

THE
BEET-ROOT SUGAR MANUFACTURE
IN
IRELAND.

By K. P.

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PREFACE.

WHEN I first formed the intention of establishing a Beet-root Sugar Manufactory in Ireland, I had not the least idea of asking the co-operation of Irish capitalists.

Arrangements had been entered into with some of my Continental friends, who are deeply interested in similar undertakings abroad, to buy or rent a sufficient area of land on which to grow the roots and erect a manufactory, and work it on mutual account. The result of enquiries relative to the suitability of the Irish and English soil and climate, was such as to make them agree with me that Ireland offered more scope for the successful working of this branch of industry than England, and my personal inspection has convinced me that this is really the case.

I regret to say, that the information my friends received concerning the state of Ireland, and the advice given by a leading English house as to the risk of investing a large capital in a country constantly liable to political agitation, and where no dependence could be put on manual labour, made them alter their minds; and no amount of argument on my part, nor their knowledge that I am prepared to take a considerable interest in this undertaking, was able to make them change their views. Although anxious to avoid here all allusions to politics, I cannot refrain from calling the attention of my readers to this fact, as clearly showing

that if the population of Ireland wishes to see the growth of this and similar useful undertakings, and thus to assist in developing the great natural resources of the country, they will do well carefully to study what course of action will best promote their interest. My own experience has taught me that it is *working* and not talking which brings success, prosperity, and peace.

I must now publicly acknowledge the great obligations I am under to Dr. Charles A. Cameron and Mr. T. Baldwin; it is mainly due to their assistance that I was induced to prosecute my intentions.

I am convinced that, with the introduction of sugar-beet cultivation, Ireland is entering upon the right road to improve her agricultural interests; and those who assist in the development of this industry, will share with the above gentlemen in the honour of having paved the way for the welfare and prosperity of Ireland.

VIEWFIELD LODGE,

STIRLING, N.B., *December*, 1871.

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IN IRELAND.

ON reading the title, the first questions that naturally arise will be—

- I. Is this industry a healthy one, that is, is it based on sound principles?
- II. Does it offer a guarantee for the profitable employment of capital? And lastly,
- III. Is this a useful industry?

These questions must first be satisfactorily solved, before any one who proposes to prosecute such an undertaking can have any chance of success. It is imperatively necessary that he should have thorough confidence in it himself, and that he should be able to show his reasons for this confidence.

This can only be done by a careful examination of the points which I shall now lay before my readers. I am convinced that, after perusing my statements, they will agree with me that the erection of such works in Ireland will not only benefit those who are prepared to invest their capital in this industry, but will offer the means of employing the labouring classes

with advantage; and last, but not least, greatly affect the agricultural prosperity of Ireland.

But, first, let me ask the indulgence of my readers, for, in order to prove the soundness of my views, I shall necessarily come into repetition, by referring to the opinions of different authorities on the subject.

My readers must not expect a learned discourse, as I merely wish to show, in a simple way, that this industry is worthy of all the support which I claim for it; and that it will be of enormous benefit to Irish agriculture, and will assist materially in the development of the country.

The Beet-root has been known for years as an article for feeding purposes, but it is only of late years that it has been employed for the production of sugar. It is a biennial plant, indigenous to Portugal, where it grows wild on the banks of the rivers. There are several species, but most of them are best adapted for feeding purposes, as giving a larger crop; only a few are suitable for the manufacture of sugar, as possessing a larger quantity of sugar in the juice. My object being to treat only of the kinds fit for manufacturing sugar, I will mention the principal varieties generally used:—

1. The large Beet-root (called *Dissette*).
2. Silesian.
3. Siberian.
4. Quedlinburg.
5. Improved Beet of Vilmorin.
6. Betterave Imperiale.

The use of these six varieties is regulated according to soil and climate, but Nos. 2, 5, and 6 are generally

adopted. The average composition of the root of the sugar beet may be stated as follows:—

| | |
|-----------------------------|---------------|
| Sugar, - - - - - | 10½ per cent. |
| Gluten, - - - - - | 3 “ |
| Woody fibre, &c., - - - - - | 5 “ |
| Water, - - - - - | 81½ “ |
| | <hr/> |
| | 100 “ |

The parenchyma of the beet is a spongy mass, the cells of which are filled with juice. These cells are so small that there are one and a half million of them to the square inch. The substances of the roots are numerous, and are chemically divided. It is not, however, my intention to name them all, I shall limit myself to specify the principal ones only:—

1. Water.
2. Sugar.
3. Cellular Tissue.
4. Albumen.
5. Pectine.
6. Gluten.
7. Grease.
8. Colouring Matter.
9. Organic Substance.

All known chemists, with the exception of Dr. Basset, agree with Pelouze and Peligot, that the Beet-root contains only crystallizable sugar. Dr. Basset has some doubts about this.

The proportion of these different substances in the beet depends on various influences, to which we shall have occasion to refer afterwards.

The foregoing remarks must serve as an introduction

to the subject. I will now proceed to enquire if the undertaking referred to is a sound one.

My reply is, yes; and without following the history of this industry from its beginning, I will endeavour to give a short outline of its course. It dates back from the reign of Frederick the Great, when a man of the name of Achard erected a manufactory; but defective machinery prevented him from abstracting enough sugar from the roots to make it pay. Some works were also erected in France, and the result of the trials made in 1810 was, that the cost of one kilo. of sugar came to about 7 francs, equal to about 5s. 9d. sterling. The proprietors succeeded in abstracting only from 1 to 2 per cent. of sugar.

This industry was fully developed under Napoleon in 1806, in consequence of the difficulty of obtaining colonial sugar. Not only was the high price of sugar a stimulus to invention, but the government offered, as a prize, a million of francs for the most successful method of manufacturing indigenous sugar. Protection further strengthened this industry, which, however, was put a stop to by Napoleon's fall. The free importation of colonial sugar caused a renewed competition, and no one will be surprised to learn that many manufactories were unable to go on. Some, however, survived the storm, and, in their struggle for existence, all means were adopted for the improvement of the machinery, and improvement was really made; however, if all protection had been taken away, the results would certainly not have been the same.

Owing to the fact that the cultivation of cane sugar in the French colonies had much decreased during

Napoleon's reign, the French government was induced to adopt a protective tariff; and, in 1814, cane sugar was charged an import duty of 60 francs per 100 kilos.; and, by a decree dated April 26, 1833, the duty was fixed as follows:—

| | |
|------------------------|--------------------------------|
| French colonial sugar, | 38 to 70 francs per 100 kilos. |
| Foreign “ “ | 80 to 105 “ “ |

The French colonies not producing enough sugar, it was left to Beet-root sugar manufactories to provide for the deficit; and it was under this system of protection (but which was not at all intended) that this branch of industry became more fully developed, and collected strength to withstand the coming storms and revolutions.

These were not long in breaking out. By the law of July 18, 1837, a duty of 15 francs per 100 kilos. was imposed on inland sugar; and, in 1840, this was further raised to 25 francs. In 1843 the duties on beet and cane sugar were put on the same footing; and, if we can accept what Dureau says in his work, “*La fabrication du sucre de Betterave*,” published in 1860, Beet-root sugar was at that time charged 7 francs higher than cane sugar imported from French colonies. From page 236 we quote the following extract, given to justify his assertion:—“The density of colonial sugar is fixed at 75 per cent. of refined, and of raw sugar at 100 per cent.; thus, on exportation, for every 75 kilos. of refined sugar exported, the government refunds the duties paid on 100 kilos. raw sugar. The revenue officer fixes the density of beet sugar at 83 per cent., and refiners do not obtain less refined sugar from cane sugar. This

stipulation gives the refiner a profit of 6·58 francs on every 100 kilos. refined sugar which he exports."

Notwithstanding these drawbacks, this branch of industry not only remained in existence, but survived the many obstacles and difficulties put in its way, and at present there are in France over 400 manufactories doing a paying business, and assisting greatly in the development of the general prosperity.

And now let us look back at Germany, the native land of this industry. Several manufactories had been erected under the same conditions as those in France. They had to contend with the same difficulties and drawbacks; the results, however, were very different. In Germany these manufactories became extinct, the proprietors losing all heart, and making no efforts to improve their machinery, and generally neglecting to adopt means which might have met the difficulties put in their way.

