

timber could be had for cutting and carting to the workshed, so that beyond the small sum required for the purchase of tools, etc., the sole outlay would be the cost of carriage to the merchant's warehouse, which, from the northern settlements, in any case must be much less than American freight rates, while the import duty of 15 per cent. *ad valorem* would be altogether in favour of the settler, although this of itself may be a disadvantage to the community.

ART. XII.—*On the Growth of Sugar-Beet in New Zealand.*

By S. M. CURL, M.D., F.L.S.

[*Read before the Auckland Institute, 25th October, 1880.*]*

It is some years ago since I wrote in the public papers and otherwise to advocate the introduction of the sugar-beet industry in this colony, being thoroughly satisfied by the experiments I made of the growth of various beets from different countries under test culture, and the large percentage of sugar by analysis, that the establishment of sugar-beet manufactures would greatly enrich this country. Had my plans been adopted and carried out, this colony would have been rich and prosperous, instead of being deeply in debt as it now is, and in place of the farmer working his land, as he now does, at a loss, by the introduction of the sugar-beet industry quite a different state of things would quickly arise, and the farmers might every year make a profit of from ten to fourteen pounds per acre for every acre they had in beet culture, and still leave six pounds for working and manuring each acre, thus, at the same time, increasing their capital, paying good interest upon that invested, employing more labour than they can now afford to do, and meanwhile the capital invested in the manufacture of sugar and spirit would be profitably introduced, and more labourers would be employed.

That these are facts and not fancies the history of the beet industry in all countries proves beyond a doubt, and having formerly had the advantage of seeing the beet culture and manufacture in France, in Russia, in Germany, in Austria, and other countries, and seeing the profit it brought to the farmers growing it, and to the manufacturers who obtained from the roots sugar, spirit, and the waste products used for cattle feeding, &c.,—

* [This paper was first read before the Wellington Philosophical Society on the 22nd November, 1879, and its publication was postponed by direction of the Board, as the author might wish to acquaint himself with the voluminous Parliamentary papers on the subject (App. Journ. H. of R. 1876, H.-2 and H.-2A; 1877, I.-4), especially as these papers include analyses of New Zealand grown beets, showing much less favourable results.—ED.]

after coming to this colony, by writing, and in various other ways, I endeavoured to point out the great advantages that would follow the introduction of this industry here; but, further than this, with a view to determine how far the climate and soil would be favourable to the formation and development of sugar in the beetroot here, I wrote to seedsmen in France, Germany, and other countries, and imported seed of the several kinds of beet, and grew it, and submitted it to various test cultures in this colony; and having tried the effects of different modes of culture upon the various sorts of beet, I proved to my own satisfaction and that of the friends who took an interest in these experiments, that not only would the sugar-beet grow and flourish, but that under the ordinary plough and harrow culture of the farm, it would produce a crop of from eighteen to twenty-seven tons to the acre, but that with appropriate manures and careful cultivation, this quantity could be considerably exceeded, and that, in proportion to other parts of the world, very large crops could be grown here.

But as all who know anything of beet culture and manufacture will recognize, it is not only the quantity of tons of beetroot to the acre that is the great desideratum, but more especially the percentage of sugar that the roots contain that makes the greatest difference. To determine this, I analysed, and in other ways tested, this percentage of sugar, and afterwards, by "maceration and diffusion," extracted the sugar, and crystallized what was crystallizable, and the molasses left fermented, and distilled off the alcohol, and by these several methods checked and verified the results; and I found that this climate would enable beets to be grown that had a very high percentage of sugar in proportion to that produced from the same kind of seed in the other countries from which they came, as the following details will show.

The seeds which were obtained from France and Germany were said to have a percentage of sugar in the same kind of roots, the previous year to my obtaining seed, as that given below, and the average of my tests from several roots selected at various parts of the field when grown, and tested by the different methods, gave as under.

Betterave blanche	9½ per cent. of sugar in France.
With me	12 per cent.
Disette blanche à collet rose	7 per cent. of sugar in France.
With me	9 per cent.
Disette blanche à collet vert	8 per cent.
With me	9½ per cent.
Betterave Vilmorin	16 per cent.
With me	17½ per cent.
Betterave jaune globe	6 per cent.

With me	6 per cent.
Betterave jaune sarrazin	6½ per cent.
With me	7 per cent.
Magdebourg	11½ per cent. sugar in Germany.
With me	13½ per cent.
Imperial	13½ per cent. in Germany.
With me	15½ per cent.
One of the best Russian varieties.	15½ per cent. in Northern Russia.
With me	16 per cent.
A variety from Austria	15 per cent. in Austria.
With me	16½ per cent.

These figures coming out as the result of cultivating some of the best varieties to yield sugar in other countries, proved to me that the beetroot would, in this country, yield a large, or larger, proportion of sugar; and as the quantity per acre was as much as that in other countries, and in some experiments greater, I saw that it only required a manufactory to be established here to enable that root to be grown, and sugar made, at a profit to all concerned; and even while there was no manufactory of sugar the beet-roots fed to cattle, pigs, etc., quickly fattened them as soon as they were taught to eat this new kind of food. But, as labour is so expensive here, the beetroot will not be largely cultivated until a manufactory is established to work up the beetroot into sugar. But directly this is done the profit will be so manifest that this industry will rapidly increase.

