board 1 in. thick. What must be the width of the board? How many 1-inch cubes does it contain?

5. Make a box whose inside measurements are 12 in. by 12 in. by 12 in. How many 1-inch cubes does it contain?
6. How many gallons of milk can be put into a can containing 1{386 cu. in.?

7. How many gallons of water are there in a well 4 ft. in diameter, when the water stands 6 ft. deep?

Suggestion. For practical purposes, square one half the diameter in feet, multiply by $3\frac{1}{3}$, by the depth in feet, and by $7\frac{3}{8}$.

8. How many barrels of water are there in the well in problem 7?

9. How many gallons of water are there in a well 6 in. in diameter, when the water stands 10 ft. deep?

10. How many gallons of water will a tank 6 ft. in diameter and 2 ft. deep hold?

11. How many gallons of water will a barrel contain, the head diameter being 20 in., the bung diameter 24 in., and the length 30 in.?

Suggestion. $\frac{20 \text{ in.} + 24 \text{ in.}}{2} = 22 \text{ in.}$, the average diameter.

12. Measure a cistern and approximate the number of gallons it will contain.

13. How many gallons will a bucket contain, the head diameter being 10 in., the bottom diameter 9 in., and the depth 10 in.?

SPECIFIC GRAVITY

41. The specific gravity of a substance is its weight measured by the weight of an equal volume of pure water. Any substance whose weight is less than the weight of an equal volume of water will float. One cubic foot of water weighs 62.5 lb.

42. Weigh a pailful of sand very carefully and subtract the weight of the pail. Then weigh a pailful of water and
subtract the weight of the pail. Now divide the weight of the sand by the weight of the water. The quotient is called the specific gravity.

If the substance whose specific gravity is to be found is of an irregular shape,—for instance, a piece of iron,—weigh it. Then place it in a pailful of water. Some of the water, an amount equal to the bulk of the substance, will run out. Weigh the water that runs out, and divide the weight of the substance by the weight of the water that runs out. The quotient will be the specific gravity of the substance.

43. Rule. To find the specific gravity of a substance, divide its weight by the weight of an equal volume of water.

EXERCISE

1. A cubic foot of zinc weighs 437.5 lb., and a cubic foot of water weighs 62.5 lb. What is the specific gravity of the zinc?

2. A cubic foot of lead weighs 712.5 lb., and a cubic foot of water, 62.5 lb. What is the specific gravity of the lead?

3. The specific gravity of cast iron is 7.4. What is the weight of a bar 2 ft. long, 9 in. wide, and 8 in. thick?

4. Find the specific gravity of a pailful of gravel, and estimate the weight of a load of gravel in a bed 9 ft. long, 3 ft. wide, and 12 in. deep.

5. A flatboat 40 ft. long and 12 ft. wide sinks 2½ in. when a team drawing a load of wheat is driven upon it. What is the combined weight of the team, wagon, and load?

6. To what depth will 400 bu. of wheat sink a flatboat 60 ft. long and 18 ft. wide?
7. The specific gravity of oak is .75, of poplar .45, of white pine .4. Compare the weights of a sill of each 12 ft. long, 12 in. wide, and 10 in. thick.

8. If a cubic foot of water weighs 62.5 lb., and the specific gravity of ice is .92, what is the weight of a cubic foot of ice?

9. If a gallon of water weighs 8.35 lb., and the specific gravity of milk is 1.03, what is the weight of a gallon of milk?

10. If a gallon of water weighs 8.35 lb., and the specific gravity of oil is .9, what is the weight of the oil in a barrel holding 40 gal.?

**LAND MEASURE**

44. A rectangular field is one bounded by four straight lines, having four square corners. An acre contains 160 sq. rd.

**EXERCISE**

1. Lay off a square rod on the school yard, and mark with 4 firmly set stakes.

2. Lay off an acre of land in the form of a rectangle near your schoolhouse, and mark with stakes.

3. How many acres are there in a rectangular field 80 rd. long by 60 rd. wide?

4. What must be the width of a rectangular field 80 rd. long to contain 25 A.?
45. A triangular field is one bounded by three straight lines. The altitude of a triangle is the perpendicular distance between the base of the triangle and the highest point opposite it.

Lines are perpendicular (⊥) to each other when they meet forming a square corner.

If two sides of a triangle are perpendicular to each other, the triangle is called a right triangle.

**EXERCISE**

1. Cut a 4-inch square into 2 equal right triangles. How many square inches are there in each triangle? At a point halfway between the base and the apex of one of the triangles, cut on a line parallel with the base, and so place the two parts as to form a rectangle. Now make your own rule for measuring a triangle.

2. How many acres are there in a triangular field the longest side of which is 30 rd., and the altitude of which from the opposite corner to this side is 35 rd.?

3. Stake off a small triangular field, measure the longest side and the altitude from the corner opposite this side, and determine the number of acres.
4. Select a triangular field near the schoolhouse, measure it, and estimate the number of acres it contains.

5. A farmer has 2 rectangular pieces of land to fence; one is 40 rd. by 40 rd., the other 80 rd. by 20 rd. How much will it cost to fence each at 55¢ per rod? How many acres in each field?

6. Select an irregular 4-sided field near the schoolhouse, and estimate the number of acres it contains.

Note. To measure the acres in an irregular, 4-sided field, measure the diagonal (the distance from one corner to the opposite corner), and solve each triangle. Their sum will be the area of the field.

46. Barbed wire is sold by the roll. The average-sized roll weighs 100 lb. One pound of barbed wire averages 12 ft. in length. A pound of staples contains about 100.

**EXERCISE**

1. How many rolls of wire and pounds of staples must be bought for 80 rd. of fence 3 wires high, the posts being 12 ft. apart?

2. With wire at $1.75 per cwt., and staples at 4¢ per pound, estimate the cost of the wire and staples required to build $\frac{3}{4}$ mi. of fence 4 wires high.

3. A fence 80 rd. long is built out of posts set 12 ft. apart with woven wire 27 in. high, and 3 strings of barbed
wire. What is the cost of the fence when posts cost 15¢ each, woven wire 23¢ per rod, and barbed wire 1.8¢ per rod?

4. A fence answering the same purpose could have been built with the same number of posts at the same price, using woven wire 48 in. high at 27¢ per rod. What would have been the difference in the cost of the two fences?

AREAS OF STATES

47. Maps are drawn to a scale, that is, 1 in. on a map may be used to represent 80, 90, or 100 mi., etc. From the scale of a map the area of the surface represented may be determined.

48. Rule. To determine approximately the area of a state or a county from a map drawn to a scale, square the number represented by 1 in. on the scale and multiply the product by the number of square inches in the map. The result will be the area in square miles. If the state is irregular in shape, use an average length and width.

EXERCISE

1. A square surface 4 ft. long is represented by a drawing 1 ft. square. In what ratio are the dimensions diminished? The surface of the drawing (1 sq. ft.) represents how many square feet of the original surface?

2. A square surface 3 ft. long is represented by a drawing 1 ft. square. In what ratio are the dimensions diminished? The surface of the drawing represents how many square feet of the original surface?

3. A rectangular surface 12 in. by 8 in. is represented by a drawing 3 in. by 2 in. In what ratio are the dimensions diminished? How many square inches of the original surface does 1 sq. in. of the drawing represent?
4. Colorado is represented on a map as 3 in. long and 2\frac{1}{2} in. wide. The scale of the map is 1 in. for every 124 mi. Find the approximate area of the state.

5. Consult a map of North Dakota and determine the area of the state.

6. Kansas is represented on a map as 4.125 in. long and 2.625 in. wide. The scale of the map is 1 in. for every 97 mi. Find the approximate area of the state.

7. If .05 in. on a certain map represents a mile, what is the scale of the map?

8. If .06 in. on a map represents 1.8 mi., what is the distance on the map between two places if their real distance apart is 75 mi.?

**PAPERING**

49. **Rule.** To estimate the number of rolls of paper required for the walls of a room, multiply the distance around the room in feet by the height in feet and divide by 72 if the rolls are double, and by 36 if the rolls are single. Deduct a double roll for each three openings.

A fractional roll is counted as a whole roll.

**EXERCISE**

1. How many double rolls of paper would it take to paper the walls of your schoolroom? the ceiling?

2. At 15¢ per double roll for walls and ceiling, and 15¢ per roll for border, what would the paper for the schoolhouse cost?

3. At 20¢ per double roll for walls and ceiling, and 20¢ per double roll for border, what would the paper cost for your living room at home?

4. How much would it cost to paper your dining room with paper at 18¢ per double roll, the border at the same price, and 20¢ per double roll the price for hanging?
CARPETING

50. Carpeting is usually $\frac{3}{4}$ yd. or 1 yd. wide, and matting is 1 yd. wide. They are sold by the yard. The number of yards needed for a given room depends upon the way the strips are to run — that is, lengthwise or across the room — and the amount of waste in matching. A fractional part of a strip cannot be bought.

51. Rule. To determine the number of yards required to carpet a room, decide which way the strips shall run, and estimate their length and number. Add to the length of each strip after the first the allowance for waste in matching. The combined length of the strips in feet divided by 3 will give the number of yards required.

EXERCISE

1. Measure your schoolroom floor and determine how many yards of matting it would take to cover it, placing the strips lengthwise; crosswise.

2. Bring to school the dimensions of your living room, and estimate the most economical way of covering the floor with matting worth 35¢ per yard.

3. A room 13½ ft. by 10 ft. is to be carpeted with carpet 1 yd. wide at 80¢ per yard. Which is the more economical way of laying the strips? How much more economical is it?

4. Find the cost of carpeting a room 16 ft. 6 in. by 12 ft. 2 in. with carpeting $\frac{3}{4}$ yd. wide at $1.10$ per yard, when the strips are laid lengthwise. Allow for a waste of 9 in. on each strip in matching the pattern.
CONSERVATION OF THE SOIL

SOIL EROSION

52. Soil erosion is the washing away of the soil by rain and snow. It is prevented by proper crop rotation and by keeping all ditches filled with rock or brush or some other substance.

ERODED FIELD

EXERCISE

1. Ordinary sandstone will hold \( \frac{1}{20} \) of its bulk of water. How many gallons of water are there in a bed of sandstone underlying a 5-acre field, if it is 10 ft. thick and soaked with water?
2. After a heavy summer rain the water of a small stream contained 1 lb. of sediment for every 500 gal. of water. If the rainfall was 1 in., the area of the basin drained 4 sq. mi., and the amount of water that ran off ¼ of all that fell, how much soil did the rain carry away?

3. After a heavy rain the water of a small stream that drained a meadow contained 1 lb. of sediment for every 2000 gal. of water. If the rainfall was 2 in., and ¼ of all the water that fell ran off, how much soil was carried away from a 40-acre meadow?

4. If the water running from a piece of land that has been planted with corn contained 1 lb. of sediment for every 250 gal. of water, how much soil was carried away from a 40-acre cornfield after a 2-inch rainfall, ¼ of the water running off?

TAX UPON THE SOIL BY DIFFERENT CROPS

53. Nitrogen, phosphoric acid, and potash are the most important plant foods contained in the soil. They are extracted from the soil in different proportions by different crops. Clover, cowpeas, and a few other crops draw their nitrogen from the air and thus save the soil.

54. The table below will give some idea of the amount of plant food removed from the soil in growing certain crops.

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<td>10</td>
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</tbody>
</table>
EXERCISE

1. How many pounds of plant food are required to grow 18 A. of corn, averaging 50 bu. to the acre?

2. How many pounds of plant food are required to grow 18 A. of clover, averaging 2 tons to the acre? averaging 1 ton to the acre?

3. What is the tax upon the soil in growing a 50-acre field of wheat, averaging 20 bu. to the acre?

4. What is the value of the plant food removed from the soil in growing 50 bu. of corn, nitrogen being quoted in the market at 22¢ a pound, phosphoric acid at 5¢ a pound, and potash at 6¢ a pound?

5. A father tells his son that he may have all the wheat he can grow on a 10-acre field if he will pay, at commercial prices (see problem 4), for the plant food removed from the soil. If the son grows 20 bu. per acre, how much does he owe his father?

THE COST OF RESTORING PLANT FOOD TO THE SOIL

55. Nitrogen, phosphoric acid, and potash may be returned to the soil by means of commercial fertilizer, straw, and manures.

56. The table on the following page gives some idea of how plant food may be returned to the soil, and what it is worth per ton at commercial prices: nitrogen, 20¢ per pound; potash, 5¢; and phosphoric acid, 5¢.

Pupils should complete the table with values based on commercial prices, and make a duplicate copy on a large piece of pasteboard for their parents to inspect and to keep for future reference.
CONSERVATION OF THE SOIL

<table>
<thead>
<tr>
<th>Name of Material</th>
<th>Pounds per Ton</th>
<th>Market Value per Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nitrogen</td>
<td>Phosphoric acid</td>
</tr>
<tr>
<td>Fresh farm manure</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Barnyard manure</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Corn stover</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Oat straw</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>Wheat straw</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Clover hay</td>
<td>41</td>
<td>7</td>
</tr>
<tr>
<td>Cowpeas</td>
<td>39</td>
<td>10</td>
</tr>
<tr>
<td>Rye straw</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Redtop</td>
<td>23</td>
<td>7</td>
</tr>
<tr>
<td>Average, complete</td>
<td>33</td>
<td>33</td>
</tr>
</tbody>
</table>

EXERCISE

1. What is the loss in plant food to a farmer who burns a straw stack weighing 20 tons?

2. How much plant food does a farmer lose when selling the fodder from a 10-acre field averaging 50 bu. per acre?

3. What is the value of the plant food returned to the soil when 25 A. of clover, averaging 1 ton per acre, are plowed under?

