AN INVESTIGATION INTO THE POSSIBILITY OF SUBSTITUTING MECHANICAL FOR HAND LABOUR IN TRINIDAD.

A Thesis Presented
by
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In Part Requirement for the Associateship of
The Imperial College of Tropical Agriculture.
1928-29.
SYNOPSIS OF CONTENTS.

1. EXPLANATION AND SCOPE OF PROBLEM.
Early History of Labour - Present position - Investigation confined to sugar industry. p. 1

2. DATA AVAILABLE AND THEIR TREATMENT.
Distribution of Labour - Limitations of Results.
A. Using Ste. Madeleine:
Field ledgers - Operations considered - No. of labourer days extracted - unit of labour - graphs - Rainfall.
B. Caroni Estate:
Weekly abstracts - Operations considered - Labour units extracted - Graphs - Rainfall.
Characteristics of Estates - seasons.

3. INTERPRETATION OF DATA.
A. Using Ste. Madeleine:
Distribution of Field Labour - Shortage of Labour - Causes - Rainy and Dry season - Preparation and Planting - Cultivation - Reaping - Transport, Factory, and Total.
B. Caroni Estate:
Distribution of Field Labour - Shortage - Preparation and Planting - Cultivation - Reaping - Transport, Factory, and Total.

4. DISCUSSION AND CONCLUSIONS.

Summary pp. 37 - 38
Acknowledgments.

PLATES:
Plate I. Road System at the Ste. Madeleine p. 57
Plate II. Rounddriving with road grader at the Ste. Madeleine p. 60
Plate III. Dairies - cutting canes - working at Caroni p. 63
TABLES.

I. Detailed Statement of Labourers employed.
   Usine Ste. Madeleine - Crop 1928  Facing p. 3

II. Distribution of Units of Labour employed on
    Usine Ste. Madeleine - four weekly 1927-8. Facing p. 4

III. Distribution of Units of Labour employed on
     Caroni Estate - four weekly 1927.  Facing p. 7

FIGURES.

Fig. 1. Distribution of Field Labour Units - Groups and

Fig. 2 Distribution of Field Labour Units in Rainy and
      Dry seasons - Usine Ste. Madeleine - four weekly
      1927-28.

Fig. 3 Distribution of Labour Units employed in Prepara-
      tion and Planting - Usine Ste. Madeleine - four
      weekly 1927-28.

Fig. 4 Distribution of Labour Units employed in Cultiva-

Fig. 5 Distribution of Labour Units employed in Reaping -

Fig. 6 Distribution of Total Labour Units - Usine Ste.
      Madeleine - four weekly 1927-28.

Fig. 7 Distribution of Field Labour Units - Groups and
      Total. - Caroni 1927 - four weekly.

Fig. 8 Distribution of Labour Units employed in Prepara-
      tion and Planting - Caroni 1927 - four weekly.

Fig. 9 Distribution of Labour Units employed in Cultiva-
      tion - Caroni - 1927 - four weekly.

Fig. 10 Distribution of Labour Units employed in Reaping -
      Caroni 1927 - four weekly.

Fig. 11 Distribution of Total Labour Units Caroni 1927 -
      four weekly.

PLATES.

Plate I. Road Grader at the Usine Ste. Madeleine  p. 21

Plate II. Roundridding with road grader at the
          Usine Ste. Madeleine  p. 21

Plate III. Chaff- cutter at work at Caroni  p. 22
At the present day labour is supplied, partly, by the descendants of the emancipated negro slaves, and partly, by the East Indians who have remained after their period of indenture was over. Even now, numbers of these return to India at intervals - a boat load of 900 left in March 1929. The net result has been to cause a shortage of labour in the island.

The purpose of the present investigation, which is part of a general scheme for investigating labour in the colony, is to examine this shortage and attempt to discover, how far, and in what way, it may be lessened by the use of machinery instead of hand labour. The two principal crops of the island are Sugar and Cocoa, the labour requirements for other crops being comparatively small. Owing to the hilly nature of the land and the conditions under which it is grown, cocoa cultivation is unsuited for mechanical treatment, so the investigation has been confined to the sugar industry.
EXPLANATION AND SCOPE OF PROBLEM.

In the early days of the Sugar Industry in Trinidad, the labour was supplied by negro slaves from West Africa. The slaves were emancipated in 1834, and this caused the plantations to suffer severely from shortage of labour. A remedy was found in 1845, when indentured labour was brought into the Colony from India. Many of these labourers returned to India when their period of indenture had expired, and others were brought out in their places. This system ceased in 1917, when the Indian Government put a stop to further indenture.

At the present day labour is supplied, partly, by the descendent of the emancipated negro slaves, and partly, by the East Indians who have remained after their period of indenture was over. Even now, numbers of these return to India at intervals - a boat load of 900 left in March 1929. The net result has been to cause a shortage of labour in the island.

The purpose of the present investigation, which is part of a general scheme for investigating Labour in the colony, is to examine this shortage and attempt to discover, how far, and in what ways, it may be lessened by the use of machinery instead of hand labour. The two principal crops of the island are Sugar and Cocoa, the labour requirements for other crops being comparatively small. Owing to the hilly nature of the land, and the conditions under which it is grown, cocoa cultivation is unsuited for mechanical treatment, so the investigation has been confined to the sugar industry.
DATA AVAILABLE AND THEIR TREATMENT.

In order to find out the periods of the year during which shortage of labour occurred, it was necessary to know the distribution of labour throughout the year. For this purpose the records of two estates were examined:—

A. The Usine Ste. Madeleine
B. Caroni.

These estates were chosen, partly, because their records are in suitable form for extracting such data as were required, and partly, on account of their easy access from the Imperial College of Tropical Agriculture, where the investigation was carried out.

The value of the results is, to a certain extent, minimised by the fact that the distribution of labour was found for one year only, owing to lack of time for further investigation, but the results give a general indication, which is all that is required. The same reason prevented more than two out of some 13 estates being considered, but these are fairly representative of the Colony's sugar industry.

A. Usine Ste. Madeleine.

The Usine Ste. Madeleine data were extracted from the Field Expenditure Ledgers, of the eight sections into which the Company's estates are divided. Their crop year is from June to June, and the year 1927-28 was selected as being most accessible. The Ledgers, which are of a loose leaf type, show the amount in dollars, spent on each operation, fortnightly, throughout the year. They are also designed to show the number of labourers employed on each operation, fortnightly, throughout the year, but as a new form was in process of introduction, this item was seldom entered.