It was not until 1834—1836, when the low price of grain greatly diminished the value of landed property in Germany, that men's eyes were opened to the necessity of creating a new source of income for agriculture, and recourse was had to the cultivation of Beet-roots, and the erection of manufactories to work them on the most approved principle. Strengthened by the experience gained by their neighbours, they were able to grapple with the drawbacks which were soon put in their way by increased taxation, a proof of which we give in the following table for better illustration :—

| In Year | | Duty per Cwt. Beet-roots. Sqr. | | Manufactories. |
|---------|-------|--------------------------------------|-------|----------------|
| 1840 | ..... | $\frac{1}{2}$ | ..... | 136 |
| 1841 | ..... | 1 | ..... | — |
| 1844 | ..... | $1\frac{1}{2}$ | ..... | — |
| 1848 | ..... | — | ..... | 145 |
| 1850 | ..... | 3 | ..... | — |
| 1853 | ..... | 6 | ..... | 227 |
| 1857 | ..... | — | ..... | 249 |
| 1858 | ..... | $7\frac{1}{2}$ | ..... | — |
| 1859 | ..... | — | ..... | 257 |
| 1869 | ..... | 8 | ..... | 296 |

In the season 1848—1849, the manufactories consumed, on an average, each 68,000 cwt.; in 1858—1859, the 257 manufactories consumed, on an average, 140,000 cwt. of roots each.

The duties were as follows:—

| | Beet Sugar. Thr. | | Cane Sugar. Thr. | | Total. Thr. |
|------|---------------------|-------|---------------------|-------|----------------|
| 1847 | 281,692 | ..... | 6,323,662 | ..... | 6,605,354 |
| 1851 | 1,470,845 | ..... | 3,156,280 | ..... | 4,627,045 |
| 1856 | 4,497,732 | ..... | 2,711,196 | ..... | 7,208,928 |
| 1857 | 5,665,418 | ..... | 1,360,614 | ..... | 7,026,032 |

Thus we find that the duty on this branch of German industry advanced, in the course of 18 years, 1500 per cent., and the number of manufactories was doubled. This is a fact to which I call the special attention of my readers, as it will strongly support my assertion that it must be a paying business.

Protection was the means of calling this industry into existence, but if we look back on the past system of England, and the present system of America, we must acknowledge that all industrial undertakings which flourished in England are now successfully carried on in

America. It is, however, not by referring to the first period that I wish to give a satisfactory answer to my first question, but it is the present state of matters which will convince my readers of the truth of my assertion.

Dureau says, page 39, "La fabrication du sucre des Betteraves demande, desire, espère la liberté complète de son travail, et de ses transactions, c'est à dire une législation equitable. Dans les conditions de parfaite égalité de droits avec le sucre de nos colonies, le sucre de Betterave n'en craint pas la concurrence."*

As it may be interesting to show my readers the present extension of the Beet-root manufactories on the Continent, I give the following table, showing the number of factories, which I take from Walkhoff's "Practical Sugar Manufacturer":—

| | Number of Manu- factories. | Quantity of Beet-roots used. In Cwts. | Quantity of Sugar extracted. In Cwts. | Average con- sumption per Manufactory. In Cwts. |
|------------|----------------------------------|---|---|--|
| Germany, - | 296 | 51,495,494 | 4,319,640 | 172,619 |
| France, - | 434 | 82,850,000 | 5,800,000 | 190,915 |
| Russia, - | 300 | 42,400,000 | 3,792,000 | 141,334 |
| Austria, - | 212 | 42,300,000 | 3,400,000 | 199,530 |
| Belgium, - | 108 | 14,200,000 | 1,000,000 | 131,482 |
| Holland, - | 18 | 2,143,000 | 150,000 | 119,060 |
| Sweden, - | 4 | 770,000 | 61,600 | 192,500 |
| | 1370 | 236,158,494 | 18,523,240 | 172,380 |

A Prussian cwt. is equal to 113·426 lbs. English.

* The Beet-root sugar manufacturing interest requires, desires, and expects complete freedom in its work, and in its transactions; that is to say, just legislation. On a footing of perfect equality with our colonies as regards duties, it has nothing to fear from their competition.

The dividends paid average from 8 to 16 per cent. In Holland the manufactories, which are well managed and favourably situated, pay from 15 to 18 per cent dividend. There the hectolitre of Syrup, at a given temperature, is estimated to produce 1500 grammes of white sugar for each degree of the densimetre, and duty is charged on this sugar at the rate of 27 florins per 100 kilos.; whereas in Belgium this is considered to be second class sugar, chargeable with a duty of only 23·76 florins per 100 kilos. I may here add, that the Hon. Commissioners of Inland Revenue have, by letter dated Sept. 23, 1871, kindly consented to allow my working under the contract system, being the same as now in operation in Belgium, and paying exactly the same duties.

Now, let us consider the probable competition of cane sugar. The manufacture of cane sugar is, no doubt, capable of great development: the

| | | | | | |
|--|---|----------|---|------|-----|
| Java cane, according to Dupuis, contains 17 to 18 per cent. sugar. | | | | | |
| Cuba | " | Payen, | " | 16·2 | " " |
| Otaheite | " | Peligot, | " | 18 | " " |
| Martinique | " | Dupuis, | " | 17 | " " |

Beet-roots, as will be shown hereafter, contain much less sugar. Sugar cane is much purer than Beet-root, the latter containing much more salt and organic matter.

According to Dureau, the difference of taste is as great as that between a pine-apple and a common apple.

From cane the following quantities of sugar are obtained:—

According to Avequin, 9·85 to 10·12 per cent.

“ Basset, 7·3 to 7·6 “

Dr. Knapp says, “The cane contains 80 to 90 per cent. of liquid.” Dupuis obtained from 35 trials (analyses) not less than 54 per cent., and, at the most, 68½ per cent. of liquid; from 33 trials, an average of 59½ per cent.

Supposing cane to contain 18 per cent. of sugar, and, that we obtain, according to the above trials, only two-thirds of the liquid, we only obtain 12 per cent. of sugar; there is, therefore, a loss of 6 per cent., which remains in the cane, and thus it is evident that much sugar is lost which might be gained. There are, however, great (we may almost say insurmountable) difficulties in the way of obtaining more sugar from the cane. First, The climate, which has an unfavourable effect on the liquid while in the cane, and also after it has been pressed out of it; for the great heat of the climate often causes fermentation. Second, The skill of the native population must undergo a great deal of development; and they themselves would require to pass through an entire social revolution, before they would be equal to the skilled workmen which we have in Europe. Third, Not the least difficulty is, that the cane requires a complete crushing, in order to obtain all the sugar out of it. This is, however, impossible, from the simple fact that the cane, after being deprived of the liquid, must serve as a fuel to purify, evaporate, and boil the liquid; and for this purpose it would be useless if too much crushed. The plantations which can replace their cane by other fuel are exceptions,

whereas the condition above mentioned is the rule. Millions of lbs. of sugar are lost in this way.

After having pointed out the competition which may arise to the Beet-root sugar, supposing the difficulties just mentioned could be overcome, it is now my duty to find out if the Beet sugar manufacture has reached its highest development. Men like Knapp, Walkhoff, Otto, Dureau, Basset, and many other well known authorities, will give you the reply. Defective machinery is also the cause of the loss of millions of lbs. of sugar. The Molasses always contain 50 per cent. of crystallizable sugar. The pulp contains it as well. Beetroots contain 96 per cent of liquid, and thus far we have only succeeded in extracting from 80 to 83 per cent. Science has until now failed to find the means to preserve the sugar containing qualities of the Beets during the time they are kept in the pits.

The result of Schutzenbach's invention, who, by drying the Beet-roots, expected to be able to carry on the manufacture over the whole year, has not answered the great expectations that were formed by him. The results, however, clearly show that his idea is not a dream, and that it may hereafter be realised; the best guarantee, however, must, according to my opinion, be found in an improved system of agriculture, which will greatly increase the sugar producing qualities of the Beet-roots. Vilmorin, and after him Leplay, has succeeded, by a careful selection of seed, improved working of the soil, and more appropriate manuring, in obtaining roots containing 21 per cent. of sugar.

Walkhoff, in "Practischer Rübenzucker Fabrikant,"

affirms that the sugar producing quality of Silesian beets is from 9 to 16 per cent. Otto, in "Praxis der handwirthschaftlichen Gewerben," finds it to be from 8 to 18 per cent.; in good Beet-roots it is from 11 to 15 per cent. The last named author observes, "Nothing is more important to the culture of roots than the selection of soil, and a proper method of cultivation, with the view of obtaining more sugar in the roots." A more intimate connection between the agricultural and the sugar manufacturing interests will best promote this end. Vilmorin asserts that he has grown roots containing 21 per cent. of sugar; and I say, if one can succeed in obtaining that result from a single root, it must be possible, by a careful study of the nature of this increase, to cultivate a larger quantity with the same favourable results.