It therefore becomes a question of how much money would be required to inaugurate this industry by establishing a factory here. I have no doubt that capitalists in other countries would be induced to establish a factory here, if they were made acquainted with the fact that we are every year spending such large sums for our sugar imported into this colony. But the Government of the colony could so guarantee this investment of capital that this sugar manufactory could be at once inaugurated.

But even if a company is formed, and the directory and other preliminaries established here, and a portion of the capital subscribed for it, the remainder would rapidly be taken up in the other countries of Europe, as they know that over 20 per cent. of profit can be easily made if this business is properly gone about; but it will depend upon this, and the promoters will have to take care that they arrange this factory and plant upon the best German and French models, and have a thoroughly competent manager, fully instructed hands of the several processes engaged to carry on the work, or, instead of being a certain success and profit, it will be a certain failure. Also the central factory should be in such a well-chosen situation that it will easily obtain its water, fuel, and supply of beetroots from the neighbouring farmers; although this can be arranged to a certain extent by having local establishments, where the beets can be received from the

farmers growing them, and there dried, and then sent on to the central factory, as is done in some parts of France and Germany. The farmers could then deliver to these branch establishments the beetroots from their fields, and receive back payment at the rate of from 15s. to 20s. per ton of beets, according to the amount of sugar therein contained, which would depend upon the kind of seed sown and the care taken in its cultivation; and, as farmers could easily grow from twenty to thirty tons of the best kinds of beet with the proportions of sugar ranging from 9 to 13 per cent. on all ordinary lands, and upon selected lands higher percentages than these, (at which increasing percentages of sugar it would be profitable for the factors to pay them much more than the 20s. per ton of beets delivered) it can be seen that there would be no difficulty for the farmer to realize from each acre he laid in sugar-beets a gross sum of £20 and over per acre. Against this must be set the ploughing, seeding, manuring, cultivating, gathering, carting to factory, and wear and loss, a sum of £7 per acre, which, deducted from the £20 realized by the sale of the beet, would leave £13 profit upon every acre grown. But even if the expenses were, from locality, etc., greater, and the returns somewhat less, there would still be a very considerable profit, which, by any calculation, would be far greater than at present made by any use to which the land could be turned.

Upon examining my notes of the profit made by farmers in France, Germany, and elsewhere, I find they are much larger than my highest figures; and, better than all, instead of this being a temporary advantage to the farmer to cultivate beetroot, it is a great gain to him besides what he acquires directly from the sale of the beetroot, as it is a well-proved fact that the fields improve each year under beet culture, and that, after the beetroot comes off, the land will grow a better crop of wheat or other corn than it would before these roots were grown. In fact, the beet crop is an excellent preparation and preparatory crop for wheat or other corn, and, in addition to the roots sold, the green tops of the beet can be fed to cattle or live stock as well; and then the manure applied to the land with the beet crop, and the working this gets, so prepares the soil for the subsequent cropping that a beet crop in rotation enables the farmer to grow more wheat in a series of years than he could without the beet being grown on his land.

Again, in many parts of Germany and France when the farmer sends a load of beets to the factory he brings back a return load of the expressed beet-pulp, from which the sugar has been extracted, and with this he feeds cattle or other live stock, thus adding food for his animals, and letting them turn it into manure for his fields; so that, while feeding the leaves and pulp back to his cattle, he only removes the sugar which the beets made while growing upon his land; and, as the sugar is composed of carbon, hydrogen, and

oxygen, obtained principally from the atmosphere in the shape of rain and carbonic acid, the soil is not exhausted by the beets being grown upon these lands; and judicious application of manures, in addition to the leaves and pulp, more than keeps up the fertility of the soil to the condition it held before the beets were cultivated, while the preparation of the land and culture of the beetroot, and the profit made therefrom, enable more labourers to be kept all the year round upon each farm, and at better wages, and yet be remuneratively employed, than would be possible without the beet culture. But let us leave for the present the farmers who would grow the beet, and turn to those who would manufacture it into sugar.

The larger the capital invested in beet-sugar manufacture up to a certain amount—supposing the management to be equally good in each instance—the greater the profit, and the better altogether for all concerned, as more perfect machinery and more certain results can be attained to, and although a capitalist, or a company, could start and work a factory and make sugar for a year from a capital of £25,000, yet it would be far wiser and better in every way to have a capital of £75,000, or if possible £100,000, which would pay better than either of the other sums. But as there would be no difficulty in raising the sum in Europe for such a purpose if the directory and management was what it should be, it would be well to have the larger sum invested.

But taking £75,000 as the capital of a company, let us see what similar enterprises return as profits for such a capital in other places.

Capital £75,000; £50,000 of which would be expended upon buildings and machinery and plant generally, and £25,000 would be reserved, or spent upon a year's working expenses.