From a sheet (Table 1) obtained from the Usine Ste.
<table>
<thead>
<tr>
<th>OPERATION</th>
<th>TAROUDA</th>
<th>WILLIAMS-</th>
<th>UNION HALL</th>
<th>PETIT MORNE</th>
<th>CEDAR HILL</th>
<th>PICTON</th>
<th>LA FOR-</th>
<th>HERMITAGE</th>
<th>TOTAL</th>
<th>PERCENTAGE</th>
</tr>
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<tbody>
<tr>
<td>Overlookers</td>
<td>736</td>
<td>970</td>
<td>1,164</td>
<td>628</td>
<td>1,329</td>
<td>711</td>
<td>698</td>
<td>307</td>
<td>6,563</td>
<td>0.63</td>
</tr>
<tr>
<td>Burying Trash</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>691</td>
<td>0.07</td>
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<tr>
<td>Subsoiling (Fork)</td>
<td>1,770</td>
<td>1,685</td>
<td>1,988</td>
<td>2,248</td>
<td>1,643</td>
<td>1,803</td>
<td>2,895</td>
<td>1,678</td>
<td>15,711</td>
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<td>Fork Ploughing</td>
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<td>3,553</td>
<td>5,521</td>
<td>4,918</td>
<td>4,928</td>
<td>4,961</td>
<td>4,438</td>
<td>4,490</td>
<td>34,579</td>
<td>3.30</td>
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<td>3,180</td>
<td>3,540</td>
<td>9,381</td>
<td>3,985</td>
<td>4,634</td>
<td>3,143</td>
<td>3,262</td>
<td>33,796</td>
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<td>9,317</td>
<td>4,294</td>
<td>6,702</td>
<td>10,106</td>
<td>11,530</td>
<td>9,275</td>
<td>6,529</td>
<td>61,831</td>
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<td>8,265</td>
<td>13,314</td>
<td>9,882</td>
<td>9,617</td>
<td>9,479</td>
<td>3,151</td>
<td>11,997</td>
<td>6,954</td>
<td>72,859</td>
<td>6.95</td>
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<td>Supplying with stools</td>
<td>587</td>
<td>995</td>
<td>105</td>
<td>1,434</td>
<td>934</td>
<td>2,203</td>
<td>761</td>
<td>483</td>
<td>7,482</td>
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<td>Supplying with plants</td>
<td>1,541</td>
<td>1,530</td>
<td>2,293</td>
<td>2,364</td>
<td>1,650</td>
<td>4,135</td>
<td>2,654</td>
<td>1,235</td>
<td>17,402</td>
<td>1.66</td>
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<tr>
<td>Handweeding</td>
<td>19,037</td>
<td>37,070</td>
<td>24,279</td>
<td>29,470</td>
<td>34,442</td>
<td>41,337</td>
<td>41,176</td>
<td>35,509</td>
<td>262,320</td>
<td>25.03</td>
</tr>
<tr>
<td>Stripping Canes</td>
<td>427</td>
<td>1,461</td>
<td>810</td>
<td>819</td>
<td>1,961</td>
<td>5,033</td>
<td>2,718</td>
<td>482</td>
<td>13,711</td>
<td>1.31</td>
</tr>
<tr>
<td>Hauling trash</td>
<td>544</td>
<td>1,985</td>
<td>1,461</td>
<td>42</td>
<td>854</td>
<td>352</td>
<td>2,341</td>
<td>1,034</td>
<td>8,613</td>
<td>0.82</td>
</tr>
<tr>
<td>Digging Paragress</td>
<td>1,429</td>
<td>3,446</td>
<td>1,655</td>
<td>660</td>
<td>4,185</td>
<td>19,280</td>
<td>8,536</td>
<td>1,594</td>
<td>40,815</td>
<td>3.89</td>
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<td>Making Pen Manure</td>
<td>12,440</td>
<td>5,714</td>
<td>9,907</td>
<td>15,113</td>
<td>11,808</td>
<td>18,408</td>
<td>13,306</td>
<td>7,723</td>
<td>94,416</td>
<td>9.01</td>
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<tr>
<td>Carting Town Manure</td>
<td>558</td>
<td>268</td>
<td>209</td>
<td>323</td>
<td>343</td>
<td>161</td>
<td></td>
<td></td>
<td>1,882</td>
<td>0.18</td>
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<tr>
<td>Applying Pen &amp; Town Manure</td>
<td>5,359</td>
<td>4,464</td>
<td>7,163</td>
<td>8,171</td>
<td>8,884</td>
<td>5,598</td>
<td>4,583</td>
<td>3,277</td>
<td>48,044</td>
<td>4.59</td>
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<tr>
<td>Applying Lime</td>
<td>6</td>
<td></td>
<td>147</td>
<td>13</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td>193</td>
<td>0.02</td>
</tr>
<tr>
<td>&quot; Artificial Manure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaning Pastures &amp; Traces</td>
<td>1,608</td>
<td>2,095</td>
<td>1,611</td>
<td>4,562</td>
<td>1,947</td>
<td>4,613</td>
<td>3,881</td>
<td>2,063</td>
<td>22,380</td>
<td>2.14</td>
</tr>
<tr>
<td>Destroying Froghoppers</td>
<td>6,428</td>
<td>6,595</td>
<td>3,114</td>
<td>3,715</td>
<td>10,602</td>
<td>3,902</td>
<td>5,016</td>
<td>5,425</td>
<td>44,897</td>
<td>4.28</td>
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<td>Green Dressing</td>
<td>3,838</td>
<td>971</td>
<td>7,701</td>
<td>2,975</td>
<td>2,529</td>
<td>612</td>
<td>1,222</td>
<td>640</td>
<td>13,561</td>
<td>1.29</td>
</tr>
<tr>
<td>Cutting Canes</td>
<td>5,473</td>
<td>10,774</td>
<td>7,757</td>
<td>8,606</td>
<td>12,336</td>
<td>10,087</td>
<td>7,643</td>
<td>3,723</td>
<td>66,504</td>
<td>6.36</td>
</tr>
<tr>
<td>Carting Canes</td>
<td>5,282</td>
<td>13,929</td>
<td>10,058</td>
<td>8,868</td>
<td>14,715</td>
<td>13,041</td>
<td>7,413</td>
<td>5,465</td>
<td>73,478</td>
<td>7.49</td>
</tr>
<tr>
<td>Heading Canes</td>
<td>80</td>
<td>2,883</td>
<td>345</td>
<td>1,885</td>
<td>3,950</td>
<td>1,913</td>
<td>3,326</td>
<td>2,149</td>
<td>16,531</td>
<td>1.58</td>
</tr>
<tr>
<td>Picking Canes</td>
<td>4,004</td>
<td>3,774</td>
<td>4,915</td>
<td>7,994</td>
<td>5,971</td>
<td>9,615</td>
<td>3,720</td>
<td>2,527</td>
<td>42,520</td>
<td>4.03</td>
</tr>
<tr>
<td>Loading Canes</td>
<td>89</td>
<td></td>
<td>44</td>
<td>727</td>
<td>109</td>
<td>883</td>
<td>136</td>
<td>289</td>
<td>2,277</td>
<td>0.22</td>
</tr>
<tr>
<td>Carrying Water</td>
<td>530</td>
<td>1,255</td>
<td>1,001</td>
<td>956</td>
<td>1,918</td>
<td>1,566</td>
<td>579</td>
<td>182</td>
<td>7,988</td>
<td>0.76</td>
</tr>
<tr>
<td>Working Derricks</td>
<td>1,732</td>
<td>2,976</td>
<td>2,506</td>
<td>2,355</td>
<td>3,183</td>
<td>3,162</td>
<td>1,742</td>
<td>1,035</td>
<td>13,693</td>
<td>1.28</td>
</tr>
<tr>
<td>Working Scales</td>
<td>278</td>
<td>376</td>
<td>443</td>
<td>461</td>
<td>487</td>
<td>1,410</td>
<td>432</td>
<td>153</td>
<td>4,040</td>
<td>0.39</td>
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<tr>
<td>New Derricks &amp; Repairs</td>
<td>243</td>
<td>352</td>
<td>457</td>
<td>718</td>
<td>840</td>
<td>1,042</td>
<td>471</td>
<td>324</td>
<td>4,456</td>
<td>0.43</td>
</tr>
<tr>
<td>New Scales &amp; Repairs</td>
<td>59</td>
<td>20</td>
<td>22</td>
<td>51</td>
<td>131</td>
<td>106</td>
<td>40</td>
<td>242</td>
<td>671</td>
<td>0.07</td>
</tr>
<tr>
<td>Experimental Plots</td>
<td>399</td>
<td>136</td>
<td>58</td>
<td>72</td>
<td>144</td>
<td>18</td>
<td>829</td>
<td>662</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>Nurseries</td>
<td>332</td>
<td>288</td>
<td></td>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fork Moulding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>91,673</td>
<td>134,880</td>
<td>107,872</td>
<td>136,945</td>
<td>155,859</td>
<td>175,368</td>
<td>145,330</td>
<td>99,968</td>
<td>1,047,895</td>
<td>100.01</td>
</tr>
</tbody>
</table>
Madeleine, giving a detailed statement of the labourers employed, the Total number of labourers employed in each operation in 1927-28, was found. The percentage of the total represented by each operation was then calculated and all those over 3% were selected for further treatment.

They were:

<table>
<thead>
<tr>
<th>Operation</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handweeding</td>
<td>25.0%</td>
</tr>
<tr>
<td>Making Pen Manure</td>
<td>9.0%</td>
</tr>
<tr>
<td>Carting Canes</td>
<td>7.5%</td>
</tr>
<tr>
<td>Planting Canes</td>
<td>6.9%</td>
</tr>
<tr>
<td>Cutting Canes</td>
<td>6.4%</td>
</tr>
<tr>
<td>Draining</td>
<td>5.9%</td>
</tr>
<tr>
<td>Applying Manure</td>
<td>4.6%</td>
</tr>
<tr>
<td>Destroying Pests</td>
<td>4.3%</td>
</tr>
<tr>
<td>Picking Cane</td>
<td>4.1%</td>
</tr>
<tr>
<td>Digging Paragrass</td>
<td>3.9%</td>
</tr>
<tr>
<td>Forking</td>
<td>3.3%</td>
</tr>
<tr>
<td>Roundridging</td>
<td>3.2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>84.1%</strong></td>
</tr>
</tbody>
</table>

Making pen manure, and destroying pests were subsequently excluded, as the former is divided into a number of smaller operations, too numerous to be considered; while the latter is performed by small boys on piece work, and is therefore unsuitable for treatment. This reduces the operations considered to 70.8% of the total. On examination of the ledgers it was found that Planting was subdivided into:

- Drilling
- Preparing Land
- Planting

so for these three operations, the term Preparation and Planting has been adopted to prevent confusion.

The amount paid in wages for each of these operations from fortnight ending June 24th 1927, to fortnight ending
### TABLE II.

