1873.

NEW ZEALAND.

RECOMMENDATIONS OF INDUSTRIAL COMMITTEE OF 1872.

(*Return to an Order of the House of Representatives, dated 17th July*, 1873.)

"That there be laid upon the Table a Return showing what practical effect has been given, during the recess, to the recommendations of the Industrial Committee of last Session."—(*Mr. O'Conor.*)

MEMORANDUM of action taken in accordance with the recommendations of the JOINT COMMITTEE on COLONIAL INDUSTRIES, 1872.

COAL FIELDS.

Kawa Kawa.—A grant of £1,000 has been made to assist the Kawa Kawa Coal Company to explore their ground, by boring at the spots indicated by the Geological Department in 1866.

Brunner Mine.—The exploration of the portion of the coal field on the south side of the Grey River has been proceeded with, and several additional areas of workable coal have been discovered. A portion of the Grey Coal Reserve has been leased to the Greymouth Coal Mining Company. The railway connecting the mines with the port is now in course of construction.

Mount Rochfort and Ngakawau Mine.—The coal has been traced from Mine Creek on to the plateau, where it exists in large quantity at 1,800 feet above the sea level. A coal seam at the Waimangaroa River has also been explored for, but the result so far is not satisfactory. A preliminary survey has been made of the railway line and harbour works requisite for the development of the coal field. Explorations for coal have also been undertaken in the following districts:—Wangaroa, Collingwood, Kanieri, Southland; and reports have been obtained relative to coal seams at Wangarei, Waikato, Raglan, Malvern Hills, Rangitata, Blueskin, Waikara, and Preservation Inlet. (See Papers relative to the Development of Coal Fields.)

IRON.

A bonus has been offered for the manufacture of iron, and also for the manufacture of steel (Appendix A), and notice has been received of the intention to claim the bonus from,—

Pig Iron:—

1. Messrs. H. J. Walduck and Co., 1, Market Street, Manchester, England.
2. Magnus Manson, settler at Motupipi.
3. New Zealand Titanic Steel Company, Wellington.

Steel:—

1. New Zealand Titanic Steel Company, Wellington.
2. Magnus Manson, Motupipi.

BEETROOT SUGAR.

A bonus for the encouragement of and manufacture of sugar from the beetroot has been offered on the terms recommended. (Appendix A.) The three varieties of seed imported for Government by Mr. Krull were distributed, with forms indicating the nature of the information required; but as the seed, owing to some cause, did not germinate freely, the experiment has, on the whole, in consequence failed. (Appendix B1 and B2.)

A quantity of the seed of the best variety of *Sorghum saccharatum*, a plant used for the manufacture of sugar, and also valuable as a fodder plant, which was ordered from the United States on the suggestion of a former Committee, has been distributed, but no returns can be received until next season.

PAPER.

The bonus recommended has been offered (see Appendix A), and notices have been received of an intention to compete from Edward McGlashan, Dunedin; Joseph Mackay, Tokomairiro; Robert Stout, Dunedin; W. T. Dowdall, Waikato; but of these, the two last applications were made too late to comply with the terms of the competition.

FISH.

The offer of the bonus made last year is still in force (see Appendix A), and the period of the operation of the offer was ante-dated in terms of the resolution (see Appendix C); but no application has been made for payments on account of the bonus.

No definite information has yet been obtained relative to the size of nets and the season of the year during which their use should be allowed; but as systematic fisheries are now established in Canterbury and elsewhere, it is probable that evidence on this important subject will be forthcoming after the experience of a few seasons.

Flax.

The further Report by Professor Church, relative to the intimate structure and constituents of the flax plant, has been obtained. (Appendix D.)

It is intended shortly to publish the conditions on which the proposed exhibition of flax machinery is to be held, in terms of the resolution of the House of Representatives, of the 27th October, 1872. On the application of the Canterbury Flax Association, the Provincial Government have voted £250, on condition that the exhibition is held in Christchurch.

The experiment concerning the growth of cultivated flax has been continued at Taranaki and Wellington. (See Appendix E.)

A Return was called for of the area of flax land which exists in various parts of the Colony, by a circular addressed to Superintendents, with the following results (as shown in Appendix F):—

Auckland	No return.
Taranaki	20,000 acres.
Napier	26,000 acres.
Wellington	No return.
Nelson	No return.
Marlborough	No return.
Canterbury	22,000 acres.
Otago	307,000 acres.

The last-mentioned Return is accompanied by a plan, and appears to include the total area of those districts of the Province in which flax grows, and not merely the areas of land carrying a heavy flax crop, which appears to be the basis of the other estimate given.

Timber.

The appended circulars (Appendix G) have been issued, and timbers for experimental examination received in reply from E. H. Bold, Hawke's Bay; A. Munro, Wellington; D. Ross, Hawke's Bay; W. N. Blair, Otago.

These have been prepared for experiment, and will be operated on as soon as they are sufficiently seasoned.

Vienna Exhibition.

Full effect has been given to the resolution regarding the Vienna Exhibition (see Papers relative to Vienna Exhibition), and New Zealand will be represented by the following exhibits sent from the Colony, besides a large number obtained in England:—

Minerals and Ores	155 exhibits.
Agricultural and Pastural Products	65 exhibits.
Phormium	82 exhibits.
Timbers	127 exhibits.
Manufactures	133 exhibits.
Fine Arts	58 exhibits.
Miscellaneous	78 exhibits.

The latter includes a topographical and geological map of the Colony, upon a scale of 12 miles to the inch.

A descriptive catalogue has been prepared of all these exhibits in English, German, and French.

25th July, 1873. James Hector.

APPENDICES.

APPENDIX A.

No. 1.

Colonial Secretary's Office, Wellington, 18th November, 1872.

In compliance with a resolution of the House of Representatives, passed on 22nd October, 1872, a bonus is hereby offered for the encouragement of certain colonial industries, namely:—

Iron.—Bonus of £5,000.

For the production in New Zealand of 1,000 tons weight of pig iron, of marketable quality.

Conditions.

1. The bonus not to be given for any quantity less than 100 tons.
2. Notice of the intention to erect iron works and claim the bonus must be given to the Colonial Secretary before the 31st December, 1873.
3. The bonus must be claimed before the 30th June, 1875.
4. In the event of more than one claimant giving such notice, not more than seven-tenths of the bonus may be claimed by the first producer, and not more than three-tenths by the second producer; but if only one claimant becomes a producer on the above conditions, he may claim the whole of the bonus.

5. The iron in respect to which any bonus is claimed will be examined by an officer to be appointed by the Government, who may require the production of *bona fide* account sales of quantities not less than 100 tons weight, showing that such iron has been sold at a fair market price as pig iron.

STEEL.—Bonus of £1,000.

For the production in New Zealand of 100 tons weight of marketable steel from magnetic or titaniferous iron sand or iron ore.

Conditions.

1. Notices must be given to the Colonial Secretary of the intention to claim this bonus before the 30th June, 1873.
2. The claim for payment of the bonus must be made before 30th June, 1874.
3. The bonus will be paid to the producer who effects the first *bona fide* sale of the above quantity of steel at a fair market price.

SUGAR.—Bonus of £2,000.

For the production of 250 tons of sugar manufactured from beetroot in New Zealand.

Conditions.

1. Notice of the intention to claim this bonus must be given to the Colonial Secretary before 31st December, 1873.
2. Claims for payment of the bonus to be sent in before 30th June, 1875.
3. The bonus will be paid to the producer who first effects a *bona fide* sale of the amount of sugar specified.