In France and Germany, the average cost of producing a weight of sugar is, if calculated in English weight and money, equal to from 1½d. to 2d. per pound, varying according to the perfection of the factory, plant, etc., or about £18 per ton. A factory furnished with a plant like that proposed, could easily work up and convert into sugar thirty thousand tons of beetroot, which, supposing the beet yielded at the rate of about eight per cent. of crystallized sugar, or a total equal to 2,392 tons of crystallized sugar, would cost £43,056 to produce, and would if sold at £36 per ton, leave a profit for sale of sugar of £43,056. There would then be left from this quantity of beet, 800 tons of molasses, which if sold at £2 per ton would amount to £1,600, and there would be about 5,700 tons of beet pulp, which if sold at 10s. per ton to the farmers or dairymen, or to any one keeping live stock, would amount to £2,850, being a total of £47,506 for the year's operations, which would be a profit of over 60 per cent. upon the whole of the capital.

But large as these profits are when calculated upon the data furnished by factories working in France and Germany, they would be exceeded here, as they are based upon an average of less sugar in the beet than would be found here, for we might certainly calculate upon $11\frac{1}{2}$ per cent. of sugar in our beetroots, whereas the preceding figures are calculated for only 10 per cent. as a total, and 8 per cent. as sugar extracted and crystallized. But even if matters were much worse, and did not show a profit of 60 per cent., through mismanagement and a less percentage of sugar and the produce being sold at a lower price, even then the profits must be very large, and must altogether depend upon the management of the factory.

But, whatever may be thought of the exact amount of the profits that would accrue, there can be no doubt that large profits would be made, as is proved by the rapid way in which this industry has spread on the continent of Europe, and the enormous wealth that has been developed thereby, not only amongst manufacturers, but among the farmers and others who are engaged and interested in the beet industry.

In 1850, in France, an area equal to 87,000 British acres was under beet culture, and fifteen years afterwards this area under beet culture increased to over 300,000, and it has been increasing at a very rapid rate ever since. In fact, the production of beetroot sugar has *doubled* in France every ten years.

In Germany, they are more than doubling their production of sugar every ten years. In 1850, in Germany, they made 53,000 tons of beet sugar, and in 1865 they made 187,000 tons. In 1867 France made 220,000 tons of beet sugar, and has as rapidly increased ever since. In Austria, they have over 200 beet sugar manufactories, and are always increasing the number. The increase of this industry is also equally rapid in Holland, Belgium, Sweden, Poland, and Russia. In the year 1866, there were produced in the whole world 2,320,000 tons of sugar from the beet, the maple, the cane, the palm, and the date; out of this quantity there was more than one-fourth manufactured from the beetroot, namely 638,500 tons, of which France produced 216,000, Germany 190,000, Austria 80,000, Russia 80,000, Belgium 40,000, Poland and Sweden together 25,000, and Holland 7,500.

In the year ending 1866, in France, the returns from the beet harvest in that country were as follows, reduced into English money:—

Beet sugar.. .. .	£6,250,000
Spirit distilled from beet	1,350,000
Potash from refuse of beet	500,000
Exhausted pulp sold at factories	1,100,000

Total £9,200,000

In addition to this there were the leaves for the cattle to feed upon. In that year there were over 100,000 hands engaged in the sugar factories, and over 26,000 in the beet-distilleries ; lands leased by the farmers to grow the beetroots averaged 200 francs per hectare—over £3 per acre English.

The growers of the beetroot consider that it thrives best in a temperate climate, with sufficient but not too great moisture, a moderate amount of sun but not too much heat ; as all the root should grow under ground to contain the largest amount of sugar, in a soil not too dry or too hard, it follows that this climate would admirably suit it.

Wherever it has been once fairly tried it is never given up, but always increases. The labourers' wages rise, the farmer gets richer, the manufacturer becomes wealthy. The money that would have gone out of those countries for cane-sugar is now kept in, and not wasted for what they can themselves produce ; and are we to be more reckless and wasteful than they, and send our thousands, every year, out of the colony for what we can produce so well here ; are our commercial men such incapables that they will allow this wealth to slip past them without inaugurating an industry that would benefit them, and all concerned ; are our farmers so obtuse that what a Frenchman, a German, a Swede, a Russian, a Hollander, an Austrian, a Pole can do, and improve his farm with, and have a constant and steady income therefrom, they cannot perform ; are they so much behind the other nations, that they cannot or will not adapt themselves to a new culture that is no more difficult than the old, and that is in no way speculative, as most other nations have seized upon it, and are always going more fully into it, finding it so profitable and worthy of attention ? Surely the men who have made New Zealand their home, and have settled upon these fertile lands, and where the climate is so suitable to the beet culture that it develops more sugar than in other places, will not much longer refrain from this magnificent industry, that will make them, and their families, well off, and render them more prosperous each year—enabling them to employ more labour, more machinery, and to more highly cultivate and always keep improving their farms and making their lands more valuable—while they are establishing an industry that will make them more independent of corn and meat-growing each year, but will enable them, if they choose, to grow more wheat and meat to the acre than they can now possibly do, by reason of the improvements that beet culture would effect in the tillage and improvement of these lands ; while they will be keeping the money in the country that is now being sent out in hundreds of thousands to purchase the sugar and spirits that are now draining the money out of the colony.
