REPORT

OF THE

COMMISSIONERS APPOINTED TO ENQUIRE INTO THE PREPARATION

OF THE

PHORMIUM FIBRE

OR

NEW ZEALAND FLAX.

PRESENTED TO BOTH HOUSES OF THE GENERAL ASSEMBLY, BY COMMAND OF HIS EXCELLENCY.

WELLINGTON.

1871.

ANALYSIS.

COMMISSION.

G. F. Bowen, Governor.

Victoria, by the Grace of God, of the United Kingdom of Great Britain and Ireland, Queen, Defender of the Faith, and so forth:

To Our Trusty and Loving Subjects, James Hector, Theodore Minet Haultain, and John Kebbell, Esquires.

Whereas the House of Representatives did, on the tenth day of September, one thousand eight hundred and seventy, adopt certain Resolutions, which were as follows:—

"1st. That a Commission be appointed consisting of three members resident in New Zealand, such Commission to have power to appoint one or two Agents in England to be in correspondence with the Commission, and generally to carry out their instructions.

"2nd. That the duty of the Commission shall be—

"(1.) To visit the chief districts in the Colony where Flax fibre is prepared. To institute or to assist mechanical experiments on New Zealand Flax, with a view to cheapen the cost of manufacture and to improve the quality of the fibre produced. To collect samples of all kinds of fibre produced in quantity and by processes not precluded by their expense from being generally adopted; and to carefully collate full particulars as to the variety of the plant from which the fibre has been prepared, and the process of dressing, including Maori-dressed Flax.

"(2.) To send a portion of the samples so collected to the Agents before mentioned, with a view to their obtaining from the best authorities a report on the misroscopic structure and chemical composition of the New Zealand Flax leaf and fibre as compared with Irish Flax, Russian and Manilla Hemp.

"(3.) To ascertain if possible the reason why Manilla Hemp made into rope resists the action of sea water better than the *Phormium tenax*.

"(4.) The relative capacity of the New Zealand Flax fibre and Russian Hemp to absorb tar.

"3rd. That the Agents shall act under the instructions of the Commission, not only with regard to the above named points, but also ascertain—

"(1.) The market value of the fibre, and the reason for the different prices obtained.

"(2.) To place in the hands of manufacturers supplies of the various kinds of Flax fibre, with the view of ascertaining by practical tests to what purposes it can be profitably applied.

"(3.) To procure samples (say two or three hundredweight each) of the various fibres that compete in the English market with the *Phormium tenax*, viz., Russian, Manilla, and Italian Hemp, Jute, and Irish Flax, so as to afford information to New Zealand Flax-dressers as to the quality of fibre which it is desirable should be produced by them.

"(4.) To submit to makers of Flax Machines in the mother country samples of our prepared Flax, and invite suggestions as to the improvements of the machines usually employed in the Colony.

"(5.) Generally, to ascertain what can be done to extend the use and increase the market value of the Flax fibre.

"4th. That properly qualified officers (if possible in connection with the Customs) should be appointed at each port, who, on application by shippers, should sample the various bales, and place an official brand thereon, showing its quality as compared with standard samples issued to them by the Commission; such classification to be similar to the manner in which foreign-grown Hemp or Flax is classified, viz., first, second, and third qualities:"

Now know ye that We, reposing especial trust and confidence in your knowledge and ability, have authorized and appointed, and do by these presents authorize and appoint, you the said

James Hector,
Theodore Minet Haultain, and
John Kebbell,

to be, during pleasure, Our Commissioners for the purposes hereinafter mentioned, with power to appoint one or two Agents in England, as you may think fit, to be in correspondence with you, and generally to carry out your instructions. And it is Our will and pleasure that you should do and perform the following acts, functions, and duties:—

(1.) To visit the chief districts in the Colony where Flax fibre is prepared. To institute or to assist mechanical experiments on New Zealand Flax, with a view to cheapen the cost of manufacture and to improve the quality of the fibre produced. To collect samples of all kinds of fibre produced in quantity and by processes not precluded by their expense from being generally adopted; and to carefully collate full particulars as to the variety of the plant from which the fibre has been prepared, and the process of dressing, including Maori-dressed Flax.

(2.) Te send a portion of the samples so collected to the Agents before mentioned, with a view to their obtaining from the best authorities a report on the misroscopic structure and chemical composition of the New Zealand Flax leaf and fibre as compared with Irish Flax, Russian and Manilla Hemp.

