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for the degree of Master of Science  
They approve it as a thesis meeting the require-  
ments of the Graduate School of the University of  
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MONTHLY DISTRIBUTION OF HORSE AND MAN LABOR ON  
THE FARM.

By Lucius H. Watkins.

A THESIS

Submitted to the Graduate School of  
the University of Minnesota in partial  
fulfillment of the requirements,

For the Degree of  
Master of Science.

St. Paul, Minnesota,

May 18, 1916.

MOM  
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## MONTHLY DISTRIBUTION OF HORSE AND MAN LABOR ON THE FARM.

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- b. Farming To-day has become a Business Proposition.
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- d. The Need of Systematic Distribution of Labor on the Farm.
- e. Object of this Thesis, and the Subject outlined.
- f. The Methods Employed in this Study.
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## MONTHLY DISTRIBUTION OF HORSE AND MAN LABOR ON THE FARM.

Wonderful as has been the industrial and commercial growth of the United States in the past fifty years, the agricultural growth and development has been no less phenomenal. Even the space of a decade has witnessed giant progress. In 1900 there were in the United States 5,737,000 farms (1), valued at nearly twenty and a half billion dollars (2). Only ten years later (1910) the number of farms had increased to 8,381,000 (1), and their valuation was placed at almost forty-one billions of dollars (2). In ten years then, the valuation of the United States' farms had increased 100.9 per cent, and what the census of 1930 will show, far more than that.

This tremendous growth, together with the past era of commercial expansion, has had a marked effect upon the labor supply, not only making labor scarce, but also high priced (3). The American farmer of to-day is striving his best to economize labor without putting down production but rather increasing it. Never before in the world's history has such progress been made in the development of tools and machinery for the saving of time and labor. From 1855 to 1894 the time of human labor required to produce one bushel of corn, on an average, declined from four hours and thirty-four minutes to forty-one minutes (4). This was because inventors had given to the farmers of 1894 the gang plow, the disk harrow, the corn planter drawn by horses, and the corn sheller operated by steam and shelling one bushel of corn per minute, instead of the old way of corn shelling in which the labor of one man was required

one hundred minutes to do the work (4). Similarly in the matter of wheat production, where it took three hours and three minutes to raise a bushel of wheat, threshed, it now takes fifty-five minutes of human labor (4').

"How can we reduce the cost of production?" is frequently asked, and the rapid growth of the Farm Management departments of our government and universities attests the keen interest of the Agriculturist in a more business-like system of farming.

Farming of to-day is becoming more and more a business proposition. The farm is beginning to be regarded as a factory; the men, horses; live stock and equipment, as the machinery to convert raw material into a finished product. Efficiency principles are being rigorously applied; labor saving devices and machinery are legion; while cooperative marketing of products - cooperation of farmers in hauling dairy products to creameries, and better roads and transportation facilities - all bear testimony of progress toward greater efficiency of man and horse labor.

"Labor," says J. A. Drake, Agriculturist in the Farm Management Office, United States Department of Agriculture, "constitutes one of the hardest problems encountered on the average farm" (5). "The economical use of labor is one of the most serious problems in farming." writes J. H. Arnold, Office of Farm Management, Bureau of Plant Industry (6), and well does this question bear a careful investigation. Not only is man labor growing higher priced, but horse labor is also growing more expensive as hay and grain increase in cost. The bill for man labor on the American farms, as reported by the 1910 Census, is over \$651,000,000 annually (7), an increase of 83.3% over 1900. When it is remembered that an idle

team of horses is costing as much or more than an idle workman (8), and that the value of man labor on a farm is equivalent to approximately one-third, and man and horse labor over one-half of the total farm receipts (9), the importance of utilizing labor efficiently, thus reducing the cost of farm products, becomes apparent.

The farmer needs labor; no one will deny that. In fact, the more labor used on productive enterprises that pay, the greater will be the labor income (10). Granted that machinery has done and will do much toward solving the labor question, man labor is still necessary to direct the machinery. Because of the high price of labor, innumerable inventions have been perfected which are daily saving the brain and muscle of armies of men, and not only that, they are doing man's work far faster and more accurately.

Where the cropping system is such as to require an excess of labor at one season and little or no labor at other seasons, it is necessary to depend on transient labor which, for the general farm, is very unsatisfactory (5). It is because of this condition that new labor systems are being devised, and "Filling the Labor Gaps" in the farm labor schedule is being carefully studied by farm managers.

Heretofore, farm methods have been rather aimless and un-systematic. Labor is hired on some farms for a few weeks or months only to be dismissed when the temporary rush is over (15) This leads to two results:

- (1) Dissatisfaction on the part of the laborer because of
  - a. non-permanent work
  - b. constant need of moving around



- (3) Dissatisfaction on the part of the farmer who
  - a. cannot get workers when he wants them since every other farmer near him is also bidding for laborers,
  - b. meets a spirit of non-responsibility and lack of interest on the part of the worker.

Investigation and observation seem to bear out these facts:

- (1) The farmer wants:
  - a. Interested and responsible workers.
  - b. Labor when he needs it.
  - c. Labor at a reasonable price.
- (2) The laborer wants:
  - a. Steady work the year around.
  - b. An interest in what he does.
  - c. A reasonable wage.

As farming grows toward a strict business proposition, it demands steady, reliable help. A laborer wishes steady employment. Any farm system that employs labor steadily the year around will command a higher type of labor. Steady labor will prove financially helpful to both parties since the farmer can hire steady labor cheaper than intermittent day labor, and, on the other hand, the laborer will work for less if he can work steadily.

Horse labor has been poorly managed on most farms. It, too, properly comes into this labor problem. Since keeping a horse costs about the same (about \$100.00 per year) whether the horse works or not (Since depreciation, shoeing, feeding, interest,



and shelter go on nearly the same) the partial employment of the horse's time is a "leak" that causes a large loss.

It was with a view of acquiring a knowledge of efficient methods of using labor and of distributing the demand for that labor throughout the year in actual farm practice, that this study of the question was made. Data for the work were taken from farm survey records on 395 farms in Southern Minnesota obtained by the Farm Management Division of the University of Minnesota, and from some individual and group farms of Minnesota and other states.

The subject comprises:

- (1) A study of the productive labor hours on 395 Southern Minnesota farms and their relation to the labor income.
- (2) A study of some individual and group farms showing some well distributed and some poorly distributed labor systems.
- (3) A study of some systems which indicate a better distribution of labor throughout the year.
- (4) Conclusions.

The material used consists of:

Bulletins of this and other states.  
Government circulars, bulletins and statistics.  
Survey records compiled by the Farm Management Division of Minnesota on 395 farms.  
Labor and farm records from the Cost Accounting routes of the Minnesota Agricultural Experiment Station.  
Assistance from station men, professors and

instructors in the Farm Management Division.

A definition of some terms may well be made:

1. By farm income, is meant the total farm receipts, plus the increase of inventory (or minus the decrease in inventory, if the inventory shows a loss), minus the farm expense.
2. Labor income is the farm income, minus unpaid family labor and interest on investment. Besides this, the farmer gets the house, garden, and the living expenses furnished directly by the farm.
3. Productive labor is labor spent upon live stock (except work horses) and crops. In other words, it is labor put upon money-returning enterprises as distinguished from "Maintenance" labor.
4. The standard animal unit is the cow, horse, or steer, two years old or over.

The following table gives the relative value in animal units of the common farm animals.

TABLE 1. RELATIVE VALUE OF FARM ANIMALS IN ANIMAL UNITS

| <u>Animal</u>        | <u>Unit</u> | <u>Animal</u> | <u>Unit</u> |
|----------------------|-------------|---------------|-------------|
| Horse over 2 years   | 1.0         | Steer         | 1.0         |
| Colt under 2 years   | 0.5         | Mature Sheep  | .14         |
| Cow over 2 years     | 1.0         | Other Sheep   | .1          |
| Heifer under 2 years | .5          | Brood Sows    | .2          |
| Calves               | .5          | Other Hogs    | .1          |
| Bull over 2 years    | 1.0         | Poultry       | .01         |

5. An example of a work unit is the labor required to raise an acre of hay, cut once (24). Work units are not a measure of how hard men work, but of what is accomplished. They are a measure of productive work done on a farm. In general, one work unit is equal

to 10 man hours or 20 horse hours of labor.

The following table, taken from Warren's Farm Management (Page 351), is valuable as a comparison of productive work units:

TABLE 2. PRODUCTIVE WORK UNITS

|  | Man Work:<br>Units | Horse Work<br>Units |
|--|--------------------|---------------------|
| Timothy, alfalfa, clover, per acre per cutting | 1                  | 1                   |
| Oats, wheat, barley, rye buckwheat per acre    | 2                  | 3                   |
| Corn, husked from standing stalks, per acre    | 3                  | 5                   |
| Corn, husked from shock, per acre              | 6                  | 6                   |
| Corn for silo per acre                         | 6                  | 7                   |
| Field beans per acre                           | 5                  | 5                   |
| Cotton per acre                                | 12                 | 6                   |
| Tobacco per acre                               | 20                 | 7                   |
| Potatoes per acre                              | 12                 | 10                  |
| Cabbage per acre                               | 13                 | 12                  |
| Apples per acre                                | 15                 | 5                   |
| Dairy cow                                      | 15                 | 2                   |
| 10 Cattle or colts, running loose              | 20                 | 1                   |
| 10 Brood sows and raising pigs to weaning      | 30                 | 5                   |
| 50 Hogs (not brood sows)                       | 25                 | 5                   |
| 100 Ewes                                       | 50                 | 3                   |
| 100 Hens                                       | 15                 | 2                   |
| Raising 200 Chickens                           | 15                 | 2                   |

6. Animal index is a percentage figure which is a measure of the live stock receipts per animal unit on an individual farm, compared with a figure that represents the average receipts per animal unit of a group of farms, that figure

being taken as 100.

Inasmuch as the term "animal index" is being used widely for comparisons, the method of computing it is here given:

1. Secure the average number of each kind of animals on a farm for the year.
2. Secure the total returns for each class of animals by subtracting the value at the end of the year from the value at the beginning of the year. Add sales and subtract purchases.
3. Reduce the average number of animals on the farm for the year to animal units and divide the number into the total returns secured for the year from animals (including hides, breeding fees, and milk products). This will give the returns per animal unit for the farm.
4. Secure the average returns per animal unit for the community in the manner described for the farm. Use this number as the 100% figure and divide into each animal-unit-returns per farm. This will be the animal index on this farm.
7. Crop index, which is also a percentage figure, is a measure of crop yields per acre on an individual farm compared with a figure representing the average of each crop of the group of farms, the average yield taken as 100.
8. Operating capital, sometimes called productive working capital, is equal to the total invested capital minus the value of land and buildings.

The office of Farm Management, U. S. Department of Agriculture, has shown that "other things being equal, those farms that have the greatest variety of products to sell are the most profitable" (14). The reasons for this are not hard to find, for

1. A failure of one enterprise does not precipitate a complete failure.
2. Each enterprise boosts the total income.
3. And, most important, the diversified system distributes labor throughout the year.

The first two reasons are self evident but the third reason is not. Diversifying labor is no simple task, as can be seen from the fact that on very few farms is the labor equally distributed throughout the year. The successful farm manager of the future must know crops. He must know which crops compete for labor in planting, in cultivating, and in harvesting. He must know the time that each crop will demand attention. Moreover, he must know men and the average day's work in any farm enterprise which a man can do. Safety margins, of course, must be allowed. It is encouraging to note that information along these lines is increasing. Minnesota Bulletin 145, "The Cost of Producing Minnesota Farm Products"; Minnesota Bulletin 157 on labor requirements of various crops and enterprises, now in press, and others, throw much light on the subject.

Productive hours of labor per man and per horse is probably one of the surest measures of efficiency in the farm business. Total productive hours of labor, or work units, is probably one of the surest measures of the size of the farm business. Diversified and steadily employed labor is the only way of getting

a high number of productive hours per man annually, and one of the big lessons for the farmer to learn is to use labor effectively, at each season of the year.

In taking up the first division of this subject, viz: a study of the productive labor hours per man and horse on 395 (23) Minnesota farms, there are some interesting relations to be noted. The number of productive man hours and horse hours expended on the good, poor and average farms, and the relation they bear to the labor income, is herewith shown.

The average labor income on the 395 farms was first determined. The farms were then divided into two groups: the good farms, numbering 181, are those with labor incomes above the average; the poor farms, numbering 214, are those with labor incomes below the average.

A few facts about these farms are of interest. The farms are general southern Minnesota farms, all in Rice County, and varying in size from 17 to 540 acres. They were operated by 231 owners, 109 part owners, and 60 tenants. The farms operated by owners contained an average of 135 acres each, of which 104 acres were tillable. This is 63.7% of the total area. The farms operated by part owners contained an average of 129 acres each, of which 101 acres were tillable. This is 67.4% of the total area. The farms operated by tenants contained an average of 151 acres each, of which 118 acres were tillable. This is 66.9 per cent of the total area. Five farms were later taken out on account of unusual and non typical business enterprises. The total of the plus labor incomes equalled \$142,911.00. The total of the minus labor incomes was \$24,141.00. Deducting the minus labor incomes



from the plus labor income leaves a plus labor income of \$118,770., or an average labor income for each of the farms of \$301.00. The average labor income of the good farms was \$686.00. The average labor income of the poor farms was -\$29.00. The good farms averaged 128% above the average. The poor farms averaged 109.6% below the average. The good farms made, therefore, \$715.00 (\$686.00 plus \$29.00) more than the poor farms.

Having noted the labor incomes and grouping of the good and poor farms, a study of productive hours is interesting. The good and poor farms were divided into six groups, as follows:

1. All farms under 1500 hours per man
2. " " from 1501 to 3000 hours per man
3. " " " 2001 to 3500 " " "
4. " " " 2501 to 3000 " " "
5. " " " 3001 to 3500 " " "
6. " " over 3500

The poor farms were then further divided into the groups having plus labor incomes and minus labor incomes. The aim was to find out where the good farms differed from the poor ones, and whether the minus labor income bears any relation to the hours of productive labor.

The productive labor hours per man on all farms was 973,348. Dividing this sum by 395 gives an average of 2,464 productive labor hours per man. The productive labor hours per man on the good farms was 497,895. Dividing this sum by 181 gives an average of 2,751 productive labor hours per man. This is 12% above the average. The productive labor hours for the poor farms was 475,453. Dividing this sum by 214 gives an average of 2223 produc-



tive labor hours per man. This is 10% below the average. Hence, the good farms used on an average 529 more productive hours than did the poor farms. Table 3 gives this data by groups.

TABLE 3

PRODUCTIVE HOURS PER MAN - 395 FARMS

Under :1501 to: 2001 to:2501 to :3001 to: Over  
1500 hrs.: 2000 : 2500 : 3000 : 3500 : 3500

A. Good Farms  
(181)

|                |       |       |       |       |       |       |
|----------------|-------|-------|-------|-------|-------|-------|
| Number         | 3     | 26    | 45    | 44    | 37    | 37    |
| Av. Prod. Hrs. | 1338  | 1810  | 2234  | 2730  | 3241  | 3984  |
| Av. Labor Inc. | \$424 | \$495 | \$608 | \$680 | \$838 | \$830 |

B. Poor Farms  
(214)

|                |        |        |        |      |       |      |
|----------------|--------|--------|--------|------|-------|------|
| Number         | 35     | 48     | 58     | 47   | 21    | 5    |
| Av. Prod. Hrs. | 1153   | 1808   | 2240   | 2744 | 3260  | 4183 |
| Av. Labor Inc. | \$8.10 | \$6.00 | -\$120 | \$34 | -\$92 | \$76 |

C. All Farms  
(395)

|                |      |       |       |       |       |       |
|----------------|------|-------|-------|-------|-------|-------|
| Number         | 37   | 74    | 103   | 91    | 58    | 32    |
| Av. Prod. Hrs. | 1163 | 1809  | 2237  | 2737  | 3248  | 4015  |
| Av. Labor Inc. | \$99 | \$178 | \$198 | \$346 | \$518 | \$704 |

Of Poor Farms  
(214)

A'. Number with plus

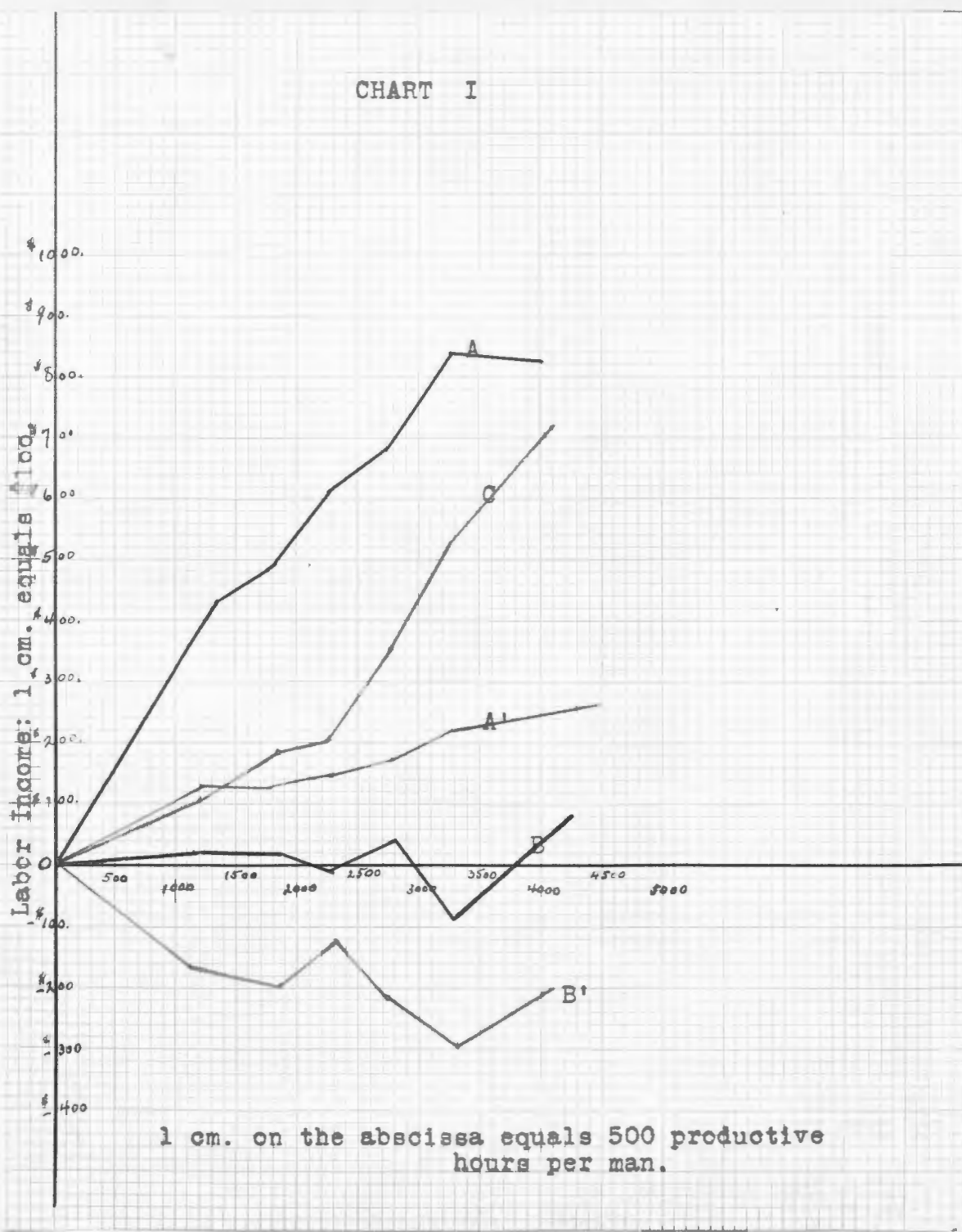
|                              |       |       |       |       |       |       |
|------------------------------|-------|-------|-------|-------|-------|-------|
| Labor Income                 | 20    | 29    | 25    | 30    | 10    | 3     |
| Average plus<br>Labor Income | \$137 | \$136 | \$150 | \$175 | \$129 | \$262 |
| Average<br>Hours             | 1217  | 1769  | 2266  | 2764  | 3238  | 4356  |

B'. Number with minus

|                               |        |        |        |        |        |        |
|-------------------------------|--------|--------|--------|--------|--------|--------|
| Labor Income                  | 15     | 19     | 33     | 17     | 11     | 2      |
| Average minus<br>Labor Income | -\$164 | -\$193 | -\$120 | -\$215 | -\$293 | -\$203 |
| Average<br>Hours              | 1070   | 1866   | 2221   | 2709   | 3279   | 3925   |

The accompanying chart represents these graphs:

CHART I



RELATION OF PRODUCTIVE MAN HOURS PER MAN TO LABOR INCOME. 395 FARMS.

A - Good farms; B - Poor Farms; C - All Farms; A' - Poor Farms with plus labor income; B' - Poor farms with minus labor incomes.

A study of this table shows that, other things being equal:

1. The greater the number of productive hours put in per man on the good farms, the greater the labor income.

However,

It would appear that after 3,341 hours per man is reached, there is a slight dropping off in labor income. This may be due to other factors affecting the labor income, or the labor may be more poorly managed and the crops or live stock on these farms may be insufficient to warrant over 3,341 hours per man.

2. No definite relation can be drawn from the productive hours per man on the poor farms. For instance, 3000 productive hours per man show less labor income than 1000 productive hours per man (See curve B).
3. An average of all farms shows greater fluctuations, but the relation of productive man hours to labor income is fairly constant and the labor income rises nearly proportionately as the number of productive hours per man increases.
4. Separating B into farms of plus A' and minus B' incomes, we find a fairly good relation. A'. Those of the poorer farms which have plus labor incomes show that the productive hours per man is a definite factor, although not so valuable as in the good farms. In other words, labor incomes increase as the productive

hours per man increase, but only slowly. 2. Of the poor farms with a minus labor income, the relation is the reverse. The conclusion seems to be that on a poor farm the more productive labor hours put in per man, the greater the loss. At least, this conclusion holds up to the point where 3,300 hours per man are used.