4. How does the value of 1 ton of fresh farm manure compare with that of 1 ton of cowpeas plowed under for fertilizer? (A ton of fresh manure shrinks one half in weight during the first six months when exposed to the weather.)

5. How does 1 ton of barnyard manure compare in soil fertility with 1 ton of wheat straw?

6. What is the loss on 10 tons of piled manure exposed 6 or more months? (Make an estimate based on the commercial value of plant food given in the table.)
7. What is the value of the plant food in the cornstalks from 1 A., when the stalks weigh 3500 lb.?

8. It is estimated that a 1000-pound steer during the process of fattening makes .9 ton of manure per month. What is the value of the manure from a herd of 20 for 3 mo.?

9. It is estimated that the value of the manure produced annually by a farm horse is $30; that produced by the cow, $24; and that produced by the hog, $10. If the statement is true that the average farmer saves only $ of the value of the manure on the farm, what is the annual loss on 2 horses, 3 cows, and 5 hogs?

**THE COMPARATIVE VALUE OF MANURES**

57. The table on the following page gives the analysis of farmyard manures made by the Department of Agriculture at Washington, D.C.

58. When nitrogen is worth 20¢ per pound, potash 6¢, and phosphoric acid 5¢, complete the table by estimating the value of each ton of manure.
<table>
<thead>
<tr>
<th></th>
<th>Manure water</th>
<th>Nitrogen</th>
<th>Phosphoric acid</th>
<th>Potash</th>
<th>Value per ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>75.25%</td>
<td>.426%</td>
<td>.20%</td>
<td>.44%</td>
<td></td>
</tr>
<tr>
<td>Horse</td>
<td>48.60%</td>
<td>.49%</td>
<td>.26%</td>
<td>.48%</td>
<td></td>
</tr>
<tr>
<td>Hog</td>
<td>74.13%</td>
<td>.84%</td>
<td>.39%</td>
<td>.92%</td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td>59.52%</td>
<td>.768%</td>
<td>.391%</td>
<td>.591%</td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td>56%</td>
<td>.8%</td>
<td>.5%</td>
<td>.85%</td>
<td></td>
</tr>
</tbody>
</table>

**EXERCISE**

1. The Maryland Agricultural Experiment Station grew 65.1 bu. of corn on land which had been given one application of rotted manure; on adjoining land it grew 70.7 bu. of corn from an equal amount of fresh manure. What was the per cent of gain from using fresh manure?

2. At the same station fresh manure when used as a top-dressing, instead of being plowed under, resulted in a gain of 10 bu. of corn per acre. The yield of corn on the land where the manure was plowed under was 87 bu.; what was it on the other? What was the per cent of gain from using the manure as a top-dressing?

3. On an unmanured piece of land 16 bu. of wheat was the average yield per acre. The same land when given a top-dressing of fresh manure made an average yield of 20 bu. What was the per cent of increase of the manured land over the unmanured?

**MIXING FERTILIZERS ON THE FARM**

59. It is usually much cheaper and more satisfactory to buy the fertilizer ingredients and mix them on the farm. A fertilizer labeled 2-8-4 contains 2% nitrogen, 8% phosphoric acid, and 4% potash. (In some states the order of naming the ingredients is phosphoric acid, nitrogen, and potash.)
60. Commercial fertilizers are used for the nitrogen, phosphoric acid, and potash they contain. Nitrogen is obtained chiefly from nitrate of soda, dried blood, dried fish scrap, and cottonseed meal. Phosphoric acid is obtained from ground bone, basic slag, ground phosphate rock, and acid phosphate. Potash is obtained from muriate of potash, sulphate of potash, and kainite.

61. Fertilizer materials are about as follows: Chilean nitrate of soda, 15%; acid phosphate, 16%; and muriate of potash, 50%.

The prices of these materials are subject to market changes, but are usually about as follows: nitrate of soda, 3¢ per pound in 200-pound bags; muriate of potash, 3¢ per pound in 200-pound bags; and acid phosphate, 1¢ per pound in 125-pound bags.

62. A complete fertilizer (one containing all the ingredients) is quite often unnecessary and expensive. A crop of clover or other legumes may supply the soil with all the nitrogen needed for the next crop. In this case phosphoric acid and potash are the only fertilizing elements necessary.

A farmer can make at home 100 lb. of 2-8-4 fertilizer from nitrate of soda containing 15% of nitrogen, acid phosphate containing 16% of phosphoric acid, and muriate of potash containing 50% of potash as follows:

The mixture must contain 2% nitrogen, 8% phosphoric acid, and 4% potash.

2% of 100 lb. = 2 lb., amount of nitrogen required.
8% of 100 lb. = 8 lb., the amount of phosphoric acid required.
4% of 100 lb. = 4 lb., the amount of potash required.

(1) Since only 15% of the nitrate of soda is nitrogen, the 2 lb. of nitrogen is 15% of the amount of nitrate of soda required for the mixture, or 13 1/3 lb. of nitrate of soda.

(2) Since only 16% of the acid phosphate is phosphoric acid, the 8 lb. of phosphoric acid is 16% of the amount of acid phosphate required for the mixture, or 50 lb. of acid phosphate.
(3) Since only 50% of the muriate of potash is potash, the 4 lb. of potash is 50% of the amount of muriate of potash required for the mixture, or 8 lb. of muriate of potash.

(4) To the $7\frac{1}{3}$ lb. of nitrate of soda, phosphoric acid, and muriate of potash must be added also $28\frac{2}{3}$ lb. of sand or dry dirt, called filler, to make the proper per cent.

EXERCISE

1. In a 125-pound sack of 2–10–2 fertilizer there are how many pounds each of nitrogen, phosphoric acid, and potash?

2. In a ton of 4–8–4 fertilizer there are how many pounds each of nitrogen, phosphoric acid, and potash?

3. Make 1 ton of wheat and corn 3–10–3 fertilizer from nitrate of soda containing 15% of nitrogen, acid phosphate containing 16% of phosphoric acid, and muriate of potash containing 50% of potash. How much filler must be used?

4. From data given in paragraph 61, estimate the cost of the material for making 1 ton of 4–8–4 potato fertilizer; 1 ton of 2–5–8 tobacco fertilizer; 1 ton of 2–8–7 potato fertilizer; 1 ton of 2–10–2 grain fertilizer. How much filler is used with each ton?

5. Bring to school a number of labels taken from fertilizer sacks at home, and from the data previously given estimate the cost of the material for making 1 ton. Find the local dealer’s price on each brand, and estimate the saving on each ton by mixing it at home.

6. Cottonseed meal that contains $5\frac{1}{2}$% of nitrogen, 2% of phosphoric acid, and 1$\frac{1}{2}$% of potash is worth how much per ton if nitrogen is 20¢ per pound, phosphoric acid 4¢ per pound, and potash 4¢ per pound?

7. If a farmer puts 400 lb. of fertilizer valued at $24 per ton on 1 A. of corn, how many additional bushels of corn worth 50¢ per bushel must he raise to pay for the fertilizer?
8. If a crop of potatoes following a clover crop requires a special fertilizer, 0-8-7, instead of a 2-8-7, using the preceding data for the cost of material, estimate the saving on 5 tons of special fertilizer.

9. What is the difference in the cost of a 4-8-4 and a 0-8-4 fertilizer?

DRAINAGE

63. Low and wet land not suitable for farming can usually be made into rich and productive fields by a proper system of drainage.

EXERCISE

1. A fall of 6 in. for each hundred feet is considered a good grade for farm drainage. How much fall is this to the rod?

2. A fall of 3 in. for each hundred feet is considered a minimum grade for farm drainage. How much fall is this to the rod?

3. A 40-acre field in the form of a square is 5 ft. higher at one end than at the other. How much fall is this to the rod?

4. If 4-inch tiling 1 ft. long costs $20 per 1000, and the cost to dig the ditch, lay the tile, and fill the ditch is 25¢ per rod, what will it cost to tile a field 40 rd. by 80 rd., if the tiles are run in strings lengthwise of the field and placed 4 rd. apart, the outside ones being 2 rd. from either side? How much is this per acre?

5. With wheat at $1 per bushel, what must be the increase in yield per acre to make it possible to pay half the expense of tiling the land in 2 years’ time?

6. With corn at 40¢ per bushel, what must be the increase in yield per acre to make it possible to pay the remaining expense of tiling the land in 2 yr. more?

7. What per cent did the farmer make on the expense of the tiling?
HOUSEHOLD AND HEALTH PROBLEMS

SEWING

64. Several dollars a year can be saved in providing for a family by knowing the quality, quantity, and the proper season for buying food and clothing.

EXERCISE

1. If it takes $3\frac{1}{2}$ yd. of 25-cent material and 5 cents' worth of thread and buttons to make a man's shirt that might be bought ready-made for $1.50, what is saved by making the shirt at home?

2. How many yards of 27-inch goods will be required for a flounce on a skirt that measures $2\frac{1}{2}$ yd. around the bottom, if the flounce is to be cut 8 in. wide and one third is allowed for fullness?

3. How many yards of soutache braid are required for 5 rows around a boy's sailor collar, the distance around the collar being 39 in.?

4. How many yards of sheeting $2\frac{1}{4}$ yd. wide must be bought to make 6 sheets, if each sheet is to measure $2\frac{3}{4}$ yd. finished, with a 1-inch hem at one end and a $2\frac{1}{2}$-inch hem at the other, and 3 in. is allowed for shrinkage?

5. How long must a skirt be cut to measure 39 in. when finished, if it has two clusters of tucks each composed of five $\frac{1}{4}$-inch tucks, and is lengthened by a 6-inch flounce? (Allow $\frac{3}{4}$ in. for adding the flounce.)
6. If 8 yd. of goods 27 in. wide will make a dress, how many yards of goods 36 in. wide will it take?

Suggestion. (1) When wider material is to be used, multiply the number of yards required of the narrower material by its width in inches, and divide the product by the width in inches of the wider material.

(2) When narrower material is to be used, multiply the number of yards required of the wider material by its width in inches, and divide the product by the width in inches of the narrower material.

7. If 6 yd. of material 36 in. wide will make a dress, how many yards of material 44 in. wide will it take; of material 54 in. wide?

8. Woolen dress goods of the same quality is offered at 50¢ per yard in a 36-inch width, and at 75¢ per yard in a 54-inch width. If it takes 6 yd. of 36-inch goods, what is the cost of the dress when made from the 54-inch goods?

9. Which is the cheaper to buy for a dress, 8 yd. of linen 27 in. wide at 15¢ per yd., or linen 36 in. wide at 25¢ per yard?

10. Which is the cheaper to buy for a dress, 7 yd. of goods 27 in. wide at 35¢ per yd., or goods of the same quality 54 in. wide at 65¢ per yard?

FOOD

65. If the body is to do efficient work, it must be properly fed. It is important, therefore, that the child should understand something of the value of food, its elements, and its use in the body.

66. The food substances are proteid, a muscle former; fat, a fuel to yield energy in the form of heat and muscular power; carbohydrate, a fuel to yield heat and energy or to be transformed into fat; and mineral matter, a bone-tissue former.
67. Food substances and their percentages found in different foods are about as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>Proteid</th>
<th>Carbohydrate</th>
<th>Fat</th>
<th>Water</th>
<th>Mineral matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>3.3</td>
<td>5.</td>
<td>4.</td>
<td>87.</td>
<td>.7</td>
</tr>
<tr>
<td>Bread (wheat)</td>
<td>8.9</td>
<td>56.7</td>
<td>4.1</td>
<td>29.2</td>
<td>1.1</td>
</tr>
<tr>
<td>Potatoes</td>
<td>2.5</td>
<td>20.9</td>
<td>1.</td>
<td>75.5</td>
<td>1.</td>
</tr>
<tr>
<td>Sweet potatoes</td>
<td>1.8</td>
<td>27.4</td>
<td>.7</td>
<td>69.</td>
<td>1.1</td>
</tr>
<tr>
<td>Butter</td>
<td>1.</td>
<td>85.</td>
<td>11.</td>
<td>90.</td>
<td>3.</td>
</tr>
<tr>
<td>Eggs</td>
<td>13.4</td>
<td>10.5</td>
<td>73.7</td>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td>25.9</td>
<td>33.7</td>
<td>34.2</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td>21.5</td>
<td>2.5</td>
<td>74.8</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Roast beef</td>
<td>22.3</td>
<td>28.6</td>
<td>48.2</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>Smoked ham</td>
<td>20.2</td>
<td>22.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef, round</td>
<td>20.3</td>
<td>13.6</td>
<td>65.5</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Dried beans</td>
<td>22.5</td>
<td>59.6</td>
<td>12.6</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>Canned salmon</td>
<td>21.8</td>
<td>12.1</td>
<td>62.5</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>Oatmeal</td>
<td>16.1</td>
<td>67.5</td>
<td>7.2</td>
<td>7.3</td>
<td>1.9</td>
</tr>
<tr>
<td>Rice</td>
<td>8.</td>
<td>79.</td>
<td>.3</td>
<td>12.3</td>
<td>.4</td>
</tr>
<tr>
<td>Green corn</td>
<td>3.1</td>
<td>19.7</td>
<td>1.1</td>
<td>75.4</td>
<td>.7</td>
</tr>
<tr>
<td>Fresh cabbage</td>
<td>1.6</td>
<td>5.6</td>
<td>.3</td>
<td>91.5</td>
<td>1.</td>
</tr>
</tbody>
</table>

68. The farm hand requires daily about 4½ oz. of proteid, 4½ oz. of fat, and 16 oz. of carbohydrates. These food elements are found in widely different ratios in different foods. By a chemical analysis of a food it is possible to find the approximate quantity of that food which must be eaten to furnish the required amount of proteid, fat, or carbohydrate for a day.