DISTRIBUTION OF UNITS OF LABOUR EMPLOYED ON USINE STE. MADELEINE - 4 WEEKLY - 1927-28

<table>
<thead>
<tr>
<th>Four weeks ending</th>
<th>Preparing &amp; Planting</th>
<th>Cultivation</th>
<th>Reaping</th>
<th>TOTAL FIELD</th>
<th>Preparation &amp; Cultivation</th>
<th>Field Factory Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 8</td>
<td>3,212</td>
<td>53,103</td>
<td></td>
<td>84,882</td>
<td>94,796</td>
<td>89,164</td>
</tr>
<tr>
<td>Aug. 5</td>
<td>2,674</td>
<td>49,766</td>
<td></td>
<td>99,510</td>
<td>95,362</td>
<td>110,993</td>
</tr>
<tr>
<td>Sept. 2</td>
<td>10,672</td>
<td>10,468</td>
<td></td>
<td>105,674</td>
<td>92,555</td>
<td>118,550</td>
</tr>
<tr>
<td>Sept. 28</td>
<td>12,435</td>
<td>15,339</td>
<td></td>
<td>120,090</td>
<td>125,273</td>
<td>138,128</td>
</tr>
<tr>
<td>Nov. 25</td>
<td>14,269</td>
<td>21,347</td>
<td></td>
<td>109,987</td>
<td>104,981</td>
<td>127,033</td>
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<td>Dec. 23</td>
<td>13,913</td>
<td>10,028</td>
<td></td>
<td>93,463</td>
<td>95,059</td>
<td>114,259</td>
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<tr>
<td>Jan. 20</td>
<td>14,004</td>
<td>35,831</td>
<td></td>
<td>125,832</td>
<td>124,659</td>
<td>127,839</td>
</tr>
<tr>
<td>Feb. 17</td>
<td>20,604</td>
<td>25,883</td>
<td></td>
<td>138,593</td>
<td>138,593</td>
<td>166,686</td>
</tr>
<tr>
<td>Mar. 16</td>
<td>20,785</td>
<td>22,063</td>
<td></td>
<td>125,154</td>
<td>125,154</td>
<td>153,520</td>
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<tr>
<td>Apr. 13</td>
<td>17,848</td>
<td>13,150</td>
<td></td>
<td>98,900</td>
<td>98,900</td>
<td>120,015</td>
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<tr>
<td>May 11</td>
<td>18,752</td>
<td>3,114</td>
<td></td>
<td>101,726</td>
<td>101,726</td>
<td>126,844</td>
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<tr>
<td>June 8</td>
<td>16,337</td>
<td>1,609</td>
<td></td>
<td>105,865</td>
<td>105,865</td>
<td>127,780</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>185,813</strong></td>
<td><strong>457,145</strong></td>
<td></td>
<td><strong>1,375,551</strong></td>
<td><strong>540,880</strong></td>
<td><strong>1,623,525</strong></td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td><strong>14,293</strong></td>
<td><strong>35,165</strong></td>
<td></td>
<td><strong>105,811</strong></td>
<td><strong>41,604</strong></td>
<td><strong>125,555</strong></td>
</tr>
</tbody>
</table>
June 8th 1928, was extracted for each of the sections of the estate. The figures thus acquired were divided by a factor, representing as nearly as could be estimated, the average wage earned per day, for the particular operation, and the results were tabulated. The following are the factors used:

- Draining: 80 cents
- Forking: 50 cents
- Roundridding: 50 cents
- Drilling: 50 cents
- Planting: 40 cents
- Preparing Lands: 30 cents
- Applying Manure: 30 cents
- Handweeding: 30 cents
- Digging Paragress: 20 cents
- Cutting Canes: 50 cents
- Carting Canes: 40 cents
- Picking Canes: 20 cents

The results, giving the number of labourer-days employed, fortnightly, throughout the year, from each section, were added up to give the total for the estate. (Table II.). The four weekly average of each, for the year, was calculated, with the exception of Cutting, Carting and Picking Canes, which were averaged for the six months during which they were performed. A sheet giving the total number of labourers employed fortnightly on the whole estate, was obtained, and also a sheet showing the amount paid in wages, fortnightly, in the factory and on transport, i.e., the estate railway. The last two were treated in the same manner as the figures from the ledger, the factor used being 75 cents both for factory and transport.

At this point the meaning of a unit of labour must be considered. The labour force on the sugar estate consists of men, women, and children, the two latter performing the lighter operations like handweeding, while the men do heavier work, such
as draining. No data are available, however, to show how each operation is divided amongst these, so there is no possibility of reducing the number of labourers to a common basis. Dividing the wages by a factor would give a close approximation to the number of average individuals, were it not for the fact that wages vary at different times of the year. In spite of this, however, the results may be accepted as being sufficiently accurate to show the general trend of the distribution of labour.

A graph was drawn of the Total Distribution of Field Labour fortnightly throughout the year, but as the fortnightly variation was so wide, it was, subsequently, drawn at four-weekly intervals, which gave a much smoother curve (Fig. 1). The four-weekly average for the year is shown by a broken line.

The individual operations were next grouped into Preparation and Planting; Cultivation; and Reaping; the operations being assigned to them as follows:-

**Preparation and Planting:**
1. Preparing Lands.
2. Drilling
3. Planting

**Cultivation:**
1. Roundridging
2. Working
3. Applying Manure
4. Draining
5. Digging pargrass
6. Weeding

**Reaping:**
1. Cutting
2. Carting
3. Picking

The graphs of these groups and their average, were then drawn along with the total, on Fig.1. It must be noted, however,
that these include only 70.8% of the total.

In order to show how labour was distributed on each operation throughout the year, histograms were constructed of the details of each of the three foregoing groups, at four-weekly intervals. (Figs. 3, 4, & 5). Fig. 2 is a graph of Preparation and Planting added to Cultivation, along with the graphs of Reaping and the total distribution, in order to show how each predominates at different seasons. The difference between Preparation and Planting and the Total in the first half of the year, represents the sum of those items not considered. In Fig. 6 graphs are shown of the distribution of Transport, Factory, Total Field Labour units, and the Total of Field, Factory and Transport labour units, at four-weekly intervals. This is intended to show the relative amounts of labour used by each, and how they affect each other.

The monthly rainfall figures of the Usine Ste. Madeleine were procured from the St. Clair Experiment Station, and were graphed along with the Total Distribution of Field labour, to see if there was any correlation between the two, but as they obviously bore no relation to each other the graphs are not shown.

B. Caroni Estate.

The data from Caroni were obtained from the weekly abstracts, returned by each of the five sections of the estate. As the year at Caroni starts on January 1st the abstracts for January 1st to December 31st 1927 were used. These are single forms, giving on one side details of the operations performed every day during the previous week, while on the other, this is summarised, and the amount paid in wages, and the number of labourers employed, is entered for each operation. The number of labour units employed weekly on the following operations was tabulated for each section, and the sections were added to give
### TABLE III.

**DISTRIBUTION OF UNITS OF LABOUR EMPLOYED ON CARONI ESTATE - 1927 - FOUR WEEKLY.**

<table>
<thead>
<tr>
<th>Four weeks ending</th>
<th>Banking</th>
<th>Outlassing</th>
<th>Planting</th>
<th>Supplying</th>
<th>Weeding</th>
<th>Digging</th>
<th>Parassing</th>
<th>Draining</th>
<th>Applying</th>
<th>Manure</th>
<th>Forking</th>
<th>Making</th>
<th>Pen Manure</th>
<th>Cutting</th>
<th>Carting</th>
<th>Canes</th>
<th>Loading</th>
<th>Canes</th>
<th>Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 29</td>
<td>2</td>
<td>164</td>
<td>-</td>
<td>251</td>
<td>9,694</td>
<td>3,446</td>
<td>336</td>
<td>1,300</td>
<td>2,932</td>
<td>1,398</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>631</td>
</tr>
<tr>
<td>Feb. 26</td>
<td>43</td>
<td>1,606</td>
<td>75</td>
<td>625</td>
<td>6,911</td>
<td>3,714</td>
<td>109</td>
<td>371</td>
<td>2,627</td>
<td>1,330</td>
<td>1,026</td>
<td>941</td>
<td>240</td>
<td>677</td>
<td>1,746</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Mar. 26</td>
<td>559</td>
<td>1,279</td>
<td>698</td>
<td>837</td>
<td>2,411</td>
<td>2,887</td>
<td>24</td>
<td>-</td>
<td>1,232</td>
<td>1,448</td>
<td>4,290</td>
<td>3,553</td>
<td>749</td>
<td>1,746</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Apr. 23</td>
<td>364</td>
<td>335</td>
<td>706</td>
<td>103</td>
<td>3,915</td>
<td>2,483</td>
<td>55</td>
<td>-</td>
<td>1,076</td>
<td>1,541</td>
<td>5,161</td>
<td>1,154</td>
<td>1,140</td>
<td>1,778</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td></td>
</tr>
<tr>
<td>May 21</td>
<td>279</td>
<td>156</td>
<td>329</td>
<td>43</td>
<td>1,739</td>
<td>2,845</td>
<td>160</td>
<td>-</td>
<td>1,577</td>
<td>1,293</td>
<td>3,897</td>
<td>4,129</td>
<td>983</td>
<td>1,654</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>June 18</td>
<td>420</td>
<td>54</td>
<td>536</td>
<td>6,399</td>
<td>2,995</td>
<td>1,136</td>
<td>278</td>
<td>437</td>
<td>1,396</td>
<td>329</td>
<td>863</td>
<td>298</td>
<td>359</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td></td>
</tr>
<tr>
<td>July 16</td>
<td>224</td>
<td>246</td>
<td>111</td>
<td>893</td>
<td>12,970</td>
<td>3,991</td>
<td>2,726</td>
<td>1,543</td>
<td>1,739</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>70</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Aug. 13</td>
<td>874</td>
<td>583</td>
<td>699</td>
<td>873</td>
<td>6,523</td>
<td>3,142</td>
<td>3,022</td>
<td>787</td>
<td>-</td>
<td>1,987</td>
<td>-</td>
<td>90</td>
<td>201</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Sept. 10</td>
<td>1,844</td>
<td>1,600</td>
<td>1,707</td>
<td>167</td>
<td>5,459</td>
<td>3,559</td>
<td>2,705</td>
<td>801</td>
<td>1,421</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,028</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Oct. 8</td>
<td>3,263</td>
<td>2,104</td>
<td>1,520</td>
<td>258</td>
<td>8,423</td>
<td>4,443</td>
<td>3,449</td>
<td>832</td>
<td>1,291</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,066</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Nov. 5</td>
<td>3,547</td>
<td>2,119</td>
<td>2,131</td>
<td>819</td>
<td>8,583</td>
<td>4,997</td>
<td>2,820</td>
<td>1,061</td>
<td>1,423</td>
<td>1,423</td>
<td>1,423</td>
<td>1,423</td>
<td>1,423</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Dec. 3</td>
<td>1,953</td>
<td>1,695</td>
<td>1,307</td>
<td>807</td>
<td>7,071</td>
<td>3,733</td>
<td>2,472</td>
<td>1,136</td>
<td>1,297</td>
<td>1,297</td>
<td>1,297</td>
<td>1,297</td>
<td>1,297</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Dec. 31</td>
<td>45</td>
<td>1,131</td>
<td>103</td>
<td>1,522</td>
<td>6,922</td>
<td>3,622</td>
<td>1,140</td>
<td>987</td>
<td>1,175</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2,217</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td>1,004</td>
<td>9,701</td>
<td>724</td>
<td>604</td>
<td>6,734</td>
<td>3,512</td>
<td>1,550</td>
<td>600</td>
<td>951</td>
<td>1,439</td>
<td>2,945</td>
<td>2,834</td>
<td>684</td>
<td>1,017</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE III (continued)