Up to this moment very little attention has been paid to this important matter, and the only precaution taken thus far has been that of a careful selection of the soil, combined with the study of the preceding crop.

The question of sugar manufacture is also the question of the cultivation of the Beet-roots. It is of great importance that the manufacturer, in the selection of his soil, should pay attention to the cultivation of wheat, this being a good crop to guide him. To him it is a matter of vital importance to obtain the greatest quantity of sugar from the smallest quantity of roots. To prove this, I will just quote an example from Walkhoff. I need not add that the figures have no other value than simply to illustrate this matter:—

| | | | |
|---|----|----------|------------|
| Suppose we pay for the rent of an acre of ground, - | £1 | 10 | 0 |
| And cultivation of soil costs, - - - - - | 1 | 16 | 0 |
| | | <u>3</u> | <u>6</u> 0 |

| | | | |
|---|---|----------|-------------|
| The working of a cwt. of roots in the manufactory costs, say 1s. 4d., or 100 cwts., - - - | 6 | 13 | 4 |
| | | <u>9</u> | <u>19</u> 4 |

| | | | |
|---|----|----|---|
| These roots contain 12 per cent. of sugar, out of which we get only 7 per cent. ; this, at 30s. per cwt., would be, - - - - - | 10 | 10 | 0 |
| Showing a Profit of, - - - - - | £0 | 10 | 8 |

But if the soil was prepared more with the view of obtaining roots than sugar, the result would be:—

| | | | |
|---|----|-----------|-------------|
| Rent and cultivation of soil, - - - - - | £3 | 6 | 0 |
| The weight of the roots would be doubled, and also the cost of manufacture, thus we get 200 cwts. at 1s. 4d., - - - - - | 13 | 6 | 8 |
| | | <u>16</u> | <u>12</u> 8 |

| | | | |
|---|----|----|---|
| But as the sugar content diminishes in proportion to the gross weight of the roots, we may safely put down that the roots would only contain 9 per cent. of sugar, out of which we can only get 5·27 per cent. of sugar; this would make, at 30s. per cwt., - - - - - | 15 | 15 | 0 |
| Showing a Loss of, - - - - - | £0 | 17 | 8 |

In the former case there is a profit of 10s. 8d., and in the latter a loss of 17s. 8d.

After showing thus the great influence exercised by the sugar containing qualities of the roots on the manufacture, experience has further brought to light the importance of good cultivation, by proving that the nett weight of crystallizable sugar obtainable from roots

increases in proportion as the gross weight of the sugar contents in the roots is greater.

Walkhoff gives the following figures as the result of his experience: roots containing—

| | | | | | |
|---|---|---|------|---|---|
| 14 per cent. of sugar juice give 9.27 per cent. of raw sugar. | | | | | |
| 13 | “ | “ | 8.50 | “ | “ |
| 12 | “ | “ | 7.72 | “ | “ |
| 11 | “ | “ | 6.94 | “ | “ |
| 10 | “ | “ | 6.11 | “ | “ |
| 9 | “ | “ | 5.27 | “ | “ |
| 8 | “ | “ | 4.38 | “ | “ |

This point being of so much importance, the question will naturally arise, How can we best obtain this result? and my reply is, by studying my own comfort as a manufacturer, the interest of the farmer, and the conditions of buying and selling of the Beet-roots. The two latter points only are of importance. Beet-roots are sold by weight, allowing a certain percentage for roots, dirt, &c. It is only a few years ago that the manufacturer was able to test the sugar containing properties of the roots, by means of the saccharometer, which serves him as a guide in his price. It is the interest of the farmer to obtain the greatest amount of weight from his fields, and his interest is thus directly at variance with the interest of the manufacturer. I have just before observed that the sugar containing qualities of the roots decrease in proportion to their increase in weight, and now beg to refer to the following analyses, made by H. Knapp, which I take from his “Lehrbuch der Chemischen Technologie:”—

| Silesian Roots. | | | | | Siberian Roots. | | |
|--------------------------------------|---|------|-----|-----|-----------------|-----|-----|
| Sugar Contents, - | - | 11.4 | 9.4 | 9.5 | 7.4 | 5.9 | 5.1 |
| Weight of Beet-roots in ounces, - | - | 6 | 13 | 23 | 45 | 16 | 16 |

Walkhoff gives, as result of the analyses of 12 Beet-roots, from different soils:—

Those from 3 to 1 lb. contain 13.9 per cent. of sugar.
 “ 4 to 1½ “ “ 11.1 “ “
 “ 5 to 2 “ “ 9.9 “ “

Knapp finds that in European Russia, up to 56° N. latitude,

Beet-roots from 4 to 8 ounces contain 10 to 13 per cent. of sugar.
 “ 8 to 16 “ “ 9 to 12 “ “
 “ 16 to 32 “ “ 8 to 11 “ “
 “ 32 to 64 “ “ 7 to 10 “ “

Basset, in “Guide pratique du fabricant de sucre,” observes:—“Les grosses Betteraves sont d’un rapport proportionnel moindre pour le fabricant qui achète, parcequ’elles renferment plus d’eau et moins de sucre sous le même poids, elles sont plus chères à travailler, et forcent à un contact prolonge le calorique, ce qui perd encore une proportion notable de sucre en sus de la dépense supérieure occasionnée par l’évaporation.”*

* The large Beet-roots are relatively of less value to the manufacturer who buys, because they contain more water and less sugar in the same weight; they are more expensive to work, and necessitate a prolonged contact with heat, which also destroys a considerable proportion of sugar, not to speak of the extra expense caused by evaporation.

And now, let us consider our last question, and see if this industry is a useful one.

Our reply must again be in the affirmative. Let us, in the first place, consider its influence on agriculture; and secondly, its effect on the general prosperity of the country.

The fields on which Beets are to be cultivated, must be ploughed very deep, and be entirely cleansed from weeds, the cancer of agriculture. The unavoidable necessity of this mode of working the soil is the best guarantee that this will be done; for roots fit for the manufacture of sugar can only grow in loose, pure soil, and there is nothing to prevent this expenditure of labour, as the production amply repays the extra outlay. Good virgin soil does not require manuring; but, for poorer soil, the use of artificial manure is resorted to. Dung must on no account be used, having a damaging influence on the roots. Agriculturists who read this will at once agree with me, that this mode of working the soil must be beneficial to agriculture; and, for those of my readers who require further information, I beg to refer to a treatise of Mr. Gomart, who was awarded a gold medal for it by the Imperial Society of France.

Our space does not allow us to say more about it here, for we confine ourselves to prove facts only. In the north of France, where the Beet-root sugar manufacture is carried on with success, the average produce of wheat per acre is fully one-third more than in many other parts of France, and this from the same quality of soil. In the north of France it is well known that the cultivation of crops, which must be kept free from weeds, and which require deep, constant, and very care-

ful working of the soil, together with a good deal of manure, although demanding larger capital, contribute greatly to the prosperity of agriculture.

Another result of this cultivation is worth mentioning. In order to improve agriculture, it must be our constant study to increase the supply of food for cattle, so that, by an increase of cattle, we may obtain an additional quantity of manure, and the cultivation of Beet-roots entirely answers this object. The roots, after being worked in the manufactory, returns from 20 to 25 per cent. of their weight in pulps. Chapsal, a well known chemist, and formerly Minister of Commerce and Agriculture in France, makes the following observation about pulps as a means of feeding:—"Pulps, being almost dry, have not the same disadvantage for cattle as watery grass or roots, nor that of dry feeding; they do not, like the former, produce putrefaction, nor obstructions and heating, like the latter. Pulps contain nearly all the feeding qualities of the Beet-roots themselves, for the process of manufacture only deprives them of about 65 per cent. of water and a small quantity of gluten. Both cattle and birds are very fond of this sort of feeding, and it fattens them in no time." But this learned authority forgot to mention one very great and important fact, *i.e.*, that it possesses the property of keeping without deterioration, in fact it improves by the fermentation to which it is subject.

Pulp feeding, further, produces an excellent manure. Besides this animal manure, the farmer derives the benefit of all the leaves, tops, &c., of the Beet-roots which are left on the field, and which may be safely estimated to amount from 10,000 to 15,000 lbs. per

acre. Moreover, the manufactory produces a refuse consisting of scum, bone-black, lime, &c. ; a manure containing, according to Dureau, about 0·54 per cent. of nitrogen. In his work on the manufacture of Beet-root sugar, he comes to the conclusion that, suppose you keep on one acre of land one head of cattle, you will have one-sixth less manure than that which is now obtained from the cultivation of Beet-roots and the refuse of the manufactory.