This point should be emphasized. Given a farm, say with poor soil or non paying live stock, the more the productive hours put in the greater the loss. Moreover, since the greater number of productive hours per man measure, as a rule, the greater business, it follows that the man putting in the most hours on a poor business will lose most, for the biggest losses can only happen on the biggest enterprises or in big business.

To prove this point, one should analyze carefully these particular farms. Perhaps a poor condition of soil is the cause of poor crops. Perhaps the animals are below the average, or the farm too small for efficient use of machinery. However, the labor incomes are far below the average and, as before defined, they must fall in the poor farm group. To check this, the 181 good farms have been compared with the 214 poor farms, and from the data of these 395 farms the following table was made.

TABLE 4

COMPARISON OF GOOD AND POOR FARMS IN RELATION TO SIX FACTORS.

|  | All<br>Farms | Good<br>Farms | Poor<br>Farms | Difference |
|--|--------------|---------------|---------------|------------|
| 1. Animal Index                            | 100%         | 118%          | 84%           | 34%        |
| 2. Crop Index                              | 100%         | 107%          | 95%           | 12%        |
| 3. Productive Work Units (Av.)             | 558          | 615           | 510           | 105        |
| Productive Work Units (Av.)                | 100%         | 110.2%        | 92%           | 18%        |
| 4. Productive hours per<br>Horse (Average) | 800          | 850.8         | 756.6         | 94.2       |
| Productive Hours per<br>Horse (Average)    | 100%         | 106.4%        | 94.6%         | 11.8%      |
| 5. Productive Hours per<br>Man (Average)   | 2464         | 2751          | 2222          | 529        |
| Productive Hours per<br>Man (Average)      | 100%         | 112%          | 90.1%         | 21.9%      |
| 6. Size of Farm (Average)                  | 135A         | 138.6         | 131.6         | 7A         |
| Size of Farm (Average)                     | 100%         | 102.7         | 97.4          | 5.3%       |

It is noticeable that size, crop index, and hours per horse are the only items that come at all near the average of the group. It might be expected that crop yields on the smaller farms would exceed those of the larger farms, but the records do not indicate that such was the case in this region. The next nearest factor to the average is productive hours per horse; the good farms using 94.2 more productive hours annually per horse than the poor farms. Besides this, the good farm group uses 529 productive hours per man annually more than the poor farm group. This extra work, and on better animals and crops, is an indication of better manage-

ment. It should be noted that the good farms exceed the poor farms in every factor. Animal index is the factor of greatest range between good and poor farms. A. H. Benton, Asst. Professor in Farm Management at the University of Minnesota, thinks that animal index is of large importance and that acres per animal unit is a good measure of diversity - the smaller the acreage per animal unit, the greater the diversity.

It is probably safe to say in every instance that, given a farm in a good locality which exceeds the average farm in the region in its animal and crop index, in its productive use of hours per horse and man, and in size, that the greater the productive work units expended on that farm, the greater will be the labor income. There is a limit, of course, to which this could be carried for diminishing returns would soon be reached by increased expenses. However, the ability of making each factor above the average means a high labor income. Each factor may be small, but added, their power is greater and the labor income shows their added effect.

Efficient use of horse labor is essential to success. "Economy in the use of horse labor is becoming increasingly important." (11) Since it costs as much or more to keep a team of horses as it does to keep a man, "the chief economy to be effected in the use of horses is to keep them employed" (11). Therefore, under normal circumstances, the best managed farm will show a high rate of horse hours per horse.

Following the plan as above for productive man hours, similar tables were worked out for productive hours per horse:



TABLE 5

PRODUCTIVE HOURS OF LABOR PER HORSE - 395 FARMS

Under:601 to:701 to:801 to:901 to :Over  
600 : 700 : 800 : 900 : 1100 :1100

A. Good Farms

|                   |       |       |       |       |       |       |
|-------------------|-------|-------|-------|-------|-------|-------|
| Number            | 24    | 31    | 25    | 34    | 40    | 27    |
| Av.hrs. per horse | 508   | 661   | 745   | 854   | 982   | 1308  |
| Av. Labor Inc.    | \$527 | \$562 | \$690 | \$779 | \$697 | \$868 |

B. Poor Farms

|                    |     |       |      |       |        |       |
|--------------------|-----|-------|------|-------|--------|-------|
| Number             | 50  | 45    | 38   | 34    | 30     | 17    |
| Av. hrs. per horse | 464 | 653   | 748  | 841   | 986    | 1338  |
| Av. Labor Inc.     | \$9 | -\$39 | \$10 | -\$19 | -\$101 | -\$54 |

C. All Farms

|                 |       |       |       |       |       |       |
|-----------------|-------|-------|-------|-------|-------|-------|
| Number          | 74    | 76    | 63    | 68    | 70    | 44    |
| Av.Horse Hours  | 478   | 656   | 747   | 848   | 984   | 1320  |
| Av.Labor Income | \$177 | \$206 | \$280 | \$380 | \$355 | \$491 |

Of Poor Farms

|                                |    |    |    |    |    |   |
|--------------------------------|----|----|----|----|----|---|
| A'. Number with plus Lab. Inc. | 28 | 24 | 25 | 17 | 16 | 7 |
|--------------------------------|----|----|----|----|----|---|

|                      |       |       |       |       |       |       |
|----------------------|-------|-------|-------|-------|-------|-------|
| Av.Labor Inc. (plus) | \$154 | \$155 | \$143 | \$164 | \$138 | \$155 |
|----------------------|-------|-------|-------|-------|-------|-------|

|                                |    |    |    |    |    |    |
|--------------------------------|----|----|----|----|----|----|
| B'.Number with minus Lab. Inc. | 22 | 21 | 13 | 17 | 14 | 10 |
|--------------------------------|----|----|----|----|----|----|

|                        |        |        |        |        |        |        |
|------------------------|--------|--------|--------|--------|--------|--------|
| Av. Labor Inc. (minus) | -\$174 | -\$261 | -\$244 | -\$207 | -\$372 | -\$294 |
|------------------------|--------|--------|--------|--------|--------|--------|

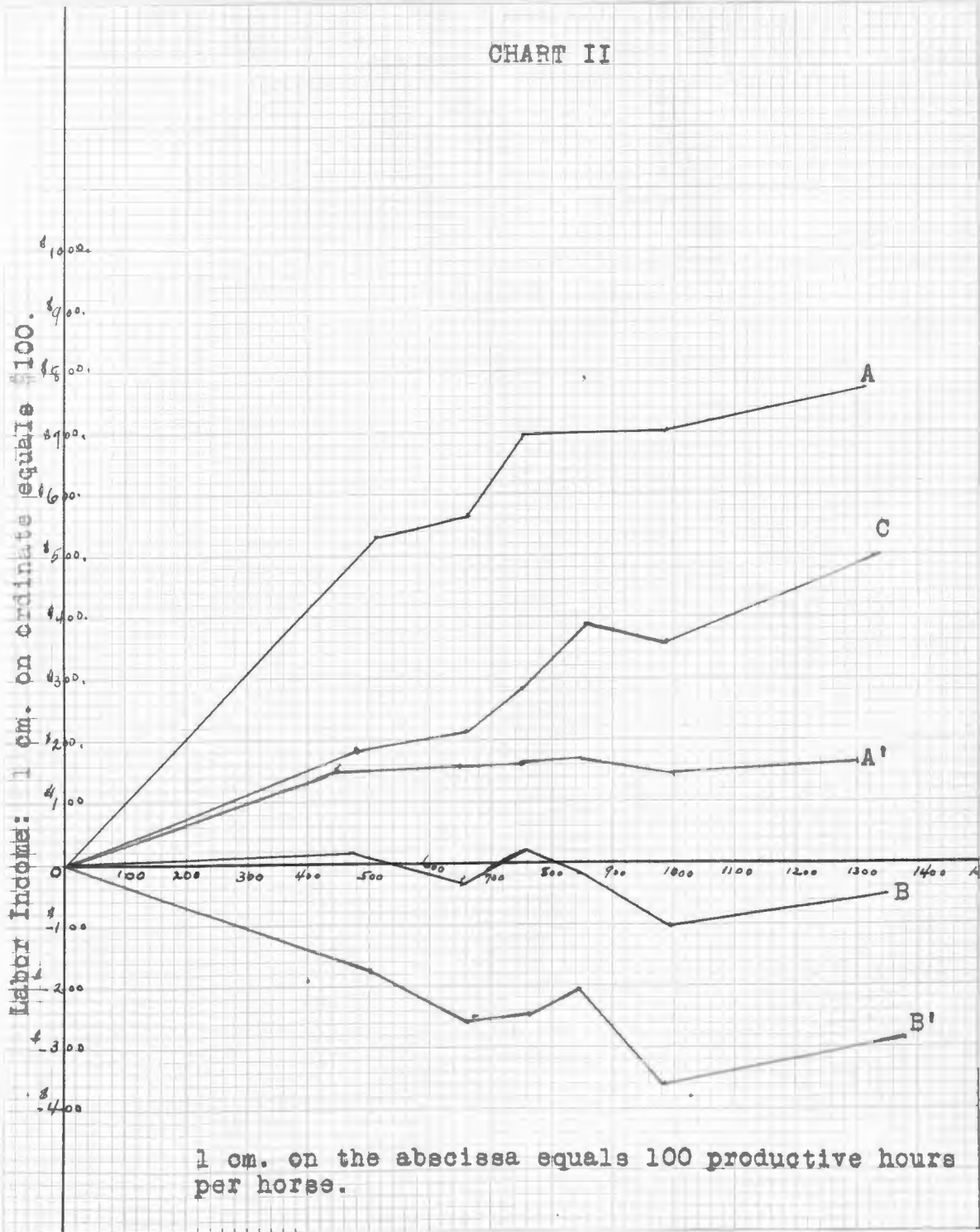
|                            |     |     |     |     |      |      |
|----------------------------|-----|-----|-----|-----|------|------|
| Horse Hours plus Lab. Inc. | 443 | 652 | 744 | 841 | 1000 | 1299 |
|----------------------------|-----|-----|-----|-----|------|------|

|                             |     |     |     |     |     |      |
|-----------------------------|-----|-----|-----|-----|-----|------|
| Horse Hours minus Lab. Inc. | 491 | 653 | 756 | 841 | 970 | 1364 |
|-----------------------------|-----|-----|-----|-----|-----|------|

The graphs are shown on the following chart:



CHART II



RELATION OF PRODUCTIVE HOURS PER HORSE TO LABOR INCOME. 395 FARMS.

A - Good Farms; B - Poor Farms; C - All Farms A'-Poor Farms with plus labor income; B' - Poor farms with minus labor income.

The total hours per horse of good farms was 153,985 (Prod.labor)

The total hours per horse of poor farms was 161,918

The total hours per horse of all farms was 315,903

The average hours per horse for all farms was 800

The average hours per horse for the good farms was 850.75.

This is 6.4% above the average.

The average hours per horse for the poor farms was 756.62.

This is 5.4% below the average.

Notice that the good farm averages 94 more productive hours per horse than does the poor farm.

A study of Table 5 shows that, where other things are equal, the higher the productive hours per horse the greater the labor income. However, after 850 hours per horse is reached, there is a slight decline in the constancy of the curve. There may be factors other than this one that bear on the labor income. For instance, fields may be too small to effectively use three and four horse teams. This would reduce efficiency and, consequently, the labor income. Note that the good farms show the best height of curve at 850 hours per horse. Also, the curve B of all farms shows a very close relation to A, though at less height. Curve C (the plus incomes of the poor farms) shows that 1300 horse hours per horse resulted in little or no more labor income than did 450 hours. Curve D (poor farms) shows that the more horse hours put in the less the labor income, while curve E (the minus labor incomes of the poor farms) shows this to a more marked degree. This but emphasizes the conclusions on the productive man hours, i.e., that given a poor enterprise or farm, the more the labor expended, the greater the loss.

The productive work units on these 395 farms will give a measure of the size of the farm business. The same plan of grouping the good and poor farms is followed, and the relation of productive work units to labor income is shown:

The total labor or work units of the good farms was 111,358.3.

The average per farm was 615.24.

The total labor or work units of the poor farms was 109,155.7.

The average per farm was 510.

The total labor or work units of all the farms was 220,514.0.

The average per farm was 558.

The good farms exceeded the average by 10.2%.

The poor farms were below the average by 8.6%.

The average good farm exceeded the average poor farm by 105 productive work units annually.

Table 6 indicates that, in general, the labor income increases with an increase in work units. Note on Chart III the abrupt rise of the labor income on the good farms with the increase of work units, especially from 900 to 1200. The rise is much less on the average of all the farms. The labor curve of the poor farms (B) shows a loss occurring with an increase of work units, while the curves A' and B' show that of the better of the poor farms (A'), over 200 work units made very little difference in the labor incomes. Curve B' shows constant loss for increase of work units.

Note that there are two extremes of these labor curves. The curve of the work units on the good farms (A) shows an increase in labor income as the productive work units increase; the curve B' (poorer farms) shows a decrease in labor income as productive work units increase. - 21 -

TABLE 6

ANNUAL PRODUCTIVE WORK UNITS - 395 FARMS

Under : 200.1 : 400.1 : 600.1 : 800.1 : Over  
 200 Units: to 400: to 600: to 800: to 1000: 1000.1

A. Good Farms

|                  |       |       |       |       |       |        |
|------------------|-------|-------|-------|-------|-------|--------|
| Number of Farms  | 2     | 40    | 59    | 38    | 25    | 17     |
| Av. Work Units   | 188   | 334   | 507   | 680   | 877   | 1173   |
| Av. Labor Income | \$424 | \$474 | \$646 | \$726 | \$791 | \$1171 |

B. Poor Farms

|                  |         |      |       |          |      |        |
|------------------|---------|------|-------|----------|------|--------|
| Number of Farms  | 17      | 61   | 73    | 34       | 16   | 13     |
| Av. Work Units   | 157     | 304  | 496   | 678      | 852  | 1157   |
| Av. Labor Income | \$47.40 | \$45 | -\$46 | -\$95.50 | \$37 | -\$303 |

C. All Farms

|                  |      |       |       |       |       |       |
|------------------|------|-------|-------|-------|-------|-------|
| Number of Farms  | 19   | 101   | 132   | 72    | 41    | 30    |
| Av. Work Units   | 161  | 316   | 501   | 679   | 867   | 1165  |
| Av. Labor Income | \$87 | \$214 | \$263 | \$338 | \$496 | \$532 |

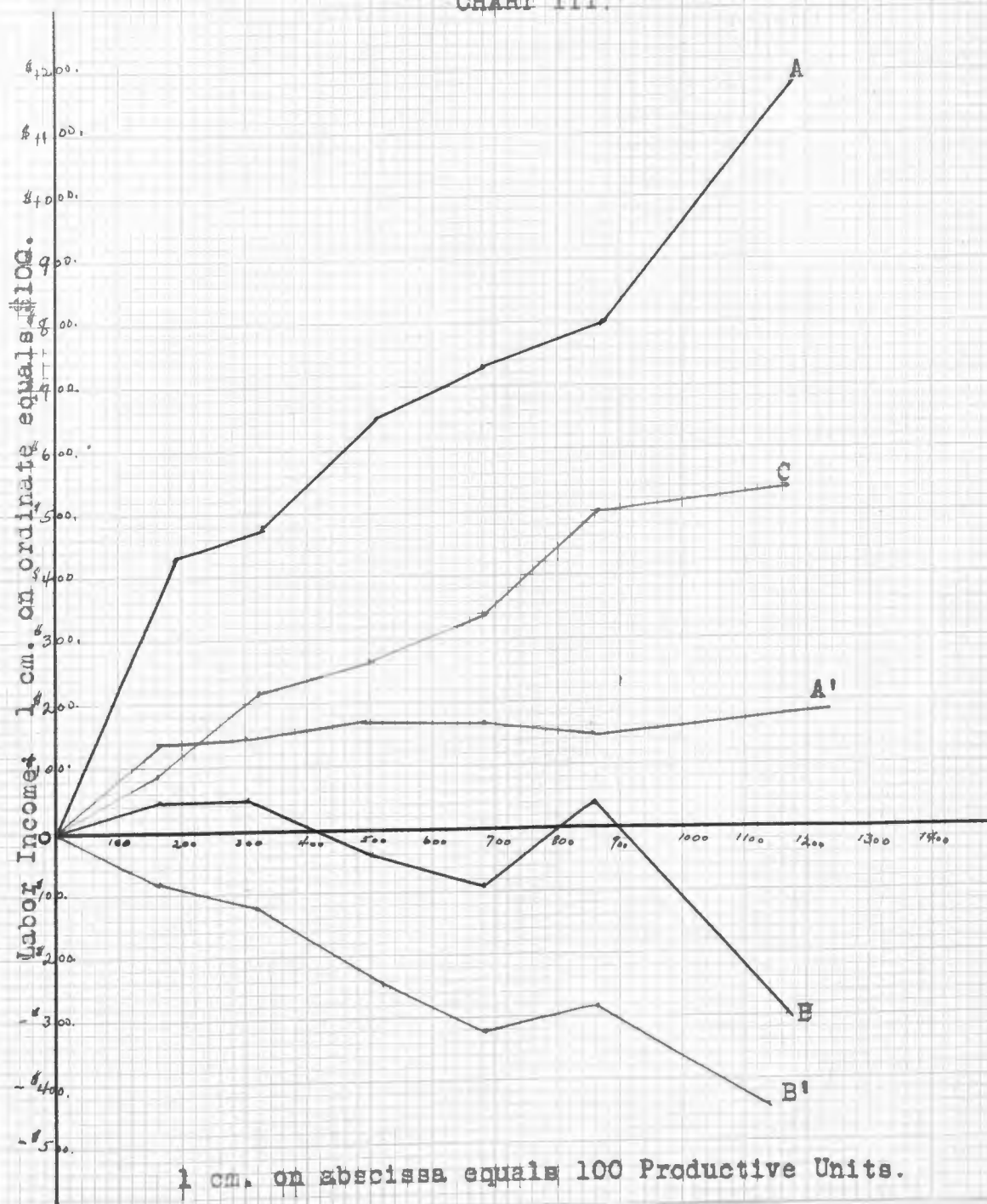
Of Poor Farms

|                                 |       |       |       |       |       |       |
|---------------------------------|-------|-------|-------|-------|-------|-------|
| A'. Number with Plus Labor Inc. | 10    | 40    | 36    | 16    | 12    | 3     |
| Average Number Work Units       | 158   | 299   | 483   | 678   | 848   | 1227  |
| Average Plus Labor Income       | \$140 | \$141 | \$164 | \$161 | \$145 | \$172 |

|                                  |       |        |        |        |        |        |
|----------------------------------|-------|--------|--------|--------|--------|--------|
| B'. Number with Minus Labor Inc. | 7     | 21     | 37     | 18     | 4      | 10     |
| Average Number Work Units        | 137   | 314    | 512    | 677    | 862    | 1136   |
| Average Minus Labor Income       | -\$85 | -\$136 | -\$250 | -\$324 | -\$389 | -\$446 |

Graphs of these farms are shown on the following chart:

CHART III.



RELATION OF PRODUCTIVE UNITS TO LABOR INCOME  
395 FARMS.

A - Good Farms; B - Poor Farms; C - All Farms;  
A' - Poor farms with plus labor income; B' -  
Poor Farms with minus labor income.



W. J. Spillman, Agriculturist in Office of Farm Management, U. S. Department of Agriculture, in an article on "Factors of Efficiency in Farming (13) says: "Not only does labor income increase with the amount of productive labor provided by the farm, but it increases at a considerably higher rate, so that the greater the amount of labor, the greater the profit per day's labor. This is to be explained presumably on the basis that the farmer who has the ability so to organize his farm as to give a maximum amount of productive labor, also has the ability to make that labor more effective than in the case of the average farmer".

TABLE 7

RELATION OF LABOR INCOME TO AMOUNT OF PRODUCTIVE LABOR (13).

| <u>No. of Farms</u> | <u>Labor</u> | <u>Labor per Year</u> | <u>Income per Day</u> |
|---------------------|--------------|-----------------------|-----------------------|
| 23                  | 278 days     | \$279.00              | \$1.00                |
| 28                  | 406 "        | 574.00                | 1.41                  |
| 13                  | 678 "        | 1,037.00              | 1.53                  |

The above figures are given by Mr. Spillman, taken from a survey in Chemung County, New York. However, care should be used in drawing conclusions from them for unless the farm and live stock would improve with extra labor, the labor income would be lowered rather than raised.

Note in Chart III, Curve B, that as the work units increased, the labor income decreased. This can be explained only on the ground that the more time put into a losing or non-paying enterprise, the greater the loss will be. In other words, Mr. Spillman's conclusions hold well unless the soil, or stock, or some other factor is poor, in which case the reverse of his conclusions will apply.

A study of these farms shows that the average productive hours per man annually is 2460; the average annual productive hours per horse is 800; the average work units per farm annually is 558. The good farms exceed this average in each case; the poor farms are below this average. Efficiency of labor, as shown by a use of more than the average number of hours per man or horse, or a large sized business, as shown by the use of more than the average work units, may mean a large labor income. But unless the live stock is productive and the soil and soil conditions favorable, the labor income may vary inversely as the labor expended.