**Example.** Wheat bread contains about 8.9% of digestible proteid. How much bread will be required to produce 4½ oz. of proteid?

**Solution.** 4½ oz. of proteid is the amount required.

8.9% of the wheat bread is proteid.

4½ oz. equals 8.9% of the required amount of bread.

The amount of proteid required divided by the per cent of the analysis expressed as a decimal gives the quantity of bread.

\[4.5 \text{ oz.} \div .089 = 47 \text{ oz.}\]
EXERCISE

1. How many pounds of wheat bread will it take to produce 16 oz. of carbohydrate?

2. How much roast beef will it take to produce 4½ oz. of proteid?

3. How many pints of milk will it take to yield 4½ oz. of fat? (16 oz. = 1 pt.)

4. How much butter will it take to produce 1 oz. of fat?

69. It is household economy to be able to work out in dollars and cents the comparative values of different foods. This may be done by finding the cost of a pound each of proteid, fat, and carbohydrate in different foods.

Example. If a loaf of bread weighing 1 lb. sells for 5¢, and by analysis 8.9% of it is found to be proteid, what is the cost of 1 lb. of proteid?

Solution. 5¢ = the cost of 8.9% of 1 lb.

The cost of 1 lb. = $0.05 ÷ .089 = $0.56 –.

EXERCISE

1. Find the cost of 1 lb. of proteid in milk which sells at 5¢ per quart and which by analysis shows 3.4% proteid.

2. Find the cost of 1 lb. of proteid in roast pork which sells at 12½¢ per pound and which by analysis shows 14% proteid.

3. Find the cost of 1 lb. of proteid in sirloin steak which sells at 20¢ per pound and which by analysis shows 19% proteid.

4. Which of the above-mentioned foods is the most economical muscle-producing food?

5. Estimate which is the cheapest food for producing fat and heat: (1) butter, which is 85% fat, at 25¢ per pound;
(2) eggs, which are 10% fat, at 20¢ per dozen (count 9 eggs 1 lb.); (3) round steak, which is 13% fat, at 15¢ per pound; (4) milk, which is 5% fat, at 5¢ per quart or 2 lb.

70. The cost of living may be greatly increased by poor preparation of food, unwise selection of foods for the season, bad stoves, and waste of food.

EXERCISE

1. If 30¢ is the average daily cost per person for raw material, what is the cost of the raw material necessary to supply a family of three grown children and their parents for 1 yr?

2. What would be the increased cost of the table supplies in problem 1 if 2½% were added for a bad oven and waste of food?

3. If 20¢ is the average daily cost per person for raw material, what will it cost to supply the table of a family of 8, adding 2% for food wasted?

4. A huckster has for sale a lot of small, lumpy potatoes, 25% of which would be lost in peeling, for 45¢ per bushel; and a lot of smooth potatoes, 16½% of which would be lost in peeling, for 50¢ per bushel. Which lot would prove the better economy for the buyer?

HEALTH AND SANITATION

71. Typhoid fever is a filth disease. It is impossible to have it unless the seed, or germs, of the disease are taken into the body. This happens only when the water that we drink or the food that we eat has come in contact with part of the discharges of a person who has had the disease. This is brought about through the agency of flies, through
contaminated water — especially springs and wells — and through carelessness in handling food supplies — especially milk. If the discharges from every typhoid-fever patient were thoroughly disinfected, every community would be free from the disease, except when it was brought from outside its borders.

**EXERCISE**

1. The death rate from typhoid fever in the United States during the year 1910 was 23 out of each 100,000 persons. What per cent of the population died from typhoid fever?

2. In a certain state the death rate from typhoid fever was 45 out of each 100,000 persons. In the year 1911 this state reported 1035 deaths from typhoid fever. What was the population of the state?

3. In the state mentioned in problem 2, the State Board of Health estimated a loss of $28,450,950 to the state in deaths, doctors' bills, and loss of time of those ill from preventable diseases. What was the cost of this carelessness per capita, if equally distributed among the entire population?

4. In a village of 400 inhabitants who were indifferent to the laws of sanitation, surface water was allowed to seep into the wells, surface closets were used, the majority of the kitchens were unscreened, and flies in abundance visited closets and kitchens alike. During one summer there were 5 severe cases of typhoid fever. Estimate what the unsanitary conditions of the village cost 5 citizens, if the expense items were as follows for each fever patient: 84 da. of lost time at $1.50 per day; $30 in doctors' bills; 3 wk. of special nursing at $20 per week; and $15 for other charges.

5. A prominent physician has estimated that the average well man loses 5 da. each year from work on account of headaches, toothaches, colds, and other similar minor ailments.
Dr. L. H. Gulick, an eminent authority, says that 90% of these minor ailments could be prevented by careful attention. According to the census of 1910 there were 29,000,000 workers in the United States. Estimate the loss of the nation due to carelessness, if each man could earn an average of $1.25 per day.

6. A large optical-goods factory in Germany reduced the hours of its working day from 9\(\frac{1}{2}\) hr. to 8 hr. The firm reported, after a careful record had been kept, that the output of the factory per hour had been increased 16.2%. If the daily output of each man working 9\(\frac{1}{2}\) hr. per day was $4.75 worth of goods for the market, what was the value of the goods produced by the man working 8 hr. per day? By the conservation of the employee's vitality and efficiency, how much productive wealth was added to the output of each man per day.
7. It has been authoritatively estimated that a farm hand infected with the hookworm disease is on an average 50% less efficient in his work than the well man. Estimate the loss to a county having 28,500 farmers and hired hands, each man working an average of 290 da. a year at $1 per day, if 11% of the men are infected with the disease. To cure each man will not cost on an average over 70¢. Estimate the saving in 1 yr. from the labor of these men by curing them.

8. It has been conservatively estimated that, on an average, it takes the child who attends school in a house improperly heated, lighted, and ventilated 20% longer to complete the common-school course of 8 grades of 8 mo. each than when attending school in a house that is sanitary and comfortable in all its appointments. How much time does each child lose in completing a common-school education when compelled to attend school in an unsanitary and uncomfortable house?

9. In rural communities 400,000 persons die annually, and about 2,000,000 others are seriously ill from infectious diseases. If only 50% of these deaths and cases of sickness can be eliminated by normal schools and teachers' colleges in giving rural teachers special courses in the first principles of sanitary science and public health, what would be the annual value of such training to the rural communities of the United States, if a human life is rated at $1000 (the price of a slave) and each case of prevented sickness at $75?
GROWING CROPS

IMPORTANT THINGS THAT SHOULD BE KNOWN ABOUT SELECTING SEED CORN

72. The quality and quantity of corn that is harvested depends in a large measure upon the care used in selecting the seed. The points to be observed are as follows: (1) the ear should be selected from the stalk in the fall; (2) the ear should be firm; (3) the ear should be cylindrical in shape; (4) the ratio of the circumference of the ear to its length should be about 3 to 4; (5) the butt should be rounded.
SELECTING SEED CORN

out around a cup-shaped cavity; (6) the shank should be of medium size; (7) the tip should be filled out with deep kernels in as regular rows as possible; (8) the kernel should be uniform in size and shape, but not pointed; (9) the furrows between the rows should be narrow, with kernels fitting closely together at the top; (10) at least \( \frac{3}{4} \) of the weight should be corn. From 80 to 100 average ears should weigh 70 lb.

EXERCISE

1. In Holmes county, Mississippi, one season, the members of the boys' corn club grew corn averaging 76 bu. per acre. The corn grown by their fathers and neighbors averaged 16 bu. per acre. When corn was selling at 50¢ per bushel, how much smarter, to the acre, were the boys than their neighbors?

2. How many hills of corn are planted to the acre when the rows are 3 ft. 8 in. apart, the hills in the row being the same distance apart?

3. How many stalks to the acre are there when the average is 2 to the hill? when the average is 3 to the hill?

4. Seed corn will average 800 grains to the ear. How many ears will it take to plant an acre, 2 grains to the hill, when the rows are 3 ft. 8 in. apart, the hills in the row being the same distance apart?

5. Which will produce the greater yield per acre: 2 ears to the hill, 100 ears making a bushel, or 3 ears to the hill, 190 ears making a bushel?

6. If the farmer can increase the weight of each ear of corn 2 oz. by proper selection of seed in the fall, what will the increase amount to on a 30-acre field averaging 6480 stalks per acre, with 1 ear for each stalk, when corn is selling at 50¢ a bushel?
7. When corn sells at 50¢ a bushel, what is the loss to a farmer on each bad ear of seed planted, if there are 800 grains of corn to the ear and each grain planted averages 1 good ear such that 100 make a bushel?

8. If 12 ears of properly selected seed corn will plant an acre, how many ears will it take to plant a rectangular field 64 rd. by 30 rd.?

9. A farmer spends a half day in selecting seed corn for a 5-acre field. If the increase in yield is 5 bu. per acre, how much does he make at the present price of corn?

10. At gathering time 1200 bu. of corn should weigh approximately how many bushels the first of the following May?

   NOTE. Corn shrinks about \( \frac{1}{3} \) of its entire weight during the first 6 mo. following gathering time.

11. A man is offered 50¢ a bushel for corn at gathering time. He holds the crop 6 mo. and sells it at 60¢ a bushel. How much does he gain or lose by holding a crop of 600 bu.?

12. A man is offered at gathering time 60¢ per bushel for his corn crop. How much must he receive per bushel so that he will neither lose nor gain by selling in the spring?

**TESTING SEED CORN**

73. Corn selected for seed should be tested before planting. This can be done easily. Make a box 36 in. by 40 in. and 2 in. or 3 in. deep. Fill the box about half full of moist dirt, sand, or sawdust. Press it down so that it will have a smooth, even surface.

Take a white cloth about the size of the box, rule it off into squares 2 in. or 3 in. each way, numbering them 1, 2, 3, 4, etc., and place it in the box upon the sand.
Carefully remove 5 or 6 grains from each ear of corn, place them in the numbered squares corresponding to the numbers on the ears, and cover with a flour sack padded with about 2 in. of moist sand or sawdust. Place the box in a warm place where it will not get chilled. Keep the pad well dampened and warm, and in five or six days remove the pads carefully. Select for seed those ears whose grains have both sprouts and rootlets.

**EXERCISE**

1. When corn is selling at 75¢ a bushel, what is a farmer's loss by planting one bad ear of seed corn?

2. When corn is selling at 60¢ a bushel, what is the loss to a neighborhood by planting 50 bad ears of seed corn?

3. A farmer, by planting only tested corn, may depend upon an increase of 5 bu. per acre. If your father did not test his seed last spring, estimate his loss at the present price of corn.
4. The children of the public schools can do all the testing for their own district. Find out how many acres of corn were planted in your district last year and estimate, at the present price of corn, how much the school could have earned for your neighborhood by testing its seed corn.

5. If a clean field produces 60 bu. of corn per acre and a weedy one only 40 bu., what is the loss per acre caused by weeds, with corn at 35¢ a bushel? Suppose 4 days' work would keep an acre clean, how much would 1 day's work profit the farmer?

6. A field of oats clear of weeds produces 50 bu. per acre. If a weedy field produces only 37 bu., what is the loss on 1 A. of weedy oats when oats sell at 25¢ a bushel?

7. In a demonstration a field plowed 4 in. deep produced 30 bu. of corn per acre, and a field plowed 6 in. deep produced 42 bu. of corn per acre. At the present price of corn, determine the value of the deep plowing on one acre; on a 40-acre field of corn.

8. If a man charges $2.50 a day for plowing, what is the difference in the cost of plowing the field in the above problem if in one day the man can plow 2½ A., 4 in. deep, or 1½ A., 6 in. deep. At the present price of corn, does deep plowing pay?

9. Seventy-five bushels of corn per acre would be a good yield when the land is plowed deep and carefully cultivated; and 30 bu. a fair yield when the land is plowed shallow and only reasonably well cultivated. If a man is able to cultivate 20 A. thoroughly or 35 A. carelessly, by which method of cultivation would he realize more when corn is worth 40¢ a bushel? What important consideration has been left out of this problem?
10. How many cubic feet of cultivated soil are there in 1 A. if soil is cultivated 4 in. deep? if soil is cultivated 6 in. deep?

11. If a cubic foot of soil weighs 75 lb. and contains $3\frac{1}{2}$ oz. of nitrogen, $1\frac{1}{2}$ oz. of phosphoric acid, and 4 oz. of potash, find the number of pounds of each of these fertilizing substances in 1 A. of cultivated soil 4 in. deep; 6 in. deep; 8 in. deep. Why plow deep?

12. How much more plant food is made available by cultivating the soil 6 in. deep than by cultivating it 4 in. deep?

## COST OF GROWING CORN ON ROUGH LAND

74. The farmer should know the cost of growing a bushel of corn on his farm. This will enable him to determine to what extent he should grow corn.