PAPER.—Bonus of £2,500.

For the production of 100 tons of printing paper, manufactured in New Zealand, by machinery.

Conditions.

1. Notice of the intention to claim this bonus must be given to the Colonial Secretary before 31st January, 1873.
2. The paper must be made by machinery, permanently established, and working in the Colony.
3. Claims for payment of the bonus must be sent in before 31st December, 1874.
4. The bonus will be paid to the producer who effects the first *bona fide* sale of the amount of printing paper specified.

FISH.—Bonus of 4s. per cwt.

This bonus will be paid on cured fish, dry or pickled, exported from the Colony for consumption abroad.

Conditions.

1. The bonus will be paid to the producer on the production of account sales showing that the fish has been sold out of the Colony for fair market value.
2. The exporter to enter into a bond not to re-land in the Colony any fish upon which a bonus has been paid.
3. The bonus may be claimed on all fish exported between 1st August, 1872, and 1st November 1879, and is to be paid out of any moneys appropriated by Parliament for the purpose.

The above rewards will be paid on the certificate of an officer appointed by Government, that the conditions applicable to each reward have been complied with.

JOHN HALL.

APPENDIX B1.

No. 2.

The attached form was distributed to the undermentioned persons with parcels of beet seed.

The Botanic Gardens, Wellington.	Report enclosed (*a*).
Major Jackson, Waikato	No return.
Mr. Hay, Auckland	,,
Superintendent, Hawke's Bay	,,
Mr. Hulke, Taranaki	Report (*b*).
Provincial Secretary, Nelson	No return.
Hon. Mr. Robinson, Cheviot	,,
Superintendent, Christchurch	,,
Hon. Mr. Holmes, Oamaru	,,
Mr. Murray, Clutha	,,

MEMORANDUM relative to the Experimental Cultivation of the SUGAR BEET from Seed distributed by Government.

THE object of the distribution of this seed is to ascertain the proportion of sugar which can be produced *per acre* from beet grown in different parts of the Colony.

The three following varieties have been obtained from Germany, as those which are most profitably cultivated in that country for the manufacture of sugar:—1. White Silesia; 2. White Imperial; 3. Improved Vilmorius.

These varieties must be kept separate throughout the experiment, and the following conditions should be observed as closely as possible, so that uniform results may be obtained for comparison:—

1. The ground must be prepared as for a turnip crop, but not to have been manured within three months of the time of sowing.
2. The seed, after steeping for twenty-four hours, is to be sown, by hand, in drills 18 inches apart, and the plants to be singled with an 9-inch hoe.
3. Several small patches or plots should be sown when there is much variety of soil and aspect in the locality, so that a fair average be obtained of what might be expected from cultivation on a large scale.
4. The roots should be lifted as soon as ripe, but only after and during dry weather
5. Ten cleaned roots of average size are to be weighed and forwarded to the Colonial Laboratory, Wellington, together with the information required in Form A.
6. A sample of the soil and subsoil from each plot in which the beet is grown to be furnished for analysis at the same time, in the manner and with the information required in Form B.

FORM A.—EXPERIMENTAL BEET CULTURE.

LOCALITY. PLOT NO.

Questions.	*Answers.*
1. Area of plot.	
2. Date of sowing.	
3. Date of showing above ground.	
4. Date of taking up crop.	
5. Number of sound roots.	
6. Total weight of crop after topping, the fangs and tails to be included.	
7. Weight of the largest and smallest root observed.	
8. Weight of the 10 roots forwarded for analysis.	

(Signed.)

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APPENDIX B2.

No. 3.

ESTIMATE of the Percentage of SUGAR contained in BEETROOT grown in the Wellington Botanic Gardens.

FOR the purpose of comparison, samples were taken for analysis at two periods: in February, when the growth of the roots was still vigorous; and in June, when the plant was thoroughly ripe and the leaves all withered down.

VARIETIES.	1. Collected in February.		2. Collected in June.	
	Average weight.	Sugar per cent.	Average weight.	Sugar per cent.
1. Silesia	3·5 lbs.	2·1	5 lbs.	5·5
2. Vilmorius	1·7 lbs.	6·7	4 lbs.	5·3
3. White Imperial ...	5·0 lbs.	2·2	3 lbs.	6·7*

The crop was grown on a slope facing the N.W., in a loose friable loam, chiefly derived from rotten sandstone rock.

J. HECTOR.

APPENDIX C.

No. 4.

Mr. R. J. CREIGHTON to the Hon. the COLONIAL SECRETARY.

SIR,— Auckland, 6th December, 1872.

I have the honor to acknowledge the receipt of your telegram in reference to the terms and conditions on which a bonus is to be paid on cured fish exported from the Colony. In reply, I beg to state that I have consulted with Mr. McLeod, and that the date, "1st November, 1872," will interfere with the claim of McLeod and Perston. They have exported considerable quantities of fish, and the date should be altered to "1st August, 1872." Up till this date, I believe, about fifty tons of dry cured fish have been exported by Perston and McLeod, but the difficulty is in creating a market. The first condition, therefore, "That the bonus will be paid to the producer on the production of account sales that the fish has been sold out of the Colony for fair market value," appears to me to be too stringent, and may defeat the object the Legislature had in view. It may be necessary to force the fish into consumption at considerable sacrifice, and the rigid application of the first condition would entail a double loss by the withholding of the bounty. I would therefore suggest that in any intended notice, the date be fixed at 1st August, 1872, and that the first condition be omitted.

I have, &c.,

The Hon. the Colonial Secretary, Wellington. ROBERT J. CREIGHTON.

* The highest yield included in this average was 8·1 per cent., which is sufficient to warrant the manufacture of sugar; the others being all too low.

No. 5.

The Hon. the Colonial Secretary to Mr. R. J. Creighton.

Sir,— Colonial Secretary's Office, Wellington, 14th December, 1872.

I have the honor to acknowledge the receipt of your letter of the 6th inst., relative to the terms and conditions on which a bonus will be paid on cured fish exported from the Colony, and asking the Government to alter the time fixed within which a certain amount of fish had to be cured and exported before a bonus would be granted.

In reply, I have to inform you that the resolution of the House of Representatives, upon which the bonus for encouragement of native industries was offered, having been passed only on the 22nd October ult., the Government would not be justified in giving it a retrospective effect not contemplated by the Legislature.

With reference to the other point raised, viz., that the first condition be omitted, Mr. Waterhouse will discuss the matter with the Hon. the Colonial Secretary upon his return to Wellington, with a view to seeing how far its modification is desirable.

I have, &c.,
G. S. Cooper,
(for the Colonial Secretary).

R. J. Creighton, Esq., M.G.A., Auckland.

No. 6.

Mr. R. J. Creighton to Mr. G. S. Cooper.

Sir,— Auckland, 20th December, 1872.

I have the honor to acknowledge the receipt of your letter of the 14th instant, in reply to a letter from me of the 6th, relative to the proposed bounty on fish. In reply, I have to thank the Hon. the Premier for the attention he has given to this subject; but I beg respectfully to remind him that my request "that the Government should alter the time fixed within which a certain amount of fish had to be cured and exported before a bonus would be granted," is not inconsistent with the resolution or intention of the Legislature.