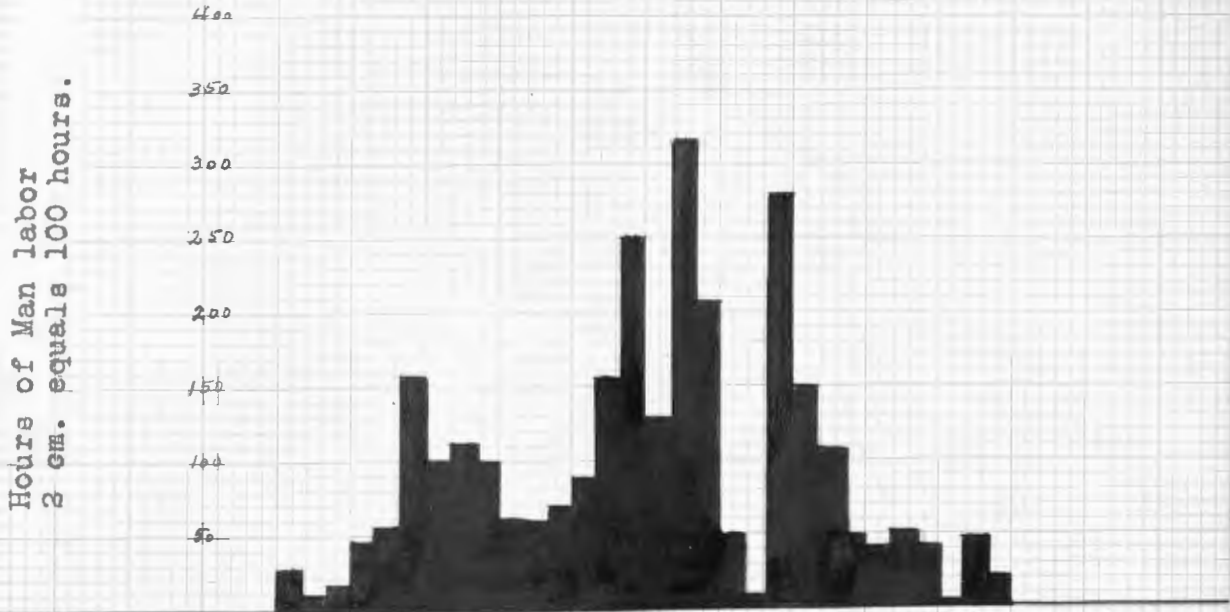
There is much said to-day about filling the "labor gaps" by providing steady work throughout the year. In order to illustrate the application of filling these "gaps", a study of the labor distribution on typical individual farms has been made. Chart IV shows the actual monthly labor hours as distributed upon field crops on a New England Dairy Farm (14). The crops grown were: corn 11.4 acres, peas and oats 14.2 acres, hay 33.6 acres, potatoes 1.7 acres, orchard 2.9 acres. The total is 63.8 acres. Note that the labor in March and 20 days in April is very low; then up to May 20th both man and horse labor is high; through June and early July the labor demand is relatively low; running highest in July and August. Note that from September 10th to 20th it is almost nil; high in the plowing and harvesting of September 20th - 30th; and then gradually declining.

Again, a North Dakota Grain Farm shows still poorer distribution of labor (14). (See Chart V) There can be little improvement in the labor distribution unless there is more diversity.

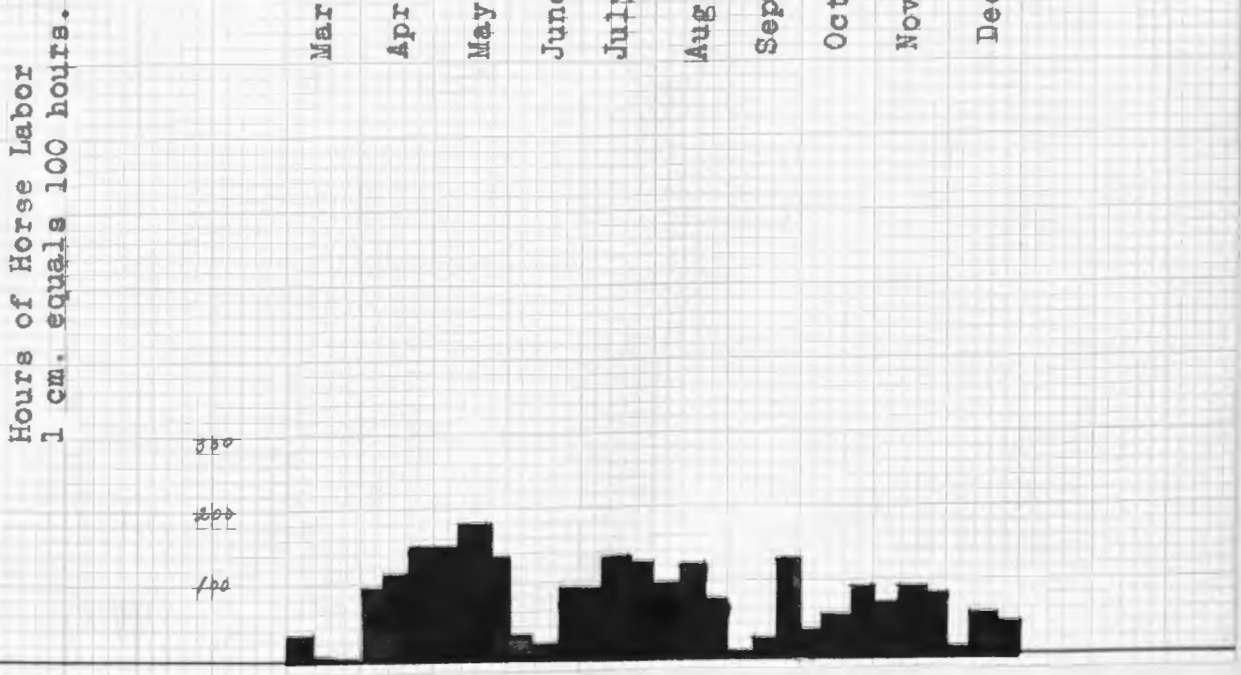


MAN LABOR

CHART IV.



HORSE LABOR



MONTHLY DISTRIBUTION OF LABOR ON FIELD CROPS OF A NEW ENGLAND DAIRY FARM (14).

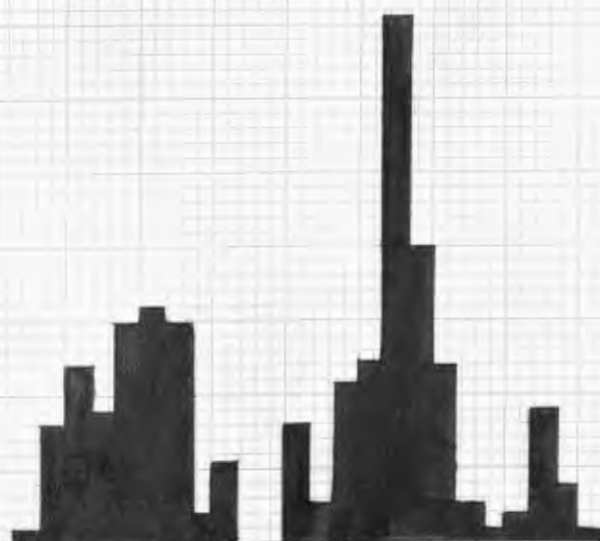
Crops grown: corn, 11.35 acres; peas and oats, 14.20 acres; hay 33.62 acres; potatoes 1.69 acres; orchard 2.91 acres.

Man Labor

CHART V.

Hours of Man Labor  
2 cm. equals 100 hours.

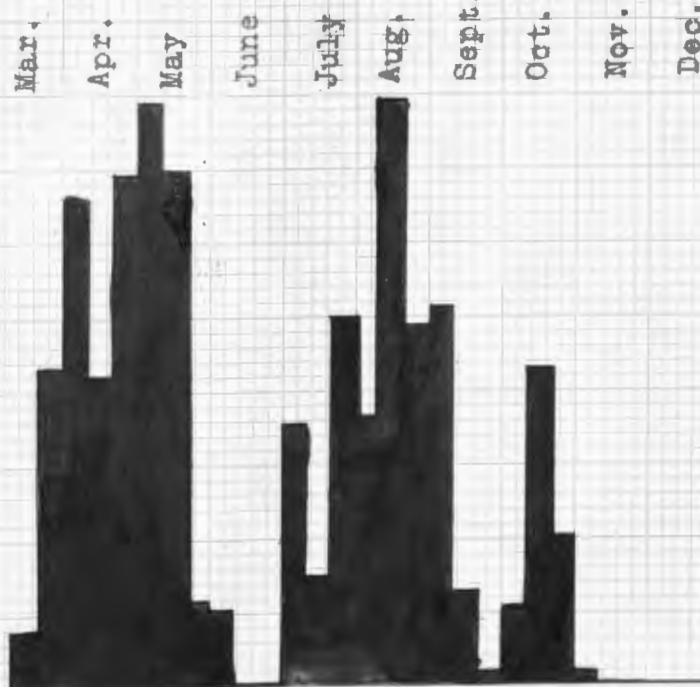
400  
350  
300  
250  
200  
150  
100  
50



Horse Labor

Hours of Horse Labor  
1 cm. equals 100 hours.

900  
800  
700  
600  
500  
400  
300  
200  
100



MONTHLY DISTRIBUTION ON A NORTH DAKOTA GRAIN FARM (14).

Crops grown: wheat, 280 acres; oats, 127 acres; barley, 60 acres; flax, 49 acres; hay, 20 acres; fallow, 52 acres, Total 588 acres.

The hourly labor distribution as shown by Chart V is for a total of 588 acres of crops, consisting of 280 acres of wheat, 127 acres of oats, 60 acres of barley, 49 acres of flax, 20 acres of hay, and 52 acres of fallow. Note the high April and August labor load and the following gaps in June and September. This indicates the frequent gaps in the labor schedule which occur on undiversified farms. Cultivated crops, such as corn and potatoes, would help fill the May and June labor gaps. Live stock would furnish winter work and demand but little extra summer labor.

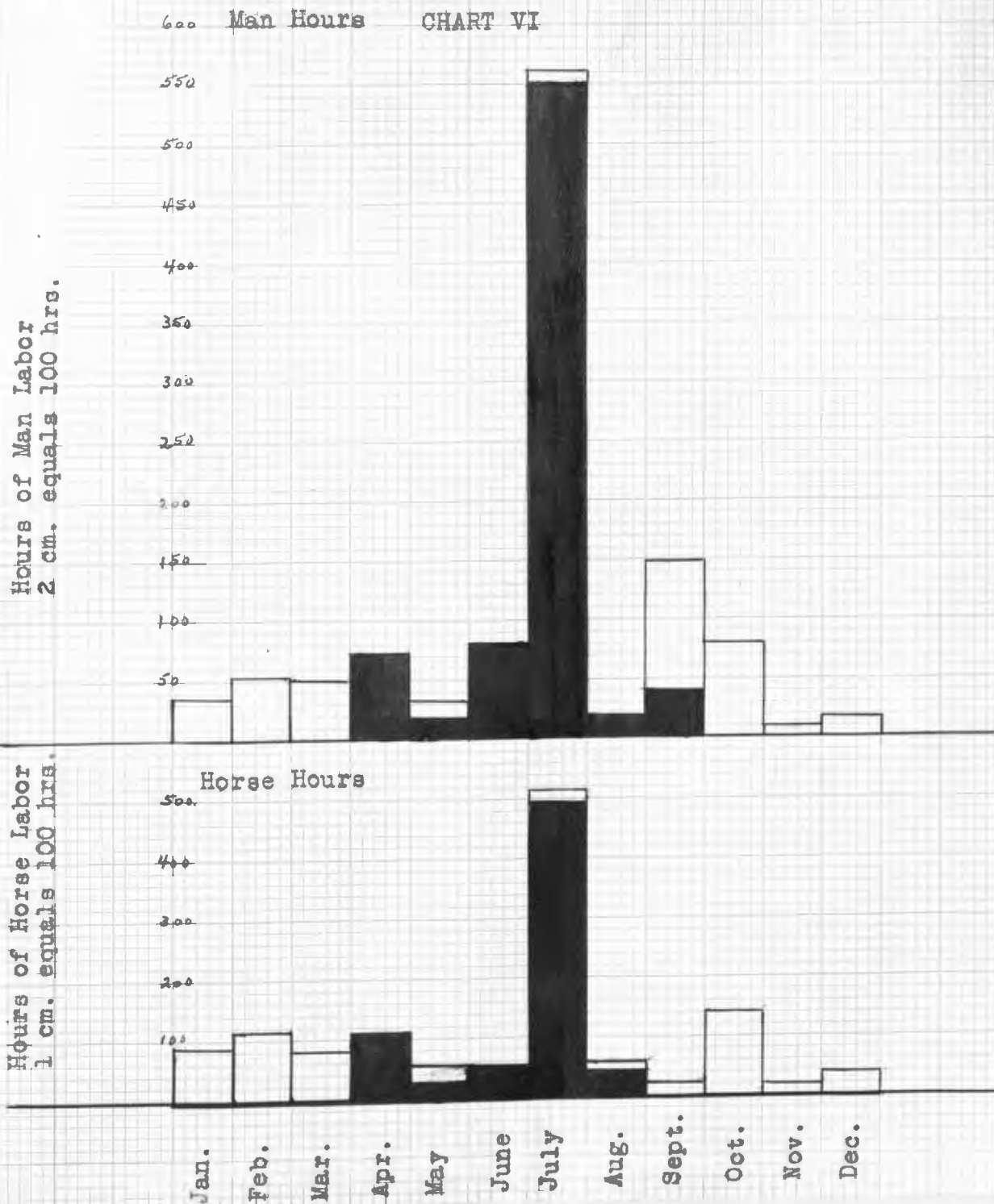
Chart VI shows the distribution of labor on 67 acres of Timothy hay (20). Note how poorly man and horse time is utilized in such a system and how the peak load is reached in July. The black area represents work fixed as to time, such as seeding, and haying, while white is for such operations as baling and marketing, not fixed as to time.

Maintaining live stock helps the labor distribution, as indicated in Table 8.

TABLE 8

DISTRIBUTION OF LABOR ON LIVE STOCK ON 92 NORTHFIELD,  
MINNESOTA FARMS OVER A PERIOD OF TEN YEARS (1902-1912) (18).

|                 | Jan   | Feb  | Mar   | Apr   | May   | June  | July  | Aug.  | Sept. | Oct.  | Nov.  | Dec.  |
|-----------------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Horses          | 6.8   | 6.9  | 6.8   | 6.8   | 6.8   | 6.8   | 6.8   | 6.9   | 6.8   | 6.7   | 6.8   | 6.7   |
| Cows            | 13.3  | 13.4 | 13.5  | 13.5  | 13.5  | 13.5  | 13.3  | 13.0  | 12.5  | 12.5  | 12.6  | 12.8  |
| Misc.<br>Cattle | 11.3  | 12.3 | 11.8  | 11.9  | 12.2  | 12.0  | 11.5  | 11.9  | 11.4  | 11.4  | 12.1  | 12.0  |
| Swine           | 10.2  | 9.0  | 8.3   | 10.0  | 14.3  | 19.2  | 18.8  | 18.6  | 19.8  | 18.2  | 18.3  | 13.1  |
| Poultry         | 109.3 | 90.0 | 88.0  | 107.5 | 88.0  | 88.0  | 97.0  | 94.0  | 114.0 | 76.0  | 73.0  | 110.6 |
| Sheep           | 8.0   | 6.4  | 7.5   | 9.3   | 9.7   | 10.1  | 9.7   | 10.9  | 10.2  | 9.3   | 8.6   | 8.6   |
|                 | 158.9 | 138. | 135.9 | 160.  | 145.5 | 149.6 | 157.1 | 155.3 | 174.7 | 134.1 | 129.4 | 163.8 |



DISTRIBUTION OF LABOR IN RAISING 67 ACRES OF TIMOTHY HAY..

Black is work fixed as to time, applying fertilizer, seeding, haying, etc. White is manuring, baling, marketing, etc.

ChartVII shows this relation graphically. It needs only a glance to show how live stock gives the steadiest employment of labor, - the summer requiring fewest hours even though a larger number of stock is usually maintained.

Now certain questions arise: Can a cropping system be devised that will permit a minimum amount of competition for labor during the active crop seasons? Should live stock be maintained to use this labor profitably during the inactive crop season?

Probably the best way to study these questions is to analyze the labor actually expended on a few typical farms (18).

A Central Minnesota farm, designated as Farm A, consists of 387 acres, of which 274 are tillable. This is probably one of the best types of general farms and is considered very well managed. The crops for 1914 consisted of:

|      |       |    |                   |
|------|-------|----|-------------------|
| 23.5 | acres | of | barley            |
| 43.6 | "     | "  | oats              |
| 52.5 | "     | "  | wheat             |
| 69.4 | "     | "  | corn              |
| 2.3  | "     | "  | potatoes          |
| 56.3 | "     | "  | hay (and hayseed) |

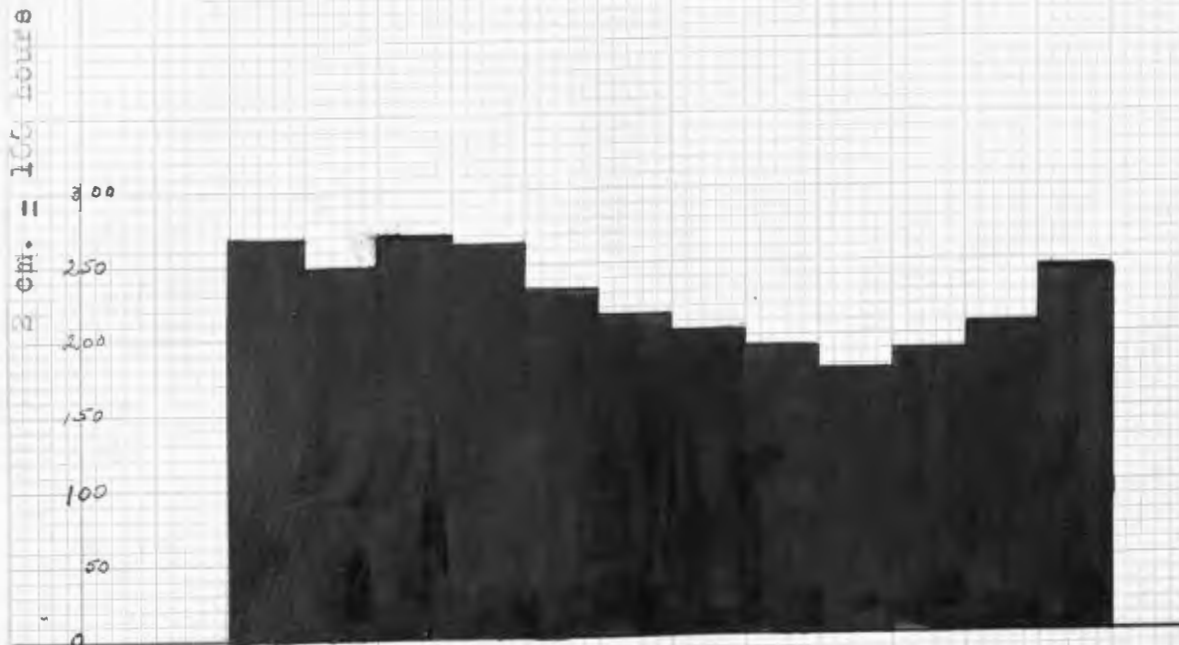
One man is kept the year around, there being no children of working age. Some extra labor is hired in the summer. The stock consists of 39.6 units, as follows:

|             |   |
|-------------|---|
| 8.44        | horses  |
| 9.00        | cattle (2 dairy cows and 7 beef cows)             |
| 10.12       | units of beef cattle (bought in the fall and fed) |
| 10.95       | units of hogs                                     |
| <u>1.11</u> | units of poultry                                  |



Man Labor

Chart VII.



MONTHLY DISTRIBUTION OF LABOR ON LIVE STOCK.

72 Northfield farms averaged for 10 years.  
 The farm group consists of: 6.77 horses, 13.3 cows, 11.3  
 miscellaneous cattle, 10.2 swine, 109.3 poultry, 8.0 sheep.

Table 9 shows the average hours worked per man per day and the total hours of the hired man per month.

TABLE 9

AVERAGE HOURS WORKED PER DAY AND TOTAL HOURS OF HIRED MAN PER MONTH.

|           | <u>Week Day</u> |           | <u>Sunday</u> |           | <u>Per Month</u> |
|-----------|-----------------|-----------|---------------|-----------|------------------|
|           | Owner           | Hired Man | Owner         | Hired Man | Hired Man        |
| April     | 9.2             | 11.2      | 1.5           | 3.6       | 303              |
| May       | 10.1            | 11.7      | 1.4           | 3.6       | 317              |
| June      | 9.1             | 11.8      | 1.7           | 3.2       | 318              |
| July      | 9.8             | 12.0      | 1.7           | 3.0       | 336              |
| August    | 10.2            | 12.3      | 1.8           | 2.9       | 335              |
| September | 9.0             | 10.9      | 1.6           | 2.8       | 288              |
| October   | 9.6             | 11.4      | 1.6           | 1.7       | 315              |
| November  | 9.1             | 10.7      | 2.1           | 1.8       | 284              |
| December  | 8.4             | 10.5      | 2.8           | -         | 284              |
| January   | 6.5             | -         | 4.1           | -         | -                |
| February  | 7.7             | 9.6       | 3.6           | 2.5       | 238              |
| March     | 8.3             | 10.4      | 2.0           | 3.1       | 293              |

Note that the labor is very steadily employed, with the exception of January.

It will be of interest to compare the hours of work per month on this farm with that of the average hired man through a number of years. Table 10 shows the average maximum and minimum hours of labor performed per hired man at Northfield and Halstad (1905 - 1912) (18).