### EXERCISE

1. Estimate the cost of growing a 15-acre field of corn when (1) a man with a two-horse plow can break $1\frac{1}{2}$ A. per day; (2) a man with a one-horse plow can lay off 8 A. per day; (3) a man can plant 5 A. per day; (4) a man with double shovel can cultivate 3 A. per day; (5) a man can hoe 1 A. per day; (6) the corn is to be cultivated 3 times; (7) the corn is to be hoed twice; (8) a man with team and wagon and 2 helpers can gather 3 A. per day; (9) a man with a team is paid $3 per day and given 2 meals; (10) a man with a horse is paid $1.50 per day and given 2 meals; (11) a man working alone is paid 75¢ per day and given 2 meals; (12) meals for men are reckoned at 15¢, for horses at 15¢; (13) seed corn costs 30¢ per acre.

2. The yield being 25 bu. per acre, what was the cost per bushel to grow corn in problem 1?
3. At the present price of corn, is it better for the renter to give a third of the crop as rent, or to pay $2 cash per acre and take all the corn?

4. The conditions stated above hold for a county whose corn crop averaged 17½ bu. per acre for the year 1911. What was the average cost of growing each bushel of corn?

COST OF GROWING CORN ON SMOOTH LAND

75. The merchant who does not know the cost of his goods cannot reasonably hope to be successful. The farmer should be as familiar with the cost of producing his farm products as he is with their market prices.

EXERCISE

1. Estimate the cost of growing a 30-acre field of corn in the corn belt when (1) a man with a two-horse plow can break 2 A. per day; (2) a man with a three-horse disk harrow can disk 7½ A. per day; (3) a man with a three-horse harrow can harrow 15 A. per day; (4) a man with planter can plant 12 A. per day; (5) a man with cultivator can cultivate 5 A. per day; (6) two men with a wagon and team can gather 3 A. per day; (7) the corn is to be cultivated 5 times; (8) a man with a team is paid $3 per day; (9) a man working alone is paid $1 per day; (10) thirty cents' worth of seed corn per acre is used.

2. The yield being 60 bu. per acre, what was the cost per bushel to grow the corn in the above problem?

3. At the present price of corn, is it better for the renter to give ⅓ of the crop as rent, or to pay $3 per acre for the use of the land? How much per acre does the owner of the land realize if he receives ⅓ of the crop as rent? ⅓ of the crop as rent?
COST OF GROWING COTTON 69

COST OF GROWING WHEAT

76. The improved machinery now used for planting and harvesting wheat has greatly reduced the expense of growing wheat.

EXERCISE

1. Estimate the cost of growing a 20-acre field of wheat when (1) a man with a two-horse plow can break 2 A. per day; (2) a man with a three-horse harrow can harrow 15 A. per day; (3) a man with a three-horse roller can roll 12 A. per day; (4) a man with a two-horse drill can drill 10 A. per day; (5) the seed per acre is worth $1.50; (6) the land is harrowed twice and rolled once; (7) a man with a team is paid $3 per day; (8) the cost of fertilizing each acre is $1.50; (9) the cost of putting the wheat in the shock is $1 per acre; (10) the cost of threshing the wheat is 6¢ per bushel.

2. The yield being 20 bu. per acre, what was the cost per bushel to grow the wheat in the above problem?

3. Using 10 men 3 da. at $1.50 per day and 45 bu. coal at 15¢ per bushel, estimate the cost of threshing 800 bu. wheat @ 4¢ per bushel, 1000 bu. oats @ 2¢ per bushel, 200 bu. flax @ 8¢ per bushel, 100 bu. timothy @ 20¢ per bushel.

COST OF GROWING COTTON

77. Cotton is a staple crop of the South. It is valuable both for the lint and the seed it yields.

EXERCISE

1. If a 20-acre field yields 840 lb. of seed cotton per acre and this cotton when ginned yields 40% lint, what is the seed worth at 90¢ per hundred and the cotton at $54 per bale of 500 lb. each, the weight of the bale including 20 lb for bagging and ties?
2. If, in the preceding problem, the cost of preparing the land and cultivating the cotton was \$15 per acre, fertilizer \$6.50 per acre, picking 50\(\frac{\text{c}}{\text{hundred}}\) per hundred, and ginning, bagging, and ties \$1.60 per bale, what was the net cost per 100 lb. of raising the cotton?

3. If seed cotton yields 40% lint when ginned, how many pounds of cotton in the seed will it take to make a 520-pound bale, including 20 lb. for bagging and ties?

4. A 30-acre field of cotton produced 1155 lb. of seed cotton per acre. If the ginned cotton yielded 33\(\frac{1}{3}\)% lint, how much was the cotton worth at 12\(\frac{1}{2}\)\(\text{c}\) per pound?

5. At an experiment station land that was plowed 8 in. deep yielded 1160 lb. of seed cotton per acre, and land plowed 4 in. deep yielded 950 lb. If the ginned cotton yielded 35% lint, and was worth 12\(\text{c}\) per pound, and the seed was worth 90\(\text{c}\) per hundred, what was the value of the deep plowing per acre?
ESTIMATION OF CROPS IN THE BULK CORN

78. Approximately $3\frac{1}{4}$ cu. ft. of corn in the husk and $2\frac{1}{2}$ cu. ft. on the cob make a bushel.
There are 2150.4 cu. in. of shelled corn in a bushel.

79. The capacity of a crib in bushels equals the product of the length, width, and depth in feet divided by $3\frac{1}{4}$ for corn in the husk, and by $2\frac{1}{2}$ for corn on the cob.

80. Rule. To find the number of bushels of corn in the husk in a round pile, square $\frac{1}{2}$ the distance across the pile in feet and multiply by $3\frac{1}{4}$; then multiply by $\frac{1}{2}$ the height of the pile in feet and divide by $3\frac{1}{4}$.

EXERCISE

1. How many bushels of corn in the husk are there in a crib 12 ft. long, 8 ft. wide, and 7 ft. high?

2. How many bushels in the husk will a rail pen $7\frac{1}{2}$ ft. long, $7\frac{1}{2}$ ft. wide, and 9 ft. high hold?

3. Measure the crib at home and estimate how many bushels it will hold. How many bushels are in it now?

4. Measure the wagon box at home and estimate the number of bushels it will hold.

5. How high must a crib 10 ft. long and 8 ft. wide be built to hold 150 bu.?

6. How many bushels of corn in the husk are there in a round pile 12 ft. across, tapering to a point 6 ft. high in the middle?
7. How many bushels of ear corn will a wagon bed that is 10 ft. long, 3 ft. wide, and 26 in. deep hold?

8. How many bushels of corn in the husk will the crib at home hold? How many bushels of corn on the cob will it hold?

**HAY**

81. A ton of packed timothy hay contains about 450 cu. ft.; a ton of clover, alfalfa, or cowpea hay, about 550 cu. ft.

82. The capacity of a hayloft in tons equals the product of the length, width, and height in feet, divided by 450 for timothy hay, and by 550 for clover hay.

83. **Rule.** To find the approximate number of tons in a stack, square $\frac{1}{4}$ of the distance around the stack, measured at a point halfway from the ground to the top; multiply this by the height of the stack in feet, and divide by 450 if timothy hay; by 550 if clover, alfalfa, or cowpea hay. For ricks: Measure over the rick, from the ground on one side to the ground on opposite side; also the width of stack near the ground. Add the over measure and the width together; divide by 4; square the result and multiply by the length of rick; then divide by 450 if timothy; by 550 if clover, alfalfa, or cowpea hay.

**EXERCISE**

1. How many tons of timothy hay are there in a loft 30 ft. long, 24 ft. wide, with an average depth of 7 ft.?

2. Measure and estimate the number of tons of timothy hay that your barn will hold.

3. How many tons of clover hay can be stored in a place 15 ft. long, 12 ft. wide, and 6 ft. deep?

4. Measure a number of haystacks in your neighborhood and estimate the approximate number of tons in each stack.

5. Measure one of your father's or neighbor's haystacks and estimate its worth at the local price of hay.
APPLES AND POTATOES

84. Apples, potatoes, turnips, etc. are measured by the heaped bushel (2747.7 cu. in.), but for practical purposes it is sufficiently accurate to take $1\frac{3}{8}$ cu. ft. as a bushel.

85. Rule. To find the number of bushels in a round pile of apples, potatoes, etc., square $\frac{1}{2}$ the distance across the pile in feet, multiply by $3\frac{1}{7}$, then by $\frac{1}{2}$ the height of the pile in feet, and take $\frac{5}{8}$ of the product.

EXERCISE

1. How many bushels of potatoes can be put in a wagon bed 10 ft. long, 3 ft. wide, and 16 in. deep?

2. How many bushels of apples can be put in a box 4 ft. long, 3 ft. wide, and 2 ft. deep?

3. When potatoes are selling at 50¢ per bushel, what is the value of a round pile which is 10 ft. across at the bottom, and tapers to a point 6 ft. high in the middle?

4. How many bushels of apples are there in a round pile 12 ft. across, which tapers to a point 5 ft. high in the middle?

5. Measure and estimate the bushels of apples, potatoes, turnips, etc. holed up at home.
6. How many bushels will a wagon bed 10 ft. long, 3 ft. wide, and 2 ft. deep hold?

7. A huckster in selling apples gives stricken measure (2150.4 cu. in.) instead of heaped measure. In selling 23 bu. of apples at $1 per bushel, he cheats his customers out of how much money?

8. A grocer pays $1.20 per bushel for apples which he retails at 3 for 5¢. The apples average 96 to the bushel. What per cent does he make on the sale of each bushel if 10% of the selling price is the expense of handling?

9. A grocer uses a half-peck measure 6 in. in diameter. What is the height of the measure?

10. A grocer uses a peck measure 7 in. in diameter. What is the height of the measure?

11. A farmer sold .2 ton of hay for $2.50. What was the value of the hay per ton?

12. A farmer sold his hay at the barn. The average weight of each bale was determined by weighing 15 representative bales. Their combined weight was 1320 lb. How many bales would a purchaser of 2 3/4 tons receive?
STOCK AND FEED PROBLEMS

KINDS AND QUANTITIES OF FEED

86. The value of any feed lies in the food elements which it contains. These elements are protein, fats, and carbohydrates. The work horse and the cow of average size require daily about 2 lb. of protein and 12 lb. of carbohydrates. The amount of any feed to be given depends largely upon the quantity of the elements that it contains. From the table below it will be seen that cottonseed meal, for instance, is much richer in protein and carbohydrates than is wheat bran; so a smaller quantity of it should be fed to obtain the same amount of food.

87. This table gives the percentage of digestible protein and carbohydrates contained in certain feeds:

<table>
<thead>
<tr>
<th>Name of feed</th>
<th>Protein</th>
<th>Carbohydrates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn fodder</td>
<td>2.5</td>
<td>35.5</td>
</tr>
<tr>
<td>Timothy hay</td>
<td>2.75</td>
<td>46.</td>
</tr>
<tr>
<td>Redtop hay</td>
<td>4.75</td>
<td>49.</td>
</tr>
<tr>
<td>Clover hay</td>
<td>8.5</td>
<td>46.</td>
</tr>
<tr>
<td>Cowpea hay</td>
<td>10.5</td>
<td>40.</td>
</tr>
<tr>
<td>Oat straw</td>
<td>1.2</td>
<td>46.</td>
</tr>
<tr>
<td>Wheat straw</td>
<td>.5</td>
<td>36.</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>12.</td>
<td>45.</td>
</tr>
<tr>
<td>Cottonseed meal</td>
<td>40.</td>
<td>40.</td>
</tr>
<tr>
<td>Corn</td>
<td>7.8</td>
<td>78.2</td>
</tr>
<tr>
<td>Oats</td>
<td>9.2</td>
<td>57.8</td>
</tr>
<tr>
<td>Corn ensilage</td>
<td>.9</td>
<td>13.</td>
</tr>
</tbody>
</table>

Note. One lb. of fat is equivalent to about 2 1/4 lb. of carbohydrates.

75
Example. How much cottonseed meal must be fed a cow that she may get 2 lb. of protein?

Solution. 2 lb. of protein is the amount required.
40% of the cottonseed meal is protein.
2 lb. equals 40% of the required amount of cottonseed meal.
2 lb. \( \div .40 = 5 \) lb., the required amount.

88. Rule. To determine how much feed is required to obtain a given amount of a food element, divide the required amount of the food element by its per cent in the analysis expressed as a decimal.

Exercise

Study the above table and answer the following questions:
1. If timothy and redtop hay are selling for the same price per 100 lb., which is the cheaper feed for a horse?
2. When timothy, redtop, and clover hay are selling at the same price per ton, which is the cheapest cow feed?
3. How much wheat bran must a cow be fed that she may get 2 lb. of protein?
4. If a cow is fed daily 10 lb. of bran, how much clover hay must be fed that the cow may have at least 2 lb. of protein?
5. How many pounds of oats must be fed a horse that he may have 2 lb. of protein?
6. How many ears of corn (100 ears, or 56 lb., to the bushel) must be fed a horse that he may have 2 lb. of protein?
7. Which is the cheaper feed for a work horse during summer, oats (32 lb. per bu.) at 25¢ per bu. or corn at 40¢ per bu., disregarding the carbohydrates? (Use data in problems 5 and 6.)
8. What is the cost per pound of protein in cowpea hay at $10 per ton? in clover hay at $10 per ton?
89. The nutritive ratio of any feed is the ratio of its protein to its carbohydrates.

90. Rule. To find the nutritive ratio of two or more different feeds when fed in combination, take the sum of the protein in the combined feeds as the antecedent of a ratio in which the sum of the carbohydrates is the consequent, and reduce the ratio to its lowest terms.