The fact is, that the resolution passed on 22nd October, 1872, was identical with one passed in the previous Session, but on which the Government failed to take action. The Local Industries Committee, having had evidence before it in 1872, that, in consequence of the resolution of the previous Session, a fish-curing industry had been established by Messrs. Perston and McLeod, re-affirmed its resolution of 1871 for the purpose of enabling that firm to apply for the bounty; and the clear intention of the House of Representatives, as I understood it when the resolution was carried, was that it should enable persons to claim under it as if the Government had "gazetted" conditions in 1871. Moreover, I think I am justified in saying that this opinion is held by the Hon. the Colonial Secretary, from the terms of his telegram to me, in reply to which I wrote my letter of the 6th December instant.

I hope the Government will not deem me troublesome in this matter; the simple fact being, that I have taken great personal interest from the first in endeavouring to have a fish-curing industry established, and that on public grounds I am most anxious that it should be a complete success.

I am aware that Perston and McLeod have already expended over £2,000 in this business, and as they must be a considerable time before they can hope for returns, it is desirable that they should not be debarred, on technical grounds, from enjoying so much of the bounty of Parliament as they are fairly entitled to.

I have, &c.,
Robert J. Creighton.

G. S. Cooper, Esq., Under Secretary, Wellington.

No. 7.

The Hon. J. Hall to Mr. R. J. Creighton.

Sir,— Colonial Secretary's Office, Wellington, 21st January, 1873.

In reply to your letter of the 20th ultimo, with respect to the bonus offered for the export of cured fish, under the resolution of the House of Representatives of 1872, I beg to state that the Government admit that it was intended, in acting upon that resolution, to include any operations which had been commenced under the resolution of 1871. The notice on the subject will accordingly be altered to 1st August, 1872.

With regard to your second suggestion respecting the first of the conditions given in the notice, there appears to the Government to be considerable difficulty. It is certain that the Government must have a guarantee that the cured fish exported is a fair marketable article, and the most satisfactory guarantee would obviously be the sale of the article at a fair market price. At the same time there is much force in the argument you use, that a market may have to be made for this New Zealand produce.

I have therefore to state that if Messrs. Perston and McLeod can in any other way satisfy the Government that the fish exported by them is a fair marketable article, they will consider any application which may be made by them for the bonus.

I have, &c.,
John Hall.

R. J. Creighton, Esq., M.H.R., Auckland.

APPENDIX D.

No. 8.

CHEMISTRY of PHORMIUM TENAX.—Further Report by ARTHUR HERBERT CHURCH, M.A., Oxon, Professor of Chemistry in the Royal Agricultural College at Cirencester, England.—April, 1873.

CONTENTS.

§ 1.—PROXIMATE PRINCIPLES OF THE LEAF OF "PHORMIUM TENAX."

IN examining the constituents of the fresh plant, as received from the Royal Gardens at Kew, particular attention was paid to those substances which seemed likely to prove of interest in themselves, or in connection with the preparation of the *Phormium* fibre. The experiments and results given in this section of the Report will be found to relate to the gum, wax, sugar, bitter principle, colouring matter, and organic acids of the *Phormium* leaf. A few words, however, may be first given in reference to the total percentage of organic or carbonaceous matters in the leaves employed. These leaves were in perfection,—neither decayed and faded on the one hand, nor immature on the other. They gave, on drying at 212° Fahr. (100° centigrade), and subsequent burning in the air, the following percentages:—

Moisture	71·6
Organic matter	26·8
Mineral matter	1·6
	100·0

By a reference to my previous Report, § 11,* it will be seen that these results are almost identical with those obtained in the analysis of similar leaves in the year 1871.

The next step was to extract, identify, separate, and finally to examine the chief organic constituents, or proximate principles, of the leaf. The use of water and of other solvents, cold or hot, enables us to make an examination of this kind. Cold water extracts from the divided and bruised leaf a good deal of sugar, with traces of albuminoid matters and of saline substances; hot water removes a good deal of gum and starch along with much of the bitter principle; ether removes oil and fat; and so on with other solvents. I propose to describe the methods used for isolating the several proximate principles of the plant under the respective headings "Gum," "Sugar," &c.

A.—Gum.

It is to be hoped that much of the confusion once existing as to the gum of the *Phormium* has been cleared up in consequence of recent researches. The gummy matter, which is chiefly found on the inner (or proximal) surfaces of the butts of the leaves, presents no remarkable character, and I cannot suggest any use for which it would be likely to prove peculiarly applicable. It presents the following characters:—When partially dried it swells in cold water, and dissolves almost perfectly in hot: the solution forms, on cooling, a somewhat ropy jelly. The gum has a distinct alkaline reaction to test paper; and when burnt, leaves a white ash, which contains much potash and lime. The gum is not coloured by iodine either before or after treatment with sulphuric acid: this shows that it is distinct both from starch and from cellulose. [A few particles of vegetable tissue often occur in the *Phormium* gum, and these will of course be coloured by iodine if they have previously been treated with sulphuric acid.] A ropy but clear solution of the gum in water was rendered at first milky by the addition of two measures of alcohol; then a coagulum of white filaments separated. This was a precipitate of the unchanged gum, still retaining the mineral matters (potash and lime) belonging to it in the crude state. A solution of the gum is precipitated by basic lead-acetate, but not by the neutral acetate. The gum is transformed very readily into sugar by boiling it with dilute sulphuric acid.

An attempt was made to purify the gum from its alkaline and earthy salts by means of Graham's dialytic process. An aqueous solution of the gum was acidified with dilute acetic acid, and poured into a floating dialyser of parchment-paper. A certain quantity of saline matter did escape in the course of forty-eight hours into the water employed, but the greater part of the mineral matter of the original gum remained in the solution upon the dialyser. It should be noted that gum arabic may be almost completely forced from mineral matter by such treatment.

I find that a solution of the *Phormium* gum yields, on evaporation, a residue which may be almost completely re-dissolved by boiling water.

B.—Wax or Fat.

The percentage of fixed fat or wax in the fresh plant of *Phormium* is not large, generally averaging less than 1 per cent. Most of this fat is on the surfaces of the leaf, and may be removed by the action of a caustic alkali of soap or of a solvent such as ether. It helps to impart the "bloom" to the leaf, and forms a film or fine coating which throws off water. To the presence of this wax on the exterior of the leaf much of the difficulty experienced in bringing various chemicals to act upon the cellular substance of the leaf itself is due: it also retards the commencement of the retting and fermentation processes for the preparation of the fibre. Of course, the removal of this greasy bloom

* Appendix to Journals, House of Representatives, 1871, G. No. 4A., p. 12.

could not be economically effected on a manufacturing scale by means of a solvent like ether, or even by the use of that much cheaper and still more powerful agent, the bisulphide of carbon (CS_2); but it might be worth while to see how far a brief immersion of the leaf in an alkaline or soapy liquor would answer in actual practice. As an alkaline lye might be prepared from the ashes of the rejected parts of the leaves, the cost of such a treatment as that just suggested need not be considerable. Laboratory experiments have shown me that leaves cleansed from the surface-wax by means of a boiling alkaline solution, are far more easily acted upon by the materials used in their subsequent treatment. It may be here remarked that in the treatment of the dried plant with boiling alcohol, a solution of many of the proximate principles of the plant is obtained, and amongst these some of the wax or fat will be found; but as the solution cools, the greater part of this substance is deposited in granules, which are soluble in ether, and which fuse below the heat of boiling water.

C.—Sugar.