TABLE 10

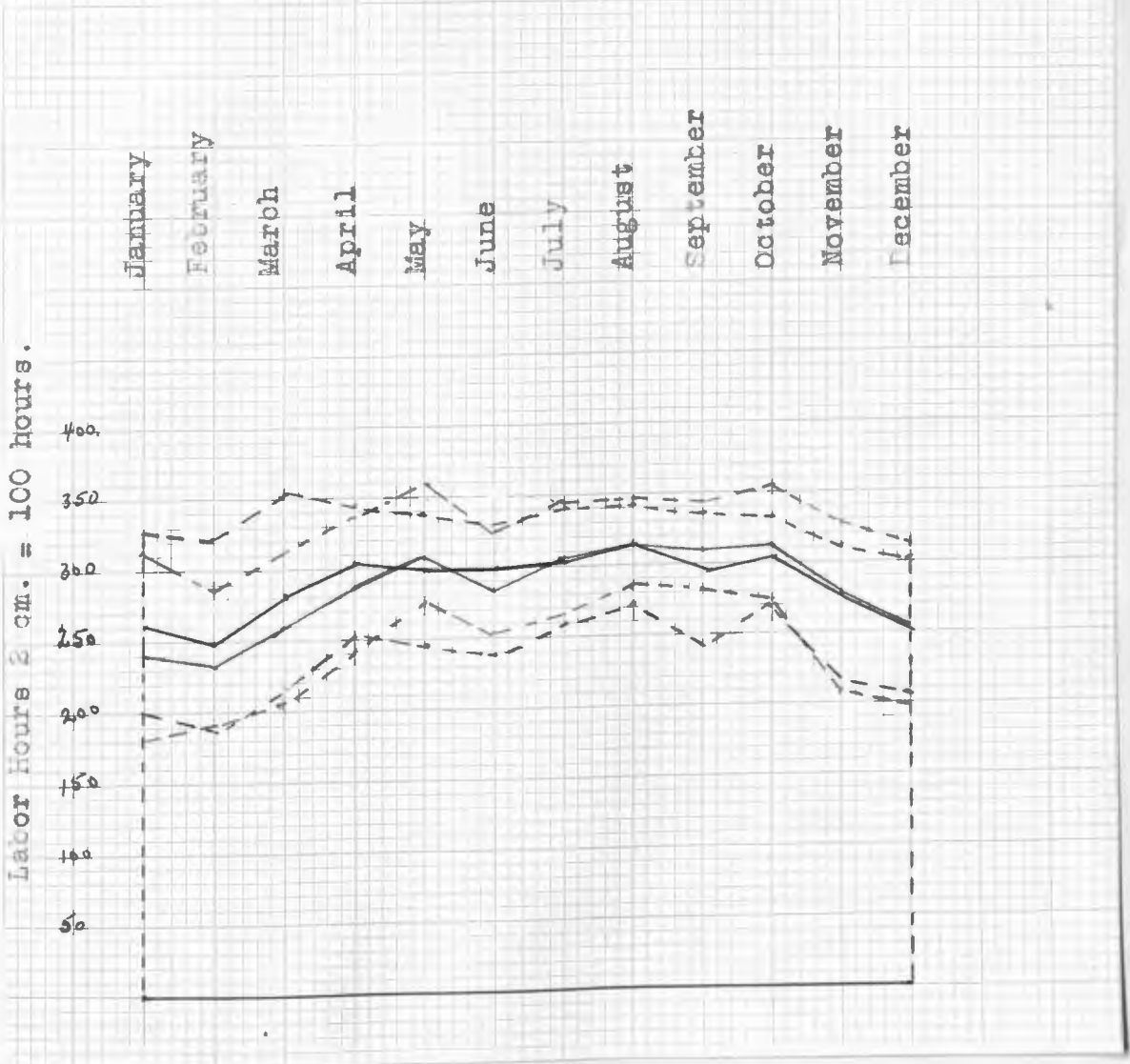
AVERAGE MAXIMUM AND MINIMUM HOURS OF LABOR PERFORMED MONTHLY  
PER HIRED MAN (1905 - 1912) (18).

|           | <u>Northfield</u>                    |                                     |                                     | <u>Halstad</u>                     |                                     |                                     |
|-----------|--------------------------------------|-------------------------------------|-------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|
|           | <u>Av. Hrs.:</u><br><u>per Man :</u> | <u>Max. Hrs.:</u><br><u>per Man</u> | <u>Min. Hrs.:</u><br><u>per Man</u> | <u>Av. Hrs.:</u><br><u>per Man</u> | <u>Max. Hrs.:</u><br><u>per Man</u> | <u>Min. Hrs.:</u><br><u>per Man</u> |
| January   | 263                                  | 326                                 | 201                                 | 243                                | 311                                 | 183                                 |
| February  | 252                                  | 325                                 | 190                                 | 237                                | 289                                 | 193                                 |
| March     | 283                                  | 354                                 | 219                                 | 260                                | 312                                 | 210                                 |
| April     | 307                                  | 346                                 | 256                                 | 290                                | 338                                 | 243                                 |
| May       | 300                                  | 340                                 | 247                                 | 309                                | 359                                 | 276                                 |
| June      | 299                                  | 330                                 | 241                                 | 288                                | 325                                 | 258                                 |
| July      | 305                                  | 344                                 | 263                                 | 307                                | 349                                 | 265                                 |
| August    | 316                                  | 343                                 | 273                                 | 315                                | 344                                 | 288                                 |
| September | 292                                  | 337                                 | 245                                 | 311                                | 345                                 | 285                                 |
| October   | 307                                  | 336                                 | 268                                 | 315                                | 356                                 | 275                                 |
| November  | 274                                  | 311                                 | 219                                 | 278                                | 329                                 | 219                                 |
| December  | 255                                  | 303                                 | 209                                 | 257                                | 314                                 | 201                                 |

Chart VIII shows the distribution of the labor of Table 10, while Chart IX compares the average hours of labor on Northfield and Halstad farms through a series of years with that of Farm A. Note that A's hired man worked more hours than the average hired man. This not only shows good management, but also good distribution of labor.

Table 11 shows the monthly hours of labor as employed on A's farm for one year.

CHART VIII.

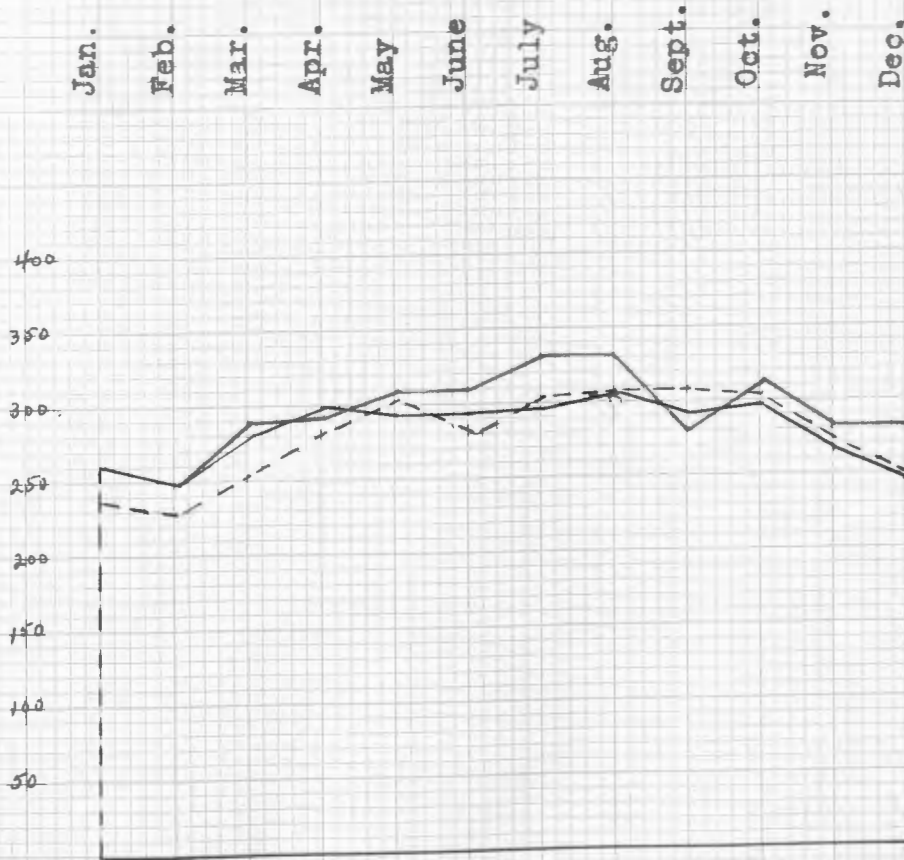


MAXIMUM AVERAGE AND MINIMUM HOURS OF LABOR  
PERFORMED MONTHLY PER HIRED MAN (1905-1912).

Red lines are for Halstad; black, for Northfield. Solid lines are the average. Dotted lines are maximum and minimum according as they are above or below the solid line.

CHART IX.

Labor Hours: 3 cm. equals 100 Labor Hours.



AVERAGE HOURS OF LABOR PERFORMED MONTHLY PER HIRED MAN AT NORTHFIELD AND HALSTAD, COMPARED WITH A'S HIRED MAN.

Black solid line is Northfield; dotted black line is Halstad; red line is A's hired man's labor hours.

TABLE XI

MONTHLY HOURS OF LABOR ON A'S FARM FOR YEAR 1914.

|           | Live Stock        |                  | :Maintenance :    |                  | Field             |                   | :Improvements:   |                 | Total              |                    |
|-----------|-------------------|------------------|-------------------|------------------|-------------------|-------------------|------------------|-----------------|--------------------|--------------------|
|           | Man<br>Hrs.       | Horse:<br>Hrs.:  | Man<br>Hrs.       | Horse<br>Hrs.    | Man<br>Hrs.       | Horse:<br>Hrs:    | Man<br>Hrs.      | Horse:<br>Hrs.: | Man<br>Hrs.        | Horse<br>Hrs.      |
| April     | 127               | 84               | 153 $\frac{1}{4}$ | 26               | 248               | 851               | 10 $\frac{1}{2}$ | 13              | 538 $\frac{3}{4}$  | 974                |
| May       | 118               | 59 $\frac{1}{2}$ | 78                | 38 $\frac{1}{2}$ | 343 $\frac{1}{2}$ | 1138              | 47 $\frac{1}{2}$ | 26              | 587                | 1252               |
| June      | 91 $\frac{3}{4}$  | 53               | 121 $\frac{3}{4}$ | 20               | 318 $\frac{1}{2}$ | 735               | 84 $\frac{1}{4}$ | 10              | 616 $\frac{1}{4}$  | 818                |
| July      | 75 $\frac{3}{4}$  | 39               | 113               | 15               | 536 $\frac{1}{2}$ | 795 $\frac{3}{4}$ | -                | -               | 725 $\frac{1}{4}$  | 849 $\frac{3}{4}$  |
| August    | 91                | 23 $\frac{1}{2}$ | 62 $\frac{1}{4}$  | 8                | 685 $\frac{1}{4}$ | 1141              | 90               | 26              | 929                | 1198 $\frac{1}{2}$ |
| September | 79 $\frac{1}{2}$  | 37 $\frac{1}{2}$ | 67                | 27               | 351               | 737               | 36 $\frac{1}{4}$ | 64              | 534                | 865 $\frac{1}{2}$  |
| October   | 102 $\frac{1}{2}$ | 72               | 69                | 28               | 371               | 706               | 51               | -               | 593 $\frac{1}{2}$  | 808                |
| November  | 105 $\frac{1}{2}$ | 72               | 75 $\frac{3}{4}$  | 21 $\frac{1}{2}$ | 337 $\frac{3}{4}$ | 804 $\frac{1}{2}$ | 16 $\frac{1}{2}$ | 10              | 535 $\frac{1}{2}$  | 908                |
| December  | 112               | 64 $\frac{1}{2}$ | 92 $\frac{3}{4}$  | 70 $\frac{1}{2}$ | 59                | 131 $\frac{1}{2}$ | 46 $\frac{1}{2}$ | 76              | 310 $\frac{1}{4}$  | 342 $\frac{1}{2}$  |
| January   | 126 $\frac{1}{2}$ | 98               | 58                | 1 $\frac{1}{2}$  | 13                | 44                | 19 $\frac{1}{2}$ | 39              | 217                | 182 $\frac{1}{2}$  |
| February  | 169 $\frac{3}{4}$ | 79               | 119 $\frac{1}{2}$ | 81 $\frac{1}{2}$ | 19 $\frac{1}{2}$  | 36                | 81 $\frac{1}{2}$ | 152             | 390 $\frac{1}{4}$  | 348 $\frac{1}{2}$  |
| March     | 194               | 161              | 188               | 57 $\frac{1}{4}$ | 133 $\frac{1}{4}$ | 201 $\frac{1}{2}$ | 12 $\frac{1}{2}$ | 18              | 527 $\frac{3}{4}$  | 437 $\frac{3}{4}$  |
| Totals    | 1394              | 843              | 1198              | 395              | 3483              | 7321              | 496              | 434             | 6504 $\frac{1}{2}$ | 8983               |

It is easily seen that this farmer has arranged a well distributed labor system. In the fall and winter, beef stock and hogs are fed, while the summer time is devoted largely to crops. The only extra labor employed, outside of one regular man the year around, was as follows:

|           |                  |       |                      |
|-----------|------------------|-------|----------------------|
| January   | 11               | hours |                      |
| February  | 36               | "     |                      |
| March     | }                | 0     | "                    |
| April     |                  |       |                      |
| May       |                  |       |                      |
| June      |                  |       |                      |
| July      | 55               | "     |                      |
| August    | 119              | "     |                      |
| September | 319              | "     |                      |
| October   | 102              | "     |                      |
| November  | 70               | "     |                      |
| December  | 127              | "     |                      |
|           | 60 $\frac{1}{2}$ | "     | or Total of 582 hrs. |

This is a small amount of outside labor. A glance at the hours on field crops, live stock, maintenance and permanent improvements will show some interesting relations. Chart X shows man hours on crops; Chart XI shows horse hours on crops; Chart XII shows man and horse hours on live stock; Chart XIII shows man and horse hours on maintenance; Chart XIV shows man and horse hours on permanent improvements and a few hours of outside labor; Chart XV shows the total man hours; Chart XVI the total horse hours.

Note that there are few wide labor gaps on this farm. The peak load for man hours comes in August. January, February, and December could probably be better filled, especially with horse labor. However, if any vacations are to be allowed, they can best be taken at this time. Permanent improvements should be reduced to a minimum in the summer months, especially July and August.

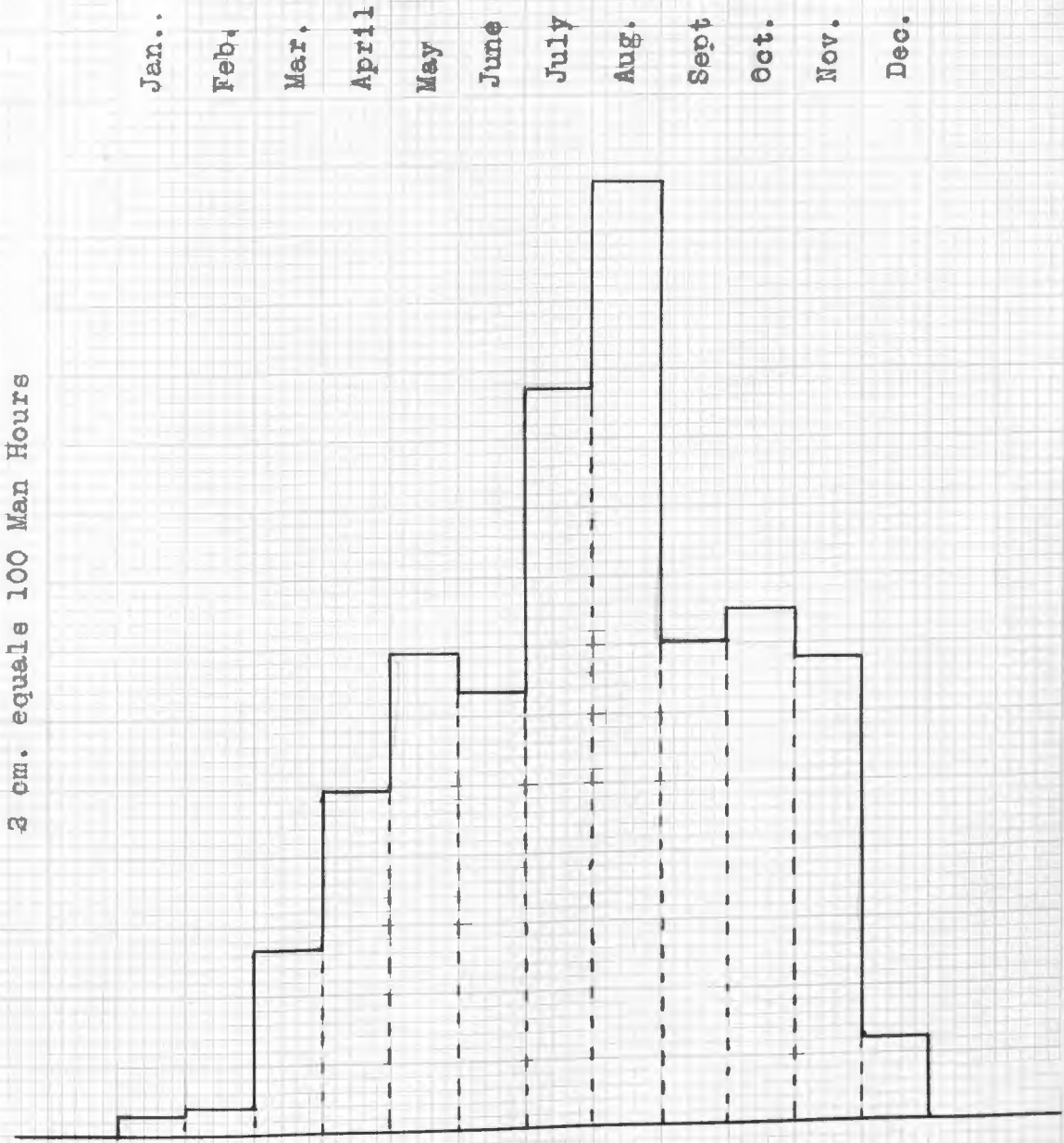
The only place for particular improvements in the labor distribution on this farm in the cropping system would be to cut down the grain area and increase the cultivated crop area. Cutting down the grain area by 23 acres would reduce the early May horse labor load, and substituting 10 acres of corn and 13 acres of potatoes for this would raise the June (planting) and September and October hours, without increasing the August load. These are paying cash crops.

Charts XVII and XVIII show the change this would make in the total labor curve. Note this throws the full man load over to May and holds steadily through August. September is lower but November is higher. Note that the horse labor curve is slightly



CHART X

2 cm. equals 100 Man Hours



MONTHLY DISTRIBUTION OF MAN LABOR ON CROPS - A'S FARM 1914.

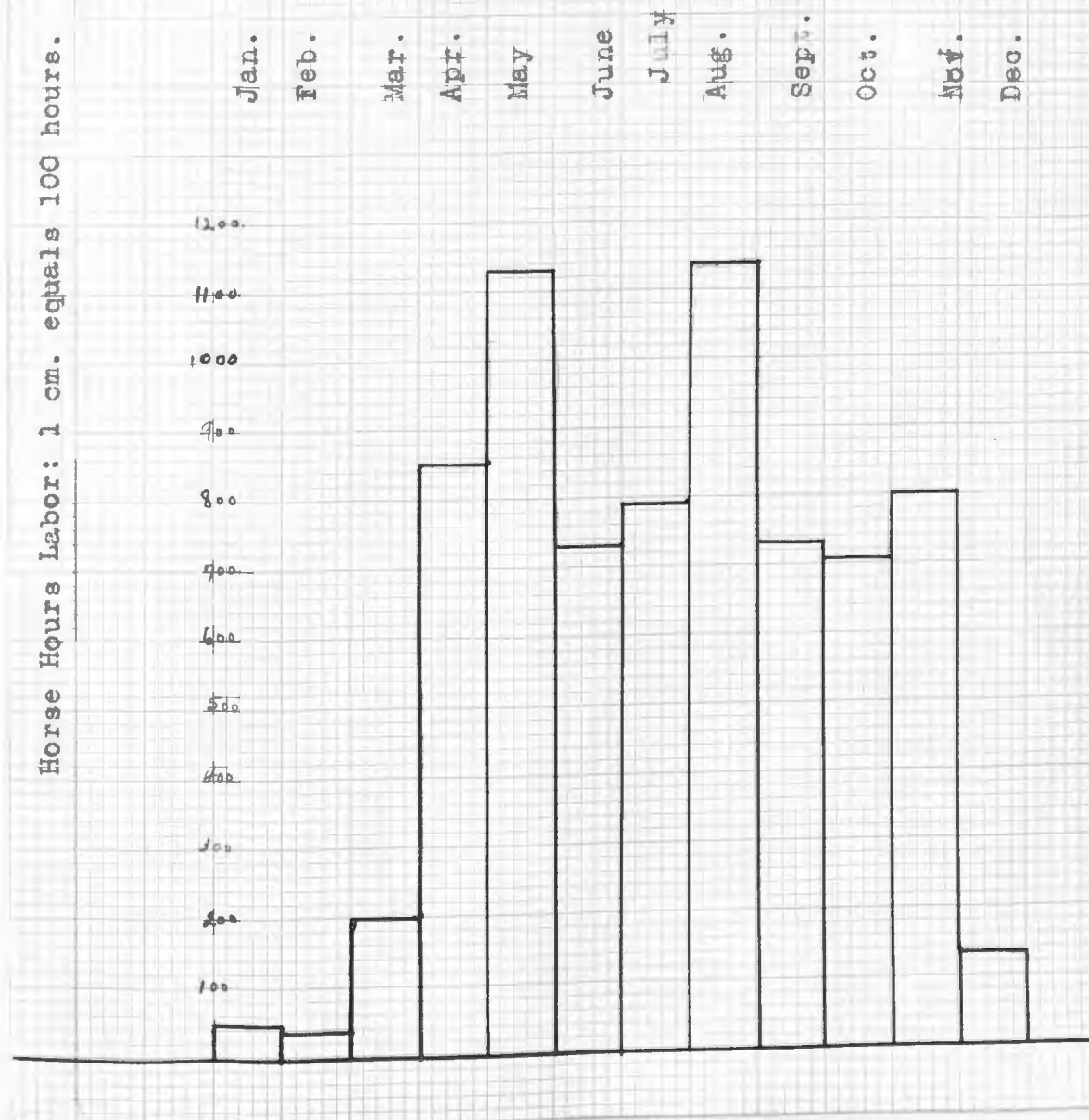
Crops grown: 23.5 acres of barley; 43.6 acres of oats; 52.5 acres of wheat; 69.4 acres of corn; 3.3 acres of potatoes; 56.3 acres of hay and hayseed.