(3.) To ascertain if possible the reason why Manilla Hemp made into rope resists the action of sea water better than the *Phormium tenax*.

(4.) The relative capacity of the New Zealand Flax fibre and Russian Hemp to absorb tar.

And it is Our further will and pleasure that you issue to the Collector or other Chief Officer of Customs at such ports or places as you may think necessary standard samples of Flax, such standards to be of classes similar to those into which foreign-grown Hemp is divided, that is to say, first, second, and third classes:

And it is Our further will and pleasure that the said Agents shall act under your instructions, not only with regard to the above named points, but shall also ascertain—

(1.) The market value of the fibre, and the reason for the different prices obtained.

(2.) To place in the hands of manufacturers supplies of the various kinds of Flax fibre, with the view of ascertaining by practical tests to what purposes it can be profitably applied.

(3.) To procure samples (say two or three hundredweight each) of the various fibres that compete in the English market with the *Phormium tenax*, viz., Russian, Manilla, and Italian Hemp, Jute, and Irish Flax, so as to afford information to New Zealand Flax-dressers as to the quality of fibre which it is desirable should be produced by them.

(4.) To submit to makers of Flax Machines in the mother country samples of our prepared Flax, and invite suggestions as to the improvements of the machines usually employed in the Colony.

(5.) Generally, to ascertain what can be done to extend the use and increase the market value of the Flax fibre.

And it is Our further will and pleasure that you, from time to time as you may think fit, report to Us what you have done in the premises, together with such recommendation in relation to the premises as you may think fit to make.

In testimony whereof We have caused these our Letters to be made Patent, and the Seal of Our said Colony to be hereunto affixed.

Witness our Trusty and Well-beloved Sir George Ferguson Bowen, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Governor and Commander-in-Chief in and over Our Colony of New Zealand and its Dependencies, and Vice-Admiral of the same; and issued under the Seal of the said Colony, at Wellington, this nineteenth day of October, in the year of our Lord one thousand eight hundred and seventy, and in the thirty-fourth year of Our reign.

W. GISBORNE.

DONALD MCLEAN,
Presiding.

Approved in Council,
FORSTER GORING,
Clerk of the Executive Council.

REPORT

OF THE

COMMISSIONERS APPOINTED TO ENQUIRE INTO THE PREPARATION OF THE PHORMIUM FIBRE, OR NEW ZEALAND FLAX.

MAY IT PLEASE YOUR EXCELLENCY.—

THE Commissioners appointed by your Excellency to enquire into the manufacture and uses of the *Phormium tenax*, in accordance with certain resolutions adopted by the House of Representatives on the tenth day of September, 1870, respectfully submit the following report of the steps taken towards the fulfilment of the duty remitted to them, of the information they have collected, and of the conclusions at which they have arrived after careful consideration of the various matters that have been brought under their notice. It has not been thought necessary to recapitulate the valuable information which was collected with labour and zeal by the Commissioners appointed by your Excellency in 1869.* Notwithstanding the difficulties which these gentlemen, as the first official enquirers, had to encounter, few of their conclusions have been disputed; and most of what they set forth has been verified by subsequent information, and still remains to assist and guide manufacturers. It is, therefore, only necessary to refer to those points in their report in respect to which fuller particulars have been obtained, or where light has been thrown on what was then obscure.

In accordance with the terms of the Commission, and with the view of circulating as early as possible the information obtained, a report was forwarded to your Excellency on the 20th December, 1870, the greater part of which has been incorporated in the following pages.

The extracts from correspondence and other papers and tables given in the Appendix, will explain in detail the manner in which the instructions received have been carried out, and it is intended in the present report to summarize that information.

Appointment of, and Instructions to, Agents.

The Commissioners met in Wellington on the 17th November, 1870; and, in the first place, took into consideration the appointment of agents in England, and the drawing up of instructions for their guidance. Several persons, well qualified for the duties, offered to proceed from this country in order to conduct the investigations, but the Commissioners were compelled to decline their services, having no funds available for such expenditure. They therefore, had recourse to the services, willingly and zealously rendered, of Mr. John Morrison, agent to the General Government; and also secured the good offices of Messrs. Christie & Co., of Sermon Lane, St. Paul's, London, who are largely connected with the fibre trade, and had already taken much interest in the introduction of the *Phormium* fibre into the English market. As a first result of the correspondence with these gentlemen, sample bales of those fibres which compete in the English market with *Phormium* fibre, have been procured from England. (See App. p. 5, *et. seq.*)

Competing fibres.