In determining the existence and proportion of sugar in the *Phormium* leaf, two plans were adopted. When an alcoholic extract of the leaves had been prepared, as described further on, under the heading "Bitter Principle," it yielded, after treatment with lead subacetate and separation of the resulting precipitate, a solution which contained certain lead compounds along with the bitter principle, and much sugar. This solution was freed from lead by means of sulphuretted hydrogen (H_2S), and then, after filtration and concentration, gradually deposited a considerable amount of amorphous sugar. This sugar corresponded closely in properties to the sugar of acid fruits, known as *fructose* or *laevulose*. It was soluble in alcohol, and reduced the red oxide of copper from Fehling's sugar test very readily. A rough determination of its amount gave 4·3 per cent. as existing in the fresh leaves. This number is much higher than the estimate recorded by Dr. Hector in 1865 (1 to 1·5 per cent.); but I consider it rather under than beyond the truth. This apparent discrepancy may, however, be capable of ready explanation. The leaves of *Phormium* upon which my experiments were necessarily made had been grown in a greenhouse at Kew. The plant was a good deal shaded by the crowding of other foliage, and altogether was growing under quite artificial conditions. These conditions may have been, and are likely to have been, peculiarly favourable to the production of sugar.

When an aqueous extract of the plant was prepared, a still higher percentage of sugar was deduced from the examination of the matters thus removed from the tissues of the leaves. The analysis of the solution thus prepared led to the following numbers, as representing the proportion of sugar in the leaves of the *Phormium*:—

	Calculated as Cane Sugar.
In the fresh leaves	5·45 per cent.
In the dry leaves	19·20 „

It may be concluded that these numbers are rather too high, owing to the conversion of some of the gum and starch of the plant into sugar by means of the treatment to which the aqueous extract had been submitted. But though 5½ per cent. of sugar is probably an extravagant estimate, I am inclined to think that it is not more than 1 per cent. in excess of the truth; so far, at least, as the richness of English grown leaves is concerned.

D.—The Bitter Principle.

A notion appears to prevail that the bitter principle of the *Phormium tenax* is a coloured substance: this is quite incorrect. Doubtless when an aqueous or alcoholic extract of the leaf is made, the bitter principle, thus dissolved out, is accompanied by colouring matters, but these matters merely accompany the true bitter principle. If reference be made to the Report, p. xix., 1871, of the Flax Commissioners,* it will be seen that the bitter principle is therein spoken of as coloured—"purity of colour can only be obtained by thoroughly washing out the *bitter* principle from the plant." Again, in the Appendix to the above-named Report, at page 84, Captain Hutton states, "The bitter principle might perhaps be used as a dye or stain for wood," &c. The mixed nature of the substances extracted from the plant by water, and the subsequent changes which some of the substances undergo in the presence of air and moisture, account for the mistake which I have pointed out. As I shall have again to refer to the colouring matters of *Phormium* in the next section, I will now merely describe the method by which the bitter principle was obtained in a state approaching purity.

The selected leaves were cut into small pieces and then carefully dried. About a pound of the dry matter was then exhausted with boiling alcohol. The hot alcoholic extract (or rather extracts) was then filtered, some wax (see § 1 B) being deposited on the filter during the passage of the liquid through it. The filtered liquid was then evaporated, first in a retort, then at 100° centigrade, and finally *in vacuo*. The residue corresponded to 19·6 per cent. of the dried leaves taken. It was of course free from starch and gum, but contained many other substances besides the bitter principle. In order to isolate this principle the following plan was adopted:—The last-described residue was boiled in abundance of water, and then the liquor was filtered. To the clear filtrate basic lead acetate was added so long as it occasioned a precipitate. [This precipitate, consisting chiefly of the lead-salts of organic acids, will be referred to further on in this section of the Report, under the heading F.] This precipitate was then filtered off, and the clear filtrate purified further as follows:—Excess of hydrosulphuric acid was passed into it, it was filtered, warmed, and finally evaporated *in vacuo*. The syruppy residue of this evaporation consisted mainly of sugar, but contained also a large proportion of the total quantity of the bitter principle present, as well as some acid substances. To separate the bitter principle, the concentrated liquor was shaken up with ether, in which the acids as well as the sugar are almost entirely insoluble. The ethereal solution was then decanted off and evaporated: it left a residue which was slightly yellow in colour and resinous in appearance. On boiling this residue with much water and a little powdered animal charcoal, the greater part of the bitter principle was withdrawn from solution by the charcoal, which latter substance again yielded it up to strong boiling alcohol. Thus extracted, the bitter principle of *Phormium tenax* is colourless, and exhibits but very doubtful traces of crystallization. Its bitter taste is not disagreeable nor persistent. It does not

come within the scope of a chemical report to discuss the possible medicinal value of this bitter principle, but it may be assumed that it possesses active properties, and I am inclined to think that these are tonic rather than poisonous.

E.—Colouring Matters.

The chief colouring matter of the *Phormium* leaf is the usual green colouring matter of plants, namely, chlorophyll. This substance is extracted by alcohol from the dry leaves in abundance, but it is left behind in an altered or decomposed state when the alcholic extract is evaporated and then boiled out with water. It is not necessary to dwell upon the properties of so universally distributed a substance as chlorophyll, particularly as there seems little or no probability of its being turned to account in the arts. Its interest in connection with the present inquiry appears wholly to lie in the following consideration. In preparing *Phormium* fibre the chlorophyll may give rise to stains or discolourations if it be not rapidly and thoroughly removed in the first processes to which the leaves are submitted; for though chlorophyll may be removed easily from the fresh leaf cells containing it, yet this colouring matter is susceptible of certain changes, the products of which, having a dull green or brown colour, are not very easily dissolved from the stained fibre. They seem to find their way into the central cavities of the fibres, from which it is difficult to remove them. But the chlorophyll is accompanied by another colouring matter, which appears to give rise to certain reddish-brown stains on the *Phormium* leaf and fibre. I am inclined to think that this colouring matter originates in a peculiar principle, of an acid character, which not only exists in the healthy and vigorous leaves of this plant, but which may actually be developed by an alteration of one of the constituents of the fibre itself. I refer to the substance mentioned in my former report under the name "pyrocatechin" (see page 18 of that Report.) A large quantity of this substance, which has the chemical formula $C_6 H_6 O_2$, appears to be found, as I previously concluded, from the mere heating of the *Phormium* fibre with water to a temperature of 150° centigrade, when about one-fifth of the weight of the dressed fibre taken is dissolved and transformed into soluble matter. My conclusions on this point have been lately confirmed by another chemist, F. Hoppe-Seyler, who has made pyrocatechin by heating pure linen filter-paper to a temperature of 210° centigrade, for four to six hours, with water. But the action on the *Phormium* fibre, though requiring a much lower temperature, is far more extensive than is the case with flax, with hemp, or even with Manila. We have therefore, in the natural occurrence of pyrocatechin in the *Phormium* leaf, and in its easy production by the action of heat and moisture upon the very substance of the fibre itself, a mode of accounting for some at all events of the discolourations and alterations to which the *Phormium* fibre is liable under some modes of treatment. For it must be remembered that pyrocatechin gives rise to a variety of colour-reactions under the influence of chemical re-agents, &c. Of this matter I shall however speak in the next heading of the present section.

F.—Organic Acids of the Phormium *Leaf.*

In describing the mode adopted of separating the bitter principle of the *Phormium* leaf, I mentioned the lead subacetate precipitate, formed from the extract of the plant, as containing the lead compounds of the organic acids present. When this lead precipitate has been washed with water and decomposed with hydro-sulphuric acid, it yields a mixture of several acid substances. From the small quantity obtained of these bodies, and the difficulty of separating them, I can give but very slight indications as to the acids of the *Phormium* plant. These appear to be oxalic and citric acids in small proportions, and pyrocatechin in greater amount. This latter substance has been already alluded to under the heading E. It has many of the characters of an acid. Its occurrence in the extractive matters of *Phormium tenax* was recognized by—

1. The formation of a precipitate with neutral lead acetate, and the solubility of this precipitate in acetic acid.
2. The volatility and odour of the substance.
3. The darkening of the solution by the addition of lime-water and exposure to the air.
4. The dark green colour produced by the addition of ferric chloride, and the subsequent change of this colour to a red or purplish red by the addition of an alkali.