<table>
<thead>
<tr>
<th>Four weeks ending</th>
<th>Factory</th>
<th>TOTAL</th>
<th>Preparation &amp; Planting</th>
<th>Cultivation</th>
<th>Reaping</th>
<th>Field Work</th>
<th>Factory Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan. 19</td>
<td>3,294</td>
<td>21,864</td>
<td>568</td>
<td>19,736</td>
<td>2,207</td>
<td>25,789</td>
<td>-</td>
</tr>
<tr>
<td>Feb. 26</td>
<td>3,641</td>
<td>24,239</td>
<td>2,351</td>
<td>15,728</td>
<td>3,552</td>
<td>26,558</td>
<td>-</td>
</tr>
<tr>
<td>Mar. 26</td>
<td>8,125</td>
<td>25,596</td>
<td>3,373</td>
<td>9,696</td>
<td>11,007</td>
<td>35,467</td>
<td>-</td>
</tr>
<tr>
<td>Apr. 23</td>
<td>8,942</td>
<td>24,552</td>
<td>1,503</td>
<td>12,288</td>
<td>9,009</td>
<td>35,372</td>
<td>-</td>
</tr>
<tr>
<td>May 21</td>
<td>6,955</td>
<td>21,494</td>
<td>827</td>
<td>23,162</td>
<td>9,216</td>
<td>30,109</td>
<td>-</td>
</tr>
<tr>
<td>June 18</td>
<td>2,743</td>
<td>20,143</td>
<td>1,012</td>
<td>13,105</td>
<td>1,490</td>
<td>23,148</td>
<td>-</td>
</tr>
<tr>
<td>July 16</td>
<td>1,372</td>
<td>20,586</td>
<td>1,541</td>
<td>23,162</td>
<td>28,037</td>
<td>25,879</td>
<td>-</td>
</tr>
<tr>
<td>Aug. 13</td>
<td>2,000</td>
<td>23,559</td>
<td>2,328</td>
<td>15,963</td>
<td>25,454</td>
<td>24,204</td>
<td>-</td>
</tr>
<tr>
<td>Sept. 10</td>
<td>1,846</td>
<td>22,157</td>
<td>5,669</td>
<td>14,188</td>
<td>31,254</td>
<td>35,264</td>
<td>-</td>
</tr>
<tr>
<td>Oct. 8</td>
<td>2,362</td>
<td>28,766</td>
<td>7,413</td>
<td>18,840</td>
<td>35,264</td>
<td>30,050</td>
<td>-</td>
</tr>
<tr>
<td>Nov. 5</td>
<td>2,540</td>
<td>31,656</td>
<td>9,156</td>
<td>19,021</td>
<td>30,050</td>
<td>28,297</td>
<td>-</td>
</tr>
<tr>
<td>Dec. 3</td>
<td>3,014</td>
<td>25,418</td>
<td>5,024</td>
<td>15,936</td>
<td>367,866</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dec. 31</td>
<td>2,771</td>
<td>20,070</td>
<td>3,271</td>
<td>15,471</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>49,612</td>
<td>314,212</td>
<td>44,869</td>
<td>198,440</td>
<td>32,316</td>
<td>367,866</td>
<td>-</td>
</tr>
<tr>
<td><strong>AVERAGE</strong></td>
<td>3,816</td>
<td>24,225</td>
<td>3,451</td>
<td>15,264</td>
<td>6,455</td>
<td>28,297</td>
<td>-</td>
</tr>
</tbody>
</table>
The totals of the estate (Table III.). The four weekly average for the year of each item and group was calculated, except in the case of Reaping which was averaged for the five months during which it took place.

- Weeding
- Digging Paragrass
- Banking
- Applying Manure
- Making Pen Manure
- Forking
- Planting
- Supplying
- Cutlassing
- Draining
- Roundriding
- Cutting Canes
- Carting Canes
- Loading Canes

Livestock Cultivation

- Subsoiling

Livestock Cultivation, Subsoiling and Roundriding were subsequently omitted, as the amount of labour expended on them was small compared with the other items. Draining is done by contract, so no figures were given of the number of labourers employed. These were, therefore, obtained by dividing the amount spent on wages for draining, by 80 cents, being the approximate average wage of a drainer per day. The number of labourers employed weekly in the factory, and on transport was found from the weekly abstracts, as well as the Total Field labour distribution for the estate.

Graphs were made of the Total distribution of labour four-weekly, the distribution of Preparation and Planting; cultivation; and Reaping; with their averages shown by means of...
The operations are distributed among these groups as follows:

**Preparation and Planting:**
1. Cutlassing
2. Banking
3. Planting
4. Supplying.

**Cultivation:**
1. Weeding
2. Digging Paragras
3. Draining
4. Applying Manure
5. Forking

**Reaping:**
1. Cutting
2. Carting
3. Loading.

The amount of labour employed on these operations will be found on the charts in Figs. 8, 9 & 10. The distribution of labour employed in the Factory, on Transport, in Cultivation, and the Total of these three is shown in Fig.11.

As with the Usine Ste. Madeleine, attempts to correlate rainfall with the distribution of Total Field labour proved a failure.

Before proceeding to investigate this data, it would be well to explain shortly, the main characteristics of the two estates concerned.

The Usine Ste. Madeleine is situated in the Naparima district, in the south-west of the island, and covers 24,500 acres, which is about one-third of the total area of sugar estates in the colony. The contour of the land is hilly, which
makes cultivation difficult. The soils vary, from a fertile but fairly heavy loam, to raw, infertile and heavy clays. Some of these being highly acid suffer considerably from Froshopper blight. About 40% of the cane are grown by cane farmers and the rest by the estate. In 1928 the average yield on the estate was 15.4 tons per acre, and 9.4 tons of cane were required to produce one ton of sugar.

Caroni Estate occupies about 6,000 acres of land on the flat fertile Caroni plain. It has a heavy soil, which is liable to suffer from flooding. About half the weight of canes crushed is grown by the estate. In 1928, 12.9 tons of cane were grown per acre and 11.0 tons were required to produce one ton of sugar.

The seasons in Trinidad are divided into a Rainy season from June to December, and a Dry season from January to May. It is during the latter that the cane crop is reaped, the crop season lasting as a rule for about 5 months. There is then a gradual fall, which becomes more marked during the crop season, and a rise again after crop is over.

The graph of the distribution of labour employed on Reaping shows a marked peak at the beginning of crop, and one at the end. This is due to the fact that for the first few weeks of crop, no farmers cane is accepted, to ensure its being sufficiently ripe, so all farmers are employed cutting estate cane. The amount of labour employed by the estate drops, when farmers start reaping their own cane, and reaches a minimum in April. It gradually rises again as farmers canes are reaped, and some come back and work for the estate.

Shortage of labour is complained of, chiefly, during the crop season from the end of January to the beginning of June. This is due directly to lack of sufficient labourers who are able and willing to work. There is another period of shortage which lasts for two or three weeks, any time from the end of July to the beginning of September. This is caused by the East
INTERPRETATION OF DATA.

After the graphs and charts had been drawn, visits were paid to the estates concerned, and the data discussed with the respective field managers, and other officials.

A Usine Ste. Madeleine.

The graph of the distribution of Total Field Labour, (Fig.1) shows a general rise from July to September, with a fall to the end of the year, when it rises again during the crop season. It exceeds the average only in September, October, February and March.

The Preparation and Planting curve rises to September, and then falls to January, after which little more planting is done till the next July. The Planting season was extended in 1927 owing to wet weather, but it is usually finished in November.

The distribution of Cultivation labour units shows a slight rise to September, following a slight depression. There is then a gradual fall, which becomes more marked during the crop season, and a rise again after crop is over.

The graph of the distribution of labour employed on Reaping shows a marked peak at the beginning of crop, and one at the end. This is due to the fact that for the first few weeks of crop, no farmers cane is accepted, to ensure its being sufficiently ripe, so all farmers are employed carting estate canes.

The amount of labour employed by the estate drops, when farmers start reaping their own cane, and reaches a minimum in April. It gradually rises again as farmers canes are reaped, and some come back and work for the estate.

Shortage of labour is complained of, chiefly, during the crop season, from the end of January to the beginning of June. This is due directly to lack of sufficient labourers who are able, or willing, to work. There is another period of shortage which lasts for two or three weeks, any time from the end of July to the beginning of September. This is caused by the East
Indian coolies staying at home, to plant rice. Its time and duration are controlled by the weather conditions in each particular year. It affects some sections of the estate more than others, especially those situated near the low lying Oropouche district. A third factor causing shortage of labour, is the labour demands of the oilfields. This fluctuates greatly, and operates only when some special work is being carried out by them. The higher pay attracts labour, temporarily, from the sugar estates, and the labourers are unwilling to return at a lower wage. As a factor in the labour shortage, however, it is too variable to warrant further consideration.