These are Russian, Italian, Bombay, Sisal, and Manilla hemp, Egyptian flax, and Aloe fibre. Mr. Morrison also re-exported two bales of machine dressed *Phormium* fibre, which Messrs. Noble, who selected the other fibres, considered it desirable to send in order that flax-dressers in the Colony might have an opportunity of seeing for themselves specimens of those qualities which were most in demand in the English market at the beginning of this year. These bales are now in Wellington, and samples from them will be available for distribution.

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* App. to Jour. H. of R., 1870.

Manilla the standard.

The correspondence with Messrs. Noble on the subject, leaves no doubt that at the present time the *Phormium* fibre is more eagerly competed for in the London market as it approaches nearer the appearance of Manilla hemp. Attention must also be called to the correspondence with Mr. Thorne, (see App. pp. 7, 17, & 96.) forwarded at the same time and subsequently, relative to the manufacture of rope from *Phormium* fibre improved by a new method. These letters prove that many defects which have hitherto been imputed to the rope can be removed, and that, in the opinion of those who are well qualified to judge, New Zealand rope is in many respects, when properly prepared, preferable even to Manilla.

An endeavour was also made to procure information relative to the preparation of the Manilla hemp, with which object the Commissioners communicated with Mr. J. C. Ricketts, H.B.M. Consul at Manilla, and have received from that gentleman a short account of the method in use, which appears extremely simple, no machinery whatever being used in the process. (App. p. 10.) Papers furnished by Dr. Forbes Watson, relative to the manufacture of the Rheea fibre in India, have been re-published (App. p. 11) with the view of indicating the efforts which the Indian Government is making to promote a kindred industry to that which is the subject of this commission.

Market in America.

Copious reports have also been received from the Hon. Mr. Vogel (App. p. 14.) of the state of the fibre market in America, and of the estimation in which New Zealand fibre is held by various manufacturers to whom it is known, and from which it appears that a sufficient quantity of fibre has not yet been circulated in America for manufacturers to judge of its qualities; though in all cases in which a good sample was shown, it seemed to draw forth favourable remarks from mercantile men.

Flax Machinery.

In a further report by the Hon. Mr. Vogel, received through the Colonial Secretary, is embodied the result of investigations made by Mr. E. Fox (App. p. 19) as to the qualities of various flax and hemp dressing machines, which will interest flax-dressers in the Colony, although none of them are of a kind adapted without modification to the New Zealand fibre.

Microscopic and Chemical reports.

A report is shortly expected from Dr. McNab and Mr. Church, Professors of Botany and Chemistry in Cirencester Agricultural College, who have agreed, at the request of Dr. Hooker, to undertake conjointly the chemical and microscopic examination of the *Phormium tenax*, which the Commissioners were directed in their instructions to obtain. (App. pp. 2-4.)

Manufactures other than rope.

An application for articles other than rope, to which the *Phormium* fibre is at present applied in England, was made through Mr. Morrison; but, excepting some small quantities of yarn and cloth made in 1850, and a small sample of paper made about five years ago, no manufactured articles could be obtained (App. p. 17).

The endeavours of Messrs. Christie & Co. to induce manufacturers to make experiments, with a view of testing the textile qualities of the fibre, even when the Commissioners undertook to defray all expenses, were equally unsuccessful App. p. 21.). At a subsequent date, however, it will be seen from a letter of Mr. Thorne (App p. 96), that he had succeeded in getting the fibre, and also the tow of the *Phormium* made into yarn, and that although some little difficulty was at first experienced in getting the flax machinery to work, yet, as the spinner took interest personally and watched the causes of failure, these were overcome, and a very strong canvas obtained, samples of which have been received, and are now in the Exhibition. From the inspection of these samples, it is evident that a very inferior description of fibre was employed in the first instance, and that the result is not so favourable as may be achieved in future, the softening having been effected by the use of alkalies, which have not been entirely removed.

It will be seen that Mr. Thorne considers that fibre may be prepared by the particular process which he follows for £20 a ton, and that the value which has been set upon it in London is £56 for the fibre, and £28 for the tow.

Reports of the Flax Sales.

To the above may be added that very valuable data respecting the position occupied by the *Phormium* fibre in the London market have been obtained from monthly detailed reports of the flax sales, which have been furnished

by Messrs. McLandress, Hepburn & Co., of Dunedin, and from which tables A and B have been compiled (App. p.p. 99 and 100.).