Example. What is the nutritive ratio of a ration consisting of 10 lb. of corn, 3 lb. of cottonseed meal, and 15 lb. of timothy hay?

Solution. From the table it is seen that 7.8 lb. of every 100 lb. of corn is protein and 78.2 lb. carbohydrates. Then 10 lb. would contain .1 of the protein and carbohydrates in 100 lb.

\[
\begin{align*}
.1 \text{ of } 7.8 \text{ lb.} &= 0.78 \text{ lb. protein.} \\
.1 \text{ of } 78.2 \text{ lb.} &= 7.82 \text{ lb. carbohydrates.}
\end{align*}
\]

From the table it is seen that 40 lb. of every 100 lb. of cottonseed meal is protein and 40 lb. carbohydrates. Then 3 lb. would contain .03 of the protein and carbohydrates in 100 lb.

\[
\begin{align*}
.03 \text{ of } 40 \text{ lb.} &= 1.2 \text{ lb. protein.} \\
.03 \text{ of } 40 \text{ lb.} &= 1.2 \text{ lb. carbohydrates.}
\end{align*}
\]

From the table it is seen that 2.75 lb. of every 100 lb. of timothy hay is protein and 46 lb. carbohydrates. Then 15 lb. would contain .15 of the protein and carbohydrates in 100 lb.

\[
\begin{align*}
.15 \text{ of } 2.75 \text{ lb.} &= 0.4125 \text{ lb. protein.} \\
.15 \text{ of } 46 \text{ lb.} &= 6.9 \text{ lb. carbohydrates.} \\
7.82 \text{ lb.} + 1.2 \text{ lb.} + 0.4125 \text{ lb.} &= 2.3925 \text{ lb. protein.} \\
7.82 \text{ lb.} + 1.2 \text{ lb.} + 6.9 \text{ lb.} &= 15.92 \text{ lb. carbohydrates.}
\end{align*}
\]

Making the protein the antecedent and the carbohydrates the consequent of a ratio, we have \(2.3925:15.92 = 6\). The nutritive ratio is 1:6.

Note. A ratio may be reduced to its lowest terms by dividing each term by the antecedent.
EXERCISE

1. What is the nutritive ratio of a ration consisting of 1 bu. of oats mixed with 1 bu. of corn?

2. What is the nutritive ratio of a ration consisting of 5 lb. of corn, 1 lb. of cottonseed meal, 8 lb. of cowpea hay, and 30 lb. of corn ensilage?

3. What is the nutritive ratio of 100 lb. of wheat bran and 1 bu. of corn? Is this a suitable cow feed if a nutritive ratio of about 1:6 is a balanced ration for a dairy cow?

4. What is the cost of feeding a work team 56 ears of corn per day during January, at 50¢ per bushel (100 ears to the bushel), and 32 lb. of timothy hay daily at $12 per ton?

5. It has been demonstrated at a state experiment station that a farm horse at steady work should be fed each day 1 lb. of grain and 1.2 lb. of hay for each 100 lb. of its weight. If 100 ears of corn make 1 bu. (56 lb.), how many ears should be fed per day to a work horse weighing 1200 lb.? to a horse weighing 1500 lb.?

6. A state experiment station that made recent tests in feeding farm horses reports that the present method of feeding horses as practiced by most farmers is uneconomical, as to the amount and kind of grain fed. The average loss per day on each horse is placed at 2¢. What is the annual loss in feeding a team?

7. The department of agriculture of a Western state estimates that the average farm horse of that state works about 1000 hr. per year, and is fed about 5215 lb. of grain and 7073 lb. of hay annually. If the grain is worth 4¢ per pound, and the hay ½¢ per pound, find the cost of the horse labor per hour.

8. If a mule doing the same work as a horse can be fed for 3¢ less per day than the horse, what is the annual saving to a farmer in using a mule team instead of a horse team?
It takes about 8.5 lb. of milk to make 1 gal. Milk varies in the per cent of butter fat it contains, from about 2% to 6%. One pound of butter fat will make about 1 1/2 lb.

of butter. Much care should be used in the selection of milch cows, if they are to be a profitable source of income on the farm.

**EXERCISE**

1. How many pounds of butter will 180 lb. of butter fat make?

2. How many pounds of butter fat in 290 lb. of butter?

3. If 2¢ per pound will cover the expense of making butter, which would be the more profitable, to sell butter for 25¢ per pound, or the butter fat to a creamery at 20¢ per pound?

4. If you live near a creamery, compare the prices paid for butter fat and for butter, and determine which method of sale is the more profitable.
5. If a cow averages daily 3 gal. of milk which is 4% butter fat, how much butter does she produce per year?

6. A man can buy for $30 a scrub cow that gives 14 lb. of milk per day, or for $70 a Jersey that gives 25 lb. of milk per day. If the scrub cow's milk is 2% butter fat and the Jersey's 4½%, and the butter is worth 20¢ a pound the year round, which cow will yield the greater per cent on the investment for a year?

7. If a cow that gives daily 3 gal. of milk testing 4% butter fat is fed dry feed for 7½ mo. at $5 per month, and is pastured the rest of the year at $1.50 per month, what is the money return in excess of the cost of her keep, when butter is 25¢ per pound and skim milk 10¢ per gallon?

8. If by feeding a suitable ration to a milch cow she will produce 10 cents' worth more milk and butter fat each day, what will the knowledge of a proper ration yield a farmer in the course of the 7½ feed months on 3 milch cows?

9. If it costs $32 a year to keep a cow that produces 200 lb. of butter fat, what is the average cost per pound of the butter, assuming that the skim milk pays for all labor?

10. A cow whose milk contains 4.2% butter fat must produce how many gallons of milk to yield 84 lb. of butter?

11. Each student should be asked to keep a strict account of the feed given the cows at home for 4 wk. and of the amount of milk produced, and estimate at the local price of feed the cost of producing 1 gal. of milk.

12. A cow when fed 1 bu. of corn and 1 shock of fodder every 5 da. gave 1 gal. 1 pt. of milk a day; when fed each day 8 lb. of corn and 3 lb. of oats crushed together, and 15 lb. of clover hay, gave 3 gal. a day. If the cow's milk weighed 8½ lb. to the gallon and tested 4% butter fat, how much butter did she produce in 90 da. when fed on corn and fodder? How much when fed on good rations for a dairy cow?
CATTLE AND HOG PROBLEMS

SILOS

92. Silos are built with rigid, smooth, perpendicular walls, which are air-tight to prevent fermentation of the ensilage.
93. Thirty pounds is the average weight of 1 cu. ft. of corn ensilage in a small silo.
94. One cubic foot of ensilage per head is the usual daily ration.

EXERCISE

1. Assuming that a cow is fed daily 30 lb. of ensilage for a period of 180 da., what must be the capacity in cubic feet of a silo for a herd of 12?
2. If the silo in problem 1 is round, with a diameter of 10 ft., what must be the height?
3. Estimating 10 tons of corn and fodder to the acre, how many acres will be required to fill the silo in problem 2?
4. How many tons of ensilage in a silo 10 ft. in diameter and 29 ft. high? How many acres of corn (10 tons to the acre) will it hold? How many cows will it feed for 180 da.?

CATTLE AND HOG PROBLEMS

95. Good authority places the weight of calves at birth as follows:

Light-weight calves . . . . . 40–60 lb.
Average calves . . . . . . . 60–80 lb.
Heavy calves . . . . . . . 80–110 lb.

96. On an average 1 1/4 gal. of fresh milk will produce 1 lb. of gain, live weight. The suckling calf should gain on an average 2 lb. per day. The fat calf dressed is from 40% to 50% of its live weight, and cattle from 50% to 60% of their live weight.
97. Count 8 1/2 lb. of milk to the gallon.
EXERCISE

1. Under normal conditions, what should a calf weighing 50 lb. at birth weigh at the end of 90 da.?

2. When milk is worth 20¢ per gallon, what is the cost of making a calf that weighs 80 lb. at birth weigh 150 lb.?

3. Which is the better proposition, to keep a young calf for 120 da., feeding it on an average 2½ gal. of fresh milk per day, at 12¢ per gal., and then sell it for $18; or sell it at birth for $2 and make and sell butter at 20¢ per pound from the milk, which contains 4% butter fat, the skim milk and buttermilk paying for the trouble of milking and churning?

4. A calf at birth weighs 70 lb.; at the end of 60 da. it weighs 220 lb. What is the per cent of gain for the period?

5. If a fat calf dressed is 45% of its live weight, what was the live weight of a calf that when dressed weighed 126 lb.?

6. If a beef steer when dressed is 59% of its live weight, what was the live weight of a steer whose dressed weight was 768½ lb.?

7. A steer on foot weighed 1325 lb.; when dressed it weighed 768½ lb. The dressed beef was what per cent of its live weight?

8. According to the tests of an experiment station in pig feeding, a pig when fed for 46 da. a total of 397 lb. of shelled corn gained 79 lb. At this rate, how many pounds of corn did it take to produce 100 lb. of flesh?

9. When corn is 50¢ per bushel (56 lb. to the bushel), what does it cost to put 1 lb. on a pig? (Use data in problem 8.)
10. At the time the test in problem 8 was given, another was made in which pigs fed for 46 da. a total of 334 lb. of middlings gained 91 lb. At this rate, how many pounds of middlings would it take to produce 100 lb. of flesh?

11. Is it cheaper to feed corn at 50¢ per bushel or middlings at $1.50 per 100 lb.?

12. If a hog gains on an average 11 lb. for every bushel of corn that it is fed, at the present price of corn and fat hogs would it pay to buy 100-pound hogs and fatten them?

13. If 1 bu. of corn produces 11 lb. of flesh, when corn is 50¢ per bushel what must be the price of fat hogs to enable a farmer to realize 50¢ per bushel for the corn when fed?

14. Can a farmer afford to feed corn at 40¢ per bushel when fat hogs are selling in the local market at $5.50 per hundredweight?

15. If 1 bu. of corn produces 11 lb. of flesh, what is a man's profit on 20 shotes weighing on an average 100 lb., which originally cost $5 each, are fed corn at 45¢ per bushel until they weigh on an average 257 lb., and are then sold at $5.85 per hundredweight?

16. A lot of pigs fed in a yard without grass made an average gain of 100 lb. for every 629 lb. of corn fed them. Another lot of pigs of the same stock and weight were given full feed of corn at all times while running on blue-grass pasture, and made an average gain of 100 lb. for every 507 lb. of corn fed them. The pasture made a saving of what percent of the corn?

17. It is conservatively estimated that an acre of rape pasture saves 2600 lb. of corn (56 lb. to the bushel) in the preparation of 20 pigs for the fattening period. What is the value of rape when corn is 35¢ per bushel?
98. In butchering hogs butchers count on a loss of 25 lb. on the first 100 lb., 15 lb. on the second, and 10 lb. on each additional hundred. Country-cured meat shrinks one third of its weight. Packing houses employ methods of curing meat with practically no shrinkage.

EXERCISE

1. What is the waste in butchering a hog weighing 350 lb.?

2. A farmer butchered and cut up a hog weighing 283 lb., as follows: head, 20 lb.; backbone, 13½ lb.; spareribs, 8 lb.; feet and hocks, 6½ lb.; lard and sausage, 63 lb.; 2 hams, 37½ lb.; 2 shoulders, 37½ lb.; 2 sides, 43½ lb. Which would have been the more profitable, to sell the hog on foot at the market price of 6¢ per pound, or to salt and smoke the salable meat and sell it at the local price of country-cured meat?

3. Is it better for a farmer to sell fresh meat as follows: 4 hams averaging 32 lb. at 10¢ per pound, 4 shoulders averaging 27 lb. at 10¢ per pound, 4 sides averaging 28 lb. at 10¢ per pound; or to country cure and sell the hams and shoulders at 15¢ per pound and the sides at 12½¢ per pound?

4. A butcher pays 5¢ a pound for a hog weighing 139 lb. It was butchered, and cut up as follows: 48 lb. of cutting meat, at 12½¢ per pound; 9 lb. of bacon, at 10¢ per pound; 30 lb. of lard, at 10¢ per pound; 2½ lb. of ribs, at 12½¢ per pound; 12 lb. of head, at 6¢ per pound. How much does the butcher make?

5. At butchering time a farmer can sell his hams at 9¢ per pound. If one-third is lost in curing meat, what price should he receive for the cured meat that he may neither lose nor gain?
TRANSPORTATION

THE COST OF BAD ROADS

99. Good roads enable farmers to haul all their products to market at all seasons of the year. The increased size of the load that can be hauled and the less time required for hauling reduces the cost of marketing crops.

BAD ROADS ARE EXPENSIVE

EXERCISE

1. A town is 55 mi. from the nearest railroad point. The roads are such that the average load hauled is 1600 lb., and the average time required for a round trip is 8 da. The price for drayage from town to railroad point is $1 per hundred, and from railroad to town $1.50. How much does the freighter receive for a round trip when loaded each way?
2. If the road were piked, the round trip could be made in 4 da. by a freighter hauling 2500 lb. each way. If the freighter is to receive the same price per day for his work as in problem 1, what must be his average charge per hundred?

3. If 100 lb. of flour will last a family of six 2 mo. when eating white bread once a day, what will the freight charges (at the rate given in problem 2) on the flour amount to in 1 yr.? What will be the freight charges if the family eat white bread twice a day?