CHART XI

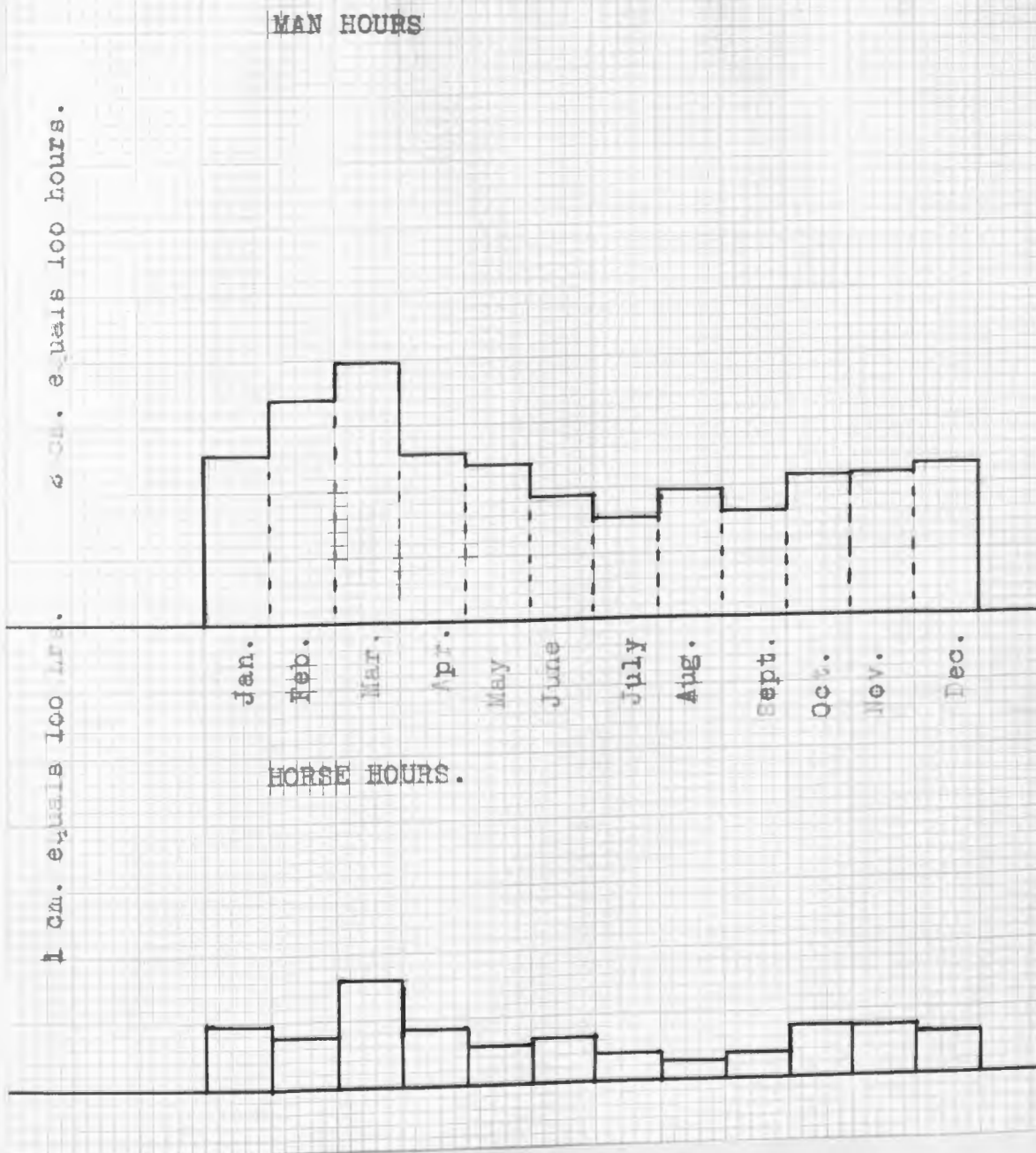
HORSE HOURS.

Horse Hours Labor: 1 cm. equals 100 hours.



MONTHLY DISTRIBUTION OF HORSE LABOR ON FIELD CROPS - A'S FARM  
 Crops grown: 23.5 acres barley; 43.6 acres oats; 52.5 acres wheat; 69.4 acres corn; 2.3 acres potatoes; 56.3 acres hay and hayseed.

CHART XII

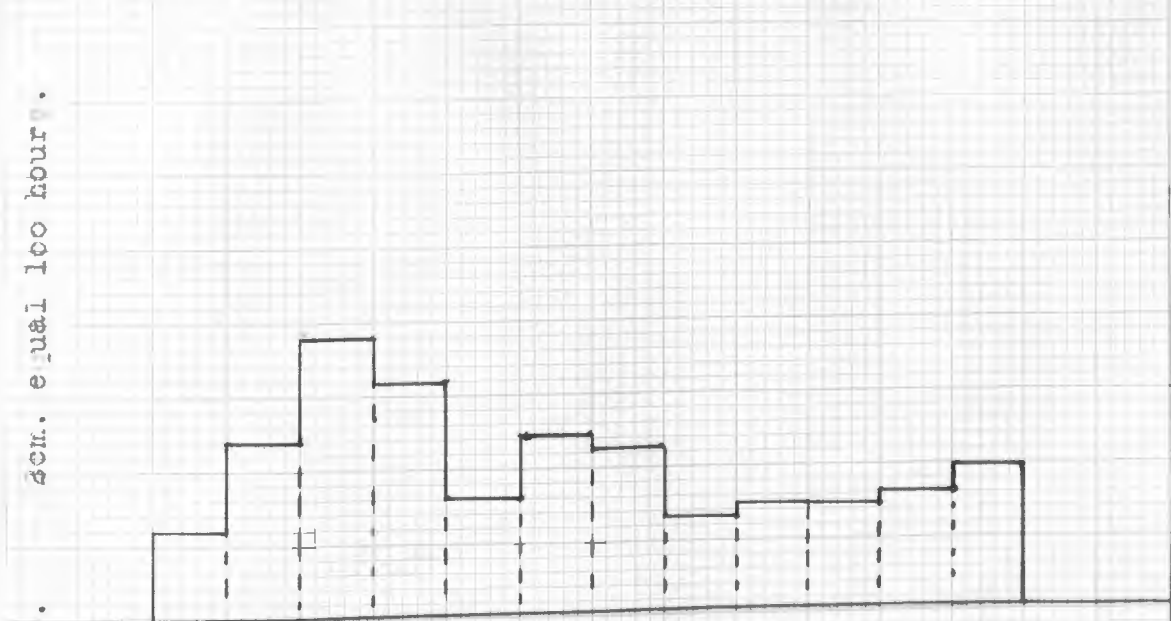


MONTHLY DISTRIBUTION OF LABOR ON LIVE STOCK -  
A'S FARM 1914.

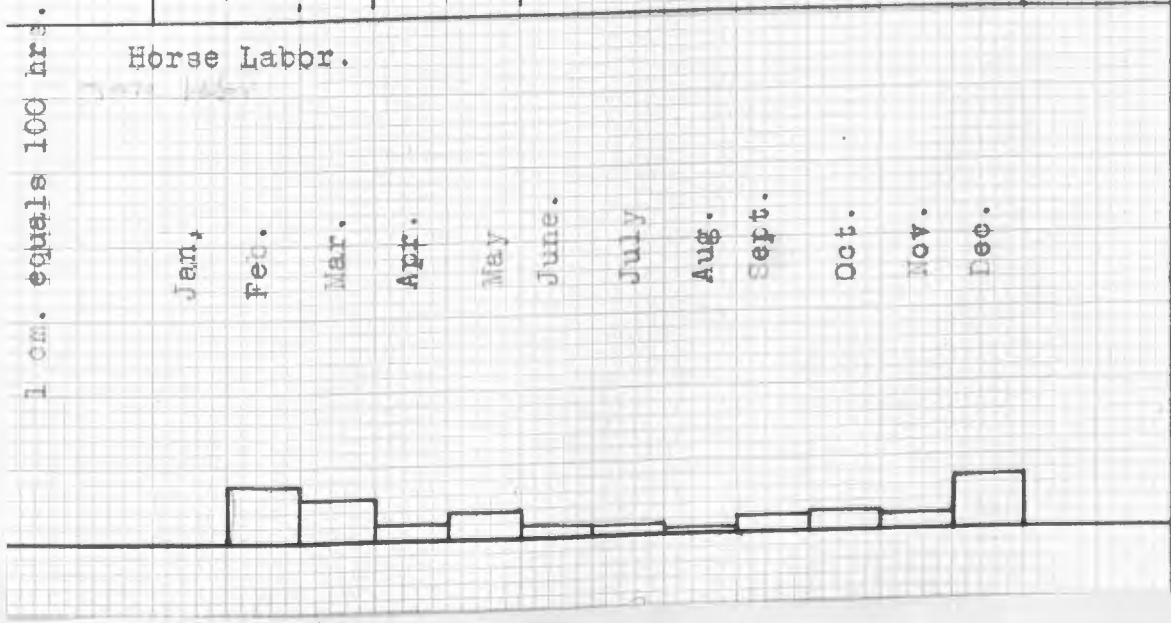
Dairy and Beef Cows 9 units; Steers 10.12 units;  
Hogs 10.95 units; Poultry 1.11 units -- Total  
31.62 units.

CHART VIII

Man Labor.

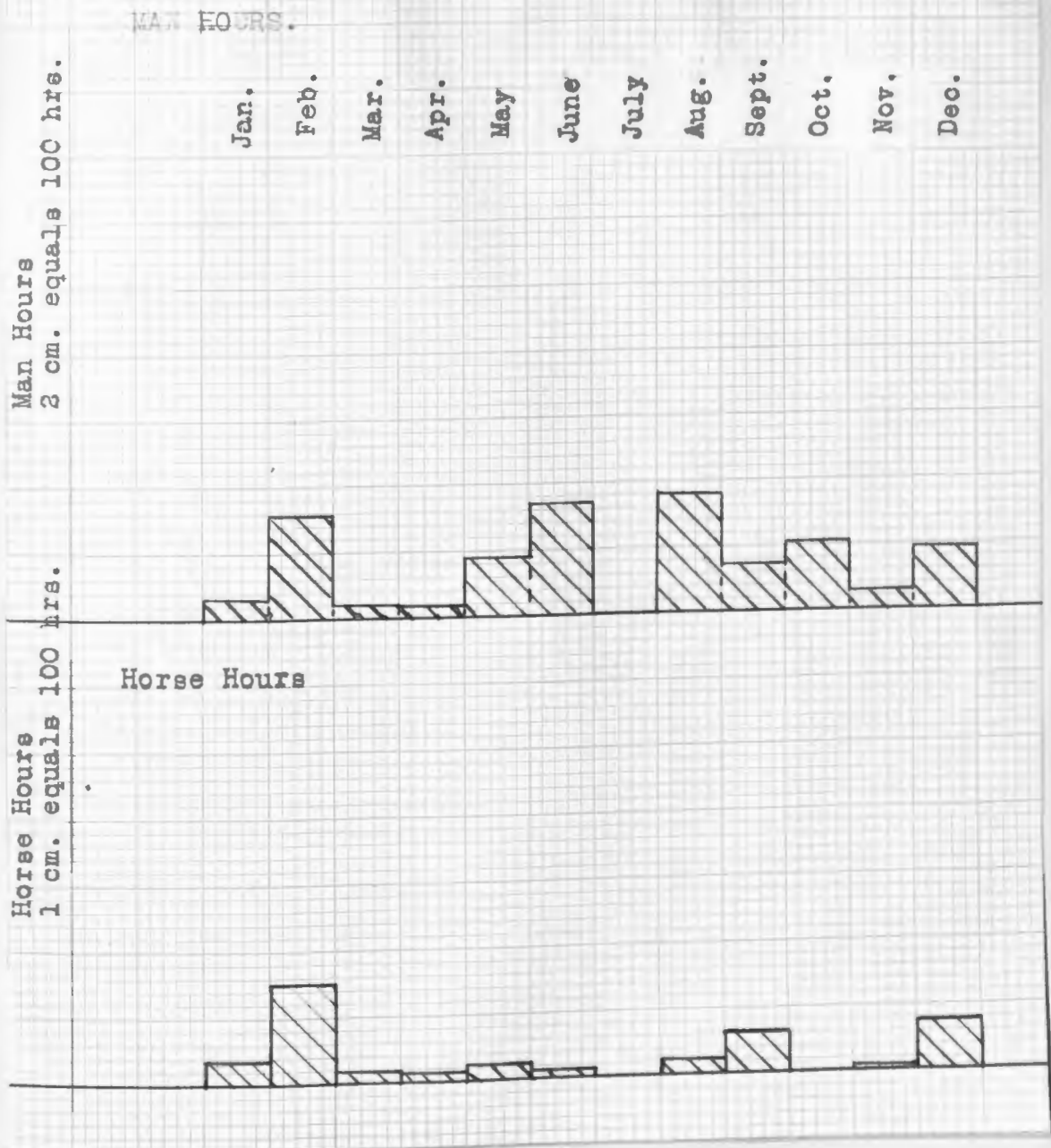


Horse Labor.

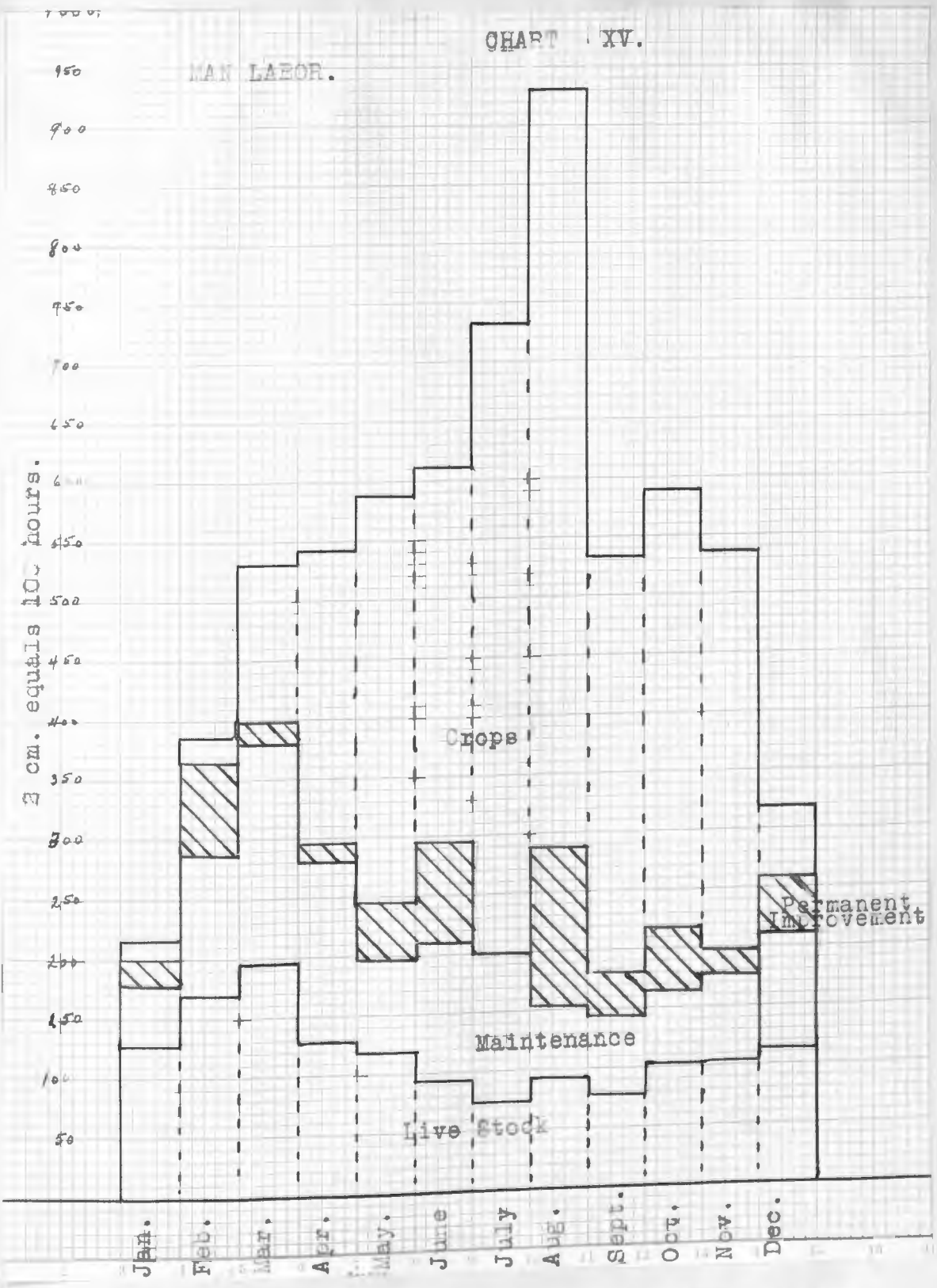


HOURS OF LABOR EXPENDED FOR MAINTENANCE (INCLUDING WORK HORSES) ON A'S FARM - 1914.

CHART XIV



MONTHLY DISTRIBUTION OF LABOR ON PERMANENT IMPROVEMENTS,  
A'S FARM - 1914.

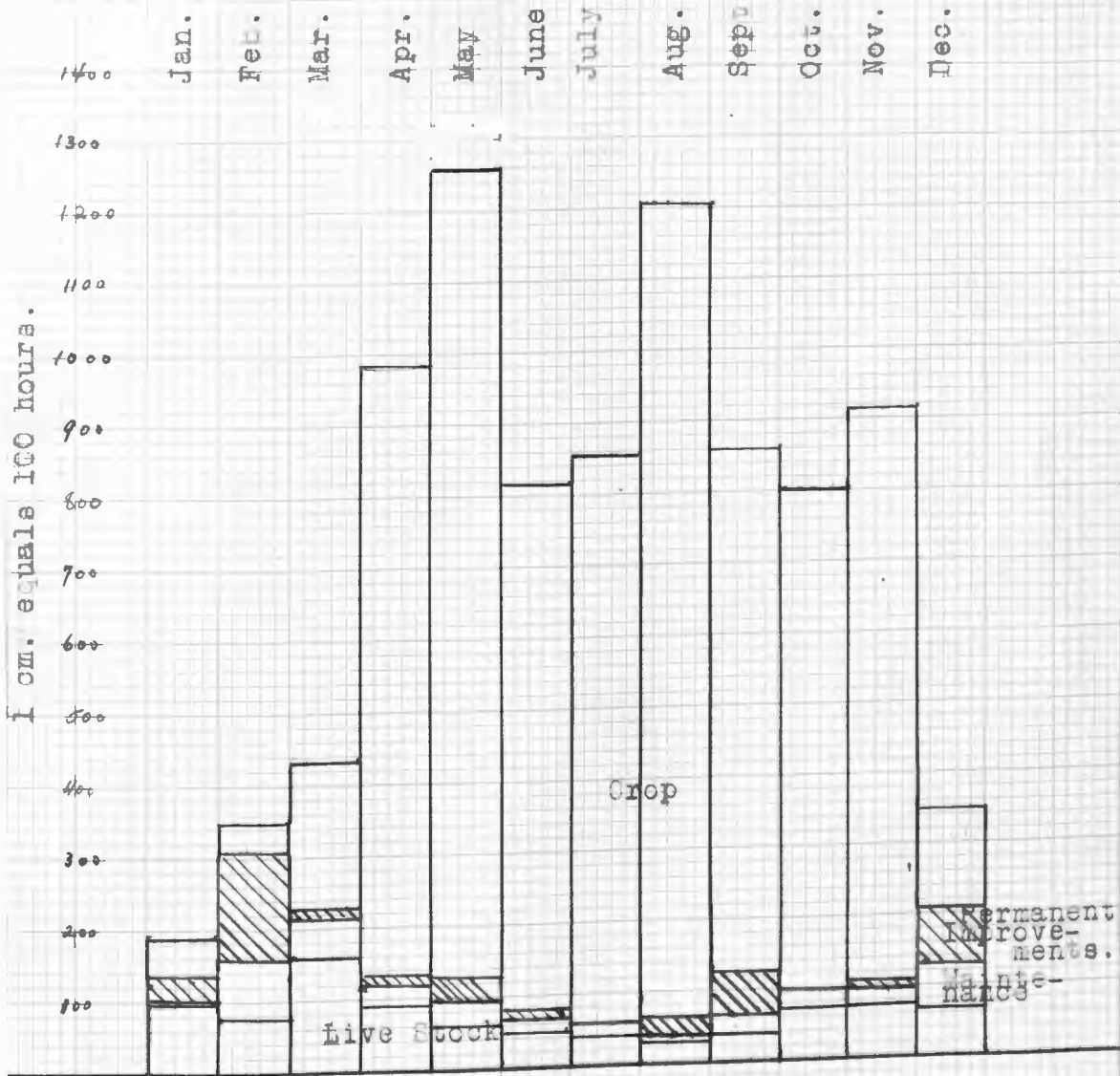


MONTHLY DISTRIBUTION OF MAN LABOR ON A'S FARM - 1914.