§ 2.—Mineral Matter or Ash of the Leaf of "Phormium tenax."

The amount of ash in the whole leaf of this plant was recorded in my last Report.* The percentage of ash in the fresh plants corresponds to 1·59 per cent.; in the dry plant it is no less than 5·56 per cent. There is, however, according to a recent determination made in my laboratory, rather a higher percentage of ash in the lower part of the leaf than in the whole leaf. A fair sample of the lower part of the leaves—from one-third to one-quarter of their total length—was prepared, and a careful burning gave, of ash, 6·91 per cent. Of this ash the most valuable, but not the most abundant, constituent is probably potash. An estimation of this substance in the ash prepared as above described, showed the presence of 12·45 per cent. of potassium oxide (K_2O), corresponding to 18·28 per cent. of potassium carbonate (K_2CO_3.) It may be roughly calculated that 100 lbs. of the fresh butts of the *Phormium* leaves would yield, on burning, an amount of ash containing at least one-third of a pound of pearl-ash. This fact may be of some utility in connection with the preparation of the leaf for the after processes by which the fibre is separated; the ash of the rejected parts of the leaves being applicable to the preparation of a lye, by which the valuable parts of the leaf could be partially cleansed.

§ 3.—Experiments with Prepared Fibre.

Most of the experiments now to be detailed are connected with the oiling of the *Phormium* fibre. The samples used were submitted to certain tests so far as regards their hygroscopic condition, ash, and natural grease, with the following results:—

* Appendix to Journals, House of Representatives, 1871, G. No. 4A., p. 12.

Description of Fibre.	Moisture.	Ash.	Percentages of Volatile Oil.	Fixed Oil.	Total Oil.
A. Native—good	13·74	·74	·29	·20	·49
B. Machine dressed—good ...	13·32	·63	·14	·29	·43
C. Machine dressed—ordinary	12·79	·51	·38	·26	·64
D. Nichol's process ...	14·17	·70	·56	·36	·92

In the following series of experiments, the samples called A, B, and C in the above table were employed.

Oiling Experiments, Series I.

Oil used, paraffine lubricating or machinery oil, having the specific gravity ·9243. The fibres used were in their ordinary condition as to hygroscopic moisture. They were thoroughly saturated with the oil, and then submitted to pressure and hammering to remove all excess of oil. The following numbers represent the final percentages of oil absorbed and retained by the several samples of *Phormium* fibre, two experiments being made in each case, and numerous weighings :—

Absorption of Mineral Oil (Paraffine Oil) by Fibres.

	A. Native—good.	B. Machine—good.	C. Machine—ordinary.
Percentage of oil retained	12·11	19·41	22·25
	13·30	20·66	24·97
Mean ...	12·70	20·03	23·61

In order to see how far these numbers really represented the percentages of oil retained by the several samples, it was necessary to ascertain whether the absorption of oil had been accompanied by any loss of hygroscopic moisture. The samples used in this series were therefore reweighed and dried till constant in weight *in vacuo* over oil of vitriol. The loss of water they then suffered sufficiently proved that the absorption of the oil had driven out but little if any of the natural moisture of the fibres.

	A. Native—good.	B. Machine—good.	C. Machine—ordinary.
Percentage of water lost by oiled fibres *in vacuo*.	10·79	9·52	8·91
	11·63	10·34	9·64
Mean ...	11·21	9·93	9·3

It thus appears that the fine Native-dressed fibre absorbs least oil and retains during such absorption the highest percentage of hygroscopic moisture.

In order further to test the accuracy of the determinations of oil retained by the fibres, direct determinations by means of the "ether process" were made. The prepared and oiled samples which had been dried *in vacuo* contained the following amounts of oil in 100 parts :—

	A. Native—good.	B. Machine—good.	C. Machine—ordinary.
Percentage of oil retained by the fibre, but removed by ether	11·00	17·14	20·88
	11·54	18·91	20·26
Mean	11·27	18·03	20·57

These numbers accord as closely as could be expected with those given in the first table, and show that the fine Native-dressed fibre retains the least oil amongst the samples tried.

Oiling Experiments, Series II.

The oil used was the same as that of Series I., but the fibres were dried at 100° centigrade (212° Fahrenheit) previous to their being soaked in the oil. It was thought that the removal of the hygroscopic moisture from the fibres would increase the quantity of oil absorbed, and render its penetration into the fibres more thorough. This anticipation was not realized, for less oil was absorbed under the single altered condition (of previous drying) of these experiments. The percentages of oil retained by dry fibre, after pressing and hammering, as in Series I., were as follows :—

	A. Native—good.	B. Machine—good.	C. Machine—ordinary.
Per centage of oil retained by fibres which had been previously dried	8·31	12·34	15·67
	8·19	14·65	15·36
Mean	8·25	13·50	15·52

Thus we learn that dry fibres absorb less oil than those which are naturally moist; and that the fine Native fibre retains the same position as to the percentage of oil which it held in the first series of experiments. From other trials I conclude that drying the fibres previous to oiling or tarring them will prevent the sufficient absorption of the liquid used, while submitting the fibres to a moisture-laden atmosphere may prove beneficial, especially if they be subsequently dried,—that is, after the treatment with oil, &c.

Oiling Experiments, Series III.

The oil now used was a colza oil, of sp. gr. ·910. The fibres used were from the same samples as before: the operations of pressing and hammering were conducted in the same manner. The experiments, however, were not very successful or uniform in their results; and the inferiority of a vegetable oil for such purposes was shown by the appearance of the samples after treatment. The following

results are selected from a large number which were obtained, but which I do not think would be of any service if introduced into this Report:—

	A. Native—good.	B. Machine—good.	C. Machine—ordinary.
Percentage of oil (colza) retained by moist fibres	13·6	17·0	14·6
Percentage of oil (colza) retained by dried fibres at 100° c.	13·3	13·9	16·3

Oiling Experiments, Series IV.

An animal oil (sperm oil), having the sp. gr. ·927, was used for these experiments, which were in other respects conducted as before. As in Series III., the previous drying of the fibres made but little difference in the amount of oil retained after pressure and hammering. However, the character of the treated fibres showed a distinct superiority over those dressed with vegetable oil. A few of the results are here given:—

	A. Native—good.	B. Machine—good.	C. Machine—ordinary.
Percentage of oil (sperm) retained by moist fibres ...	12·8	13·4	13·4
Percentage of oil (sperm) retained by fibres dried at 100° c.	10·8	15·2	14·1

It will be seen that in all the series no appreciable advantage was gained by drying the fibre previous to treating it with oil. When paraffine machinery oil was used, the result was distinctly disadvantageous when dried fibres were employed. It should be added that the fibres which had been oiled after drying reabsorbed a large proportion of their original percentage of moisture on subsequent exposure to the air.