Beet-root cultivation may replace the rotation crop, or the lying fallow, and succeed a wheat crop. In the department of Valenciennes, the corn crop, before the introduction of this branch of industry, amounted to 23,700,000 kilos., and the number of cattle was 700 ; after its introduction, it soon rose to 29,480,000 kilos. of corn, with 11,500 head of cattle. In 1825 the department du Nord possessed 173,000 head of cattle ; and, in 1840, after the introduction of this industry, it possessed 227,000 head of cattle, and 300,000 sheep. In the same department the production of corn has greatly increased, without in any way affecting the cultivation of Beet-roots.

I take the following extracts from a very useful little book lately published, "Small Farms made Profitable," by Thomas Baldwin, Esq., which will at once illustrate the effect which we may expect from the introduction of this industry in Ireland :—

"The area under grass is far greater than in any country in Europe similarly circumstanced and ought to be reduced.

"The rich fattening lands and all the high hills should be left in pasturage, but there are four millions of acres

of medium land now growing poor grass which would pay far better in tillage. If these four millions of acres were skilfully cultivated, the wealth of the country could be increased to the extent of £3 an acre, or £12,000,000 a year, which would be available for distribution among labourers, farmers, manure and seed merchants, and shopkeepers of all kinds. In due time, too, the landlords would obtain an increase of rent.

“The state of cultivated land of Ireland is also very defective, as is well known to all persons of experience. Throughout the country we meet a great many farmers who till their land in a very creditable way; but it is notorious that on the vast majority of small farms the mode of management is very bad. It will be useful to notice briefly the most glaring defects, and to estimate the loss they cause.

“Manured crops form the backbone of the rotations of crops. The Irish small farmer rarely grows any manured crops but potatoes. He ought to grow turnips or mangold, or some of both, for feeding his cows in winter and spring.

“Tillage is done in a slovenly fashion. Root crops are, as stated above, the basis of improved agriculture; a condition essential to the growth of these crops is, to dig or plough the land deeply as early in autumn as possible, so that, by the action of the weather during the winter, plant food would be liberated.

“By good, early, and deep tillage, the value of every acre of arable land in Ireland could be increased by at least £1, and thus the wealth of Ireland would be increased by five and a half millions sterling, even without adding to the area of cultivated land.

“Sufficient care is not taken to keep the land clean. In some parts of the country weeds are permitted to grow freely and to shed their seeds, this causes a heavy loss. The yield of the crops is greatly reduced, and the weeds take up the plant food, which would go to feed the crops if the land were kept clean.

“The live stock of Ireland is not made as profitable as it ought to be. The value of the animals has greatly increased of late; but there is still great room for further improvement, especially of the stock kept by small farmers. The gross value of the horses, cattle, sheep, and pigs in Ireland is considerably upwards of forty millions; by better modes of breeding, rearing, and feeding, this could be increased by one-fifth in five years, and, as the quality of the animals on the small holdings is the lowest, the greater part of this addition to the wealth of the country would go into the pockets of the small farmers.

“And, again, as our climate is on the whole better adapted for roots than that of England, we see no reason why a large number of the store cattle now exported should not be fattened in Ireland. It would increase the profit of the farmer, and the wealth of the country; the large quantity of valuable manure obtained would put the land in better condition for other crops, and the labouring class would receive more employment.”

By thus showing its influence on agriculture, and on the general welfare, we have almost answered our second question. To carry on this cultivation a good deal of manual labour is required. In summer it gives abundant occupation to labourers in the fields; and in

winter, the season in which the agricultural labourer is most exposed to want, the same hands can all be employed in the works. The Beet-root sugar manufacture provides for this; and it is a fact well known on the Continent, that in those districts where the industry has been introduced and has *succeeded*, poverty is almost unknown; poorhouses have become empty, and no healthy or able-bodied persons have to receive any support. And now, let me ask, Is it too much to say that the inland sugar manufacture will prove to be a blessing to Ireland, and do far more for the population where it is going to be established, than legislation can ever effect? Every one, who wishes to benefit his country, or improve its soil, should therefore assist in developing this industry.

Walkhoff very rightly observes, "Sie beschäftigt den landwirth, fordert ihn auf zur höchsten cultur, reinigt die acker, giebt an kraft, wirht belebend auf die ganze Landwirthschaft, und vergilt mit Redlichkeit die darauf verwendete mühe durch höhere Rente des Bodens, durch eine grössere und sichere Ertragsfähigkeit," &c.*

Basset says, "Source de richesse pour l'homme du sol, producteur de la matière première, elle est un des éléments de la prospérité nationale, la base de fortunes honorables pour les particuliers qui en font leur spécialité."†

* It occupies the farmer, calls upon him for improved cultivation, cleans the soil, gives it more vitality, has a beneficial effect on agriculture, and amply repays all the trouble expended on it, by procuring higher rents for the soil, at the same time rendering its productive power larger and more certain.

† A source of riches for the agriculturist, who produces the raw material, it is one of the elements of national prosperity, and the foundation of honourable fortunes for those who follow it as a line of business.

And now, let us consider what is required to make a sugar manufactory repay—

1. The Soil.
2. The Site selected for the Establishment.
3. Machinery.
4. Capital.

I.—THE SOIL.

In practice we distinguish or separate sandy soils loam, and clayey soil, from lime soils, humus, &c., according as quartz sand, loam, clay, carbonate of lime, and humus predominate in the composition of their crusts.

According to Walkhoff—

Sandy soil contains about 90 per cent. of quartz granules.

Clayey soil contains about 60 per cent. and even more improvable clay.

Loamy soil contains under 60 per cent. of loam.

Sandy clay soil contains under 30 per cent. of loam.

Clayey sand soil contains under 20 per cent. of loam.

The three last are preferred. They are more easily worked, being more porous, and therefore less apt to ball together. If the soil does not pulverize or break well, it makes a bad seed furrow, this again causes defective germination of the seed, and consequently inferior roots are produced. The result of Leplay's analysis is—

ROOTS TAKEN UP ON 1ST OCTOBER.

Those grown on—

| | | | | | | |
|---|---|---|-----|---|---|---|
| Loamy soils contained 114 grammes of sugar per litre of liquid. | | | | | | |
| Sandy | “ | “ | 114 | “ | “ | “ |
| Lime | “ | “ | 117 | “ | “ | “ |
| Loamy sand | “ | “ | 104 | “ | “ | “ |

The experience of many years, and in different countries, has shown that if lime is properly and equally in the soil, roots are produced which contain more sugar, and are more easily and profitably worked in the manufactories.

In vain have we sought for an explanation of this fact, but we conclude that, as lime adds to the heating capacity of the soil, and thus accelerates the growth of the Beet-root, it causes it to possess a liquid purer and richer in sugar than that of roots which have required a longer time for development.

Schübler quotes,* that if we could express by numbers the capacity of the soil to retain heat, we should come to the following conclusions:—

| | | | | |
|----------------------------|---|---|---|------|
| Land containing much lime, | - | - | = | 100 |
| “ “ “ gravel, | - | - | = | 95·6 |
| Lime containing soil, | - | - | = | 74·5 |
| Loamy soil, - | - | - | = | 68·4 |
| Garden soil, | - | - | = | 64·8 |
| Humus, - | - | - | = | 49 |

This result would speak favourably for the above theory.

It is of the greatest importance that the manufacturer should not only obtain the greatest amount of sugar from a given quantity of roots, but that he should get a liquid in which the sugar is most pure, and not mixed with saline bodies, which make its extraction difficult and uncertain. Newly reclaimed soils must be avoided; clover or grass is a less preferable fore crop than wheat or corn. It may be considered a rule, that the lighter

* “Cosmos” XI. année, 20 B, 26 livraison, page 274.

the soil the better it is adapted for growing roots for this manufacture; however, it is quite evident that the soil must be solid and substantial, in order to produce a sufficient quantity.

Dr. Jul. Otto observes, in his "Lehrbuch der landwirthschaftlichen Gewerben," what is required is "a soft humus, lime containing clay ground, being well open and exposed to the sun, a soil commonly called a first-class wheat soil being a full bodied calcareous clayish sand soil." The soil should be sufficiently, but not too loose. The worst soil for growing Beet-roots are heavy clay grounds, in which the Beets have to grow above the soil. This is very bad, it having been chemically proved that the part of the Beet-root growing above the soil possesses only one half of the specific weight, as compared with the part growing under the soil. This is further certified by a report of M. Leplay to the French Academy, in which he asserts that Beet-roots grown under the ground contain 50 per cent. more sugar than those grown above the ground.