Visiting mills.

One of the first duties the Commissioners were directed to undertake was to visit the chief districts where *Phormium* fibre is prepared, and to enquire into the different processes of manufacture. Returns were obtained at the time when the Census was taken in March last for the purpose of ascertaining the extent and importance of the fibre industry, and in anticipation of the published tables, the approximate results given in Table F of the Appendix, have been furnished by the Registrar-General. From this table it appears that during the year 1870 there were 161 mills in operation, with an aggregate of 342 stripping machines, employing 1,450 horse-power, 1,766 persons, the produce being 4,457 tons of fibre. Towards the close of the year, however, the fall in the value of the fibre had so discouraged the proprietors, that a large number of the mills were closed. It was therefore determined that only such mills should be visited as were easily accessible, and where the manufacture was still being persevered in. Colonel Haultain accordingly inspected the mills that were in operation on the West Coast of the Wellington Province, and in the immediate vicinity of the chief towns, and his separate report is given in the Appendix (p. 61), whilst the most prominent points of the information obtained are as follows :—

Number of mills in 1870.

Method of Preparation.

Throughout the Colony there is one almost universal method of manufacture, having for its object the production of fibre for rope-making. The green leaves are stripped by revolving rollers, with projecting beaters, travelling at a high rate of speed, which crush the epidermis against a fixed plate so set as to allow room for the fibre to remain intact. The fibre thus freed from the leaf of the plant, is washed by various methods, put on the ground or on lines to dry and bleach, finished by an arm or barrel-scutch, and when baled, is ready for the market. Although it appears that there have been no material alterations in the various processes of manufacture as they were detailed by the late Flax Commissioners, yet, as labour has become more skilled, and experience has suggested modifications in the machinery employed, there has been a marked improvement in the general quality of the fibre produced. This may be readily observed by comparing samples from parcels which were sold last year in London with others from bales that have been recently exported; and there can be no doubt that if all manufacturers could take advantage of every minor improvement that has been effected in different districts, they would still further improve the fibre, and diminish the cost of its production.

Wet scutching important.

The only important improvement recently introduced which requires description, is wet scutching; the effect of which in cleaning and softening the fibre is so marked that no part of the process of manufacture deserves more attention in order to perfect its application; for there appears to be nothing contained in the *Phormium* leaf, which, for the purpose of rope manufacture requires to be removed, that cannot be got rid of by washing, provided the fibre is never allowed to dry till the process is completed. Unfortunately, the mode of wet scutching usual in the Northern district, has not been effected so as to be commercially successful. The fibre, immediately after passing through the stripping machine, was submitted to the action of an ordinary barrel-scutch, whilst a flow of water passed over the hank that was being operated on. Although the fibre was by this means so much improved that local purchasers were ready to give £3 extra for the flax, yet the loss of fibre by the formation of an excessive amount of tow and the additional expense for labour, (which together caused an extra cost variously estimated at from £6 to £10 per ton) rendered the process an unprofitable one, so that manufacturers were compelled to abandon it. The advantage of wet scutching is, however, so great, particularly in reducing the time required for bleaching, which is a point of the utmost importance in seasons when the weather is unsettled, that we strongly recommend it for further trial. We may mention that Messrs Benn & Walker, of Canterbury, by modifying the process, are still able to adopt it with profit. They employ scutching machines with rounded wooden beaters, instead of the usual iron plates, and by reducing the rate of speed are able to secure all the advantage of thoroughly cleansing the fibre

Wet stripping.

without involving a great loss in the form of tow. There are some other minor improvements that also deserve notice, as they will no doubt come into general use; such as directing a flow of water over the fibre as it passes through the stripping machines, and, when water power is abundant, passing the fibre through a second machine, set somewhat differently, immediately after it leaves the first; an improvement which is in use by Messrs. Stonyer and Co., of Kaiapoi. It should be mentioned that the use of water in the stripping machines not only improves the appearance of the fibre, but also reduces the friction of the machinery, causing it to wear better, and economising the driving power. In some mills, also, a travelling web or table removes the bruised leaf as it is run from the machines, by which a saving of labour is effected. The only improved stripping machine which has been brought under the notice of the Commissioners, is that of Mr. White, of Auckland; and, judging from the samples of fibre prepared by it, which have been submitted, it deserves the attention of manufacturers, as it appears to clean the fibre without bruising or cutting it in the manner which is so frequently observed in the ordinary machine dressed fibre (App. p 77), its action appearing to produce a result on the leaf more analagous to the scraping process of the Natives.