Colouration of Phormium *Fibre.*

Mr. Skey records some experiments of his own upon the presence in *Phormium* fibres of a substance "susceptible of some striking colourific changes." (See Appendix to Commissioners' 1871 Report, p. 92.)* The observation is not new, full details concerning this staining of the fibre by the successive application of chlorine and ammonia having been published by M. Vincent in the *Comptes Rendus* of the Paris Academy a quarter of a century ago. (*Comptes Rendus*, xxvi., p. 598, 1848.) M. Vincent, indeed, recommended the following plan for detecting *Phormium* fibre:—Soak the fibre in chlorine water for two or three hours; then wash it with ammonia water; a violet or pink colour will be developed. But when M. Payen, in 1849 (*Comptes Rendus*, xxix., p. 491), submitted this plan for distinguishing *Phormium* from other fibres to further scrutiny, he was unable to regard it as satisfactory if applied to thoroughly bleached and cleaned fibres, though it might serve to distinguish *Phormium* fibre from crude unbleached roping fibres of different origin. M. Payen regarded the principle which gave rise to the colour as not essential to the *Phormium* fibre, but merely adherent to it. The experiments of Mr. W. Skey scarcely sanction such a conclusion, but rather point to the intimate union subsisting between this principle and the cellular substance of the fibre. I cannot doubt, from my own experiments on this point, that the "encrusting" matter of the fibre is the true origin of the substance which gives the coloured re-action in question. The following experiments seem conclusive on this point, unless, indeed, they go further, and prove that the pure cellulose of the fibre is itself capable of such a transformation—a position which it would be difficult to accept.

1st. *Experiment on the Pink Colouration of* Phormium *Fibre after Purification.*

One gram of fine Native white *Phormium* fibre (No. 1 of old Report†) was treated with twelve grams of nitric acid of specific gravity 1·10, and 0·8 gram potassium chlorate, for eighteen days, at a temperature of from 12° centigrade to 18° centigrade. At the conclusion of the experiment, and after suitable purification of the residual cellulose, a proportion of that substance amounting to 83·8 per cent. of the original fibre taken remained. This cellulose did not acquire any colour by treatment with ammonia, but chlorine water followed by ammonia water did stain it pink. When this fibre, so treated (with nitric acid and potassium chlorate), was further acted on by means of water at a temperature of 150° centigrade for four hours, it gave a yellow acid liquid, and lost a considerable portion of its weight. And yet, after this second and most severe purification, the residual cellulose still gave the characteristic pink colour after a few minutes' soaking in chlorine water and the subsequent application of ammonia. It is impossible to regard the substance susceptible of the colour-change as other than a transformation-product of the very substance of the fibre itself.

2nd. *Experiment on the Pink Colouration, &c.*

A similar purified sample of *Phormium* fibre, but in the preparation of which the acid and alkali method had been employed, gave a dark red-brown colouration with chlorine water followed by ammonia.

Miscellaneous Observations on Phormium *Fibre and the Fresh Plant itself.*

Some experiments on the action of an ammoniacal solution of copper upon the constituents of the fibre were made with the hope of gaining some further insight into the cellulosic constituents of *Phormium*. The results were not accordant with each other, nor with the deductions from the results of other methods of analysis. It was found that the above-named reagent dissolved out only 21 per cent. of cellulose from a fair sample of machine-dressed *Phormium* fibre, but that it extracted no less than 40 per cent. of cellulose from a sample of the same fibre which had been treated with nitric acid and potassium chlorate. Thus it appeared that this latter treatment opened up the fibre to the more complete penetration and solvent action of the ammoniacal copper solution. In another experiment the residue of the action of oil of vitriol upon a sample of *Phormium* fibre was submitted to the action of the reagent for cellulose. In this case the presence of some cellulose was also indicated, although the previous treatment with sulphuric acid (of sp. gr. 1·53) should have removed it altogether.

* Appendix to Journals, H. of R., 1871, G. No. 4. † Appendix to Journals, H. of R., 1871, G. No. 4A, p. 12.

It is difficult to effect a complete separation of the various soluble constituents of the *Phormium* plant by means of precipitation with basic lead-acetate, as described in § 1 of this Report. The following table gives some idea of the partial separations thus effected:—

Lead precipitate contains pyrocatechin and acids, a little bitter principle on agitation with ether.		Filtrate from lead precipitate contains much sugar and much bitter principle on agitation with ether.	
The residue contains the acids.	The ethereal solution contains traces of the bitter principle and resin.	The residue contains the whole of the sugar.	The ethereal solution contains the bitter principle nearly pure.

Appendix to Report.

The following analyses of the seeds and capsules of the *Phormium tenax* were made in 1865 by Dr. Adriani. In the belief that they may prove a useful addition to a report on *Phormium tenax*, I add them here as an Appendix. I have not had the materials for verifying them at my disposal.

Analyses of Phormium tenax.

	Seeds.	Capsules.
Moisture	8·0	10·7 per cent.
Oil	20·1	1·0 „
Resin	3·8	2·6 „
Mucilage	14·3	24·0 „
Albuminoids or flesh-formers	18·3	6·9 „
Fibre	31·0	47·9 „
Ash	4·5	6·9 „
	100·0	100·0

APPENDIX E.

No. 9.

Report respecting the *Phormium* Cultivations.

1. *Wellington.*

The seedlings of the different varieties of *Phormium* referred to in last Report* have on the whole made good progress during the past year.

They have now been two years in the ground, and they have attained the same and in some cases even a larger size than the transplanted specimens of the same varieties which were planted out at the same time for comparison. The result of the experiment, so far, is to show that it is more desirable, in establishing cultivations, to raise the plants from seed, instead of transplanting roots. The advantage is gained in the more rapid and powerful growth, and the small cost of the process. These experiments also show that, on the whole, the most important varieties may be depended on to come true from the seed; an important fact, which was hardly anticipated from experience of younger plants.

The following is a note of the progress of the plants of the different varieties during the period from July, 1872, to July, 1873:—

No. 1. *Raumoa.*—This variety shows great irregularity of growth, chiefly on account of poor clay soil. Number of fans average 8; length of leaf, 3 feet.

No. 2. *Parekoritawa.*—Several plants are not true to description of the original characters, as some have dark brown or black-edged leaves. Number of fans average 8; length of leaf, 4 feet.

No. 3. *Huhiroa.*—Generally true to description. Number of fans 9; length of leaf, 4 feet.

No. 4. *Takaiapu.*—Generally true to description. Number of fans 9; length of leaf, 5 feet.

No. 5. *Korako.*—Generally correct to description in three-fourths of the specimens; the others have varied to orange-margined leaf. Number of fans 9, length of leaf, 5 feet.

No. 6. *Atiraukawa.*—Number of fans 10; length of leaf, 5 feet.

The above six varieties grow in good but unequal soil at the bottom of a gully, and have made good progress during the last year in the growth, length, and number of leaves, especially in rich moist patches. Some of the varieties have already put out many young fans, others a few, and in the case of *Takaiapu* very few. The further growth of the whole will be checked by the closeness of the plants, so that it will be necessary to thin them.

In No. 2, *Parekoritawa*, the variegated flax, no appearance of striped variegation has as yet shown except in two plants, where faint traces may be observed.

With regard to a tendency, formerly noted, in all the varieties to revert to the orange-bordered leaf of the variety 1, a careful examination will probably lead to the conclusion that another year's growth has tended more to confirm the described characters of the varieties than depart from them. Many instances in every variety no doubt show the orange-bordered leaf.

Of No. 1, *Raumoa*, and No. 6, *Atiraukawa*, several seedlings were planted out on a dry clay bank, well broken up, but no progress has been made. Number of stools 4, length of leaf, 2 feet.