Experience in Holland has shown that the nature of the soil has less influence on the Beet-roots than the depth to which the earth has been loosened, deep ploughing being essential. However, a good loam or sandy clay, or calcareous clay soil, more or less fresh and damp, is found to answer best.

Basset, in "Guide pratique du fabricant de sucre," says, "La pratique est d'accord pour recommander qu'on place la Betterave dans un sol meublé et profond. La racine, pourtant, hait les sols tenaces, les loams argileux, mais elle prospère dans les terrains sablonneux, terres franches à blé, perméables à l'eau, meublées et chargées

d'éléments nutritifs à une certaine profondeur. Qu'on ne la place, ni sur des sols calcaires, inertes, qui admettent à peine le sainfoin, ni sur des fonds trop argileux. Cependant, il convient de dire, que ceux-ci, bien amendés, produisent quelquefois une bonne récolte, et que la Betterave elle-même, par la culture qu'elle exige, contribue à l'ameublement de ces sols."*

And again, "Il est importe de remarquer que les terres sablonneuses, de bonne nature, fournissent des Betteraves plus abondantes en sucre, plus denses, et susceptibles d'une meilleure conservation. Les terres chargées de sols minéraux sont impropres à la culture de la Betterave sucrière, qui absorbe aisément les matières salines, et on sait que les sols alcalines sont un des plus grands obstacles à l'extraction du sucre."†

And further on, "Il convient, autant que possible, d'éviter les sols à peu près exclusivement argileux, calcaires, ou sablonneux, dans lesquels l'un des éléments de la terre arable, argile carbonate de chaux ou silice

* Experience is unanimous in recommending that the Beet-root should be put in a rich and deep soil ; the root, however, does not thrive in tough soils or clayey loams, but it prospers in sandy soils, and in free wheat soils, permeable to water, which are enriched and charged to a certain depth with nutritive elements. It should neither be put in inert, calcareous soils, which are hardly fit for clover grass, nor in too clayey grounds. It is, however, proper to say that these, when well manured, sometimes yield a good crop, and that the Beet-root itself, from the culture which it requires, contributes to the improvement of these soils.

† It is of importance to remark, that good sandy soils yield Beet-roots more abundant in sugar, denser, and more easily kept. Lands impregnated with mineral salts are unsuitable for the culture of the sugar beet, which readily absorbs saline substances, and it is known that alkaline salts form one of the greatest obstacles to the extraction of the sugar.

domine trop, au dépens des autres. Les sols argilo-sablonneux, avec une faible proportion de calcaires, sont bons pour toutes les plantes saccharines, les terres argilo-calcaires viennent ensuite, puis les terres sablo-calcaires. Si l'on a le choix du sol, la terre franche, riche, et humus, et en débris végétaux, est la meilleure de toutes. A quantité égale d'humus, les sols présentent de notables différences dans leur produits, les terres argileuses donnent des rendements plus abondants, mais plus aqueux, moins riches en sucre, et contenant plus de sols alcalins; les terres sablonneuses donnent des plantes moins vigoureuses, mais plus sucrées, les terres calcaires tiennent le milieu entre les précédentes. Les sols nouvellement défrichés ne conviennent à aucune plante saccharine; les végétaux y croissent magnifiquement, il est vrai, mais ils sont pauvres en matières sucrées cristallisables, et le sucre liquide domine dans leurs tissus. Les terres franches, les alluvions humifères, les sols, où le sable domine sur le calcaire, mais où l'argile approche des proportions normales, sont des terrains favorables aux plantes à sucre. Il convient de remarquer, que par des amendements judicieux, on peut amener plus de la moitié des terres arables à recevoir avantageusement des plantes saccharines. Les sols d'alluvion sont les meilleurs.”*

* It is proper to avoid, as much as possible, soils which are almost exclusively clayey, calcareous, or sandy, in which one of the elements of arable land, such as clay, carbonate of lime, or silica, as the case may be, predominates too much at the expense of the others. Soils composed of clay and sand, with a slight proportion of calcareous matters, are well adapted for all saccharine plants; those composed of clay and calcareous matters come next in order, and, after them, those composed of sand and calcareous matters. If

F. de Neufchateau observes, "La Betterave sucrière demande une terre légère, profonde, sablonneuse, mais fraîche et substantielle, et surtout parfaitement meublées."*

Chapsal, formerly Minister of Commerce and Agriculture, says, "Toutes les terres à blé sont plus ou moins propres à la culture de la Betterave, et celles de cette nature qui ont de la profondeur en terres sablonneuses dont le grain est très fin, provenant des alluvions et dépôts de rivières, sont aussi très favorables aux Betteraves; elles n'exigent même pas des engrais artificiels lorsque les inondations peuvent y déposer périodiquement des luvions. Les terres riches, calcaires, légères, ne conviennent pas à la Betterave.

"Les terres fortes argileuses sont peu propres à la culture de cette racine; pour que la Betterave prospère, il faut, en général, un sol meublé et fertile, dont la

a choice of soil is to be had, a mould rich in humus and vegetable debris is the best of all. With the same quantity of humus, soils show important differences in their products. Clayey lands give more abundant returns, but more aqueous, less rich in sugar, and containing more alkaline salts; sandy soils yield less vigorous plants but containing more sugar; calcareous soils hold the middle place between the two preceding. Newly reclaimed lands are unsuitable for any sort of saccharine plants. No doubt, vegetables grow splendidly in them, but they are poor in crystallizable sugar, and liquid sugar predominates in their tissues.

Vegetable moulds, humiferous alluvia, soils in which the sand predominates over the calcareous matters, but in which the clay approaches the normal proportion, are favourable to the growth of saccharine plants. It is proper to observe, that by a judicious system of manuring, more than one half of the arable lands can be made capable of receiving saccharine plants with advantage. The alluvial soils are the best.

* The sugar beet requires a soil light, deep, and sandy, but fresh and substantial, and, above all, it must be in thorough good heart.

couche de terre végétale ait au moins 12 à 15 pouces d'épaisseur.”*

Matthieu de Dombarte, in “Calendrier du bon Cultivateur,” says, “Beets succeed in all soils, even in those of ordinary fertility, provided they have sufficient depth.”

Then, we have in the “Maison rustique du XIX. siècle,” “Beets can be cultivated with more or less success on all soils, but those best adapted are the light, deep broken soils, and such as possess much alluvium and drift deposits. In sandy soils the Beet-root never attains the same size as on clay grounds; but, in that case, small roots of from 1 to 2 kilos. contain more sugar than the larger ones, which contain more water in proportion.

I could quote many other authorities, but I consider the above as quite sufficient, being the results of the experience of well known authorities. We come thus to the conclusion that all soils, except the heavy clay grounds, or soil mixed with sea salts, are adapted to this cultivation; and that the soils most preferred are those possessing the alluvium and drift deposits, or those possessing a calcareous loam with a light sub-soil.

* All wheat lands are more or less adapted for the cultivation of the Beet-roots, and those of this nature which have some depth of vegetable soil, are the best. Sandy soils of a fine grain, formed by alluvia and river deposits, are also very favourable to the Beet-root. They do not even require any artificial manure when the alluvia can be deposited upon them by periodical inundations.

Light soils, rich in calcareous matters, are not suitable for the Beet-roots. Heavy clay grounds are also ill adapted for its culture. Generally speaking, that which is wanted to make the Beet-root thrive is a rich and fertile soil, with a bed of mould at least 12 to 15 inches in thickness.

II.—ESTABLISHMENT.

In order properly to consider this subject, we must take in consideration—

- A. Communication.
- B. Wages.
- C. Fuel.
- D. Water.
- E. Disposal of Pulps.

Having fully considered the importance of a proper selection of soil, we cannot disguise the fact, that the selection of the site for establishing our manufactory deserves every attention and consideration. The most eligible place would be on the land where the cultivation goes on. Economy, the principle of success in every undertaking, is the great essential in this industry. In a former page I have shown that the preservation of the Beet-roots is one of the great difficulties we have to contend with; and, by selecting the place as above, we shall be able to work part of our crop as it is brought from the field, without having to go to the expense of storing in pits; it will, moreover, save the cost of transport, which would be incurred if our manufactory were placed at a distance from our cultivation. It must not be taken for granted that we will be able fully to attain this object; it should, however, be studied and kept in view.