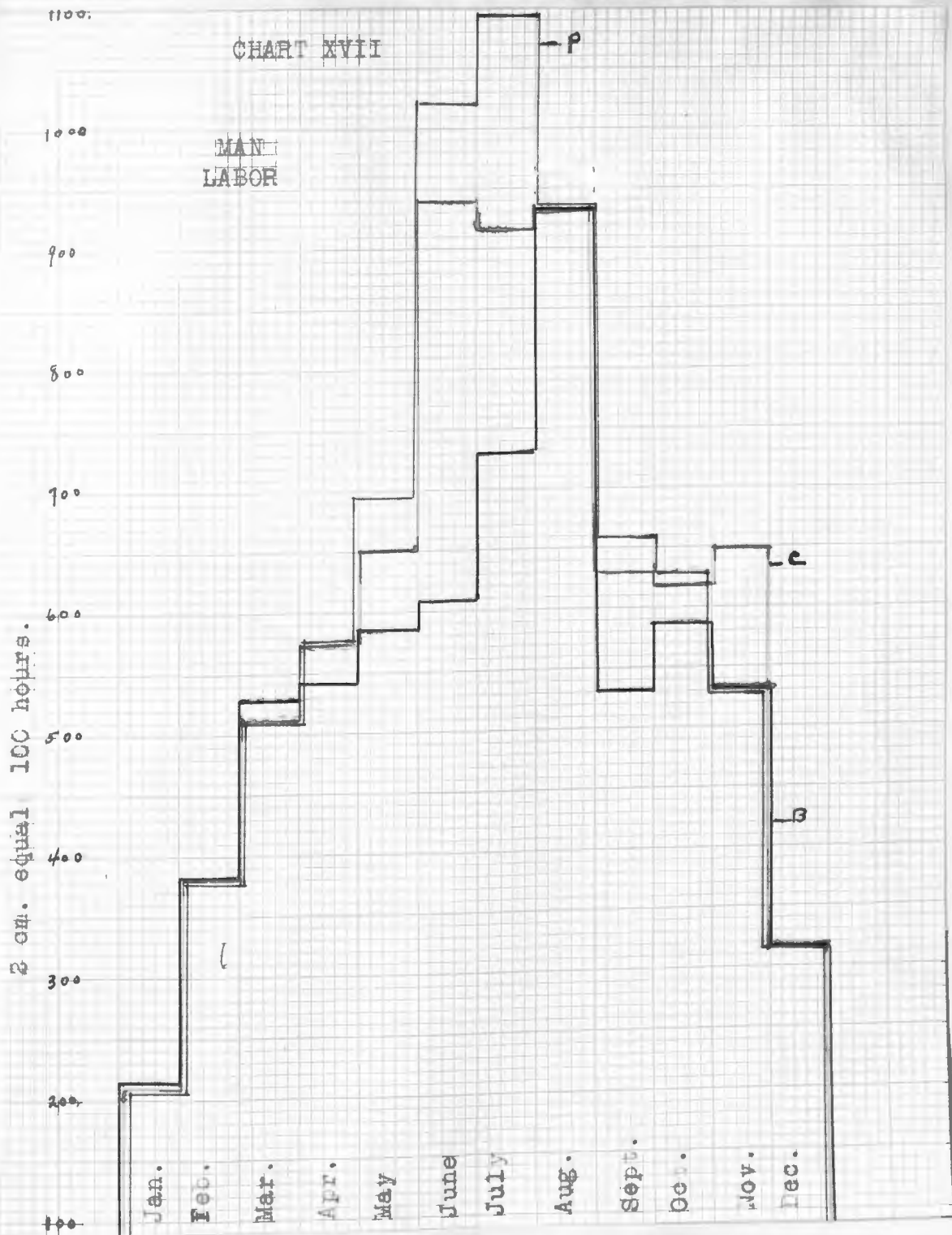
CHART XVI

Horse Labor Hours.



MONTHLY DISTRIBUTION OF HORSE LABOR ON A'S FARM - 1914.

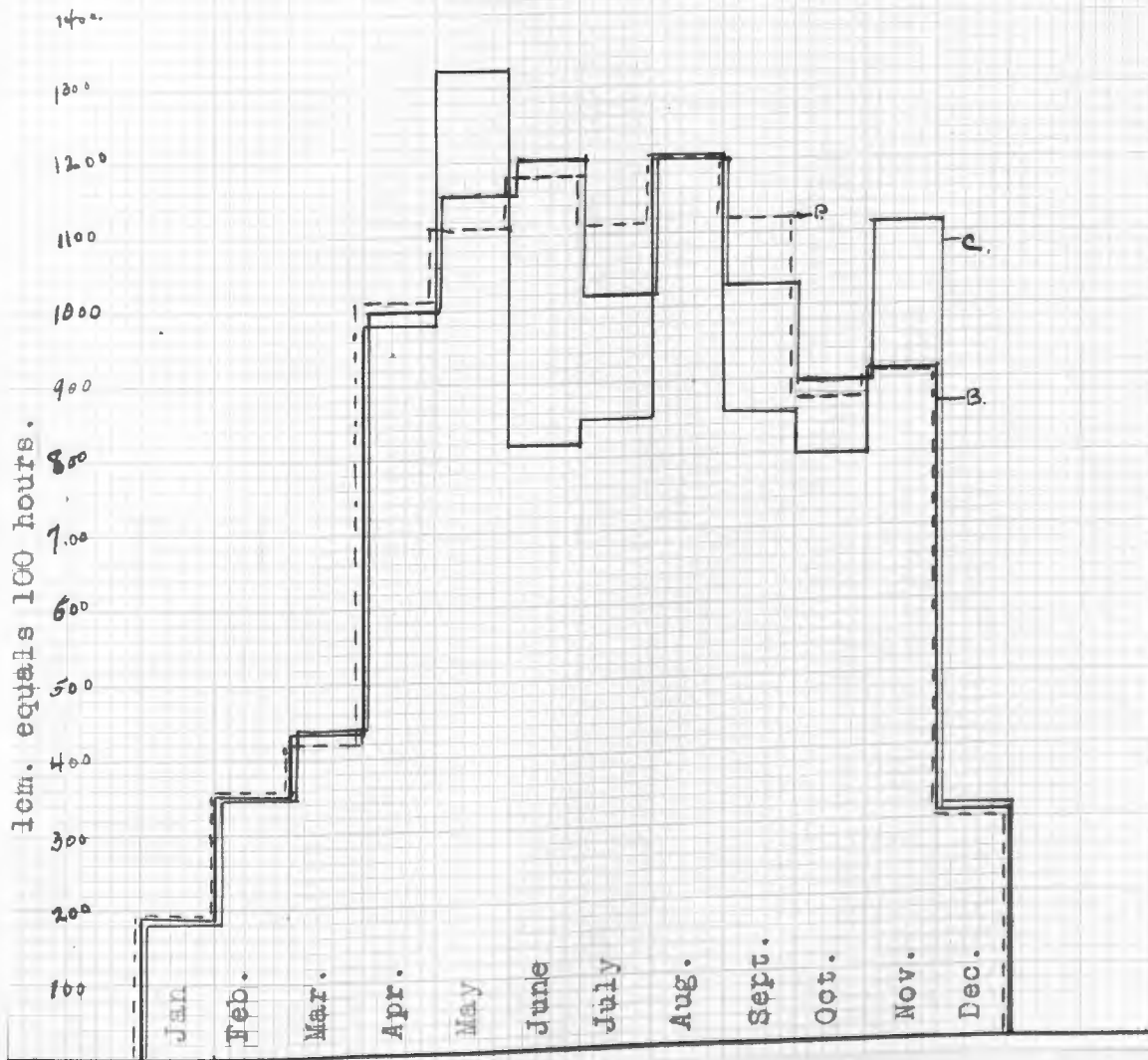




MONTHLY DISTRIBUTION OF MAN LABOR ON A'S FARM.  
 Area enclosed by black line B represents hours of labor as now employed.  
 Area enclosed by red line P represents hours of labor on 23.5 acres of potatoes in place of 23.5 acres of barley.  
 Area enclosed by green line C represents hours of labor on 13.5 acres of potatoes, and 10 acres of field corn, in place of 23.5 acres of barley.

CHART XVIII.

HORSE HOURS.



MONTHLY DISTRIBUTION OF HORSE LABOR ON A'S FARM.

Area enclosed by black line B represents hours of labor as now employed.

Area enclosed by dotted red line P represents hours of labor with 23.5 acres of potatoes in place of 23.5 acres of barley.

Area enclosed by red line C represents hours of labor with 13.5 acres of potatoes and 10 acres of field corn in place of 23.5 acres of barley.

lowered in May (when before it was high), and raised in June and July, also in September, October and November. The August load is not increased.

A table prepared by the Minnesota Cost Accounting Section shows the distribution of farm labor on crops, live stock, work horses, and miscellaneous at Northfield, Marshall and Halstad.

TABLE 12

| <u>Kind of Labor</u>             | <u>Northfield</u> |                | <u>Marshall</u> |                | <u>Halstad</u> |                |
|----------------------------------|-------------------|----------------|-----------------|----------------|----------------|----------------|
|                                  | %Man<br>Hrs.      | %Horse<br>Hrs. | %Man<br>Hrs.    | %Horse<br>Hrs. | %Man<br>Hrs.   | %Horse<br>Hrs. |
| Crop                             | 36.4              | 75.8           | 44.3            | 79.9           | 39.7           | 83.7           |
| Prod. Live<br>Stock              | 37.2              | 6.8            | 25.3            | 5.5            | 27.8           | 4.0            |
| Work Horses }<br>Miscellaneous } | 36.4              | 17.4           | 30.4            | 14.6           | 32.5           | 12.3           |
| Live Stock<br>and Crops          | 73.6              | 82.6           | 69.6            | 85.4           | 67.5           | 87.7           |

On A's farm, the percentage of hours given to maintenance, permanent improvements, live stock and crops, is as follows:

FARM A

|   | % Man Hours | % Horse Hours |
|---|-------------|---------------|
| Crops   | 53.1        | 81.5          |
| Productive Live Stock                                     | 21.2        | 9.3           |
| Maintenance and Permanent<br>Improvements (Miscellaneous) | 25.7        | 9.2           |
| Live Stock and Crops (Productive)                         | 74.3        | 90.8          |

Note that A Has a higher percentage of hours in crops than the average farmer, but a lower percentage of hours on stock. For every 100 hours of man labor expended on the farm, buildings, roads, and all farm work, 74.3 hours goes into productive work,

and for every 100 hours of horse labor expended, 90.8 hours go into productive channels (live stock or crops).

As compared with a pure grain farm (See Chart V of a North Dakota Grain Farm), A's farm labor is well distributed, and as would be expected a fair labor income was earned. The farm income was \$2,618.76. The interest on investment \$1,623.19. This leaves a labor income of \$996.57.

A Cokato farm, operated by two brothers, is designated as Farm B. This farm consists of 137 acres on which the following crops were grown: oats, 20.5 acres; wheat 8.8 acres; barley 16.3 acres; potatoes 8 acres; hay 23.2 acres; flax 5.6 acres; corn 7.1 acres; pasture 44 acres; orchard 1.8 acres. The stock units are as follows:

|             | <u>Number</u> | <u>Units</u> |
|-------------|---------------|--------------|
| Cows        | 13            | 13           |
| Work Horses | 4             | 4            |
| Steer       | 1             | 1            |
| Calves      | 4             | 2            |
| Heifers     | 7             | 3.5          |
| Brood Sows  | 8             | 1.6          |
| Pigs        | 7             | .7           |
| Poultry     | 50            | .5           |
| Total       |               | <u>26.3</u>  |

Table 13 shows the monthly distribution of labor on this farm. Chart XIX shows the hours for man labor, and Chart XX shows the same for horse labor.

TABLE 13

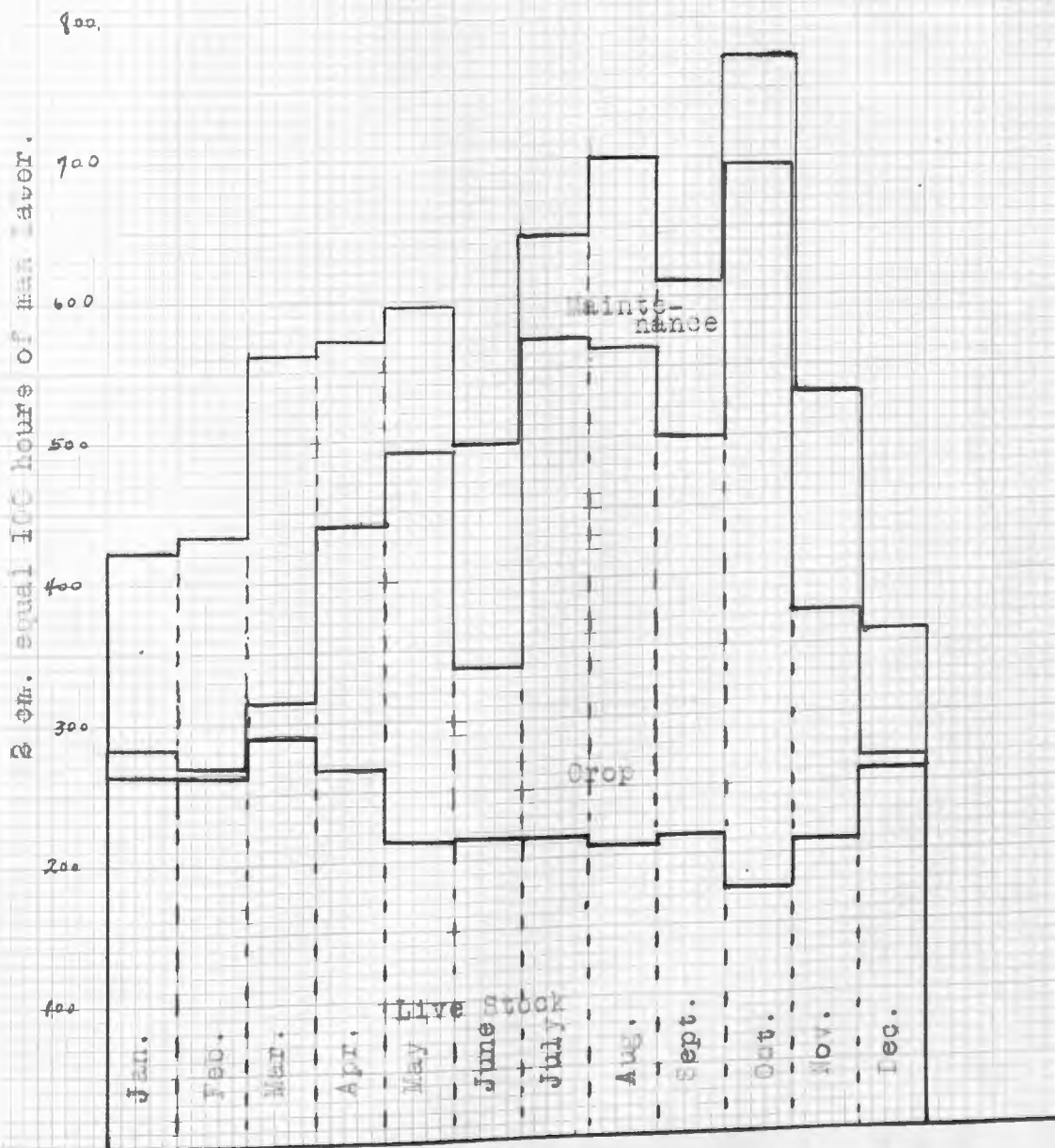
MONTHLY DISTRIBUTION OF LABOR ON FARM B.

|               | <u>Live Stock</u>  |                      | <u>Crop</u>        |                      | <u>Maintenance and Miscellaneous</u> |                      |                    | <u>Total</u>         |  |
|---------------|--------------------|----------------------|--------------------|----------------------|--------------------------------------|----------------------|--------------------|----------------------|--|
|               | <u>Man</u><br>Hrs. | <u>Horse</u><br>Hrs. | <u>Man</u><br>Hrs. | <u>Horse</u><br>Hrs. | <u>Man</u><br>Hrs.                   | <u>Horse</u><br>Hrs. | <u>Man</u><br>Hrs. | <u>Horse</u><br>Hrs. |  |
| April         | 265½               | 49½                  | 174½               | 317½                 | 133                                  | 67                   | 571½               | 434½                 |  |
| May           | 213                | 29½                  | 277                | 364                  | 102                                  | 37                   | 592                | 430                  |  |
| June          | 213½               | 23½                  | 122                | 193                  | 160                                  | 100                  | 496                | 315½                 |  |
| July          | 213                | 27                   | 356½               | 407                  | 74                                   | 37                   | 643                | 471                  |  |
| August        | 206                | 18½                  | 357                | 599                  | 131                                  | 60                   | 693½               | 688½                 |  |
| September     | 209½               | 21½                  | 289                | 429                  | 110                                  | 16                   | 609½               | 466½                 |  |
| October       | 178                | 5                    | 516                | 748                  | 76                                   | 8                    | 770                | 761                  |  |
| November      | 206½               | 26                   | 168                | 284                  | 153                                  | 45                   | 528                | 355                  |  |
| December      | 257                | 46                   | 4                  | 31                   | 90                                   | 44                   | 351                | 121                  |  |
| January       | 263½               | 29                   | 14                 | 4                    | 146                                  | 30                   | 425                | 63                   |  |
| February      | 262½               | 45                   | 5                  | -                    | 164                                  | 42                   | 431½               | 88                   |  |
| March         | 289                | 34                   | 24                 | 24                   | 254                                  | 28                   | 567                | 86                   |  |
| <b>Totals</b> | <b>2777</b>        | <b>367</b>           | <b>2307</b>        | <b>3401</b>          | <b>1592</b>                          | <b>514</b>           | <b>6678</b>        | <b>4280</b>          |  |

Comparing this chart with Charts XV and XVI of A's farm. we note a good distribution of labor. However, this farmer gets in only about one-half the horse hours that A does. His man hours are slightly greater. This farm too has a well balanced load curve, especially for man labor. Note that live stock not only has a very similar curve to A's live stock curve, but that it makes up approximately one-half of the total hours. Note also that October is the peak month (both horse and man). The 8 acres of potatoes accounts for much of this. The only way of balancing this farm work would be to put in a few less acres of potatoes and the same



CHART XIX



MONTHLY DISTRIBUTION OF MAN LABOR  
 ON B'S FARM. COKATO 1914.  
 Live Stock 26.3 units. Crops and pasture  
 134.3 acres.



CHART XX



MONTHLY DISTRIBUTION OF HORSE LABOR  
ON B's FARM. COKATO. 1914.

Live Stock 26.3 units Crop and pasture 134.3 acres  
1. Live stock; Maintenance (2); Crops (3).

amount of extra grain.

On this farm we have the following relation of hours:

| Per cent of total hours given to:       | <u>Man</u> | <u>Horse</u> |
|---|------------|--------------|
| Maintenance                             | 23.9       | 12.0         |
| Live Stock                              | 41.5       | 8.6          |
| Crops                                   | 34.6       | 79.4         |
| Total Live Stock and Crops (Productive) | 76.1       | 88.0         |

This compares fairly close with A's farm, except that A has a higher percentage of crop hours but lower percentage of live stock hours.

|                                    | <u>FARM A</u> |                | <u>FARM B</u> |                |
|------------------------------------|---------------|----------------|---------------|----------------|
|                                    | %Man<br>Hrs.  | %Horse<br>Hrs. | %Man<br>Hrs.  | %Horse<br>Hrs. |
| Maintenance and Permanent Imp's    | 25.7          | 19.2           | 23.9          | 11.6           |
| Live Stock                         | 21.2          | 9.3            | 41.5          | 8.6            |
| Crops                              | 53.1          | 81.5           | 34.6          | 79.4           |
| Total Live Stock and Crops (Prod.) | 74.3          | 90.8           | 76.1          | 88.0           |

B's farm was only about one-half as large as A's, consequently, as much time on crops could not well be used.

B's farm income was \$2,008.94

Interest on Investment was 946.33

Labor Income (two men) \$1,062.61

Since Northfield is known as a farming district practicing diversified farming, a study of the labor distribution through eight years (1905 - 1912) is made (17).

Table 14 gives the man and horse hours per month for crops, live stock, maintenance and miscellaneous.

TABLE 14

MONTHLY LABOR DISTRIBUTION ON 64 FARMS AT NORTHFIELD, MINN.