Northern District.

In Auckland, as in other parts of the Colony, a large number of the mills that were started a couple of years ago have been closed. In the Mauku and Waiuku districts, those that continued running were all worked by water power, as the extra expense of steam would have swallowed up the little profits that were still attainable.

Price's and Gibbons' machines, with an improvement on the former by Dugald, were chiefly used, but there was a difference of opinion as to their respective merits. The plant is not abundant in this district, and the cost of the green leaf is correspondingly high; but there is sufficient for these small mill owners, who, working themselves, and with their families, and sparing no pains to produce a good article (for none other will sell at a remunerative price), can earn fair wages. Their fibre meets with a ready sale in Auckland to the rope spinners, or for export to Sydney, where a good deal is made use of, as much as £13,000 having been paid within the last three years by one firm for New Zealand fibre, —from £17 to £21 a ton being the prices given for favourite brands. Murray's brand is considered one of the best, and fetches the highest rate; it is not only carefully prepared, but is also very neatly baled, as is the greater part of the Auckland fibre; and there is no doubt that this is one of the advantages that the Northern fibre has over that of the other Island in the home market. Thompson Bros., and Keleher's are also favourites for the Sydney market. Mr. Dugald has a good mill nearer the Waikato, and also makes a first-class fibre, which he states only costs him £14 10s. at his mill, though he pays as much as 16s. a ton for his green leaf; but wages are low in this district, as men can be got for £1 a week, finding their own food.

Importance of neat baling.

It is encouraging to have to report that at the present time (September, '71) the best brands find a ready sale in Auckland, for the local supply and for the neighbouring Colonies, and the favourite manufacturers cannot produce fibre fast enough to meet the demand.

Central District.

The only mill at work in the vicinity of Napier was that of Messrs. Nelson Bros. Steam power is used, and two of Price's machines were at work, a stream of water from artesian wells being kept running over the flax as it is passed through. It is then squeezed through rollers, and washed and dried in the usual manner; the leaves are carefully sorted into three lengths, and the cost of a ton of ordinary fibre is about £15, exclusive of interest and management. About three tons have been further hackled, to test its value in the London market, but as twelve tons of leaf will only make one of hackled fibre, and one of tow, at an expense of £35, it is hardly to be expected that the sale will be remunerative. Messrs. Nelson have sent a bale of this fibre for the Exhibition, and also a very interesting series of specimens showing the fibre in the different stages of manufacture at the mill (Cl. A. II a. Nos. 55-8, App. p. 42).

Cost of hackling.

The cutting of the green leaf has been systematically conducted by Messrs. Nelson, and the subsequent growth of the plant carefully noted. The results

of the observations, which are of much interest, will be found in the Appendix (p. 63.).

The only mills in operation on the West Coast of the Province of Wellington were working on a small scale, steam being the usual motive power, as there is rarely a sufficient supply of water for the purpose of driving machinery in the vicinity of the raw material. In many cases the supply is even so short that there is not enough to allow of the fibre being thoroughly washed, which is a serious disadvantage to the manufacturer. Price's stripping machines are the most general in use, and are universally preferred in this district, as they are said to dress the fibre more evenly, although Gibbons' machine causes less waste. Wet-scutching is employed only in one mill—Mr. Musson's—owing to the deficient supply of water. At this mill, also, there being no screw press, a beam of wood thirty-six feet long, is used for baling, a contrivance which is in common use in North America for compressing fur-bales, and might be usefully employed by small capitalists. Mr. Scrivener's is the best in this district, and took the first prize at the Wanganui Show. The superiority must be attributed solely to the extreme care which he takes in cutting the green leaf clear of the butts. Half a ton of this flax has been sent to England by the Commissioners for experiment, and one bale placed in the Exhibition. He uses horse-power to drive his stripping machine, and as most of the work is done by the family, and a good price is obtained for all the produce, the business, though on a small scale, is profitable. The horses are fed chiefly on the strippings from the green leaf, of which they are very fond. Messrs. Rees and Richardson, of Rangitikei, have displayed much enterprise and skill in various experiments, which, however, are not yet perfected. They find that the use of boiling water to clean the fibre, immediately after stripping, removes the red tinge from the butts, with no other advantage. They have also tried steaming and rolling, with a pressure up to 3 tons, but have not yet produced a sufficient quantity to test the market.