I have no doubt that, once fairly started, we shall soon have to enlarge our works, and to find means of extending the cultivation; we must, therefore, select a

position where we shall be within easy communication of such lands as will answer our views.

The amount of manual labour, which forms such a great item of our daily expenses, is also an important question; for, although we shall have our own men to do the usual field labour, and work in the manufactory, we shall require, during the summer season, a good many extra hands to assist in the field labour.

Coal being largely consumed, it is only right that we should duly consider its cost price, and the facilities for getting it. The result of my researches thus far is, that in those places where coal is most expensive, the price of suitable land is proportionately cheaper, thus amply compensating for the extra outlay for the former.

The daily consumption of water varies from 200,000 to 400,000 gallons per day, according to the extent of our working; and thus far I have found that in the counties where I think of establishing my works, there will be no difficulty in obtaining this and even a larger supply.

The table which is appended to this pamphlet will show that the sale of pulps forms a large part of our income; and it would be desirable to get our establishment in a district where there is much tillage farming, and consequently a demand for such feeding. As mentioned before, the value of pulps as a feeding article cannot be too highly estimated.

III. MACHINERY; AND IV. CAPITAL.

These two subjects, being so closely connected, are best treated together.

My readers will easily understand, that in order to secure success, it is of importance that the machinery adopted should embrace all the latest improvements; my space, however, does not permit me to enter into details here. Let it suffice to say, that proper care must be taken that the *best* be erected, and this will combine economy with the greatest efficiency; and room must be left for such improvements as science may hereafter invent. The Capital should be fixed by the requirements, and not the requirements by the capital. It will be my endeavour to erect the most perfect, useful, and improved manufactory, with as little capital as possible.

I may further add, that although I am of opinion that want of capital might have a damaging effect on a successful working, I am not an advocate for working with more capital than is absolutely required, which, as a rule, leads only to carelessness and waste.

Under existing circumstances, we can only keep the works going for 120 days in the year, but if means could be found to lengthen this time, it may be easily imagined how important this would be. The substance of the beets necessitates their being worked with as little delay as possible, otherwise they would decompose and rot; moreover, the beets lose more or less of their sugar containing qualities by keeping. The more sugar that Beet-roots contain, the better do they keep.

Referring to what I said before, it will be clear to my readers that it is for many reasons important that the manufacturer should cultivate his own seed and Beet-roots, and for this he requires ground.

Otto, in "Praxis der landwirthschaftlichen Gewerben," says, "To obtain success you must only cultivate such Beet-roots as will produce much sugar and little seed, and yet it is impossible to work well without growing your own seed. For some years past great carelessness has been shown in the winning of seed, and this has given rise to many kinds entirely useless for the manufacture of Beet-root sugar."

The remark has been made, that it is difficult to be a good manufacturer and an agriculturist at the same time. I can only refer to Messrs. Hette & Co., of Bresle, in France; and many manufacturers in Magdeburg are combining the two branches; besides, this system gives the manufacturer the opportunity of showing the farmers the advantages of the pulps and manure, and of proving forcibly the great benefits to be derived from these products.

The manufactory possesses, apart from the agricultural department, most of the necessary plant, such as horses, carts, implements, &c., which are all used for pitting the beets, &c.

If the manufacturer does not cultivate his own beets, or even if the soil is worked by the lessee, as is often done on the Continent, the work of cultivation must be executed under his immediate supervision, and this will be evident if it is borne in mind, that in the latter case he pays a certain rent for the soil whether the crops succeed or not; and the result will entirely depend on the labour

and attention bestowed on it. But, further, the manufacturer having capital, machinery, implements, and men who know their work, it is of importance that he should be able to employ them at all times. Moreover, the success of this manufacture requires that the master should have men whom he knows, and who, on the other hand, know him. It is especially true with regard to the manufacture of Beet-root sugar, that a practised eye is often of more value than the nicest analysis; it is surprising to find how a simple labourer, by dint of experience and custom, obtains an amount of skill and promptness of action not to be obtained in any other way.

If you have once formed such hands from the field labourers, it is of the utmost importance to keep them; and the field labour, during the time the works are at a stand-still, gives you an opportunity to do so without loss. We must not forget that in this case we educate the labourers to become manufactory hands, and not the reverse, for they are nearly all selected from amongst the farm labourers.

However, apart from the above considerations, I have, as a result of my visits to the different counties of Ireland, been strengthened in the opinion that it would be madness on the part of any one to start or undertake the management of such a manufactory without having sufficient land to cultivate the necessary quantity of Beet-roots required for it, and thus become independent of a supply from farmers.

I could never advise any one to sink capital in an undertaking which would be dependent for its supply on farmers alone. The Irish farmers are entirely igno-

rant of the proper method of growing Beet-roots, and there are so many little incidents connected with this cultivation that it would take some time to overcome their prejudices and train them for their work.

Every one of my readers will agree with me that, after all, the result of all our vexations and troubles would simply be ruin; for we would never be able to count on a proper supply, or, even if we could, at a price which would pay, for the material would be so dear as to prevent a profitable result in our manufactory.

And now, I ask you, Are not the different departments of this industry so closely connected, as to make it imperative to combine agriculture and manufacture? I have, in a former page, shewn that it is possible to extract a far greater percentage of sugar from the roots than what is generally obtained, and that it is a matter of importance to grow our own roots. By doing so we shall not only be able to obtain such roots as are most suitable for our manufacture, but be able to direct our attention to a better mode of cultivation, with the view of producing such roots as will give a higher percentage of crystallizable sugar.

In thus closing my subject, I consider that I have plainly proved that this industry claims for itself every support from the well-wishers of Ireland, and offers them besides (and this is a fact not to be overlooked) all the advantages of a safe and profitable investment of capital. The annexed analyses of Beet-roots grown in Ireland compare favourably with the results obtained in other countries, and plainly show that the soil is most suitable for its growth. To support this further, I refer my readers to a very interesting lecture by a well

known authority, Mr. T. Baldwin, which was given this year before the Chemico-Agricultural Society of Ulster, and from which I make the following extracts:—

“On the Continent the bulk of the crop was grown on a medium clay land, and from what he had seen in France, Germany, and Belgium, he believed that in Ireland there were 6,000,000 acres well fitted for a rotation in which this crop could be introduced, so far, at least, as soil was concerned.

“Now, as regards the climate, he took a great deal of pains to compare the climate of Belgium with that of Ireland; he compared the returns of rain-fall and the humidity and temperature in Brussels with that of Dublin, and found that in the summer season the average temperature of Brussels was about 2 degrees higher than that of Dublin, while the average winter temperature of Dublin was 2 degrees higher than that of Brussels; thus, the mean temperature of both was alike. Now, the cultivation of beet in Belgium succeeded admirably, and he was in a position to satisfy them, and he hoped to prove conclusively, that so far as climate was concerned, it would succeed in Ireland too, and that the slight difference of temperature in summer and winter was immaterial, though, of course, temperature was an element in the growth of any crop.

“Some persons were of opinion that the successful cultivation of sugar beet required not only a high degree of temperature, but a hot blazing sun. Now, to prove that this was entirely a mistake, it was only necessary to mention, that in order to induce the secretion of a large quantity of a saccharine matter in the beet, the root required to be earthed up, and thus shaded from

the sun. Sun-light, so far from inducing a large secretion of sugar, was rather inimical to it. After his return from the Continent he grew some specimens of beet, which were analysed in order to ascertain their qualities. He considered that a beet crop was a superior crop to flax in respect to its action on the land, as it required the ground to be pulverized. The cultivation of Beet-root would cause more land to be brought under tillage, and thus give more employment to the agricultural population, besides furnishing a new source of industry.

“In Ireland a state of things existed unparalleled in Europe; half the land was in pasture, one-fourth in waste and water, and only one-fourth in tillage. Beet was a crop that would give to the people a large amount of employment.”