* Appendix to Journals, House of Representatives 1872, G. No. 17.

Rooted Plants.

No. 1, *Parekoritawa* (variegated flax).—Very little progress has been made in leaf growth during the last year, and there are but few new fans at the present time.

No. 2. *Atewhiki.*—The same remarks apply to this variety, and also to No. 3, *Tutaiwiki*, No. 4, *Ngutunui*. A large increase of fans shows on No. 5, *Atiraukawa*. The backward state of the rooted plants may easily be explained by their position on a dry bank, and the exceptionally dry season. In No. 5, *Atiraukawa*, the more favourable position in a small depression, in which there is always a little moisture, accounts for the earlier shooting of the fans.

JAMES HECTOR.

No. 10.

Mr. W. K. HULKE to Dr. HECTOR.

SIR,— New Plymouth, 1st June, 1873.

In reply to your telegram of the 29th instant, I have the honor to inform you that early in February last I forwarded a letter addressed to you, Colonial Museum, a copy of which I now enclose. In it you will see that the seed was distributed amongst the farmers throughout the settlement who I thought were in a position to give it a fair trial. The result, I am sorry to say, was a general failure; whilst of the few seeds I tried myself, not one in one hundred vegetated, and even these only lingered a few weeks, the slug and grub finishing them. The reason I can only guess—that is, the seed was old. That the soil is favourable to the cultivation of beet is proved again this season by Mr. Gibson growing a fair crop, from which he has made about lbs. of treacle, and has some of this made last season in stock. The best he cultivates is the produce of seed I imported from France. Should Mr. Gibson not have used all his roots, I will procure some and forward them, as also a sample of the treacle. That which I saw was rather burnt, having been made in a common iron pot. Should you at any other time have other seed, I shall be always happy to place my services at your disposal.

I have, &c.,

Dr. J. Hector, Colonial Museum. W. K. HULKE.

Enclosure in No. 10.

Mr. T. OXENHAM and others to Mr. W. K. HULKE.

SIR,— New Plymouth, 1st June, 1873.

We, the undersigned, having received from you last season seeds of one or more varieties of sugar beet, for the purpose of cultivation so as to test our soil as to its utility for beet sugar cultivation, have to report that scarcely a seed vegetated, although careful pains were taken with it, having planted it in soil especially prepared, as if for the cultivation of mangels, and the few plants that grew were so weakly that—what between the grub and the dry summer—all, we may say, have died. Should you, however, have at any future time other seed for distribution we shall be glad to give it another trial.

We have, &c.,
Thos. Oxenham, Oakura.
W. Kendall, Mangarei.
J. J. Looney, Oakura.
Chas. Waller, Manathi.
R. Street, Bell Block.
Hy. G. Tramson, Oakura.
James Nival, Leper Road.
E. Holmes, Okut.
S. Andrews, X, Waitara.
V. Davies, Matatoaoa.
W. F. Hoskin, Bell Block.
G. Cutfield, Grey and Bell.

W. K. Hulke, Esq., New Plymouth.

No. 11.

Mr. W. K. HULKE to Dr. HECTOR.

SIR,— New Plymouth, 6th February, 1873.

I have the honor to inform you that I have seen most of the farmers to whom I distributed the beet seed sent for trial by the Government in October last, and am sorry to state that with all it is a complete failure, little, or I may say none, having vegetated, although cultivated as directed; whilst with those who have sown mangel (from home-saved seed) the crop this season has been an average one as far as can be seen at present, but it is early to speculate as to weight per acre. Mr. Gibson has, however, a small plot of beet looking well, raised from seed I procured from France, and as soon as he pulls them has promised to let me know. He intends making treacle for use of his family, as he succeeded so well with it last season.

I have, &c.,

Dr. J. Hector, Colonial Museum, Wellington. W. K. HULKE.

No. 12.

Mr. W. H. Kulke to Dr. Hector.

Sir,— New Plymouth, 14th October, 1872.

I have the honor to acknowledge your letter of the 3rd instant, and parcel of beetroot seed, per steamer "Wellington," and have, in accordance with your request, arranged for its cultivation in the different soils of this Province. In furtherance of this industry (sugar growing) I may state, that observing the soil on my farm at Bell Block, and that of other lands in the neighbourhood, favourable for the cultivation of mangolds, I procured from France and Germany seeds of the best varieties of sugar beet, and grew on the sixteenth of an acre 23 cwt. 1 qr. 15 lbs. Seed saved from selected roots out of this crop I distributed amongst the settlers, who speak well of its productiveness and utility: I have therefore little doubt as to quantity, but can give no information as regards percentage of sugar.

I have, &c.,

J. Hector, Esq., Colonial Museum, Wellington. W. K. Hulke.

No. 13.

Mr. W. K. Hulke to the Chairman, Flax Commissioners.

Sir,— New Plymouth, 20th June, 1873.

Whilst no new varieties of *Phormium* have been added since my last report of 5th April, 1872, to those already in cultivation in the nursery, I have much pleasure in reporting that the two varieties raised from seed especially selected by myself, to test the question of propagating *Phormium* from seed, *Huhiroa* and *Atiraukawa* have proved true, both showing their distinctive marked edges; and in respect to the three variegated seedlings raised in 1870, I am able to report the one having a broad black edge promises to be not only ornamental but useful, being a quick grower with good broad leaves.

The plants throughout the grounds are in the highest stage of vegetation, having completely covered the ground, showing plainly the necessity of their being planted at greater distances. I should recommend to cultivators, if planting in good soil, rows 8 feet apart, plants 6 feet from each other.

Amongst those in cultivation showing leaves for manufacturing purposes, I again mention *Atiraukawa*, *Taiore*, *Huhiroa*, *Ngutunui*, *Mananu*, and *Tutaewheeke*. The last I can strongly recommend to all desirous of cultivating the better varieties of *Phormium*. My attention was first called to it by Mr. Commissioner Parris as being a variety highly prized by Natives, the fibre being long, strong, and white. It is readily distinguished from all other varieties by its tall, upright growth and bronze-coloured leaves. During the past year plants of the several varieties of *Phormium* have been distributed for planting in the Provincial Hospital grounds and the ground around Mount Elliot, for the purposes of shelter; but owing to the very low price prepared fibre has been selling for in the English market, few attempts have been made by cultivators to propagate the better varieties which in any quantity could be supplied from the plants growing in the nursery, at a minimum cost.

The disbursements slightly are in excess of the receipts shown by the accompanying statement.

I have, &c.,

The Chairman of Flax Commissioners, Museum, Wellington. W. K. Hulke.

APPENDIX F.

No. 14.

The Hon. the Colonial Secretary to Superintendents of Provinces.

(Circular No. .)

Sir,— Colonial Secretary's Office, Wellington, November, 1872.

I beg leave to enclose for your Honor's information a copy of the Report of the Joint Committee of both Houses of Parliament, presented during its last Session, on Colonial Industries.

With reference to the concluding paragraph of that portion of the Report which refers to New Zealand flax, I should feel obliged if your Honor would obtain for the Colonial Government, through the Survey Department of the Province of , an approximate estimate of the area of flax-bearing land in the Province, as well in the hands of the Government as, so far as may be practicable, in private hands, distinguishing between the two.

The Government will also feel obliged for any information which it may be in your power to afford, as to the destruction of growing flax by burning, which may have taken place in your Province.

I have, &c.,

His Honor the Superintendent.

No. 15.

His Honor J. Macandrew to the Hon. the Colonial Secretary.

Sir,— Superintendent's Office, Dunedin, 23rd January, 1873.