4. What amount would a good road save the family on flour alone, when the freight rate is that in problem 2?

5. If the freight to the above town is 416,000 lb. each year, what is the freightage at $1.25 per hundred? at 60¢ per hundred? What is the saving in 1 yr. at the reduced rate due to good roads?

6. How many years will it take the difference in freight rates in problem 5 to build 20 mi. of gravel road at $1800 per mile?
7. A hardware dealer estimates the life of a freight wagon in continuous service on the road described in problem 1 at 1 yr. If it takes 8 da. for a round trip, how many miles of service are there in a new wagon?

8. Calling 3 yr. the lifetime of such a wagon on a good road, when wagons sell at $60, what is the bad-road tax paid by a freighter in the course of 6 yr. on the road in problem 1?

9. A country store on a gravel road pays 1¢ a mile for each 100 lb. of freight hauled from the railroad station; a county seat on the same road 24 mi. from the railroad, 18 mi. of which are not gravel, pays 2¢ a mile for hauling each 100 lb. of freight. What is the annual bad-road tax paid by this county seat upon 300,000 lb. of freight?

10. It is estimated by good authority that a certain county in Kentucky, which pays annually $70,000 for hauling its goods from the railroad, could save at least $40,000 annually by having good roads. What is the average bad-road tax upon each of the 17,789 farmers in the county?
100. A good road must be oval, hard, and smooth. It is possible to make such a dirt road by using the split-log road drag illustrated below.

101. To make and use the road drag, set the split log on edge 30 in. apart, with flat sides to the front. Fasten together with strong hedge or hickory bars, the ends of which are wedged in 2-inch auger holes bored through the slabs.

**EXERCISE**

1. Estimate the cost of making a road drag when it takes a log 12 in. in diameter and 9 ft. long, lumber at $1 per hundred in the log, 2 drawing chains at 25¢ each, a double-tree at $2.50, a shoe 9 ft. long and 6 in. wide at 10¢ per foot, a board 9 in. wide and 9 ft. long at $1.50 per hundred, and the time required to make it 1 da. at $1.
2. A farmer lives 11 mi. from a grain market in a county known for its bad roads, on which 1 ton makes a load for a good team. In an adjoining county, where the roads are graded and kept smooth and firm by using the road drag, 35 cwt. is easily drawn as a load. Estimate the bad-road tax paid by the farmer living on the poor road, who markets \(933\frac{1}{2}\) bu. of wheat (60 lb. to the bushel), for the hauling of which he pays $2.50 per load.

3. A conservative estimate of the annual loss to farmers because of bad roads is \(75\frac{1}{4}\) per acre; what is the loss to a farmer who owns 80 A.?

4. If the annual saving to the farmers by maintaining good roads is \(75\frac{1}{4}\) per acre, how many days per year should a farmer work the roads who owns 120 A. of land, when a man with a team is worth $5.00 per day?

5. If a team can haul on a good macadam road 250% more than on an ordinary dirt road, when 30 bu. of wheat makes a load on a dirt road, how many bushels could be hauled over a macadam road?
BUILDING PROBLEMS

WEATHERBOARDING

102. Weatherboarding — siding or clapboarding — is sold by the width of the boards from which it is dressed. A board 6 in. wide can be dressed into weatherboarding 5½ in. wide; a 5-inch board can be dressed into 4½-inch weatherboarding.

SIX-INCH WEATHERBOARDING—4½ INCHES EXPOSED, 1 INCH LAP

In weatherboarding 1 in. is allowed for lap. To estimate a bill of weatherboarding, measure the surface in square feet; to this add ¼ of itself if 6-inch weatherboarding is used, and ½ if 5-inch weatherboarding is used. Ordinarily no allowance is made for doors and windows.
EXERCISE

1. How many square feet are there on one side of your schoolhouse? How many feet of 6-inch weatherboarding would it require? How many feet of 5-inch weatherboarding?

2. How many feet of weatherboarding would it take for the schoolhouse?

3. When paying two men $1.75 each for putting on together 600 sq. ft. of weatherboarding a day, what would be the carpenter’s bill for weatherboarding the schoolhouse? What would be the lumber bill with weatherboarding at $2.75 per hundred? What would be the total?

4. When paying $1.50 for each 300 ft. of weatherboarding placed on the house, with $2.50 per hundred for weatherboarding and nails, what would it cost to weatherboard a house, having the dimensions of your home?

5. In 6-inch weatherboarding how many inches are exposed to the weather?

6. When a carpenter is estimating the number of feet of weatherboarding required for a building, why does he add to the number of square feet to be covered one third of this number when 6-inch weatherboarding is used?

SHINGLING

103. It requires 900 shingles that average 4 in. in width, laid 4 in. to the weather, to cover 100 sq. ft.; but to allow for waste, count 1000 shingles for 100 sq. ft.

There are 250 standard-size shingles in a bunch. A fractional part of a bunch cannot be bought.

Four bunches of shingles will cover 100 sq. ft.

Allow 6 lb. of shingle nails for 1000 shingles.

Carrying up and laying 6 bunches (1500 shingles) is a day’s work for the average carpenter.
EXERCISE

1. How many bunches of shingles 4 in. wide and laid 4 in. to the weather will it take for the roof of the schoolhouse?

2. When paying the carpenter $2 a day, with shingles at $3 per thousand, and nails at 3¢ per pound, what will it cost to put a new roof on the schoolhouse?

3. When paying a carpenter $1.50 per day, with shingles at $3.25 per thousand, nails at 4¢ per pound, what would it cost to put a new roof on your home?

METAL ROOFING

104. Metal roofing is bought by the square (100 sq. ft.). Galvanized steel can be bought at from $2.50 to $4 per square; 75¢ is the average charge for laying. Galvanized iron can be bought at $4 per square; 75¢ is the average charge for laying. Tin roofing can be bought at from $2 to $6 per square; $1.50 is the average charge for laying.

EXERCISE

1. What would a tin roof for your schoolhouse cost at $3.50 per square and $1.50 per square for laying?

2. Which would be the less expensive roof for your schoolhouse, the galvanized-steel roof at $3.50 per square, and 75¢ per square for laying, or a shingle roof at $3.25 per thousand, and $1 per square for laying?
FLOORING

105. A board 2\(\frac{1}{2}\) in. wide, when tongued and grooved, covers 2 in. of floor space; a board 3 in. wide covers 2\(\frac{1}{2}\) in.; one 4 in. wide covers 3\(\frac{1}{4}\) in. (Some 4-in. flooring covers 3\(\frac{1}{2}\) in.)

106. Rule. To estimate a bill of flooring or ceiling, measure the square feet of surface; to this add \(\frac{1}{4}\) of itself if 2\(\frac{1}{2}\)-inch flooring is used, \(\frac{1}{5}\) of itself if 3-inch flooring is used, and \(\frac{3}{13}\) if 4-inch flooring is used.

EXERCISE

1. How many square feet of floor are there in your schoolroom? How many feet of flooring 3\(\frac{1}{2}\) in. wide will it take?

2. How many feet of flooring 2\(\frac{1}{2}\) in. wide will be required for a room 14 ft. by 16 ft.?

3. What would it cost to floor your largest room at home with oak flooring 2\(\frac{1}{2}\) in. wide at $3.75 per hundred? with pine flooring 2\(\frac{1}{2}\) in. wide at $2 per hundred?

4. Estimate the number of feet of ceiling 4 in. wide it would take for your largest room at home. How many feet 3 in. wide? (Allow \(\frac{1}{2}\) in. for tongue and groove.)

5. When a carpenter is estimating the number of feet of flooring 2\(\frac{1}{2}\) in. wide required for a room, why does he add to the number of square feet to be floored one fourth of the number? Why does he add one fifth of the number when 3-inch flooring is used? Why does he add three thirteenths of the number when 4-inch flooring is used? What does he add when 4-inch flooring covers 3\(\frac{1}{2}\) in.?
BUILDING PROBLEMS

CUTTING RAFTERS

107. One half the width of a house (the distance between the outside measurements of the wall plates) is called the run. The height of the rafter at their highest point above the wall plates is called the rise.

A roof is $\frac{1}{2}$ pitch when it is 1 ft. high for every 2 ft. in the width of the house.

A roof is $\frac{1}{4}$ pitch when it is 1 ft. high for every 4 ft. in the width of the house.

A roof is $\frac{2}{3}$ pitch when it is 2 ft. high for every 3 ft. in the width of the house.

The parts of a carpenter's square are the blade and the tongue. The blade is the broad and long part. The tongue is the narrow and short part.

108. To find the length of rafters, (1) measure the width of the house (distance between the outside measurements of the rafter plates); (2) decide on the rise of the rafters; (3) counting a foot an inch on the square, take $\frac{1}{3}$ the width of the house on the blade; (4) take the rise on the tongue; (5) place the square with these two points on a straight line or the straight edge of a board and mark the points; (6) then measure the distance between the points for the length of the rafters.

**Example.** A house 18 ft. wide is to have a roof $\frac{1}{3}$ pitch; that is, the roof is to be 1 ft. in height for every 3 ft. in the width of the house. Letting an inch on the square represent a foot, take on the blade of the square $\frac{1}{3}$ the width of the house (9 in.), on the tongue take $\frac{1}{3}$ the width of the house.

The length of the rafter without a projection over the side of the house is the distance between 9 on the blade and 6 on the tongue.
EXERCISE

1. What length must rafters, without a projection, be cut for a shed 12 ft. wide, the roof to be $\frac{1}{3}$ pitch?

2. What length must rafters, without a projection, be cut for a shed 12 ft. wide, the roof to be $\frac{1}{2}$ pitch?

3. What length must rafters, without a projection, be cut for a roof 9 ft. wide, the roof to be $\frac{3}{8}$ pitch?

109. To cut a rafter pattern, without a projection, out of a 2 by 4 scantling, (1) lay off the length of the rafter on one of the straight edges of the scantling; (2) place the tongue of the square with the point of the rise on the upper mark, with the point of run (on the blade) upon the same edge of the scantling; (3) mark the position of the tongue of the square for the upper cut; (4) next place the point of the run (on the blade) on the lower mark, with the point of the rise (on the tongue) upon the same edge of the scantling; (5) mark the position of the blade for the lower cut.

110. To cut a rafter pattern, with a projection for eaves, from a 2 by 4 scantling, (1) draw a straight line along the middle of the broad side of the scantling; (2) on this line lay off the length of the rafter without the projection; (3) place the tongue of the square with the point of the rise on the upper mark, with the point of the run (on the blade) upon the line; (4) mark the position of the tongue...
of the square for the upper cut; (5) next place the point of the run (on the blade) on the lower mark with the point of the rise (on the tongue) upon the line; (6) mark the position of the blade for the lower cut; (7) before removing the square from this position, erect a perpendicular to the square at the point of the run (on the blade) for the cut that fits against the outside of the roof plate; (8) if the projection is to be 1 ft., saw off the rafter 1 ft. below this mark.

**EXERCISE**

1. Lay off on a board the pattern of a rafter for a house 18 ft. wide, ½ pitch, the projection of each rafter being 1 ft.

2. Lay off on a board the pattern of a rafter for a coal shed 8 ft. wide, ¼ pitch, the projection of each rafter being 9 in.

3. Lay off on a board the pattern of a rafter for a wagon shed 10 ft. wide, ½ pitch, the projection being 9 in.

4. Estimate the lumber bill for the house on page 97, the rough stock being as follows: studding, 167 pieces, 2 in. by 4 in., 12 ft. long; sills, 16 pieces, 2 in. by 8 in., 16 ft. long; girders, 12 pieces, 2 in. by 8 in., 16 ft. long; floor joists, 40 pieces, 2 in. by 8 in., 10 ft. long; floor joists, 20 pieces, 2 in. by 8 in., 12 ft. long; ceiling joists, 40 pieces, 2 in. by 6 in., 16 ft. long; weatherboarding, 6-inch width; ceiling, 3½-inch width; floors, 3½-inch width; brick for 2 one-stove flues,
14 ft. high; hip rafters, 4 pieces, 2 in. by 8 in., 24 ft. long; common rafters, 4 pieces, 2 in. by 6 in., 18 ft. long; jack rafters, 2 in. by 6 in., 450 ft. total length; sheeting, 450 ft.; bunches of shingles (1100 sq. ft. in roof).

5. Estimate at market prices the cost of the bill of lumber in problem 4.

STONEWORK AND BRICKWORK

111. Stonework is estimated by the cubic yard or the running perch. Stone in the quarry or in massive buildings is measured by the cubic yard. Rubble work, or the foundation of the average house, is measured by the running perch.

A ONE-ROOM RURAL SCHOOLHOUSE

A running perch is a stone wall, or fence, 38 ft. long and 1 ft. high, regardless of the thickness.

Brickwork is estimated by the 1000.

112. Builders do not follow any uniform rule in estimating the number of bricks required for a wall. A well-known
contractor counts 16 bricks of the ordinary size \((8\,\text{"} \times 4\,\text{"} \times 2\,\text{"})\) for every square foot of surface in a wall 8 in. thick; 24 for a wall 12 in. thick. He makes a deduction for half of the space of all openings.

113. **Rule.** To estimate the bricks for a wall, multiply the distance around the building by the height of the building in feet and make a deduction for half of the openings in square feet; multiply this product by 16 if the wall is 8 in. thick, and by 24 if the wall is 12 in. thick.
EXERCISE

1. How many running perches of stone are there in a rock fence 80 rd. long and 4½ ft. high?

2. How many running perches of stone are there in the foundation of a house 24 ft. by 28 ft., if the foundation is 3 ft. high?