1905 - 1913

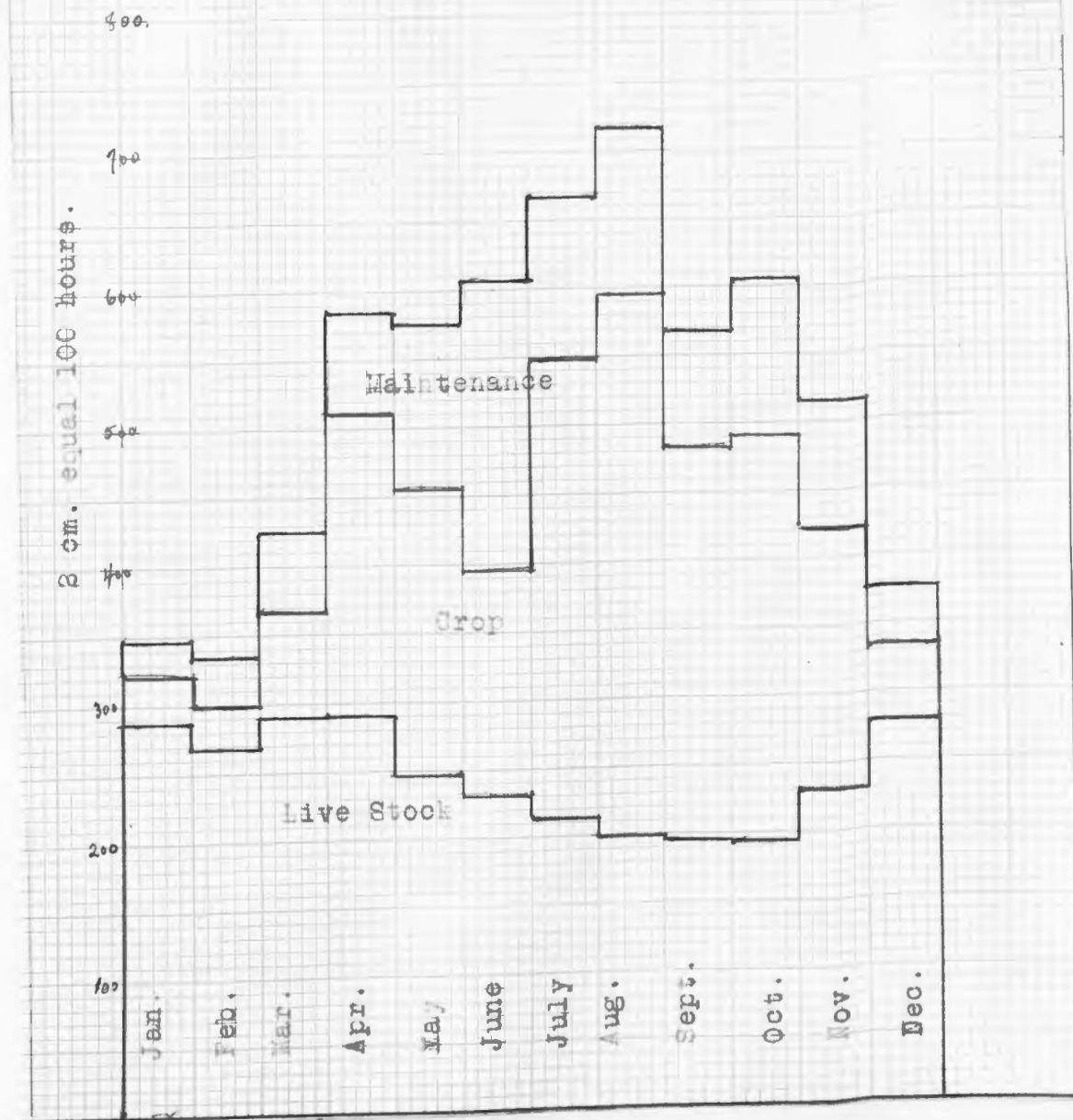
|           | <u>Crops</u>        |                       | <u>Live Stock</u>   |                       | <u>Miscellaneous<br/>and Maintenance</u> |                       | <u>Total</u>        |                       |
|-----------|---------------------|-----------------------|---------------------|-----------------------|--|-----------------------|---------------------|-----------------------|
|           | <u>Man<br/>Hrs.</u> | <u>Horse<br/>Hrs.</u> | <u>Man<br/>Hrs.</u> | <u>Horse<br/>Hrs.</u> | <u>Man<br/>Hrs.</u>                      | <u>Horse<br/>Hrs.</u> | <u>Man<br/>Hrs.</u> | <u>Horse<br/>Hrs.</u> |
| April     | 222.2               | 539.4                 | 289.5               | 60.7                  | 72.0                                     | 33.6                  | 583.6               | 633.6                 |
| May       | 209.4               | 500.7                 | 246.2               | 58.9                  | 121.8                                    | 63.2                  | 577.4               | 622.8                 |
| June      | 161.3               | 316.2                 | 233.7               | 55.0                  | 210.7                                    | 102.4                 | 605.7               | 479.6                 |
| July      | 334.3               | 468.3                 | 213.2               | 45.3                  | 118.3                                    | 43.0                  | 665.8               | 556.6                 |
| August    | 395.7               | 527.2                 | 201.4               | 46.7                  | 122.6                                    | 62.3                  | 719.7               | 636.2                 |
| September | 294.7               | 493.3                 | 191.5               | 44.6                  | 83.6                                     | 38.5                  | 569.8               | 576.4                 |
| October   | 296.2               | 460.9                 | 193.3               | 48.9                  | 114.7                                    | 75.1                  | 604.2               | 584.9                 |
| November  | 192.4               | 295.6                 | 231.0               | 50.8                  | 93.2                                     | 70.6                  | 516.6               | 417.0                 |
| December  | 56.1                | 81.3                  | 279.5               | 54.4                  | 39.7                                     | 37.3                  | 384.3               | 173.0                 |
| January   | 35.0                | 56.0                  | 286.6               | 58.2                  | 24.1                                     | 18.4                  | 345.7               | 132.6                 |
| February  | 31.6                | 50.0                  | 267.7               | 55.1                  | 34.1                                     | 26.5                  | 333.4               | 131.6                 |
| March     | 78.8                | 118.9                 | 288.0               | 67.8                  | 56.5                                     | 25.6                  | 423.3               | 212.3                 |
|           |                     |                       |                     |                       | 1091.3                                   | 602.5                 | 6,329.5             | 5156.6                |

Chart XXI shows these relations graphically for man hours, while Chart XXII shows the same for horse hours.

Maintenance and Productive Labor: Attention should be drawn to the fact that the better farms have a low maintenance requirement. The Minnesota University Cost Accounting Section figures that on an average 25% of the labor hours is used for maintenance. Note that on the above 64 Northfield farms only 17.2% of the man hours and 11.7% of the horse hours are expended for maintenance, the balance, or 82.8% of the man hours, and 88.3 per cent of the horse hours, are used on money returning enterprises.

CHART XXI

MAN LABOR



MONTHLY DISTRIBUTION OF LABOR (MAN) ON 64

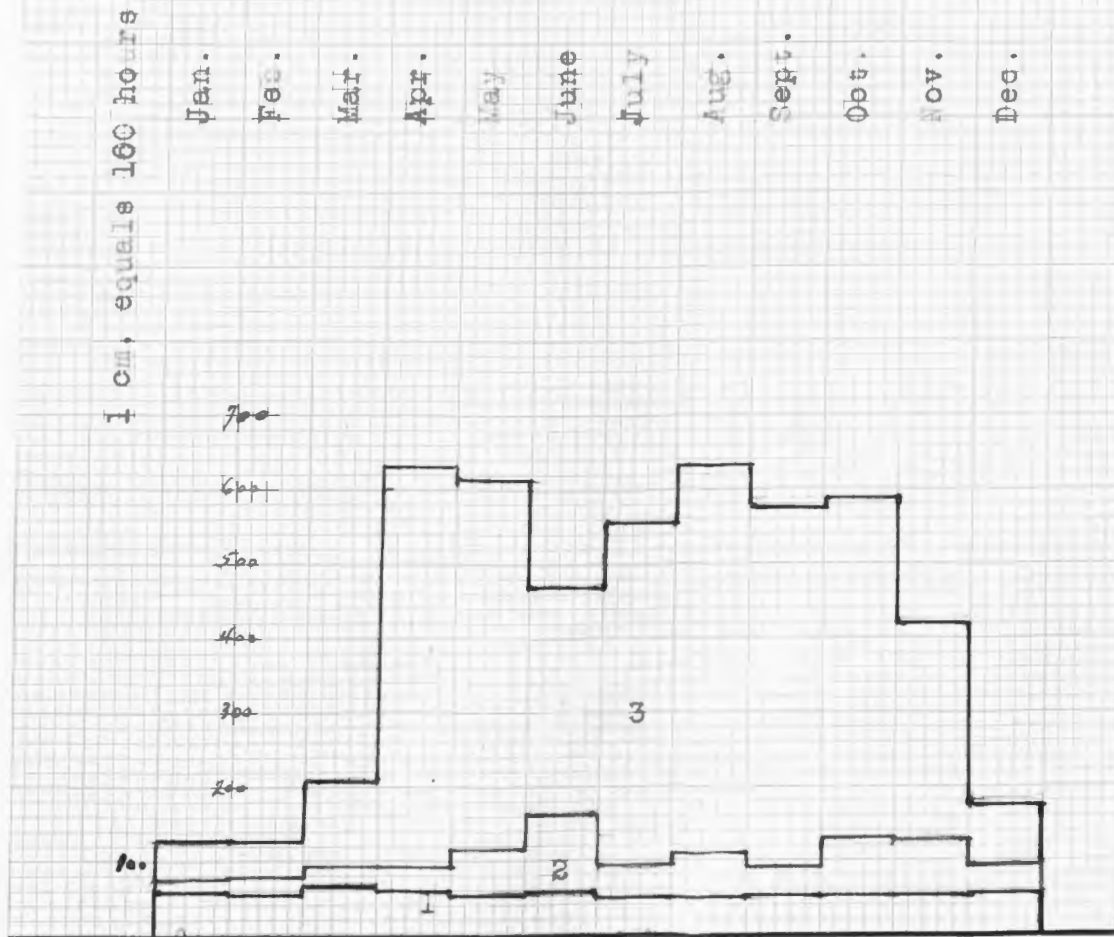
NORTHFIELD FARMS 1905 - 1912.

Live stock consists of 6.8 horses; 13.1 cows, 11.8 msci. cattle; 14.7 swine, 123.1 poultry; and 9 sheep.

Crops consist of 6.7 acres of wheat; 55.1 acres of oats; barley 9.2 a; succotash 7.1 a; corn 28.1 a; hay 23.2 a; pasture 33.8 a; garden 1.5 a; minor crops 5.3 a; Waste land 3.5 ; Farmstead 2.9 acres.

CHART XXIII

HORSE LABOR



Monthly Distribution of Horse Labor  
on 64 Northfield Farms

(1905 - 1912)

1. Live Stock; 2. Maintenance; 3. Crops.



## BALANCING THE LABOR LOAD.

Balancing the labor load consists of reducing as much as practicable the peak labor loads to an average demand in labor hours, and in filling the gaps with productive work. Theoretically the labor curve should run nearly constant through the year. But practically, several factors affect this balancing of the curve. The labor demand in the winter months is normally less than in the crop season. First, because of lessened field activity in all crop work; second, a small amount of productive stock is often kept because of the absence of the boys who are in school or college; third, because a labor let-up is wanted and needed by the farmer. Where city people take their vacation in the summer, the farmer must take his rest or vacation in the winter. Hence, the labor curve will always be lowest in the winter months and highest through the long summer days.

Consequently, to balance a labor system, the average farmer should determine: (1) how much labor is available each month during the year. If he has boys to help him, or if he can hire extra summer help, this should be added. Each month's total hours available of man and horse labor should be set down. (As a guide, note the average hours of man labor used at Northfield and Halstad. See Charts VIII and IX). (2) Each head of stock should be multiplied by the hours of labor required for its care, especially cows and horses. Other stock should be considered with the number in the farm group. Chart XXIII shows the distribution of labor per head of stock, as worked out by the Cost Accounting Section of Minnesota. (3) Estimating the hours required by crops which he intends to plant (See Table 15), the farmer



Table 15.

## MONTHLY LABOR REQUIREMENT PER ACRE OF CROPS AT NORTHFIELD (18).

| Crop               | March  |       | April     |       | May     |       | June     |       | July        |       |
|--------------------|--------|-------|-----------|-------|---------|-------|----------|-------|-------------|-------|
|                    | Hours  |       | Hours     |       | Hours   |       | Hours    |       | Hours       |       |
|                    | Man    | Horse | Man       | Horse | Man     | Horse | Man      | Horse | Man         | Horse |
| Wheat              | 2.0    | 5.0   | 1.5       | 2.1   |         |       |          |       | 2.0         | 3.2   |
| Oats               | .2     |       | 1.9       | 5.4   |         |       |          |       | 2.2         | 3.2   |
| Barley             | .5     |       | 1.4       | 4.4   |         |       |          |       | 2.1         | 3.6   |
| Flax               |        |       | .4        |       | 4.0     | 10.2  |          |       |             |       |
| Field corn-cut     | .6     |       |           |       | 3.5     | 10.5  | 8.6      | 12.9  |             |       |
| Corn fodder        |        |       |           |       | 4.6     | 15.5  | 5.1      | 9.0   |             |       |
| Corn silage        |        |       |           |       | 4.7     | 15.7  | 5.2      | 9.1   |             |       |
| Tame Hay 1st. cut. |        |       |           |       |         |       |          |       | 12.7        | 11.7  |
| Wild Hay           |        |       |           |       |         |       |          |       | 9.0         | 10.4  |
| Millet             |        |       |           |       |         |       | 4.2      | 12.0  | 1.6         | 3.1   |
| Potatoes *         |        |       | 1.3       | 1.5   | 8.0     | 7.5   | 17.6     | 15.7  | 17.5        | 14.0  |
|                    | August |       | September |       | October |       | November |       | Total Hours |       |
| Wheat              | 2.2    | 2.2   | 2.3       | 4.1   | 4.0     | 10.8  |          |       | 14.0        | 27.4  |
| Oats               | 1.2    | 1.1   | 2.3       | 4.1   | 6.0     | 13.7  |          |       | 13.8        | 27.4  |
| Barley             | 3.1    | 3.2   | 2.3       | 4.1   | 4.9     | 12.1  |          |       | 14.3        | 27.4  |
| Flax               | 4.4    | 7.3   | 2.2       | 3.7   | 3.9     | 19.7  |          |       | 14.9        | 30.9  |
| Field corn-cut     |        |       | 6.5       | 9.0   | 3.9     | 10.1  | 14.9     | 19.4  | 38.0        | 61.9  |
| Corn fodder        |        |       | 10.5      | 11.2  | 3.9     | 10.1  | 8.3      | 9.4   | 32.4        | 55.2  |
| Corn silage        |        |       | 19.4      | 21.3  | 4.0     | 10.3  |          |       | 23.3        | 56.4  |
| Tame Hay 1st. cut. |        |       |           |       |         |       |          |       | 12.7        | 11.7  |
| Wild Hay           |        |       |           |       |         |       |          |       | 9.0         | 10.4  |
| Millet             | 5.6    | 4.9   | 2.6       | 4.7   | 4.9     | 11.8  |          |       | 18.9        | 36.5  |
| Potatoes           |        |       | 9.0       | 15.9  | 4.8     | 14.0  |          |       | 58.2        | 68.6  |

\* Author's tabulation from a 22 acre Minnesota potatoe farm (18) (1914)

can determine whether his farm business fits into the hours he has to give. If it does not fit, two possibilities are presented: the system of crop and stock enterprises must be changed or more labor provided. Often a combination of the two is practised. However, about 25% of the total hours on crops and live stock should be allowed in addition for maintenance. Allowance has been made for rainy weather, soil conditions and Sundays, in the following table:

TABLE 16

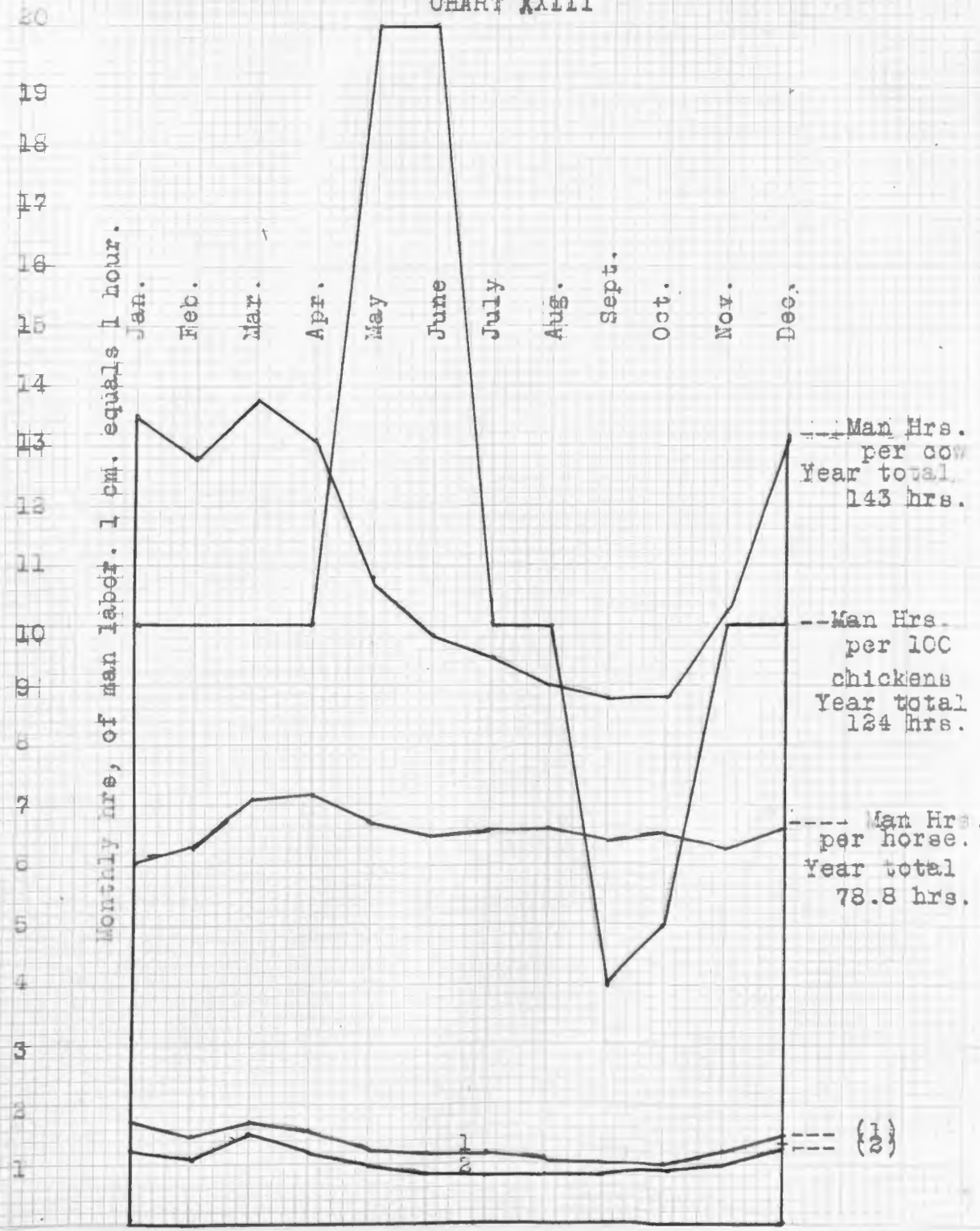
HOURS AND PER CENT OF TOTAL LABOR EMPLOYED ON CROPS PER MAN  
AT NORTHFIELD, MINNESOTA.

| <u>Month</u> | <u>Hours Available</u> | <u>Per cent</u> |
|--------------|------------------------|-----------------|
| April        | 117                    | 38%             |
| May          | 108                    | 36%             |
| June         | 81                     | 27%             |
| July         | 153                    | 50%             |
| August       | 174                    | 55%             |
| September    | 152                    | 52%             |
| October      | 151                    | 49%             |

W. J. Spillman, in an article on "Seasonal Distribution of Labor" (21) estimated one-third of the time between April and November 30th as a safe factor to be allowed for loss of time by rain, soil conditions, Sundays, and such like.

By adjusting the crops, certain hourly demands can be made to come in certain months, according to the labor requirements of those certain crops, and by a little manipulation the labor may be most economically employed. Note how on A's farm a change of 23.5 acres of barley to 13.5 acres of potatoes, and 10 acres of

CHART XXIII



MONTHLY DISTRIBUTION OF MAN LABOR PER HEAD OF LIVE STOCK (18).

1. Man Hours per head miscellaneous cattle.
2. Man Hours per head of hogs.

field corn filled the horse labor gaps of June and July to nearly a full load, and raised the June, July and November man labor hours. (See Charts XVII and XVIII). Inasmuch as these are good cash crops, A would have a good financial return with little extra hired labor, - his horse labor especially being used more efficiently.

It will take some considerable practice to fit certain crops into the valley places of the labor curves without making a peak load elsewhere, but a few changes will generally show that some crop or crops will require less work at crowded times than others. For instance, 23.5 acres of potatoes on A's farm in place of 23.5 acres of barley, would give a curve (marked P) as shown on Charts XVII and XVIII, while 13.5 acres of potatoes and 10 acres of corn give a curve of much better balance. Balancing the labor load is a factor that will be given much attention by the farm manager of the future.

#### THE VALUE OF FARMERS' TIME.

Farmers are often inclined to underestimate the value of their time and labor. Often they spend a dollar's worth of time to save a few cents in cash. "Probably the least understood of all the factors that have to do with farming is the proper use of time. This is doubtless due to the fact that much of the labor is not paid, and the inference has been drawn that time is of no value."

(19) Diversified farming makes better use of time than do specialized systems. Besides, it spurs the farmer into putting his time on productive enterprises, for succeeding crops keep demanding his attention.

Table 17 shows a comparison of 6 Cokato and 6 Halstad farms (1914), with reference to the value of man and horse labor hours as compared with farm receipts, farm expenses, farm income, labor income, value of man labor, and value of horse labor.

TABLE 17

A COMPARISON OF 6 COKATO AND 6 HALSTAD FARMS.

A - Cokato Farms

| Farm Number | Farm Receipts | Farm Expenses | Farm Income  | Value of Man Hrs. | Value of Horse Hrs. | Labor Income |
|-------------|---------------|---------------|--------------|-------------------|---------------------|--------------|
| 1           | \$3,880       | \$1,008       | \$2,872      | \$1,371           | \$900               | \$1,118      |
| 2           | 3,088         | 538           | 2,009        | 949               | 495                 | 1,062        |
| 3           | 5,012         | 1,655         | 4,204        | 998               | 651                 | 3,147        |
| 4           | 1,995         | 670           | 1,325        | 828               | 445                 | 811          |
| 5           | 2,618         | 1,390         | 1,527        | 940               | 493                 | 772          |
| 6           | <u>2,427</u>  | <u>394</u>    | <u>2,101</u> | <u>1,023</u>      | <u>664</u>          | <u>1,146</u> |
| Total       | \$19,020      | \$5,655       | \$14,038     | \$6,109           | \$3,648             | \$8,056      |
| Average     | \$3,170       | \$943         | \$2,339      | \$1,018           | \$608               | \$1,343      |

B - Halstad Farms

|         |              |            |            |            |            |            |
|---------|--------------|------------|------------|------------|------------|------------|
| 1       | \$1,802      | \$598      | \$1,204    | \$829      | \$347      | \$709      |
| 2       | 3,633        | 761        | 1,961      | 1,204      | 713        | 867        |
| 3       | 2,651        | 2,157      | 494        | 1,036      | 520        | -170       |
| 4       | 3,795        | 964        | 2,831      | 1,419      | 824        | 1,732      |
| 5       | 1,370        | 427        | 943        | 698        | 379        | 414        |
| 6       | <u>1,477</u> | <u>547</u> | <u>930</u> | <u>362</u> | <u>334</u> | <u>486</u> |
| Total   | \$14,728     | \$5,454    | \$8,363    | \$5,548    | \$3,117    | \$4,038    |
| Average | \$2,455      | \$909      | \$1,394    | \$925      | \$519      | \$673      |

Av. of  
Cokato  
and  
Halstad  
Farms

|         |       |         |       |       |         |
|---------|-------|---------|-------|-------|---------|
| \$2,812 | \$926 | \$1,867 | \$971 | \$564 | \$1,008 |
|---------|-------|---------|-------|-------|---------|



Labor value has been figured on man hours by adding board, wages, and any man labor cost, and dividing by the hours worked. Horse labor has been figured by adding cost of feed, shelter, shoeing, depreciation, veterinary charges, and such costs, and dividing by hours of work performed.