ANALYSES OF BEET-ROOTS ACCORDING TO THE FOLLOWING AUTHORITIES.

| Composition of the Beet-root. | Peligo. | | | Pelouse. | Braconot. | Hochstätter. | Hermann. | Krocker. | Boussingault. | Grown in County Wexford, Analysed by Dr. C.A. Cameron. | Grown in Ireland by Thomas Baldwin, Esq. | | | |
|-------------------------------------|---------|-------|-------|----------|-----------|--------------|----------|----------|---------------|---|--|--|-----------------------------------|--|
| | | | | | | | | | | | Dr. Hodges. | Dr. Voelcker. | Professor Jellet. | Dr. Voelcker. |
| Crystallizable Sugar, | 10.0 | 14.4 | 9.8 | 10 | 10.6 | 10.5 | 9.12 | 12.2 | 10.6 | 10.70 | 10.3 to 12.33 | 9.91 to 10.98 | 5 Roots examined optically. | 9.37 to 10.52 |
| Pectine, - - - | 1.8 | 5.2 | 3.4 | — | 2.1 | — | — | — | 2.1 | 1.49 | Grown at Glasnevin. | Grown at the Model Farm in County Cork on poor hungry gravel soil. | 12.59 | Grown at the Ballymoney Model Farm. |
| Ligneous Fibre and Albumen, - } | 3.3 | | 3.3 | 2.5 | 3.1 | — | — | — | 3.1 | 5.55 | | | 12.58 | |
| | | | | | | | | | | | | | 12.43 | |
| | | | | | | | | | | | | | 12.05 | |
| | | | | | | | | | | 11.02 | | | | |
| Water, - - - | 80.4 | 80.4 | 83.5 | — | 84.2 | — | — | — | 84.2 | 82.26 | Grown at Glasnevin. | | | |
| | 100.0 | 100.0 | 100.0 | — | 100.0 | — | — | — | 100.0 | 100.0 | — | — | — | — |

TABLE SHOWING THE COST OF PRODUCTION OF WORK-
ING 10,000 TONS OF BEET-ROOTS IN 100 DAYS.

| | | | |
|---|--------------------|-------|-----|
| Beet-roots, 10,000 tons at 15s., - - - | £7,500 | 0 | 0 |
| Consumption of coals, estimated at 10 tons per 24 hours— | | | |
| 10 tons for 100 days, 1000 tons | | | |
| 5 “ “ 40 “ 200 “ | | | |
| | 1200 tons at 21s., | 1,260 | 0 0 |
| The 200 tons are used during the months of July and August, when the third produce of a former season is worked off. | | | |
| Lime, bone-black, &c., - - - | 450 | 0 | 0 |
| Repair of machinery, grease, oils, &c., and keeping buildings in repair, - - | 1,000 | 0 | 0 |
| Salaries, - - - - - | 1,200 | 0 | 0 |
| Wages— | | | |
| 100 days at £15, - - - | £1500 | | |
| 40 “ 5, - - - | 200 | | |
| | | 1,700 | 0 0 |
| Insurance, lighting, &c., - - - | 500 | 0 | 0 |
| Cost of manufacturing 10,000 tons, - - - | 13,610 | 0 | 0 |
| Interest of Capital, £25,000 at 5 per cent., | 1,250 | 0 | 0 |
| Writing off for machinery and buildings, 5 per cent. on £20,000, - - - | 1,000 | 0 | 0 |
| | £15,860 | 0 | 0 |

RECEIPTS.

| | | | |
|--|-------|---------|-----|
| 25 per cent. of pulps, or 2,500 tons at 10s., - - - | £1250 | | |
| 2 per cent. of molasses, or 200 tons at £5, - - - | 1000 | | |
| Manure, refuse, &c., - - - | 150 | | |
| | | 2,400 | 0 0 |
| | | £13,460 | 0 0 |

Calculating the price of second class sugar to be, in bond, 24s. per cwt., less $2\frac{1}{2}$ per cent., we find that to cover this amount we must produce 11,490 cwts. of sugar, or $5\frac{3}{4}$ per cent. All over the Continent from 7 to 8 per cent. is obtained in well conducted manufactories. If producing 6 per cent. of sugar, we would obtain 12,000 cwts. of sugar at 24s., less $2\frac{1}{2}$ per cent.; or 23s. 5d. net, - - - - - £14,050 0 0

Leaving a net profit, over and above 5 per cent., of £590, or $2\frac{1}{3}$ per cent. on the capital; together $7\frac{1}{3}$ per cent.

If producing 7 per cent. of sugar, we would obtain 14,000 cwts. of sugar at 24s., less $2\frac{1}{2}$ per cent.; or 23s. 5d. net, . £16,391 13 4

Leaving a net profit, over and above 5 per cent., of £2931, or nearly 12 per cent. on the capital; together 17 per cent.

If producing 8 per cent. of sugar, we would obtain 16,000 cwts. of sugar at 24s., less $2\frac{1}{2}$ per cent.; or 23s. 5d. net, - £18,733 6 8

Leaving a net profit, over and above 5 per cent., of £5273, or over 21 per cent.; making together over 26 per cent. on the capital.

IF WORKING 12,000 TONS OF BEET-ROOTS IN 120 DAYS.

| | | | | | | |
|---|---|---|---|--------------------|---------|-----|
| Beet-roots, 12,000 tons at 15s., | - | - | - | £9,000 | 0 | 0 |
| Coals per day— | | | | | | |
| 10 tons for 120 days, 1200 tons. | | | | | | |
| 5 " 40 " 200 " | | | | | | |
| | | | | 1400 tons at 21s., | 1,470 | 0 0 |
| Lime, bone-black, &c., | - | - | - | - | 500 | 0 0 |
| Repair of machinery, grease, oils, &c., | - | - | - | - | 1,000 | 0 0 |
| Salaries, - - - - - | - | - | - | - | 1,200 | 0 0 |
| Wages— | | | | | | |
| 120 days at £15, | - | - | - | £1800 | | |
| 40 " 5, | - | - | - | 200 | | |
| | | | | | 2,000 | 0 0 |
| Insurance, lighting, &c., | - | - | - | - | 600 | 0 0 |
| Cost of manufacturing 12,000 tons, | - | - | - | - | 15,770 | 0 0 |
| Interest on capital, 5 per cent., and writing off for machinery, buildings, &c., 5 per cent., together, - - - - - | - | - | - | - | 2,250 | 0 0 |
| | | | | | £18,020 | 0 0 |

RECEIPTS.

| | | | | | | |
|-------------------------|---|---|---|-------|---------|-----|
| 25 per cent. of pulps, | | | | | | |
| or 3000 tons at 10s., | - | - | - | £1500 | | |
| 2 per cent of molasses, | | | | | | |
| or 240 tons at £5, | - | - | - | 1200 | | |
| Manure, &c., - - - - - | - | - | - | 200 | | |
| | | | | | 2,900 | 0 0 |
| | | | | | £15,120 | 0 0 |

If producing $5\frac{3}{4}$ per cent. of sugar, we would
 obtain 13,800 cwt. at 24s., less $2\frac{1}{2}$ per
 cent.; or 23s. 5d. net, - - - - - £16,157 10 0

Leaving a net profit, over and above 5 per cent., of £1037, or over 4 per cent.; making altogether over 9 per cent. on the capital.

If producing 6 per cent. of sugar, we would obtain 14,400 cwts. at 24s., less $2\frac{1}{2}$ per cent.; or 23s. 5d. net, - - - £16,860 0 0

Leaving a net profit, over and above 5 per cent., of £1740, or nearly 7 per cent.; making altogether nearly 12 per cent. on the capital.

If producing 7 per cent. of sugar, we would obtain 16,800 cwts. at 24s., less $2\frac{1}{2}$ per cent.; or 23s. 5d. net, - - - £19,670 0 0

Leaving a net profit, over and above 5 per cent., of £4550, or over 18 per cent.; or 23 per cent. on the capital.

If producing 8 per cent. of sugar, we would obtain 19,200 cwts. at 24s., less $2\frac{1}{2}$ per cent.; or 23s. 5d. net, - - - £22,480 0 0

Leaving a net profit, over and above 5 per cent., of £7,360, or $29\frac{1}{2}$ per cent.; equal to $34\frac{1}{2}$ per cent on the capital.