3. How many cubic yards of dirt are removed in excavating for a cellar 30 ft. long, 30 ft. wide, and 6 ft. deep?

4. Estimate the cost of a brick wall for a house 30 ft. long, 26 ft. wide, 16 ft. high, and 8 in. thick, when bricks are worth $12 per thousand.

5. To lay 800 bricks is a fair day's work for a good bricklayer. How much will he receive at $4 per day for building the walls in the above problem?

6. Measure the schoolhouse and estimate the number of bricks it would take to make brick walls 8 in. thick. How many rubbles of stone would it take for the foundation?
7. Estimate how many rubbles of stone there are in the foundation of your home.

RUBBLE WORK

114. Bricks are usually 8 in. long, 4 in. wide, and 2 in. thick, and average in weight 5 lb.

115. A flue for one stove is 8 in. by 8 in. in the clear. It takes 6 bricks for the round and 4 rounds to build 1 ft. high. A flue for two stoves is 12 in. by 8 in. in the clear. It takes 7 bricks for a round and 4 rounds to build 1 ft. high.

EXERCISE

1. How many bricks will it take for a 10-foot flue for one stove?

2. How many bricks will it take for a 14-foot flue for one stove?

3. How many bricks can be placed in a wagon bed 10 ft. long, 3 ft. wide, and 12 in. deep? What is the weight of the load?
PAINTING

4. How many bricks will it take for a 22-foot flue for two stoves?

5. With brick at $10 per thousand, what will the brick cost for a flue 12 in. by 8 in. in the clear, and 27 ft. high?

6. How many trips must the wagon make to the brickyard, to haul the brick in problem 5?

PAINTING

116. Allow 1 gal. of paint to every 250 sq. ft.
A thousand square feet is considered a fair day's work for a painter.

EXERCISE

1. How many gallons of paint would it take for one coat for the walls and ceiling of the schoolroom?

2. What would it cost to give the outside of the schoolhouse two coats of paint, with paint at $1.90 per gallon?

3. When a painter charges $2.50 per day, and paint is $1.90 per gallon, what will be the cost of two coats of paint for the outside of your home?

4. If you do the work yourself, with paint at $1.60 per gallon, what will it cost to paint a floor 16 ft. by 14 ft.?
MACHINE, SHOP, AND DRAFT PROBLEMS

SHOP PROBLEMS

117. Horseshoes average 1 lb. each at 44¢ per pound; nails average 112 to the pound, at 15¢ per pound.

EXERCISE

1. When a blacksmith furnishes shoes and nails, and shoes a horse all round for 80¢, what does he receive for his labor and the use of his tools? When he charges $1.60?

2. Inquire of your father how many shoes a work horse will wear during a year and what the price of shoeing is. Then estimate what it costs him to keep his horses shod for a year.

3. Iron that weighs 6.8 lb. per foot is used in making a set of tires for a wagon whose fore wheels are 42 in. in diameter, the rear wheels 46 in. in diameter. At 4¢ per pound, what will the iron cost for a set of tires?

4. What will be the cost of the leather to cover the seat of a chair 13 in. in diameter, if the leather is bought in a square at 50¢ per square foot?

5. I can get a pair of shoes half-soled for 90¢. If it takes 12 oz. of leather valued at 50¢ per pound and 2¢ worth of tacks to do the job, how much do I save by doing the work myself?

6. A screw has 13 threads to the inch. How many turns will it take to move it 2½ in.?
118. The seesaw board is one kind of lever; the point of support is called the fulcrum.

119. The seesaw board will balance when the weight on one end multiplied by its distance from the fulcrum equals the product of the weight on the other end by its distance from the fulcrum.

**EXERCISE**

1. John weighs 100 lb. and sits 5 ft. from the fulcrum; where must Oscar, who weighs 80 lb., sit, to make the seesaw board balance?

2. Cyrus, who weighs 120 lb., sits on a seesaw 6 ft. from the fulcrum; his sister, who weighs 60 lb., sits 4 ft. from the fulcrum on the same side. Their father sits on the other end of the board 5 ft. 4 in. from the fulcrum. How much does their father weigh if the seesaw balances?

3. A man with a crowbar 6 ft. long places one end of it under a stone 1 ft. from the fulcrum. If he weighs 180 lb., how many pounds of the stone can he lift?

4. A horse hitched to a doubletree, 18 in. from the clevis that attaches it to a plow, exerts a pull of 150 lb. Another horse hitched to the other end of the doubletree, 20 in. from the clevis, exerts a pull of how many pounds if both horses pull evenly?

5. A team is hitched to a doubletree 4 ft. long. At what point must the doubletree be attached to a plow so that one horse will pull twice as much as the other?
6. A team is hitched to a doubletree 4 ft. long. At what point must the doubletree be attached to a load so that one horse will pull \(1\frac{1}{2}\) times as much as the other?

![Doubletree Evener Diagram]

**Doubletree Evener**

7. When the draft is 6 lb. per square inch of cross section of the furrow, estimate the draft of a 12-inch plow running 6 in. deep; of a 14-inch plow running 6 in. deep.

*Note.* In general, the horse is able to exert a pull equal to \(\frac{1}{6}\) or \(\frac{1}{8}\) of his weight. A plow will generally require a pull, or draft, of from 4 to 8 lb. per square inch of cross section of the furrow.

8. How many square inches are there in the cross section of a furrow 12 in. wide and 4 in. deep? What pull does a team exert in plowing if the draft is 5 lb. per square inch?

![Cross Section of a Furrow Diagram]

**Cross Section of a Furrow**

9. A team weighing 2500 lb. is to be used in plowing a field 5 in. deep. If the team exerts a pull of \(\frac{1}{3}\) of its weight, and the draft is 4 lb. per square inch of cross section of the furrow, should a 12-inch or a 14-inch plow be used?
It is possible to plan work on the farm when the rate at which it is done is definitely known.

1. In practical demonstration it has been shown that a horse at his best for drawing a heavy load moves at the rate of $2\frac{3}{4}$ ft. per second. How many miles is this per hour?

2. It is estimated that a good horse carrying 160 lb. should be able to trot 7 ft. per second 7 hr. a day. How many miles will he trot in a day?

3. If a man drives from his home to town in 3 hr. at the rate of 4.1 ft. per second for \(\frac{1}{4}\) of the time, and 8.2 ft. per second for the rest of the time, what is the distance to the town?

4. If 9 hr. is the actual time per day that a team draws a self-binder, and if the binder cuts a 6-foot strip, what is the speed of the horses per hour if 14 A. is a day's work?

5. If a breaking plow turns a strip 12 in. wide, how many furrows 80 rd. long are turned in plowing 1 A.?

6. How many miles does a team walk in breaking 1 A. (55 rd. by 24 \(\frac{3}{4}\) rd.) with a 12-inch plow? with a 16-inch plow?

7. If a team travels 16 \(\frac{1}{4}\) mi. a day with a breaking plow, how many days' work can a man save in plowing 30 A. (110 rd. by 43 \(\frac{3}{4}\) rd.) by using a 16-inch instead of a 12-inch plow?

8. If a grain binder cuts a strip 6 ft. wide, how many acres of wheat will it cut in traveling 11 mi.?

9. Calling 16 \(\frac{1}{2}\) mi. an average day's work, how many acres a day will a binder cover that cuts a 6-foot strip?

10. How many miles does a team walk in harrowing a field 80 rd. by 40 rd. with a 10-foot harrow?

11. When a man can cut 12 A. of grass per day, how many acres must he cut that he may rake it the same day, if he rakes twice as fast as he cuts?
BUSINESS PROBLEMS

BORROWING MONEY FROM INDIVIDUALS

121. Individuals, as a rule, demand the interest when a note is due, or annually, if the note runs longer than a year. They reckon interest by months and years, and may or may not require the maker of the note to give security.

122. A note is a written promise to pay a certain sum of money at a specified time.

The following is the usual form of a note:

* Booneville, Ky., March 1, 1913

* One year after date I promise to pay to Raymond Davidson or order, Eighty-five Dollars, for value received, with interest at 6%.

Silas Moore

NOTE TO TEACHER. Require each member of the class to give his note to a classmate. Continue this drill until note writing becomes a simple matter.

INTEREST

123. Interest is money paid for the use of money, and is reckoned by the year.

124. Rule. To find the interest on the face of a note, multiply the face of the note by the rate of interest expressed as hundredths; then multiply by the number of years, or the fractional part of a year, that the note runs.

Example. What is the interest on $200 for 1 yr. 6 mo. at 6%?

Solution. $200 (Principal)

.06 (Rate)

$12.00

1 1/2 (Years) 1 yr. 6 mo. = 1 1/2 yr.

$18.00 (Interest)
EXERCISE

Find the interest on:

1. $500 for 3 yr. at 6%.
2. $50 for 1 yr. 6 mo. at 6%.
3. $75 for 6 yr. at 6%.
4. $125 for 9 yr. at 6%.
5. $160 for 6 yr. at 8%.
6. $250 for 1 yr. 3 mo. at 7%.

USING THE BANK

125. The first step to be taken in opening an account with a bank is to deposit some money, and receive a pass book in which all deposits are entered as credits. This book belongs to the customer, and should be left with the bank monthly to be balanced. It is then returned to the owner with all canceled checks.

It is the customer's duty to examine carefully the account of all checks, and report to the bank at once for correction any possible mistake.

CHECKS

126. A check is an order for a bank to pay a certain sum of money to the person designated, or to his order, out of the deposit of the person who signs the check.

<table>
<thead>
<tr>
<th>No. /</th>
<th>Hyden, Ky., June 3, 1913</th>
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<tbody>
<tr>
<td>HYDEN CITIZENS' BANK</td>
<td></td>
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<tr>
<td>Pay to the order of</td>
<td></td>
</tr>
<tr>
<td>Chester Dixon $10.00</td>
<td></td>
</tr>
<tr>
<td>Ten Dollars</td>
<td></td>
</tr>
<tr>
<td>For</td>
<td></td>
</tr>
<tr>
<td>Felix Feltner</td>
<td></td>
</tr>
</tbody>
</table>
127. A check should be endorsed on the back before it is cashed. An endorsement is simply the signature of the owner of the check on the back of it. Where is the money deposited with which this check is to be paid? Who gets the money on this check? Who pays the check? Whose name should appear on the back of the check when it is cashed?

Certified Checks

128. When away from home among strangers, or when sending a check to strangers, it is wise to use a certified check, to make certain that your check will be promptly honored or paid.

No. 17  Hyden, Ky., May 1, 1912

HYDEN CITIZENS' BANK

Pay to the order of

John W. Dinsmore $25.00

Twenty-five Dollars

For

John H. Asher

A certified check is one the payment of which is guaranteed by the bank on which it is drawn.

Borrowing from Banks

129. Banks demand the interest on a note to be paid in advance, the maker of the note to give security; and, for the most part, they compute the interest for the exact number of days.
A common form of a bank note is here shown:

Berea, Ky., Jan. 1, 1913

Interest
Six months after date, We promise to pay to the order of
The Berea National Bank, Berea, Ky. $500.00
Five Hundred Dollars

Negotiable and payable at The Berea National Bank, Berea, Ky., value received, with interest at the rate of 6 per centum per annum after maturity until paid. Indorsers waive demand, protest, and all legal diligence to collect.

Isaace Haeker
Charles Anderson

The day this note was made, Mr. Hacker paid to the bank $15, the interest for 6 mo.; that is, he received from the bank $485. The interest is called bank discount; the amount received by the maker of the note is called the proceeds.

The note is due in 6 calendar months. On July 1, 1913, Mr. Hacker will pay the bank $500, or he will renew the note, paying the interest in advance.

EXERCISE

1. Let each member of the class write a note for $200 for 6 calendar months, with interest at 6%, payable to the local bank. Some members of the class or school may sign the note with the maker for security. When is this note due? What is the bank discount? What are the proceeds of the note?
2. Let each member of the class write a note for $200 for 60 da., with interest at 6%, payable to the local bank. Secure some member of the class for security. When is the note due? What is the bank discount? What are the proceeds of the note?

**The Six Per Cent Method of Finding Interest**

131. The interest on $1 for

- 1 yr. is $0.06 (6¢)
- 2 mo. is $0.01 (1¢)
- 1 mo. is $0.005 (½¢)
- 30 da. (1 mo.) is $0.005 (½¢)
- 6 da. is $0.001 (1 mill)

When the rate is 6%, count \( \frac{1}{2} \) of the months cents and \( \frac{1}{6} \) of the days mills, and multiply their sum by a number equal to the number of dollars in the principal.

**Example.** Find the interest on $870 for 3 mo. 12 da. at 6%.

**Solution.**

\[
\begin{align*}
\frac{1}{3} \text{ of months counted as cents,} & \quad 2 \times 3 \text{ mo.} = \$0.015 \\
\frac{1}{6} \text{ of days counted as mills,} & \quad 6 \times 12 = 0.002 \\
& \quad \frac{}{} \quad \$0.017
\end{align*}
\]

The interest on $1 for 3 mo. 12 da. at 6% is $0.017, and on $870 it would be \( 870 \times \$0.017 = \$14.79 \).

132. If the rate is any other than 6%, find the interest on $1 for the given time at 6%, and take of this sum the fractional part the given rate is of 6% and multiply by a number equal to the number of dollars in the principal.