It will be seen (Fig.2) that the shape of the graph of Total Field labour units is controlled largely, during the crop season, by the units expended on Reaping. During the rest of the year, the total is made up of Preparation and Planting, and Cultivation, only, of which the major portion is Cultivation. Thus the dry season is the crop season, while the wet season is devoted to cultivation and planting. In each of these periods, a shortage of labour occurs. The fall in the curve of Total Field Labour units in January indicates a break between the end of one period and the beginning of the next. The decline in number of labour units towards the end of the calendar year, is due, partly to a decrease in the amount of work to be done, and partly, to financial stringency, in an attempt to keep within the estimates. Just before crop extra labourers may be employed to cope with the sudden increase of work, so that non essential work is often performed, merely to keep the gang together.

Fig. 3 shows the four-weekly distribution of the operations comprising Preparation and Planting. Except for a little dry season planting about May, this is confined to the period between August and December. Drilling takes slightly more labour than preparing lands, or planting - an average of 2,609 units as against 2,107 and 1,724 units respectively. The three
appear to bear some relation to each other, as, when one item is high, the others are usually high also.

The four-weekly distribution of labour-units expended on Cultivation will be found in Fig. 4. The preponderance of weeding in this is most striking, and it must be made clear what it comprises. Weeding is used, roughly, to mean any operation which is performed by a hoe. It includes breaking banks, but, as this is accompanied by weeding proper, the two are not separated in the returns. The period from April to September or October is occupied by weeding plant canes, and ratoons, while banks are broken from September to March. The two divisions of the operation actually overlap considerably. It will be observed that more weeding is done in the Rainy season, than the Dry season, the amount in the Rainy season being 70% of the total weeding done in the year.

Digging Paragrass is done fairly regularly throughout the year, chiefly when other work is well in hand, and labour is plentiful.

Draining is confined almost entirely to the Rainy season because the ground is too hard in the Dry season.

Manure is applied half when the land is subsoiled, and half at the breaking of banks. When the land is ploughed, however, subsooling is not done, and all the manure is applied when the banks are broken.

The distribution of forking, like the last, is dependent upon the growth of the cane.

Roundridging, when done by hand, is confined to the Rainy season as the ground is too hard in the Dry season. A road grader has recently been used, which enables it to be done in the Dry season.

The chart showing the distribution of labour units for Reaping (Fig. 5) indicates that carting is the largest item, with an average of 19,415 units as against 11,569 units for cutting.

It includes the loading of Carts.
Fig. 6 shows the relation between Transport, Factory, Field, and Total Labour Units on the Estate. Both Transport and Factory form a very small percentage of the Total Labour units and are surprisingly constant in amount throughout the year. The shape of the Total Labour graph is thus almost entirely governed by the shape of that of the Total Field Labour. The reason that the number of units of labour employed in the factory is so large during the Rainy season as compared with the crop season, is that the labourers are employed overhauling machinery. There is no flow of labour from the Factory to the field in the Rainy season. Similarly, in the Rainy season, the Transport labourers are employed in overhauling rolling stock and cleaning railway lines; and, in the present year, in constructing an extension of the railway. Cleaning railway lines may occasionally take labour from some of the sections of the estate, during the wet season, but this amount is small.

B. Caroni Estate.

The four-weekly distribution of the Total Field labour units at Caroni is shown in Fig. 7. The fall in the graph from April to June is not normal, and is due to an exceptionally wet season. The normal graph would run more or less straight across, so that there would be little or no rise from April to July. From July a fall down to September is shown, which is due to Rice planting, and the number of units reaches a maximum in November. The Preparation and Planting curve shows this group of operations to be performed chiefly from July to December - the Rainy season. The maximum is in November, and it is to this that the peak in the Total Field labour curve is largely due. The planting which is shown from February to April, is chiefly on old cocoa lands, which are being put into sugar, and would not normally recur. The graph of the distribution of Cultivation labour units, would normally approximate more closely to the yearly average, in March,
April, May, and in July, so that it would be lowest during the crop season and highest about November. It is to this irregularity that the deviation from the normal of the Total Field labour units is due. It will be noted, that cultivation continues throughout the crop season.

The distribution of labour units expended in Reaping, rises from February to a maximum in April, and falls again to June.

The only shortage of labour complained of at Caroni, is during the Rice season, between July and September. The shortage is more acute than at the Usine Ste. Madeleine, because the flat low lying land round Caroni is eminently suited for rice, so that relatively more is grown. For some reason, as yet unknown, there was no shortage of labour during the rice planting season of 1928. The coolies are usually absent for a brief period about November for harvesting their rice, but no shortage is felt, as owing to slight differences in time of ripening, and the fact that less labour is required, they are not all absent at the same time. There appears to be no shortage of labour, at Caroni, during the crop season.

The details of the Preparation and Planting graph will be found in the histogram - Fig. 8. It will be seen that banking, which corresponds to drilling at the Usine Ste. Madeleine, occupies most labour. The most striking item is supplying, (7,846 units) which nearly reaches Planting (9,441 units) in its labour requirement. It must be pointed out, however, that supplying requires more labour per stool planted than Planting, because the labourer has further to walk, and much of it is done in the Dry season, when making the holes is harder work and takes longer.

As with the Usine Ste. Madeleine, weeding is the most important item among the details of Cultivation labour units (Fig. 9). It accounts for nearly 28% of the Total Field labour units, but unlike the Usine Ste. Madeleine, only 56% of this is done in the Wet season. The peak in the graph in July, is
caused, mainly, by weeding. It is of course divided into weeding proper and breaking banks, the latter of which is done from September to January. The remarks made about digging paragrass, draining, applying manure, and forking, at the Usine Ste. Madeleine apply, also, here.

The amount of roundriding done is not sufficient to merit consideration. This is because the beds remain in the same position for a number of years, whereas at the Usine Ste. Madeleine they are usually moved, so that the centre of the new bed comes into the position previously occupied by a drain.

The chief item in the detailed chart of labour units expended on Reaping (Fig. 10) is cutting canes, with an four weekly average of 2,945 units. It is closely followed by carting with 2,834 units. Loading applies to loading estate railway trucks and not carts.

Fig. 11 indicates the relations borne by the Total labour of the estate, Total Field, Factory, and Transport labour units. The graph showing the Total Labour of the estate, follows closely that for Total Field labour, except during the crop season, when it is modified by the labour employed in the Factory. The latter shows a marked rise during crop time, but it is fairly even throughout the rest of the year.

The Transport graph shows a slight rise during crop and also at the end of the year. The latter is due to overhauling and preparation for the crop season.

The following are the chief operations being performed
DISCUSSION AND CONCLUSIONS.

It is now clear that two distinct periods of shortage must be considered,

(a) during the crop season,

(b) at rice planting.

The ultimate causation of each of these differs widely. The crop season shortage is caused by the extra amount of work the estate has to perform, and the lack of sufficient labourers who will undertake such work. The shortage during the rice planting season, on the other hand, is due not to any extra work to be done by the estate, but to the fact that a large proportion of the labourers usually available, will not work on the estate, at this time. The latter is the more difficult shortage to deal with because, its incidence is so brief:

There are certain precautions which must be observed, in seeking to substitute mechanical for hand labour. It must be borne in mind, that, as a general rule, East Indian and West Indian labourers will only work, when necessity compels them to do so. Thus the population from which labour for the sugar estates is drawn, will become stabilised, round each estate, at such a level, that each family can earn sufficient to satisfy its standard of living. This level is sufficient to fulfill the ordinary labour requirements of the estate, but is unable to cope with periods of pressure, e.g. the crop season. Anything, therefore, which tends to lower this level by reducing the labour requirements evenly throughout the year, would merely accentuate the already drawn on reserve, and could not remove the shortage at busy periods. It is assumed that labour so released, would seek employment elsewhere, but should any of the extremely difficult, and there is also the danger that in doing so, the problem of unemployment would have to be faced. Substitution of mechanical for hand-labour should, therefore, be confined to those times when shortage occurs.

The following are the chief operations being performed...
on the two estates during the rice planting season in August

Usine Ste. Madeleine
- Preparing Lands
- Drilling
- Planting
- Weeding
- Digging Paragrace
- Draining
- Applying Manure
- Forking
- Roundridging

Caroni
- Cutlassing
- Banking
- Planting
- Supplying
- Weeding
- Digging Paragrace
- Draining
- Applying Manure
- Forking
- Making Pen Manure

In addition during the crop season, at the Usine Ste. Madeleine the following are the main operations:
- Cutting
- Carting
- Picking

Each of these items will be examined in turn, to see how far mechanical methods may be applied to it.

Before doing this, however, mention must be made of one of the main difficulties in the way of mechanical tillage in Trinidad - the field drainage system. The drains are open ditches about 1 foot wide by 9 to 18 inches deep which run across the field at intervals of 25 feet and divide it into beds. These slope towards the drains, and ridges or banks are usually drawn up across them, so that water runs off freely to the drains. The passage of implements across these is extremely difficult, and there is also the danger that in doing so, the sides of the drains may be broken down.