IF WORKING 14,000 TONS OF BEET-ROOTS IN 140 DAYS.

| | | | | | | |
|---|---|----|---|--------------------|--------|-----|
| Beet-roots, 14,000 tons at 15s., | - | - | - | £10,500 | 0 | 0 |
| Coals per day— | | | | | | |
| 10 tons for 140 days, 1400 tons. | | | | | | |
| 5 | “ | 40 | “ | 200 | “ | |
| | | | | | | |
| | | | | 1600 tons at 21s., | 1,680 | 0 0 |
| Lime, bone-black, &c., | - | - | - | - | 600 | 0 0 |
| Repair of machinery, grease, oil, &c., | - | - | - | - | 1,000 | 0 0 |
| Salaries, | - | - | - | - | 1,200 | 0 0 |
| Wages— | | | | | | |
| 140 days at £15, | - | - | - | £2100 | | |
| 40 | “ | 5, | - | - | 200 | |
| | | | | | | |
| | | | | | 2,300 | 0 0 |
| Insurance, lighting, &c., | - | - | - | - | 700 | 0 0 |
| | | | | | | |
| Cost of manufacturing 14,000 tons, | - | - | - | - | 17,980 | 0 0 |
| Interest on capital 5 per cent., and writing off for machinery and buildings, 5 per cent. ; together, | - | - | - | - | 2,250 | 0 0 |
| | | | | | | |
| | | | | | 20,230 | 0 0 |

RECEIPTS.

| | | | | | | |
|--------------------------|---|---|---|-------|---------|-----|
| 25 per cent. of pulps, | | | | | | |
| or 3500 tons at 10s., | - | - | - | £1750 | | |
| 2 per cent. of molasses, | | | | | | |
| or 280 tons at £5, | - | - | - | 1400 | | |
| Manure, &c., | - | - | - | 200 | | |
| | | | | | | |
| | | | | | 3,350 | 0 0 |
| | | | | | | |
| | | | | | £16,880 | 0 0 |

If producing $5\frac{3}{4}$ per cent. of sugar, we would
 obtain 16,100 cwts. at 24s., less $2\frac{1}{2}$ per
 cent. ; or 23s. 5d. net, - - - £18,850 8 4

Leaving a net profit, over and above 5 per cent., of £1970, or nearly 8 per cent.; making together 13 per cent. on the capital.

If producing 6 per cent. of sugar, we would obtain 16,800 cwts. at 24s., less $2\frac{1}{2}$ per cent.; or 23s. 5d. net, - - - £19,670 0 0

Leaving a net profit, over and above 5 per cent., of £2790, or over 11 per cent.; making together over 16 per cent. on the capital.

If producing 7 per cent. of sugar, we would obtain 19,600 cwts. at 24s., less $2\frac{1}{2}$ per cent.; or 23s. 5d. net, - - - £22,948 6 8

Leaving a net profit, over and above 5 per cent., of £6068, or over 24 per cent.; making altogether over 29 per cent. on the capital.

If producing 8 per cent. of sugar, we would obtain 22,400 cwts. at 24s., less $2\frac{1}{2}$ per cent.; or 23s. 5d. net, - - - 26,226 13 4

Leaving a net profit, over and above 5 per cent., of £9346, or over 37 per cent.; making altogether over 42 per cent. on the capital.

STATEMENT OF CAPITAL REQUIRED.

| | | | |
|---|----------------|----------|----------|
| Buildings, Engineer's Shop, and Depot, - | £4,500 | 0 | 0 |
| Offices for Manager, Engineer, and Foremen, - | 800 | 0 | 0 |
| Porter's Lodge and Labourers' Dwellings, - | 1,700 | 0 | 0 |
| Machinery, including Freight, - - - | 13,000 | 0 | 0 |
| *Working Capital, - - - - - | 5,000 | 0 | 0 |
| | <u>£25,000</u> | <u>0</u> | <u>0</u> |

* This does not include the Capital required for the Farms, and which should be worked as an independent concern.

TABLE SHOWING THE COST PRICE OF BEET-ROOT SUGAR IN BOND BY WORKING THE FOLLOWING QUANTITIES OF BEET-ROOT.

| When extracting. | 10,000 Tons. | 12,000 Tons. | 14,000 Tons. |
|---------------------------|--------------------------|--------------|--------------------------|
| 5 $\frac{3}{4}$ per cent. | 23s. 5d. | 21s. 11d. | 20s. 11 $\frac{5}{8}$ d. |
| 6 " | 22s. 5 $\frac{1}{5}$ d. | 21s. 0d. | 20s. 1 $\frac{1}{7}$ d. |
| 7 " | 19s. 2 $\frac{3}{4}$ d. | 18s. 0d. | 17s. 2 $\frac{3}{4}$ d. |
| 8 " | 16s. 9 $\frac{9}{16}$ d. | 15s. 9d. | 15s. 0 $\frac{3}{4}$ d. |

APPENDIX.

THE following Extracts are taken from Messrs. William Connal and Co.'s Monthly Circular, dated Glasgow, 31st December, 1870:—

The import into Clyde, according to the Customs returns, from 1st January, amounts to 205,885 tons, against 144,657 tons in 1869, comprising **35,018** tons of Beet-root Sugar.

The import of Beet shows a decided increase over the two previous years, being **35,018** tons, against **14,151** tons in 1869, and 22,746 tons in 1868.

The deliveries for home consumption in the Clyde have been **196,129** tons, against 156,023 tons in 1869, of which **33,279**, or more than one-sixth, was Beet-root Sugar.

In *Beet-roots* the transactions would have been on a large scale, but for the firmness of the Continental markets, French and Belgian, which at the beginning of the month were freely offering at 24s. f. o. b. Dunkirk and Antwerp are now fully 24s. 3d. and 24s. 6d., and for Bohemian the last sale was 23s. 3d. f. o. b. Hamburg.

In their Circulars, dated 31st October, and 25th November, 1871, we read:—

The active demand on the Continent, more particularly from Germany, has led to the cancelling of numerous contracts of Austrian Beet-root, comprising about 3000 tons. The latest re-sales having been at 24s. f. o. b., basis 93 per cent. polarization. Some contracts, also of French and Belgian Beet, for October shipment, from the lateness of the

crop, have been cancelled at 25s. 6d. and 25s. 9d. f. o. b., basis 88 per cent. analysis. For shipment November and December, the quotation ranges from 25s. 3d. to 25s. 6d.

The import into Clyde, according to Customs returns, from 1st January, amounts to **185,753** tons, against 180,947 tons in 1870, and includes **67,643** tons *Beet-root Sugar*.

The deliveries for home consumption in the Clyde during the past ten months have been 175,390 tons, against 162,957 in 1870, and 130,089 in 1869. Those for the four ports of London, Liverpool, Bristol, and Clyde, during the same period amount to 503,709 tons in 1871, against 489,375 tons in 1870, and 440,725 tons in 1869.

The actual import into Clyde during November, 1870, was 19,220 tons; the deliveries for home consumption was 18,062 tons; and the quotations were then 29s. for good dry brown qualities of B.P. West India in warehouse, and 23s. 9d. for French and Belgian Beet f. o. b., basis 88 per cent. analysis, and 23s. and 23s. 3d. for Bohemia f. o. b., basis 93 per cent. polarization.

CLYDE SUGAR MARKET

FOR THE WEEK ENDING 25th NOVEMBER, 1871, 1870, & 1869.

With Estimates of the Imports and Consumption since 1st January, based on Customs Returns.

| IMPORTS. | | | | | | CONSUMPTION. | | | STOCK. | | |
|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| DIRECT. | | | COASTWISE. | | | | | | | | |
| 1871. | 1870. | 1869. | 1871. | 1870. | 1869. | 1871. | 1870. | 1869. | 1871. | 1870. | 1869. |
| <i>Tons.</i> | <i>Tons.</i> | <i>Tons.</i> | <i>Tons.</i> | <i>Tons.</i> | <i>Tons.</i> | <i>Tons.</i> | <i>Tons.</i> | <i>Tons.</i> | <i>Tons.</i> | <i>Tons.</i> | <i>Tons.</i> |
| 5,930 | 3,880 | 1,670 | 250 | 2,130 | 200 | 2,670 | 4,650 | 3,930 | 33,310 | 32,040 | 22,470 |
| 202,153 | 198,857 | 138,490 | — | — | — | 191,580 | 183,160 | 143,923 | — | — | — |

The transactions in our SUGAR Market during the week, so far as they transpired, may be estimated at 8,000 tons. The particulars comprise about 1,500 hhds. B.P. West India, in second hands, and 1 cargo Cuba Muscovado of 308 hhds., all in warehouse; 1 cargo Bahia of 6,107 bags, and 1 cargo Pernambuco, of the new crop, of 5,600 bags, on floating terms, arrived at ports of call, and about 5,600 tons Beet-root sugar, shipment November to January, all French or Belgian, except 500 tons which are Austrian, and of which fully more than a half are re-sales. The market continues to wear a very strong aspect, and good dry brown qualities of B.P. West India command rather stiffer rates, the quotation being now 33s. and 33s. 6d. The last sales of French Beet have been at 27s. 1½d. and 27s. 3d. f. o. b., basis 88 per cent. analysis, for immediate shipment. Offers for Austrian Beet have been made at 25s. 3d. f. o. b., basis 93 per cent. polarization, but it is held at 25s. 6d. and 25s. 9d.

The annual consumption of sugar in Great Britain and Ireland has reached 700,000 tons, exceeding 48 lbs. per head, and for which we annually pay *sixteen millions sterling*.