Beam press.

Horses fed on mill waste.

At Opunake, 50 miles from New Plymouth, two companies have commenced operations under very favourable circumstances. As companies, they had sufficient capital for plant and preliminary expenses. They lease extensive areas, covered with wild *Phormium* plants, from the Natives, and have an abundance of water for power and washing, while the raw material being at hand, there is no expense for land carriage, and labour is procurable at moderate rates. If, therefore, the manufacture of the fibre is to pay in any part of the Colony, it should do so here.

Price's stripping machines were the favourites here also, though considered capable of improvement, and the after washing of the fibre was attended to with especial care at the works of the Cape Egmont Company, which are a model of economical management; but neither the scutching nor selection of leaves were sufficiently thorough to enable a first-class sample to be produced.

Attention is especially directed to a small caterpillar, which has made its appearance in several districts, and has very largely injured the leaves of the plants in this neighbourhood. It is to be feared that if it continues to increase, its ravages will be seriously felt. It attacks the leaves in the early summer, and eats away the fibre in long patches, which leads to an extra quantity of tow being scutched out during the manufacture.

Ravages of a caterpillar.

There are several mills in the Wairau Valley, though at the time it was visited, only one was at work. Price's, Anderson's, and Mills' machines have been tried; Mr. Seymour much prefers the first, but Anderson's were used by Messrs. Hathaway & Howland; they, however, do not clean the fibre as well as Price's, nor can so much leaf be put through them in a given time.

There is abundance of raw material and water in this district, but the manufacture has not been in all cases profitable. It has cost one mill owner £20 a ton to produce 80 tons, including interest on capital; and as the fibre was not well washed, it would not rank above the 2nd class.

The fibre prepared in the Wairau District by Messrs. Logan and Sinclair, and by Mr. Goulter, deserves special mention, as having probably commanded the highest prices of any that has been placed in the London market. By both,

Price's machine is used in the ordinary way, being driven by water-power. Great care is taken in selecting the leaves, and water is liberally used in the washing process. The superiority is not attributed in any way to the raw material, but simply to the care and attention which is taken in every part of the process, and especially in the proper adjustment of the machine. The cost of the fibre delivered in Blenheim, ready for shipment, is stated to be £14 to £15 a ton; the prices it has realized in London have ranged from £31 to £36.

Southern District.

There is at present more life and enterprise in respect to the fibre industry in Canterbury than in any other Province. The mills at Leithfield and Ashley Gorge are the only large fibre manufactories which are in full operation, but there are several others of a smaller class still at work.

Messrs. Stonyer and Co., of the Kaiapoi mills, took the first prize of the Canterbury Flax Association in 1870, and their fibre still maintains its reputation. The superiority is due to its being passed through a second machine placed immediately below the first, whilst the water is constantly pouring over it; after which it falls into a shoot of water which carries it down to the washers.

The fibre is white, of fair texture and strength, and can be produced for £15 a ton, with another £1 for covering the bales. They prefer Anderson's machines.

The mills of Messrs. Benn and Walker at Leithfield, are conducted with great method and economy, and are the most perfect that have been visited. Wet scutching is successfully adopted; the scutch having rounded wooden beaters revolving at a speed of 250 revolutions per minute, and not wasting much fibre, as 6½ tons of green leaf will give one of fibre. Another improvement is a travelling table that takes the fibre away from the stripper, which answers perfectly, as it saves labour, and permits a flow of water to be pouring over the fibre whilst being put through the stripper. Price's machines are preferred. All accounts are accurately kept, and the cost of manufacturing one ton of leaf is estimated at £18; this includes the expense of the steam engine, which is £3.

Improved wet scutch.

The Ashley Gorge mills have seven machines at work, and give employment to about 120 hands, including wood cutters for the steam engine. Here, also, the travelling table is used to take the fibre away from the stripper. The estimated cost of a ton of fibre is £16 11s., including £3 for the expenses of the steam engine; but exclusive of carriage to Lyttelton, wear, tear, and interest on capital.

Mr. Ollivier has supplied some samples prepared by a new process, supposed to be chemical; but he has not made any communication or proposal to the Commissioners.