**Example.** Find the interest on $600 for 5 mo. 18 da. at 7%.

**Solution.**

\[
\begin{align*}
\frac{1}{2} \text{ of months counted as cents,} & \quad $0.025 \\
\frac{1}{6} \text{ of days counted as mills,} & \quad 0.003 \\
7\% \text{ the rate } & = \frac{7}{6} \text{ of } \$0.028 = \$0.032\frac{2}{3} \\
600 \times \$0.032\frac{2}{3} & = \$19.60.
\end{align*}
\]
EXERCISE

Find the discount on:

1. $875 for 10 mo. 9 da. at 6%.
2. $350 for 7 mo. 15 da. at 6%.
3. $890 for 9 mo. 24 da. at 6%.
4. $370 for 2 mo. 13 da. at 6%.
5. $365 for 19 da. at 6%.
6. $135 for 15 mo. 12 da. at 6%.
7. $550 for 1 yr. 4 mo. 6 da. at 6%.
8. $1000 for 4 mo. 18 da. at 7%.
9. $1200 for 3 mo. at 8%.
10. $860 for 1 mo. 17 da. at 8%.
11. $760 for 1 mo. 19 da. at 5%.
12. $980 for 5 mo. 8 da. at 7%.

THE DAY METHOD OF FINDING INTEREST

133. In the Six Per Cent Method of Finding Interest it was seen that one mill, or .001 of a dollar, was the interest on $1 for 6 da. at 6%. Then the interest on any principal at 6% for any number of days may be found by moving the decimal point in the principal three places to the left and multiplying by the number of days and dividing this result by 6.

Example. Find the interest on $350 for 48 da. at 6%.

Solution. Moving the decimal point three places to the left in the principal, we have $0.350. Multiplying this by 48 gives $16.80 Dividing this result by 6 gives $2.80.
EXERCISE

1. Reducing the time expressed in months to days, using the Day Method, find the interest at 6% on the following:

<table>
<thead>
<tr>
<th>Principal</th>
<th>Time</th>
<th>Principal</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>$800</td>
<td>60 da.</td>
<td>$385.00</td>
<td>2 mo. 5 da.</td>
</tr>
<tr>
<td>75</td>
<td>90 da.</td>
<td>305.50</td>
<td>1 mo. 7 da.</td>
</tr>
<tr>
<td>135</td>
<td>75 da.</td>
<td>85.50</td>
<td>89 da.</td>
</tr>
<tr>
<td>186</td>
<td>24 da.</td>
<td>100.75</td>
<td>60 da.</td>
</tr>
<tr>
<td>786</td>
<td>2 mo. 10 da.</td>
<td>135.65</td>
<td>33 da.</td>
</tr>
<tr>
<td>1600</td>
<td>4 mo. 19 da.</td>
<td>127.25</td>
<td>85 da.</td>
</tr>
<tr>
<td>1855</td>
<td>1 mo. 3 da.</td>
<td>134.16</td>
<td>3 mo. 17 da.</td>
</tr>
</tbody>
</table>

2. The following notes were made to the Berea Bank & Trust Co., Berea, Ky. Find the date when they are due. Using the Six Per Cent Method, find the bank discount and the proceeds.

<table>
<thead>
<tr>
<th>Date of note</th>
<th>Time</th>
<th>Face</th>
<th>Rate of discount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. May 20, 1913</td>
<td>4 mo.</td>
<td>$150</td>
<td>6%</td>
</tr>
<tr>
<td>2. May 20, 1913</td>
<td>90 da.</td>
<td>200</td>
<td>6%</td>
</tr>
<tr>
<td>3. July 1, 1913</td>
<td>6 mo.</td>
<td>450</td>
<td>6%</td>
</tr>
<tr>
<td>4. August 19, 1913</td>
<td>30 da.</td>
<td>800</td>
<td>6%</td>
</tr>
<tr>
<td>5. September 2, 1913</td>
<td>96 da.</td>
<td>750</td>
<td>6%</td>
</tr>
</tbody>
</table>

134. Since banks take the interest in advance, the maker of a note in order to realize a definite sum of money must give his note for a larger amount of money than the sum to be realized.

Example. For what sum must I give my note to a bank for 60 da., with interest at 6%, that I may receive from the bank $99?

Solution. Since banks take the interest in advance, the interest on each $1 borrowed for 60 da. at 6%, which is 1¢, is taken out of every dollar. Thus, the borrower realizes only 99¢ on each dollar on
the face of the note. Therefore, for every $0.99 the maker of the note receives from the bank, he must give his note for $1; then to receive $99 he must make his note for as many dollars as $0.99 is contained times in $99, the proceeds of the note. The face of the note is $100.

EXERCISE

1. For what sum must I give my note, payable to a bank, for 6 mo. with interest at 6%, so that I may realize $291?

2. For what sum must I give my note, payable to a bank in 60 da., with interest at 6%, so that I may realize $495?

3. For what sum must I give my note, discounted at a bank, for 45 da. at 6%, to realize $394?

DISCOUNTING NOTES

135. Agents and business men usually take notes from their customers due at a future date. If they need the money before the notes become due, they sell them to a bank. When a bank buys a note, it is said to discount the note.

The bank buys the note and the interest due at maturity, and discounts the amount of the note at maturity for the exact number of days of the period of discount.

Example. $500. Hazard, Ky., May 14, 1913

Three months after date, for value received, I promise to pay James H. Tate, or order, Five Hundred Dollars, with interest at 6%.

Robert C. Porter

On May 25, 1913, Mr. Tate sold this note to the Perry County State Bank at Hazard, Ky. The time the note is to run is expressed in months, so the date of maturity will be three calendar months from the date on which the note was made, or August 14, 1913.

Banks reckon the terms of discount by counting the actual number of days from the date of discount to the date of maturity. There are 81 da. of discount from May 25 to August 14.

Solution. Interest on $500 for 3 mo. at 6% = $7.50. Value of note at maturity = $500 + $7.50 = $507.50. Discount on $507.50 for 81 da. at 6% = $6.85. Mr. Tate received from the sale of this note $507.50 - $6.85 = $500.65.
EXERCISE

1. Mr. Summers discounted the following note at the Greene Co. National Bank at Greeneville, Tenn., November 1, 1913, at 6%. What did he realize on the sale?

$850.

Tusculum, Tenn., Oct. 6, 1913

Sixty days after date, for value received, I promise to pay Joseph Summers, or order, Eight Hundred Fifty Dollars, with interest at 6%.

Carl W. Lowry

2. Mr. Rudder discounted the following note at the London National Bank at London, Ky., April 12, 1913, at 6%. What did he realize on the sale?

$235.

London, Ky., Jan. 8, 1913

Four months after date, for value received, I promise to pay Roscoe Rudder, or order, Two Hundred Thirty-five Dollars, with interest at 6%.

Joe E. Riddle

PAYING CASH FOR GOODS

136. Paying cash for goods should enable the purchaser to buy his goods cheaper — first, because the merchant has his cash to use in business or to put at interest; second, because the merchant who sells for cash only has no bad debts to lose; third, because the merchant who does a credit business collects his bad debts from those who pay their bills.

Example. A farmer bought goods at a credit store to the amount of $77.25 on 6 mo. time. What was the cash value of the goods, money being worth 6%?

Solution. $1 at 6% for 6 mo. will amount to $1.03. Thus, a debt of $1.03 due in 6 mo. is worth at present only $1. Then the cash value of $77.25 due in 6 mo. without interest is worth as much as $1.03 is contained times in $77.25. The cash value is $75.
EXERCISE

1. I bought at a credit store goods to the amount of $55.08 for 4 mo. How much ready cash will be required to pay the bill, money being worth 6%?

2. I bought at a credit store goods to the amount of $101.50 for 3 mo. A neighbor bought the same bill of goods, paying cash. What was his loss, money being worth 6%?

3. A farmer sold a horse for $175 on 6 mo. time without interest. What was the cash value of the horse, money being worth 6%?

4. A farmer has a cow worth $80. What must be the selling price when she is sold on 3 mo. time without interest, money being worth 6%?

5. I bought goods at a credit store to the amount of $82.40 on 6 mo. time. I was offered a 5% discount for cash. Did I gain or lose by accepting the offer, money being worth 6%?

6. A merchant who conducts a credit store sold during the year $20,000 worth of goods. He marked his goods to sell on the following conditions; namely, 10% net profit; 6 mo. time, money being worth 6%; 2% loss on bad debts. What was the selling price of $1 worth of goods? What was a cash customer's loss on purchases amounting to $330?

STATE AND LOCAL TAXES

137. The state must provide for taking care of the insane, the blind, the deaf and dumb, other unfortunates, and the criminals; it aids in supporting schools to educate the children; it must pay the salaries of the governor and other state officials, and look after general improvements—all of which is worth many more thousands of dollars to the
people than it costs. The large sum of money required to do all this is obtained by taxing the property of the people.

The county has need of much money with which to educate its people, build bridges, roads, courthouses, schoolhouses, take care of its poor, and maintain courts of justice. These expenses are all met by taxing the people and their property.

138. A poll tax is a tax paid by each male citizen over 21 years of age without regard to how little or how much property he owns.

Real estate is any fixed property, as land and buildings.

Personal property is any movable property, as money, household goods, farming implements, cattle, etc.

139. Property tax is usually listed at so much per $100 valuation of property.

EXERCISE

1. How much tax does a farmer pay who owns 80 A. of land valued at $30 an acre, assessed at two thirds of its value, and personal property assessed at $600, if the rate of taxation is $1.50 per hundred? $1.14 per hundred?

2. How much tax does a farmer pay who owns 360 A. of land assessed at $3600, and personal property assessed at $900, if the rate of taxation is $1.50 per hundred?

3. How much does the administration of justice cost a county which pays annually on an average for 1944 da. of jury service at $2 per day and for 2½ mo. of a circuit judge's time at the rate of $4200 a year?

4. It is estimated by the circuit judge presiding in the county mentioned in problem 3 that nine tenths of the expense was incurred in prosecuting crime of which whisky and ignorance were the direct cause. If this expense were to be met by a poll tax on the 1343 farmers in the county, how much would be the share of each?
5. How many $800 schoolhouses or churches could be built each year out of this waste?

6. Estimate the rate of local tax on the $100 valuation necessary to make $50 worth of repairs on the schoolhouse and to buy a $25 library.

Note. The advanced pupils, assisted by the teacher, might, with interest, make a list of the taxable property in their district—the number of acres of land and its value, the number of head of cattle, horses, sheep, etc., with the value of each. Such a list is called an assessment roll.
### TABLES OF WEIGHTS AND MEASURES

**Long Measure**
- 12 inches = 1 foot
- 3 feet = 1 yard
- $5\frac{1}{2}$ yards, or $16\frac{1}{2}$ feet = 1 rod
- 320 rods = 1 mile

**Surveyor’s Measure**
- 7.92 inches = 1 link
- 25 links = 1 rod
- 4 rods, or 100 links = 1 chain
- 80 chains = 1 mile

**Square Measure**
- 144 square inches = 1 square foot
- 9 square feet = 1 square yard
- $30\frac{1}{4}$ square yards = 1 square rod
- 160 square rods = 1 acre
- 640 acres = 1 square mile

**Cubic Measure**
- 1728 cubic inches = 1 cubic foot
- 27 cubic feet = 1 cubic yard
- 128 cubic feet = 1 cord
- 1 cubic yard = 1 load of earth

**Liquid Measure**
- 4 gills = 1 pint
- 2 pints = 1 quart
- 4 quarts = 1 gallon
  = 231 cubic inches
**Dry Measure**

- 2 pints = 1 quart
- 8 quarts = 1 peck
- 4 pecks = 1 bushel

\[= 2150.42 \text{ cubic inches}\]

A heaped bushel, used for measuring apples, corn in the ear, etc., equals 2747.71 cu. in. A dry quart equals 67.2 cu. in. and a liquid quart 57.75 cu. in.

**Avoirdupois Weight**

- 16 ounces = 1 pound
- 100 pounds = 1 hundredweight
- 2000 pounds = 1 ton

**Troy Weight**

- 24 grains = 1 pennyweight
- 20 pennyweights = 1 ounce
- 12 ounces = 1 pound

### WEIGHT OF GRAINS, SEEDS, AND PRODUCE USED IN MOST STATES

<table>
<thead>
<tr>
<th>Articles</th>
<th>Pounds per bushel</th>
<th>Articles</th>
<th>Pounds per bushel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>60</td>
<td>Rye</td>
<td>56</td>
</tr>
<tr>
<td>Beans</td>
<td>60</td>
<td>Blue-grass seed</td>
<td>14</td>
</tr>
<tr>
<td>Corn, shelled</td>
<td>50</td>
<td>Buckwheat</td>
<td>52</td>
</tr>
<tr>
<td>Corn, on cob.</td>
<td>70</td>
<td>Clover *</td>
<td>60</td>
</tr>
<tr>
<td>Oats</td>
<td>32</td>
<td>Flaxseed</td>
<td>56</td>
</tr>
<tr>
<td>Potatoes</td>
<td>60</td>
<td>Sweet potatoes</td>
<td>55</td>
</tr>
<tr>
<td>Timothy seed</td>
<td>45</td>
<td>Green apples</td>
<td>50</td>
</tr>
<tr>
<td>Onions</td>
<td>57</td>
<td>Dried apples</td>
<td>24</td>
</tr>
</tbody>
</table>

196 pounds of flour = 1 barrel
280 pounds of salt = 1 barrel
80 pounds of coal = 1 bushel