I have the honor to acknowledge the receipt of your circular letter No. 56, 23rd November, 1872, enclosing Report of Joint Committee on Colonial Industries: also requesting that the Colonial

Government might be furnished with an approximate estimate of the area of flax-bearing land in Otago, &c.; and in reply, to forward a map of the Province, with copy of a memorandum from the Chief Surveyor, supplying the information as far as it can be obtained.

I have, &c.,
J. Macandrew,
Superintendent.

The Hon. the Colonial Secretary, Wellington.

Enclosure in No. 15.

Mr. J. T. Thomson to the Provincial Secretary.

Sir,— Department of Land and Survey, Dunedin, 6th December, 1872.

I have the honor to forward to you a map of the Province, showing approximately the flax-growing areas. The total acreage is about 307,000 acres, and of which 250,000 have passed into private hand. In the plans, that sold is coloured red; that unsold, blue.

There may be small patches of flax in other parts, but to no great extent.

I have, &c.,
J. T. Thomson,
Chief Surveyor.

To the Provincial Secretary.

P.S.—I have not much personal information as to the destruction of growing flax by burning, not having, for some years, been much out over these special districts; but I do not think it has occurred to any extent.

No. 16.

Mr. C. Weber to His Honor J. D. Ormond.

Sir,— Survey Office, Napier, 18th, December, 1872.

In reply to circular No. 56, from the Colonial Secretary's Office, 23rd November, 1872, referring to the area of flax-bearing land in this Province, I have the honor to state, that as the plans in this office afford only meagre information upon this subject, I have been compelled to supplement this with estimates based upon local knowledge. These estimates can be only roughly approximated, however extensive the local knowledge of the framer may be. In estimating the area of flax-bearing land, I have only taken into account lands that do bear at present at least six tons of serviceable green fibre per acre. This I estimate at 26,000 acres, spread principally over the districts of Mohaka, Wakaki, Poukawa, Te Auti, Ruataniwha, Porangahau, Okawa, Ngatarawa:—In addition to these there are large patches thinly covered with *Phormium* all over the Province, which, as stated above, have not been brought to account here.

Of the above area, about 20,000 acres are in the hands of Europeans as freehold, or leasehold from Natives, and 6,000 acres in the hands of Natives.

Concerning the area destroyed by burning, I feel not in the position for quoting figures, but I may state that a large aggregate area of flax has disappeared during the last thirteen years, the result of burning, stocking, and drying up of small swamps.

The effects of these agencies combined has probably been more destructive in this Province to *Phormium* than in other parts of the Colony, owing to the relative dryness of the climate.

I have, &c.,
Charles Weber,
Provincial Surveyor.

His Honor the Superintendent, Hawke's Bay.

No. 17.

Mr. S. Hawlings to the Secretary for Public Works.

The closest approximate estimate that I can give of the area of flax-bearing land in the Province is from testimony of Mr. E. P. Sealy for the portion of the Province north of the Rangitata, and from the maps of the contract surveys on which the growth of vegetation is described, south of that river, making a total of 22,000 acres, of which about 17,000 acres have been sold and appropriated.

In the progress of cultivation and drainage a large area of wet land and swamps, formerly carrying a heavy growth of flax, has been reclaimed so far as to allow cattle to depasture. Grass fires also, by clearing the vegetation, aid in changing the former retentive nature of the soil most favourable to the growth of flax, and as the young shoots appear they are eaten off by cattle. To these causes conjointly the gradual extinction of the plant is attributable.

20th December, 1872. Samuel Hawlings.

No. 18.

His Honor F. A. Carrington to the Hon. the Colonial Secretary.

Sir,— Superintendent's Office, New Plymouth, 17th December, 1872.

I have the honor to acknowledge the receipt of your circular No. 56, 23rd November, 1872, together with a printed copy of the Report of both Houses of Parliament presenting during its last Session, on Colonial Industries, and you ask for an approximate estimate of flax-bearing land in the Province, &c.

In reply, I beg leave to state that after making inquiry, and taking the mean of the same, I think the following will be a near estimate, viz. :—

Say rural lands	3,000 acres.
Native lands	2,000 „
Abandoned confiscated lands	5,000 „
Confiscated lands...	10,000 „
Total flax-bearing land in the Province of Taranaki ...	20,000 acres.

I have, &c.,
FRED. A. CARRINGTON,
Superintendent.

The Hon. the Colonial Secretary, Wellington.

APPENDIX G.

No. 19.

THE accompanying circulars were sent to the following persons:—

J. Stewart, Waikato, Auckland; S. Harding, Kaipara; A. C. Turner, Tauranga; W. N. Hales, Wanganui; O. Carrington, Taranaki; J. T. Stewart, Manawatu; A. Munro, Masterton; E. N. Bold, Napier; A. Dobson, Picton; C. J. O'Conor, Hokitika; W. N. Blair, Dunedin; W. Brunton, Invercargill.

Enclosure in No. 19.

(Circular.)

SIR,— Public Works Office, Wellington, 27th September, 1872.

It having been suggested that the officers of this department should co-operate with Dr. Hector in the collection of information respecting New Zealand timbers, I have the honor to request that you will endeavour to obtain information respecting timbers in your district, and forward the results to Dr. Hector, Colonial Museum, Wellington.

To assist you in this object I enclose copy of Parliamentary Paper G. 16, 1872, and Dr. Hector suggests that specimens should be sent in accordance with the direction on page 5 of that paper.

I also enclose printed letter and "Notes of particulars for sending specimens of Native Timbers." Copies of these should be forwarded to persons engaged in the timber trade in your district, and to any others who may take an interest in the subject.

Dr. Hector being now engaged in making a collection for the exhibition at Vienna, it would be convenient if you were to forward triplicate specimens to him.

I have, &c.,
JOHN CARRUTHERS,
Engineer-in-Chief.

PUBLIC WORKS DEPARTMENT.

SIR,— 187 .

The Colonial Government is at present making a collection of Native timbers, for the purpose of investigating their properties; and I have been requested to take steps towards getting specimens from this Province.

I therefore take the liberty of enclosing you a copy of "Particulars for sending Specimens," with the request that you will kindly contribute towards the collection.

Should you have any specimens to send, and give me notice of it, I will arrange to get them conveyed here.

I have, &c.,

Engineer.

Particulars for sending Specimens of Native Timbers to Colonial Museum, Wellington.

ORDINARY specimens of new timber to show an average section of a full-sized tree, not less than 2 feet long, and of the following thicknesses:—Trees under 18 inches diameter, full section; from 18 inches to 3 feet, half section; and above 3 feet, quarter section, the bark being left on in all cases. Samples of sawn timber of each tree should also be sent, showing the ordinary form in which it is found in the market, say a piece of 4 inch by 3 inch scantling, 4 feet long; and a 9 inch by 1 inch board, 4 feet long. The whole to be accompanied by specimens of the leaves, and (if possible) of the flowers or berries, and a note of the locality, and the soil in which the timber was grown, the season in which it was felled, and such other particulars as may be useful in arriving at a correct knowledge of its properties.

Specimens of old timber may be of any convenient size or shape; and in addition to those required with the new timber, each specimen should be accompanied by detailed particulars of the amount of seasoning it has received, the situation it has occupied, and the exposure to which it has been subjected, together with a note of the time it has been in use.

Each specimen to be labelled and distinctly numbered, the number being referred to in the description that accompanies it.

By Authority: GEORGE DIDSBURY, Government Printer, Wellington.—1873.

Price 9d.]