Cutlassing, or preparing lands can only be done by hand. It consists of cutting grass and weeds on the beds, before drilling. Where traces are being cutlassed, however, a
Drilling or banking consists of digging out old cane stools, and making the banks between which the cane is planted. As mentioned before, it is usual to make these across the bed, by hand. Drilling the land in the same direction as the drains, by means of steam tackle or tractor ploughs, has been tried, but has not been satisfactory. The drill plough cannot work close to the drain, and the space left is wasteful of land. A more serious drawback is, that the ridges hinder the free flow of surface water to the drains, and the soil becomes waterlogged, causing plants to die, and increasing the amount of supplying to be done. At Caroni, the extra cost of supplying, and the extra amount of labour employed have been proved to be more than could be saved by mechanical drilling; and the same is true at the Usine Ste. Madeleine. As an emergency measure, if labour became exceptionally scarce, it might be worth while, on the lighter types of soil, to drill along the beds. This method is usually quite safe in dry season planting, because the amount of rain is insufficient to cause waterlogging, and, before the wet season has far advanced, the banks are broken and the beds levelled, so that free draining is possible. A modification of this method is drilling by machinery along the centre of the bed, and banking across it, by hand, at the sides. This is, at best, a compromise and cannot save a great deal of labour, while to a certain extent it restricts drainage. When the banks are drawn up across the bed the plants may be spaced at regular intervals in the banks, so as to form rows along the bed, between which interculture may proceed. Something may be devised in the future is an open question, but
the variation in the size of the setts would prove a serious difficulty.

Supplying is done to a greater extent at Caroni, than at the Usine Ste. Madeleine, where it is almost negligible. This suggests that soil conditions may be an important factor in regulating this operation. If the setts can be planted in good tilth, where drainage is good, the amount of supplying should be less than in heavy soils, liable to waterlogging. Where the latter is the case, it may be desirable to bring the drains closer together, but this is a matter for each estate to decide for itself. Supplying is an operation which ought not to be necessary, except in small amounts, if due care is taken in the selection and planting of the setts and the proper cultivation of the land.

At present weeding is done entirely with the hand hoe, as there is said to be a danger of spoiling or destroying young cane by implements. It seems possible, however, that a mule plough might be used to break the banks. This could be followed up before the canes got too large by a mule-drawn cultivator between the rows, which would leave only the weeding between the plants to be done by hand. By the time the plants had grown too large for the use of a mule cultivator, they would form enough shade to suppress the growth of weeds. This would of course entail planting at regular intervals, and would be dependent on the ground being sufficiently dry, during the Rainy season, for the use of mules.

Digging Paraggrass is done with a fork. The problem is very similar to the eradication of couch grass in Britain, and the same methods might be applied to it, as are used there. The beds could be thoroughly grubbed to bring the stolons of the grass to the surface and the latter collected by harrow and burnt. Whether this would be an economic proposition or not, would depend on the extent of labour shortage. If labour is scarce,
digging grass is usually left till such time as it becomes more plentiful. The point may eventually be reached, however, when labour cannot cope with it; and, if cane yields are not to be reduced, it may become necessary to introduce some such mechanical method.

Draining is the most expensive of all the field operations, so that, apart from the saving of labour, saving of cost would be an important consideration. Several attempts have been made to devise a suitable machine, but so far nothing satisfactory has been forthcoming. The difficulty is the heavy nature of the soil, which demands great strength, and the depth to which the drains have to go. The use of ploughs to cut out a furrow, helps to lessen the work of the drainers. A road grader, which is used for roundridding has proved useful at the Usine Ste. Madeleine in cutting a shallow drain for dry season planting; this can be deepened by hand, the saving of labour, therefore, being considerable.

Applying manure is usually done by hand, as the manure is spread round each stool, when the banks are being broken. Where artificial manure is being applied, the possibility of doing this just before planting, should be considered, as it could then be done, by means of a manure distributor, with great saving of labour.

Forking is a hand cultivation between the cane stools. It can only be done by hand, as no implements could till the land at the time, without damaging the stools. It is not, however, done in all fields, as it is unnecessary when the land has been ploughed before planting.

Roundridding only requires to be done when beds are being made afresh. When the land is ploughed, much labour is saved by turning the furrows away from the drains, towards the centre of the bed, thus giving the land a preliminary rounding. At the Usine Ste. Madeleine, in the last year or two, a road grader has been used for roundridding with much success. (Plate I.)
Plate I.

Road grader at Usine Ste. Madeleine has tilting wheels, and other adjustments, which enable the blade to be set at any angle. The blade has an extension, which can, as already mentioned, be used for scooping out a shallow drain. In addition to roundriding, the machine has a beneficial effect in breaking down clods and putting a fine tilth on the surface. (Plate II.) It is also useful for making roads and traces. The chief drawback to the use of this implement is its high cost, with which is coupled the fact, that it must lie idle for the greater part of the wet...
season.

In making Pen Manure the stock are usually kept in yards near the Factory. This means that cane trash for bedding must be carted into the Factory, and the finished pen manure carted back to the fields again. To overcome this duplication of labour, field pens are being experimented with at Caroni. Cattle pens are erected at the edge of a field, and a chaff cutter and blower, driven by a small tractor, is taken from pen to pen to chop the cane trash, as it decomposes quicker in small pieces than when whole. (Plate III.) When ready the manure is carted out and spread on adjacent fields. It is possible, however, that leaching of its soluble constituents, will deprive the manure of much of its value, so that field pens will be most useful during the dry season. Portable shelters might be used, however, and taken from field to field as required. A certain amount of seepage, however, is inevitable and will cause a rank growth of cane, at the place where a pen has been situated. It is uncertain what effect such open air conditions will have on the health of the animals.

With the extended use that is being made of machinery, in field operations, fewer animals are required for draught

Plate III.

Chaff-cutter at work at Caroni.
purposes. This means that less manure will be available for the land, but the difficulty could in some cases be overcome by keeping a dairy, as at the Usine Ste. Madeleine. The labour requirement of this is comparatively small and is constant throughout the year. The sale of dairy products either as fresh milk, butter, cheese or condensed milk, should pay for the cost of the dairy, while the manure would be available for the land, free. Draught animals, at present, spend most of their energies during the wet season in carting their own fodder and bedding, so this waste would be avoided. Synthetic methods of making pen manure, such as Adco, may be useful both in increasing the amount of manure available and in reducing labour requirements.

No means of cutting cane mechanically has been found so far, and although a machine for doing this is desired, there are several practical difficulties in the way. The cane is so tough

Plate IV.

Reaping Cane at Caroni.

and fibrous, that any cutting machine with a knife, would require to have the blade constantly resharpened. This difficulty might, however, be overcome by means of a coarse toothed oscillating saw. The top of the canes must be cut off, and no machine could adjust itself to varying heights of individual canes. If the machine were adjusted to top the shortest canes, the waste of the longer
ones would be enormous, while if it cut any higher some tops
would be left and would cause trouble in the factory. It is
usual, also, to cut some of the trash off the cane when topping.
It might be possible for the cane to be topped and trashed by
hand, and then cut by machinery, but it is doubtful, if the
small amount of labour saved, would be much more than that re-
quired to manipulate the machinery.

Carting canes is one of the operations which seems most
suited for mechanisation. At present it is done chiefly by
mule carts, pulling a load of about a ton, and bullock carts with
two buffaloes drawing 30 cwt's. The distance which canes have to
be carted, varies considerably with each field, according to the
amount and layout of the estate railway. If less labour could

Plate V.

Loading Canes on to Railway
Trucks at Caroni.

be used for carting, the surplus would be available for cutting
and, as the railway organisation is usually capable of dealing
with the supply of canes, it is clear that carting is the limit-
ing factor in keeping the factory supplied. On the other hand, the canes should not lie too long at the factory, or they will deteriorate and lose in sugar content, so that a regular, constant supply, is what is required. At present, on some estates, this necessitates that the available field staff work at full pressure, and if for any reason they fall behind, they have not the means of overtaking the work, as they have no reserve serves on which to call. With mechanical carting and sufficient cutters, it should be possible to keep the factory supplied, without undue trouble. Tractors are used for drawing the carts. The mechanisation of carting is at present receiving some attention, particularly at the Usine Ste. Madeleine, and some advance has been made. As in other operations the field drains have proved a stumbling block. Roadless traction carts with caterpillar wheels, hauling 3 and 6 tons were tried. Although they proved useful for carting manure, and other wet season work, in the dry season, it was found that they could not withstand the hard conditions of the ground, and the pins joining the sections of the caterpillar became worn, and had to be replaced. In future it may be possible to construct the pins of some more durable metal. Caterpillar wheels, which have large rear wheels about 5 feet in diameter, and front wheels with a diameter of 2½ or 3 feet. The latter can swivel only for a short distance, but the cart has a long hitching bar. The cart is divided into compartments by wooden uprights, and, owing to the high wheels, the rear portion must be loaded from behind, while the front part is loaded from the side. The carts are constructed to carry 3 tons of cane. A type of four wheeled cart is at present being tried, which has eight wheels arranged in pairs. The two pairs of wheels at each end are borne on stub axles, which support the cart by a system of short girders. The rear wheels measure about 3½ feet in diameter, and the difficulty of hitching would be obviated.
feet in diameter, and front wheels 2 feet. The latter are capable of swivelling round in a complete circle, thus enabling the cart to be turned easily on a bed. The eight wheels enable the cart to cross drains, and traverse rough land with ease, as there are always four wheels on the ground. The body is divided, by uprights, into 3 compartments, each holding a ton of cane, and each furnished with a chain, on to which the canes are built, so that the bundles of canes can be lifted, complete, by a derrick. The canes are loaded from the side, across the cart. Five ton Holt caterpillar tractors are used for drawing the above types of cart, from the field to the point where the canes are loaded on to the estate railway waggons. The five ton tractor draws two carts, and while one pair is being hauled away, the other is being loaded in the field. During loading of the cart is drawn along the bed by means of a buffalo, because, if the tractor were used for this, time would be wasted standing still in the beds.