Note that on the Cokato farms the value of the man hours is approximately one-third of the farm receipts, a little greater than the farm expenses, nearly one-half of the farm income, three-fourths of the labor income, and nearly twice the value of horse labor. Averaged with Halstad, it can be seen that man labor approximates one-third of the farm receipts, equals the farm expense, is one-half the farm income, equals the labor income, and is one and three-fourths times the horse labor. Averaged, the horse labor approximates one-fifth the farm receipts, over half the farm expense, one-third the farm income, sixty per cent of the labor income, and sixty per cent of the man hours. Together, the labor bill - horse and man - approximates over fifty per cent of the farm receipts, one and seven-tenths times the farm expenses (19), ninety per cent of the farm income, one and three-fifths times the labor income, one and seven-tenths times the value of man hours alone, and two and one-fifth the value of horse hours alone. Hence the importance of distributing labor so as to utilize the most time is very apparent (12). "The most important consideration of all and the one that controls the situation in nearly every case is the problem of keeping men, horses and machinery busy throughout the year." (22)

The farmer, or farm manager, is the biggest factor in distributing farm labor. He it is who determines the amount of live stock to be kept, and the acreage of crops to be grown. He must plan crops that compete least for labor; he must know his markets, and the products best suited to his locality; he must be fore-sighted.

Probably the greatest difficulty in balancing the labor load is to provide winter work for his help, and horses. In Minnesota this is largely taken care of by dairying, which not only provides very regular work, but also a steady income. In the northern part of the state, winter labor can profitably be used on the wood-lot. Not only does the household need a good wood supply, but when treated and handled as a crop, the wood-lot is a paying proposition. (Bureau of Forestry- Bulletin #45) Fence posts are growing expensive, and on many farms these could be cut and peeled in the winter.

A carpenter's set of tools, and a tool house will give opportunity of repairing and painting machinery. Hauling ice; gravel for roads, and feed and supplies can largely be done during the winter months. Pruning the orchard is best done in the late winter months, while some of the land clearing operations could be well started. New possibilities in stock feeding as beef or sheep feeding, or the raising of early lambs for the summer market offer profitable side-lines for winter work, limited only by the ability and resources of the farm manager.

Where labor can thus be employed throughout the year, not only can a better class be hired at a reasonable rate, but it is available when most needed. -628-

The fact that there are farmers and farm managers busy with the problem of distributing labor is shown by the bulletins collected on this subject. Probably chief among these will be Minnesota's new bulletin on "Labor Requirements of Crop Production" which not only shows through a series of years what labor hours are required to produce an acre of a field crop, but just what months that labor is required.

Minnesota Bulletin No. 145 gives some valuable data on "The Cost of Producing Minnesota Farm Products" (1908-1912), the U. S. Department of Agriculture Bureau of Plant Statistics, Bulletin No. 3, gives some data on "A Normal Day's Work for Various Farm Operations". Among the many others that deserve particular attention is Farmer's Bulletin No. 614, by J. A. Drake, Agriculturist, Office of Farm Management, U. S. Dept. of Agriculture, entitled "A Corn Belt Farming System which saves Harvest Labor by Hogging Down Crops". This bulletin deserves especial attention in that it emphasizes a system which provides "productive labor for practically the entire year, yet distributes the labor so as to make it possible for one man, practically without hired help, to handle a large acreage, making a net income considerably greater than is at present commonly obtained on farms of similar size in the corn belt states" (5). Moreover, this system rapidly increases the soil fertility, and conserves its productiveness.

A brief review is here given as it falls within the line of this subject. The cropping system consists of three crops which follow in a five year rotation. The crops are corn, rye, hay, timothy and clover, or clover.

|            |             |            |           |             |
|------------|-------------|------------|-----------|-------------|
| :          | :           | :          | :         | :           |
| 1          | 2           | 3          | 4         | 5           |
| Corn 1st   | Corn 2nd    | Rye and    | Clover    | Timothy and |
| year to    | year to be  | Young Clo- | and Tim-  | Clover for  |
| be hogged. | cut and Rye | ver hogged | othy hog  | hay or pas- |
| :          | sown.       | off and    | pastured. | ture.       |
| :          | :           | pastured.  | :         | :           |
| :          | :           | :          | :         | :           |
| :          | :           | :          | :         | :           |

The ease with which the labor is done is soon apparent. Corn is the first and only crop to receive attention during the spring and early summer. When cultivation is about over, hay is ready to be cut. There is then nothing to demand labor until time to cut one field of corn and sow the fall crop of rye. Note that the program is not crowded, and each crop has its due season for attention. The fields should not be less than approximately 30 acres. One field could be left in permanent pasture, making a sixth field, if the farm was 120 acres. Forty acre fields would provide a system for 200 - 240 acres. The work would demand one good man and three horses for 100 or 120 acres of land. The only extra labor required would be in haying, and cutting and husking corn. This labor could often be exchanged.

One of the fields is plowed late in the fall. The brood sows should farrow their spring litters early in March so as to require little attention when field work starts. The fall litters should come about September 1st when work is, for the time being, quietest.

The rye crop is important in the rotation. It is seeded in the fall, and is admirable to "hog off" as the straw if it breaks, breaks near the head and holds the grain off the ground. Besides, it does not shatter out like wheat. Rye should be ripened well to allow the beards to lose their sharpness and the

grain to soften. Into the spring rye the hogs can be turned for a time, just prior to which clover is seeded over the rye. The hogs enjoy the tender rye while the tramping about seeds the clover.

As shown above, Field 1 is 1st year corn (on sod). This corn is grown and hogged off when ripe (about Sept. 1st - 10th). It is well to sow rape or soy beans just prior to the last cultivation so as to furnish green forage in the corn. This field becomes second year corn the next year.

Field 2 is corn following Field 1. Rye is sown in the fall for the rye field (#3), either between the corn rows before the corn ripens or immediately after the corn is cut and removed. This corn is husked.

Field 3 is rye. It is sown in the fall after corn cutting, with timothy and clover seeded early in the spring. This rye is pastured until the plants become tough, when the hogs are removed and the grain left to ripen.

Field 4 is devoted to timothy and clover and pastured after the rye has become tough. Often the hogs, pastured solely on the clover, leave enough timothy to be cut and saved for the horses or other stock.

Field 5 is clover and timothy. This may be kept for hay or sold as a cash crop. If cut early, it often is advisable to plow under a green manure crop which adds humus to the corn crop of the next year.

The principal live stock kept is hogs. April 10th to 15th finds them in the rye field (No.3). At six to eight weeks the young pigs are weaned. About May 15th the rye is tough and the



hogs are turned into field 4 of clover and timothy. Here, in addition, they receive five or six ears of corn per 100 lbs. in addition to the clover. This is kept up until the rye has been ripe for fully two weeks, then about July 15th to 30th they are allowed to hog down the rye crop. They must have plenty of fresh water. It has been found that six one hundred pound hogs will gather a 17 bushel per acre rye crop in six weeks. Thus this field will supply 120 hogs until about time for ripe corn to be hogged off. Care is used in turning them in to the corn until the hogs are accustomed to full feed. In Field 1 of corn the hogs have abundant feed until about November 10th. The early maturing hogs can be sold earliest.

Thus, through the spring, summer and fall, the hogs have required but little time and have harvested much of the farm crops. A few acres of soy beans will make a fine winter forage for the brood sows and make a good ration with corn.

A limited amount of dairying might well be handled with this system and one extra man hired the year around. If brood mares are kept to do the work, colts could be raised as another stock line.

Altogether, this system has given good satisfaction in some localities. The small amount of labor required and the steady employment of one man's time argue well for it, while the amount of straw and humus turned under each year, together with the manure, rapidly improves the soil. It has been determined, besides, that each hog will do about one cent's worth of work per day in spring harvesting, threshing, and marketing the grain (25). This, and the fact that a daily gain of one-half to

three-fourths pounds per hog can be made at a time when labor is hard to get and is expensive, is a big factor in the economic management of the farm.

Rye forms a valuable crop, for not only does it grow on poor soil but it can be seeded in the fall - an important item since this sowing avoids so much of the spring rush. Moreover, it is a valuable feed, ranking in composition about the same as corn. It makes a good nurse crop for the clover and timothy, and since all of the straw and 80% of the fertilizing value of the grain is promptly returned to the soil (25), the humus in the soil, especially where clover sod each year is turned under from one field in the rotation, increases the fertility of such a farm in a marked degree.

Seventeen bushels of rye per acre is considered a good yield in the corn belt states (25). When sold on the market at 70¢ per bushel, this crop will bring \$11.90 per acre. The income of the same acre hogged off, especially when clover is grown, is more. A seventeen bushel crop of rye will produce approximately 300# of pork without any supplementary feeds (25). This, when sold at 7¢ per pound, will bring \$14.00.

Therefore, in figuring this difference, not only should the \$2.10 be noted as a saving, but also the machinery cost of harvesting, the labor cost, and the marketing as well. This system then is simply utilizing the farm animal to help out on the labor problem by waiting on itself. How far this question can be carried with other stock is a question to be worked out, but that it holds tremendous possibilities no one will deny.

Although this system includes a splendid rotation and

builds up the soil fertility, still the principal feature is the way it solves the labor problem. Only those crops are grown which do not compete for labor. The chart given below and taken from pages 14 and 15 of this bulletin (36) shows how balanced is this labor load.

Chart XXIV shows the crop requirement in days, also the amount of time needed extra or that can be exchanged.

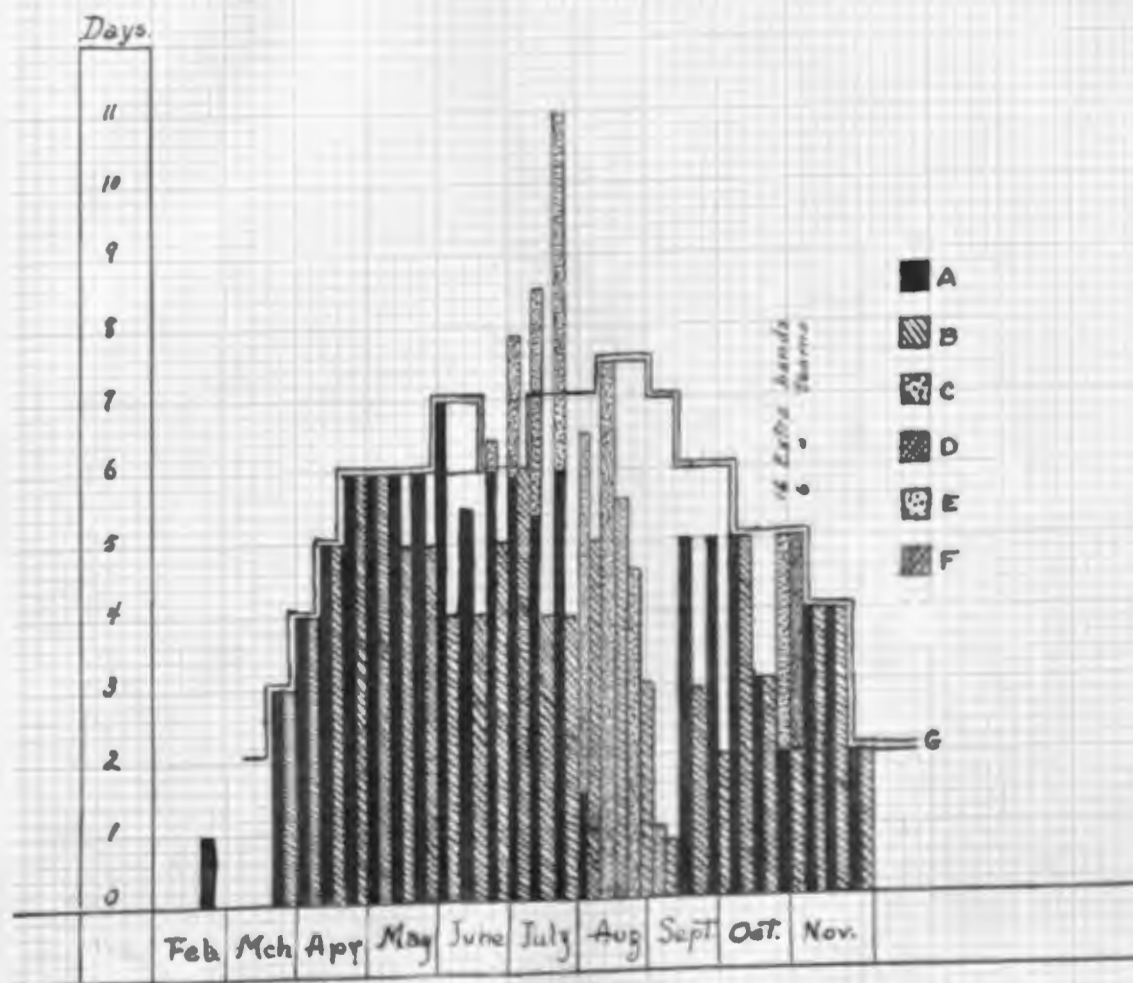
Chart XXV gives the hours per day required in feeding the hogs.

Note that in the winter months when the hogs demand the most time that the crop demands are nothing. Again, that in the summer when the crop demands are greatest, that the stock need the least care. Under this management, one man and three horses do practically all the work on this 100 acre system.

The labor indicated in Chart XXIV includes also the growing of two acres of potatoes. One field for corn is plowed in the fall. The spring work, therefore, is the planting of forty acres of corn. Cultivation is over by the time haying comes. Here some few days - about ten, of extra labor is needed. This would have to be paid for in work. After haying, the man and team will be idle until September 10th, but as this is a busy time on most farms, enough exchange labor can be arranged for to secure sixteen extra hands and six extra teams during the last ten days of October when Field 1 needs husking and shedding for bedding.

Note that the extra labor required, Sept. 1st - 10th, on the hogs at farrowing time comes at a time when the field requirements are lightest (See Charts XXIV and XXV). Of course, much difference of time will be had since every one will work at different

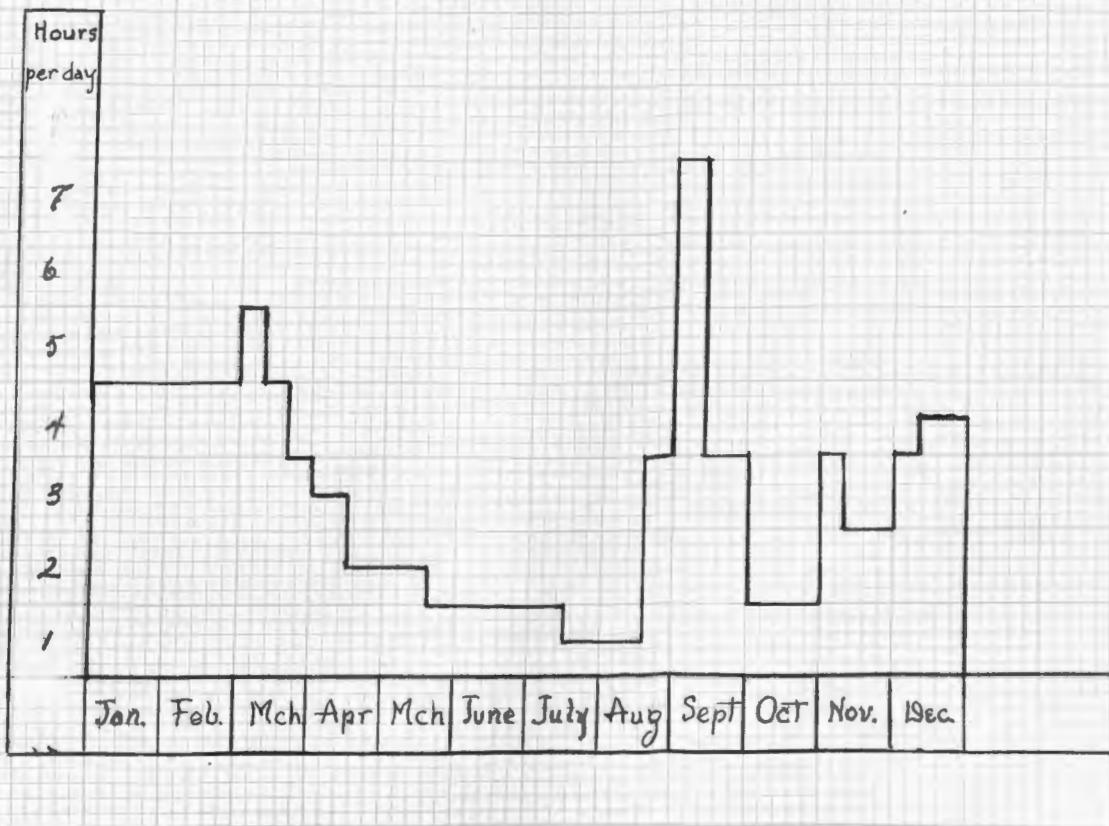
Chart XXIV



MONTHLY DISTRIBUTION OF LABOR ON A HOG FARM.

Diagram showing the distribution of labor for one man and three horses on a 100--acre corn-belt farm when run on the plan described in this bulletin. Explanation: A-man days, B-three horse team days, C-extra man labor, D-extra horse labor, E-exchange man labor, F-exchange horse labor, G-available time for one man and three horses.

Chart XXV.



MONTHLY DISTRIBUTION OF LABOR ON HOGS

Shows the amount and distribution of labor required by 10 brood sows and 120 pigs by the system of management described.



rates and often some farmsteads are better arranged than others for doing work. However, these two charts fit well together and give a lesson as to labor distribution that holds vast possibilities.

The encouraging part of this question of distributing labor throughout the year is the increasing dependable data that is accruing. The U. S. Office of Farm Management is gathering data that bears upon this subject. (27). Minnesota has a wealth of facts accumulated along this line over a period of ten and more years. Some of this will be given in the new bulletins on Crop and Live Stock Requirements of Labor soon to be printed.

As dependable data accumulate, the guessing and estimating of factors in this complex labor question are eliminated, and the subject of labor distribution will grow as it should along definite scientific channels. The expectancy of labor hours necessary to grow a certain crop in a given locality will some day be as well known to the agriculturist as the expectancy of life is now known to the life insurance companies.

As these data become more and more reliable and established, the challenge of farming will be taken up by a type of business-minded men never before interested in the subject, because of the dependability that they can place in this old, but ever new and fascinating, business - the business of farming.

To summarize:

Vast changes in commercial and agricultural expansion have made labor high priced and hard to secure.

Labor saving machinery has greatly reduced the time of human labor required in crop production.

A demand for increased margins of profit has made necessary better business practices on the farm. Labor constituting in value approximately one-half of the total cost of production has led to a study of better labor systems, that will utilize labor steadily throughout the year.

In general, the diversified farms have best answered the seasonal distribution of labor.

From a study of 395 general farms it was found that the average labor income was \$301.00.

On the good farms, or those averaging above \$301.00, the labor income was \$686.00. The average labor income of the poor farms, or those below \$301.00, was minus \$29.00. The productive hours per man on the good farms averaged 529 hours more than on the poor farms.

In general, the greater the productive hours per man attained, the greater was the labor income.

The same relation held for productive hours per horse and for productive work units.

The good farms averaged over 94 productive hours per horse more than the poor farms, and 105 productive work units more than the poor farms.

The animal index of the good farms, which may be taken as one indication of diversity, was 118; while the poor farms

averaged 84; or the live stock was approximately one-third less productive on the poor farms.

The labor gaps on a grain farm are large, and good labor distribution appears extremely difficult.

Similarly a Timothy hay farm also affords poor distribution of labor.

Maintenance of live stock makes possible a steady labor curve, - labor in all cases being lower in summer and highest during the winter months. As an enterprise for productive work in the otherwise non-productive winter months, live stock is practically indispensable on the farm.

A study of a farm in Central Minnesota, designated as A's farm, shows good distribution of labor. Stock feeding during the winter months with crop production and pork raising in the summer gives a fairly regular labor curve. A few suggestions show how the extra hired labor could be reduced by different combinations of crops.

A general farm in Wright County, Minnesota, designated as B's farm, shows a well established farming system has been devised, which provides well distributed work.

The labor incomes on the special farms studied were two to three times the average of the 395 farms.

The importance of keeping maintenance hours low is realized since this is not productive labor. Maintenance labor varies from 20% to 25% of the total labor hours. Keeping fewer idle horses, and employing those kept more efficiently, is one way of reducing maintenance expense.

Data are presented indicating a practical method of balancing

the labor load. The important steps to be followed are, first: a definite knowledge of the monthly available hours of labor; second, live stock labor requirements per head; third, crop labor requirements per acre; and fourth, increasing the live stock and crop requirements by one-fourth to allow for farm maintenance. With a little patience, a system may be devised which will give maximum use of labor at a minimum of conflicting operations.

The value of the farmer's time is often underestimated. When the total hours of hard labor are multiplied by the rate per hour, it is found that each hour of man labor is worth approximately 15¢ and each hour of horse labor 10¢. When the value of the total hours of labor is considered it is found to be approximately one-half the value of the total farm receipts; one and seven-tenths times the total expenses (excluding land rent); and ninety per cent of the farm income.

New systems of labor distribution are commanding attention. One such system has been devised that employs a rotation of crops which saves human labor and affords practically continuous pasturing of hogs. One man and three horses performed the labor commonly demanded of ten men and five horses.

Increasing data on this question are eliminating guess work and generalities and are establishing definite and dependable labor laws.





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