Five ton Holt caterpillar tractors are used for drawing the above types of cart, from the field to the point where the canes are loaded on to the estate railway waggons. The five ton tractor draws two carts, and while one pair is being hauled away, the other is being loaded in the field. During loading of the cart is drawn along the bed by means of a buffalo, because, if the tractor were used for this, time would be wasted standing still in the beds.

There are one or two problems in connection with mechanical carting, which still require solution. At present, each cart is drawn separately from the bed, and the two hitched together on the trace. This presents a difficulty, as it necessitates backing the tractor and one cart, and, since tractor hitches can only be constructed for forward draught, much time is wasted. The best way found so far, of overcoming this difficulty is to pass a wire rope from the tractor, underneath No. 1 cart on to No. 2, which can then be drawn on to No. 1 and the coupling effected. It may be worth while to fix pulleys or guides, to carry the rope underneath No. 1 cart. The eight wheeler carts are rather more difficult to hitch than the four wheelers, as they have a shorter drawbar.

Another problem is concerned with the most economical size of cart. A 6 ton cart might be used, and would require fewer journeys to and from the field. It could be drawn singly by a tractor, and the difficulty of hitching would be obviated.
On the other hand a heavy cart would damage the cane stools, thereby spoiling the next year's ratoons. It would require a tractor to pull it along the cane beds during loading, as it would be too heavy for a pair of bullocks, and a team would be too difficult to manage. At the other extreme, six one-ton carts might be used, but the difficulty of hitching would be too great. Thus a compromise has been reached, in the 3 ton size.

To save labour in loading carts the cut canes should be piled in rows, along the edges of the beds, and the carts drawn between them. This is difficult to effect, as labour is unwilling to depart from its usual custom of leaving the canes lying untidily.

It has been calculated that the carts must bring in 50 tons of cane a day to make them a financial success. So far this figure has not been reached in the experiments, but there is reason to hope that with more experience, and greater efficiency in loading, and managing the carts, this amount will be reached and exceeded.

Picking consists of cleaning up the field, and collecting canes which have been left, after carting. It seems, that if loading were done more efficiently, less labour would be required for picking, so that the loaders should be educated to be more efficient.

There are certain operations and devices, not mentioned in the foregoing list, which can effect a saving of labour and of these, ploughing is perhaps the most important. Until the advent of power machinery, no ploughing was done on the sugar estates. The beds were roundridged and banked, and the trenches for the cane, between the banks, were fork subsoiled. This was merely a further deep cultivation, as the true subsoil was seldom reached. Later in the season, after the banks were broken, the land was forked. This system is still used by cane farmers
and on modern estates, it goes on side by side with mechanical tillage.

In Trinidad two main types of mechanical tillage are in use. At Caroni, and the flat lands of the Caroni plain, Fowler's steam cable tackle is used. (Plate VI.) This is of the two engine type, and, as well as ploughing, harrowing, discing, and other cultivations can be performed by it.

Steam Engine Ploughing at Caroni.

Harrowing by Steam Cable at Caroni.

The sagging of the cable on the ground sets a limit to the length which the plough can travel between the engines, and
this necessarily limits one dimension of the field. If it is desired to plough the field in two directions, both length and breadth will be limited. In the past, the steam engine has been used to wind the cable, but recent developments indicate that it will be supplanted, sooner or later by the Diesel crude oil engine. The latter has now reached such a high standard of efficiency, that it can perform the work of a steam engine at less cost. The crude oil, on which it runs, should be cheap and easily procurable in Trinidad.

The other type of mechanical tillage is by direct traction with motor tractors, such as is employed at the Usine Ste. Madeleine, where the land is too hilly for cable tackle to work satisfactorily. 5 ton and 10 ton caterpillar tractors have been found the most successful, because the caterpillar, as well as gripping the land better than wheels, can surmount obstacles such as drains. The type of plough used with these is a heavy disc plough, and appears to be stronger and gives better results than the mouldboard type. The plough cannot turn a furrow uphill, so where fields are situated in a valley, or on the tops of hills the tractor and plough make a circle of the field, turning the furrow downhill. When, however, the slope is in one direction, a knifer is used, which consists of tines mounted on a platform, like a heavy grubber. (Plate VIII.)

Plate VIII.

Knifer at work with Holt tractor at Usine Ste. Madeleine.
These are drawn through the ground, and tear up the soil without turning it over.

When ploughing has been done, it is customary to dispense with the operations of subsoiling, and forking. Ploughing stirs the soil to a greater depth than subsoiling, and its effects are sufficiently lasting to make forking unnecessary. Not only is there great saving of labour in these operations alone, but the value of the cultivation, in improving the land, and in yielding better crops, is considerable.

There is another form of tillage which so far has scarcely proceeded beyond the experimental stage, viz: Rotary Tillage. It depends on the action of a number of revolving blades or tines, which pass through the soil and stir it up. The blades may be driven either from the land wheels or by an engine. It is claimed for this type of implement, that, since the tines revolve in the same direction as the implement is drawn, the forces which hinder its progress are at a minimum. It is said to perform all tillage operations in one, and after stirring the soil thoroughly, to leave a fine tilth behind. Such an implement has been tried at Caroni but was not successful. At present there is no suitable type for cultivation on a large scale on heavy land, but developments in this line should be carefully watched, as this method of tillage is likely to receive more attention in the future, than it has done in the past.

Mechanical operations as a whole, are done in the Dry season, because in the Rainy season the land is too wet for implements to work. Not only would the heavy tractors and implements puddle the land in the Rainy season but they would be unable to work it into a fine tilth. In this way, labour is released from work, which was, previously, done by hand during the Rainy season, and can be applied to other tasks, so that shortage of labour at the time of rice planting is much reduced. As this is merely
transferring the operation from one busy period to another, it would seem that shortage must be induced or increased in the Dry season. This, however, is not the case, since amount of labour required for mechanical tillage is, comparatively, very small, and is of a higher class than for hand operations. It is more easily obtained and can be employed all the year round.

Transferring any of the hand operations from a busy to a less busy period does not appear to possess any advantage.

The time of performance of some operations depends on the climatic conditions, (either Rainy or Dry season) while others are regulated by the stage of growth of the cane, which is also determined by climatic conditions.

In the Northern plains of Trinidad, the possibility of introducing irrigation is receiving a certain amount of attention. Experiments in irrigation are being conducted by Caroni estate, in connection with the Imperial College of Tropical Agriculture. The land seems well suited for irrigation, and is level, and retentive of moisture. A crop of canes planted in May 1928 was ready for cutting in March 1929 thus shortening the growing period by about 5 months. This saving can at present be effected by Dry season planting, but the yields are not too satisfactory since planting and reaping would both have to be done in the Dry season; this system would cause a labour shortage at that time and is, therefore, unlikely to be carried out to any extent. The real value of irrigation lies in supplying the canes with moisture during the Dry season so that they avoid the check in growth, caused by the drought. Irrigated canes, would, therefore, yield a larger crop. The possibility of combining irrigation with a new rotation crop must not be overlooked. It is unlikely that the present position as regards labour would be changed, since the little extra required for the irrigation work would be fairly constant in amount all the year round.
The varieties of cane grown differ somewhat in their
labour requirements. Some varieties do not ratoon as well as
others and thus require more frequent planting. Uba cane be-
sides ratooning for long periods—about 7 years—does not re-
quire trashing, as it is so tough that the trash has to be burned.
Burning the trash, on the other hand, deprives the land of val-
uable organic manure, but it is said that the root system is so
extensive, that it compensates for the loss of trash. Its
 toughness, however, makes it difficult to cut, and it requires
special adjustments of the factory machinery. Varieties of cane which have a large amount of trash, save weeding,
because the trash covers the ground and prevents the growth
of weeds; but on the other hand more labour is required for trashing.
Certain varieties produce a great bulk of cane but have a low su-
gar content, so that a large amount of cane is necessary to make
a ton of sugar. With a cane of high sucrose content, however,
a lesser quantity is required, so that a small saving in labour
is effected. From a labour saving point of view, therefore,
the breeder of new cane varieties should aim at greater ratooning
power, more trash, and a higher sucrose content.

The question of rotations, is one which might well be
mentioned in discussing labour shortage, since smoothing out the
labour requirements is one of the most important advantages of
a rotation. A suitable cash crop for rotating with sugar has
long been sought by the estates, but up to the present, none has
been found satisfactory. Rice has been suggested for the Northern
plains, but too little is known of the economics of the crop, i.e.
the cost of machinery to deal with it, and whether it would find
a market. It is customary on many estates to sow legumes such as
Woolly Pyrol, (Phaseolus mungo), Sword bean, (Canavalia ensi-
formis) and Sunn Hemp, (Crotalaria juncea) on the banks between
canes, and turn them in when the banks are broken. An early
and a late legume are usually sown on alternate banks, so that
the early one can be turned in at the first breaking of the banks,
and the late legume at the second. The difficulty is to find a legume, or other crop, which has a commercial value and can be dealt with easily, without extra machinery. It would be possible to sow a field with legumes, leave it for a year, and then plough it in to restore the fertility of the land, but, only in a few cases, is the loss of a year's sugar likely to be worth the increase in crop due to the fertility gained.

The possible effects of rotations on the labour supply presents a somewhat complex problem. If a rotation were adopted it would mean that either more land would be brought under cultivation, or else less would be planted in sugar. The latter would entail great waste in the factory machinery which could not then work at full pressure, while, although most sugar estates have waste land and pasture available, bringing this under cultivation would increase the labour requirements during most of the year. A certain amount of extra labour would be available throughout the year, except during the crop season and at Rice planting, but it is unlikely that this would be sufficient to supply the demands of a new crop on fresh land. This precludes the possibility of rice as a rotation crop, unless it could be planted at some other period than August. Thus for a new rotation crop to be successful it must either be sufficiently valuable to make it worth while to scrap part of the existing sugar factory machinery, or it must have a low labour requirement, especially in the crop season and about August.

Reduction of the acreage of sugar grown, though it would reduce the labour requirements would not reduce the shortage. The economic level of the population, would tend to be reduced, since the period of shortage lasts, at most, for six months and usually considerably less. In addition, the factory would be working for a shorter period and would become uneconomic. As much cane should be grown, as can be
transported to the factory during the dry season, in order to reduce as much as possible, the time during which the factory is lying idle.

Sugar estates in Trinidad have been shown to suffer from two main periods of labour shortage, and it remains to be seen how far the mechanical operations, which have been discussed, would relieve this. The shortage during the crop season is the simplest to deal with, because it is confined to a period when a particular set of operations is being performed. It is to Reaping, then, that we look for a remedy for the shortage. This remedy is to be found in the introduction of mechanical carting, since it has been shown to be the limiting factor. Although it is still in the experimental stage, there is little reason to doubt, that, in the near future, the various difficulties connected with mechanical carting will be solved; whether it will entirely remove the labour shortage at that period, of course, remains to be seen, but should it fail to do so, the next line of attack would be in finding a mechanical cane harvester, however remote the possibility of this may seem, at present.

The shortage during the rice planting season presents a more complicated problem. It lasts merely for a brief period, during the time when cultivation and planting are in progress, so that no single operation can be mechanised, which will relieve it. The remedy lies, therefore, in reducing the labour requirements over a considerable period so as to lessen the effect of the shortage, and enable arrears of work to be more easily made up. This, as previously explained, can be done by the use of mechanical cultivation in the Dry season.

The way has been led by mechanical ploughing and rounddridding, the use of which should be extended, where possible, and it is
hoped that drilling and draining will soon be added to these. No data are available to indicate how much labour would be saved by mechanisation, and as there can be no doubt that the amount would be considerable, the question arises as to whether it would be sufficient to throw a number of labourers out of employment. It would be necessary therefore, to maintain a balance between the amount of machinery employed, and the quantity of available hand-labour, and for this reason machinery would have to be introduced slowly and carefully. Any surplus of labour at this time, might be absorbed by the use of a rotation crop or catch crop.

The criticism may be made that insufficient attention has been paid to the cost of mechanical equipment, but there are not, at present, enough data from which costs could be worked out. It is known however, that the initial costs of almost all the implements required, are heavy, but where shortage of labour militates against the efficiency of the estate, it would seem to be more economical, to invest in such implements, than to let the fertility of the land decay.

Under the present critical conditions of the sugar industry, estates are unwilling to increase their working capital, so that, unless machinery is going to reduce, considerably, the costs of cane production, they are unlikely to adopt it. Thus it is incumbent on those who are concerned with the manufacture of such machinery, to turn out implements which will reduce both the labour requirement, and the costs of production. No one can tell what the future has in store for the sugar industry of Trinidad, but it is possible that the extended use of machinery might help it to tide over a lean period in its history.
I should like to express my thanks to Mr. L.A. Grant of Caroni Estate and Mr. G.A. Jones of the Usine Ste. Madeleine, for the facilities they gave me for carrying out this investigation, and for their assistance in discussing problems which arose. To Professor Shephard I owe a debt of gratitude for his ever ready assistance, and valuable criticism, throughout the investigation.

Shortage of labour occurs at the Usine Ste. Madeleine during the crop season (January to June) and at the time of rice planting (about August). At Caroni shortage is felt only during the rice planting season.

On both estates preparation and planting is confined to the Rainy season and reaping to the Dry season, and at the Usine Ste. Madeleine cultivation is done chiefly in the Rainy season.

Substitution of mechanical for hand labour should be confined to those operations performed during shortage. The main cultural operations done at this time are considered.

(a) At present drilling cannot be performed satisfactorily on account of the field drainage.

(b) Weeding is the largest item in the estate's labour requirements, and it must be done by hand to prevent damage to the cane.

(c) Subsoil tilling has recently been performed successfully by a road grader, which can also be used to assist draining.
SUMMARY.

1. The object of this investigation was to discover how far mechanical labour could be substituted for hand labour, in order to relieve the labour shortage in Trinidad. For reasons given the Sugar Industry only, was considered.

2. The distribution of labour throughout the year on the main cultural operations, and the whole estate, was obtained from data supplied by the Usine Ste. Madeleine, and Caroni Estates, and the results are indicated on diagrams.

3. Shortage of labour occurs at the Usine Ste. Madeleine during the crop season (January to June) and at the time of rice planting (about August). At Caroni shortage is felt only during the rice planting season.

4. On both estates preparation and planting is confined to the Rainy season and reaping to the Dry season, and at the Usine Ste. Madeleine cultivation is done chiefly in the Rainy season.

5. Substitution of mechanical for hand labour should be confined to those operations performed during shortage. The main cultural operations done at this time are considered.

   (a) At present, drilling cannot be performed satisfactorily on account of the field drains.

   (b) Weeding is the largest item in the estate labour requirements, and it must be done by hand to prevent damage to the canes.

   (c) Roundridging has recently been performed successfully by a road grader, which can also be used to assist draining.
(d) Toughness of cane and the difficulty of topping have prevented the use of a mechanical cane cutter.

(e) Carting canes by tractor-drawn carts is one of the most promising lines of labour saving. To be successful a cart must bring in 50 tons of cane a day, and the most suitable type of hitch and size of cart must be found.

6. Mechanical ploughing and other tillage by cable tackle or caterpillar tractors saves labour, by taking the place of subsoiling and forking, and by the fact that it is done in the dry season with a small amount of labour, thus releasing labour during the Rainy season.

7. The introduction of irrigation in the Northern plains would be unlikely to affect the labour supply.

8. New cane varieties are desirable, which would combine high sucrose content with great ratooning power and more trash.

9. A crop suitable for rotation with cane should possess a low labour requirement during the crop season and about August.

10. Shortage of labour during the crop season could be relieved by mechanical carting, while shortage during the rice planting season could be relieved by the use of mechanical cultivation, to release labour during the rainy season.

11. The expense of machinery is a serious drawback so that as well as saving labour it should reduce costs.
DISTRIBUTION OF FIELD LABOUR - GROUPS & TOTAL.

Thousands

Units of Labour. 1 space = 2,000 units.

July 8
Aug. 5
Sep. 2
Sep. 30
Oct. 28
Nov. 25
Dec. 23
Jan. 20
Feb. 17
Mar. 16
Apr. 15
May 11
June 8

4 weeks ending

Total
Cultivation
Reaping
Preparation & Planting
DISTRIBUTION OF FIELD LABOUR IN RAINY & DRY SEASONS.

Usine Ste. Madeleine - four weekly.

Total

Cult. Prep.

& Planting

Reaping
DISTRIBUTION OF LABOUR EMPLOYED IN CULTIVATION.
Usine Ste. Madeleine - 1927-28 - Four weekly

Fig. 4

- Roundridding
- Forking
- Applying Manure
- Draining
- Digging
- Parsgrass
- Weeding

Units of Labour - 1 space = 200 units.
Thousands

July 1
Aug. 5
Sep. 20
Oct. 25
Nov. 29
Dec. 23
Jan. 16
Feb. 7
Mar. 11
Apr. 13
May 8
June 11

4 weeks ending
DISTRIBUTION OF TOTAL LABOUR.

Thousands

Units of Labour - 1 space = 2500 Units.

Total
Field
Factory
Transport
DISTRIBUTION OF FIELD LABOUR - GROUPS & TOTAL.

Caroni - 1927 - Four weekly.

Fig. 7

Units of Labour - 1 space = 500 Units.

Thousands
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0

Jan. 29
Feb. 26
Mar. 26
Apr. 23
May 21
June 18
July 16
Aug. 13
Sep. 10
Oct. 8
Nov. 5
Dec. 3
Dec. 31
4 Weeks ending
DISTRIBUTION OF LABOUR EMPLOYED IN PREPARATION & PLANTING.

Caroni - 1927 - Four weekly.

Units of Labour: 1 space = 200 units.

Weeks ending:
- Jan. 29
- Feb. 26
- Mar. 26
- Apr. 23
- May 21
- June 18
- July 16
- Aug. 13
- Sept. 10
- Oct. 8
- Nov. 5
- Dec. 3
- Dec. 31

Thousands

- Supplying
- Planting
- Outlassing
- Banking
DISTRIBUTION OF LABOUR EMPLOYED IN CULTIVATION.

Caroni 1927 - Four weekly.

Fig. 9
DISTRIBUTION OF LABOUR EMPLOYED IN REAPING.

Caroni - 1927 - Four weekly.

Fig. 10

Units of Labour - 1 space = 200 units.

Thousands

12

11

10

9

8

7

6

5

4

3

2

1

0

Jan. 29
Feb. 26
Mar. 26
Apr. 23
May 21
June 18

4 weeks ending

Loading
Cutting
Carting
DISTRIBUTION OF TOTAL LABOUR UNITS.
Caroni - 1927 - Four weekly.

Units of Labour - 1 space = 500 units.

Thousands

Jan. 29
Feb. 26
Mar. 26
Apr. 23
May 21
June 16
July 16
Aug. 13
Sep. 10
Oct. 8
Nov. 5
Dec. 3

Total
Field
Factory
Transport

Fig. 11