Mr. Journeax has also forwarded to the Commissioners some samples of a very white and soft fibre, which he states can be prepared for £14 a ton. The leaves are first stripped, then retted for four days without the aid of heat, afterwards passed about 100 times through rollers in five minutes, while a copious flow of water pours over them.

Retting and rolling.

The only large mill in the neighbourhood of Dunedin is at Blueskin. Kincaid and M'Queen's machines are used, and although steam power is employed, and the green leaf costs 18s. a ton, the expense of a ton of fibre does not exceed £16, exclusive of carting to port, interest on capital, &c., but as firewood is used for the engine, the cost of this is calculated at £1 13s. only. A wet scutch and rollers were in course of erection, and if a travelling table and flow of water through the strippers were added, the machinery would be complete. The rate of wages is higher in Otago than in the North Island.

Mr. Miller, of Silver Stream, takes great care in the rejection of bad leaves, and in every part of his process, (which is that in ordinary use) and, consequently, makes a superior sample.

Mr. Campbell who is near the town, and has several members of his family working at his mill, can produce fibre and deliver it in Dunedin at a cost of £14 a ton.

New inventions.

The Commissioners had not any mechanical inventions, having for their object the improvement of the manufacture of the fibre, brought under their notice at a sufficiently early date to allow of their being assisted with the view of the results being embodied in this report.

An arrangement was made with Messrs. Rees and Richardson, of Rangitikei, for the preparation of a ton of steamed and rolled fibre, to be chemically bleached without exposure to the sun. Although they have not been able to supply the article, they have expended much time in carrying out the experiments, which, if successful, might be of considerable value; and in the event of Government considering it advisable further to assist the development of this industry, the Commissioners recommend that they should have a further opportunity of completing their experiments.

Major J. A. Gray, of Kaiapoi, also made an application, on the 12th of August last, for assistance towards the construction of a new machine, by which, he expects materially to improve the preparation of the fibre. The cost, it is stated, would be from £60 to £100; but the Commissioners declined to entertain his offer to divulge his plans, as they could not undertake that they should be tested on account of the late date at which his application was received.

On the 9th September, drawings and descriptions of some very important improvements in the existing stripping machinery, were submitted by Mr. T. Kelly, M.H.R. The value of these improvements, one of the chief of which is an arrangement by which the strippers can be adjusted while in motion, appear so great, that had the application been received at an earlier date, the Commissioners would have complied with his request for assistance towards testing them in practice.

Experiments to test durability of rope.

Experiments have been instituted to ascertain the relative durability of ropes made from *Phormium* and other fibres in common use, and a table of the results given in the Appendix No. XII shows that the New Zealand white rope when kept dry will last longer, and wear 60 per cent. better, than tarred rope of the same material, and 34 per cent. better than rope made from Manilla hemp.

When the ropes are wetted with salt water, however, the result of the comparison is very different. The lasting quality of the Manilla being actually improved, no doubt in consequence of the shrinkage equal to $5\frac{1}{2}$ per cent. which takes place.

On the other hand, the effect of the salt water on the New Zealand rope is to reduce its lasting qualities 34 per cent.

As the experiments on which these results are founded necessarily extend over several months, only one set has yet been completed. Further trials are in progress at the date of this report, and the Commissioners strongly recommend that they should be continued, so that the relative value of different fibres for roping purposes may be definitely determined.

Oiled rope.

Rope made at Canterbury from *Phormium*, dressed with black oil, has lasted well on board coasting vessels, and has evidently a great power of resisting wet. Plain New Zealand rope, used by Messrs. Stonyer & Co., in a Californian pump, that was constantly in the water, would not last more than seven or eight days; whilst Manilla rope would run for twenty; but a piece of the oiled New Zealand rope under the same conditions did not give way till it had been ninety-five days in continued wear (App. p. 74).

Durability at sea.

As bearing on the question of the relative durability of rope made from New Zealand and other fibre, a correspondence between the Hon. Mr. Vogel and the Commander of the U.S. steamer "Resaca," is given in the Appendix X. (p. 73), and also various letters (App. p. 7 to 9 and 18) particularly referring to Mr. Thorne's method of treating the fibre, from which it appears that New Zealand rope so prepared stands better both for heavy work and for running gear than that made from either Russian or Manilla Hemp.

The very favourable opinions which are expressed in these various documents are confirmed by an inspection of samples of rope exhibited in the Museum (Class A. IV. b. and B. VI. c.), which have been in use on board the ship "Crusader," since leaving London last December, the largest for discharging cargo, and the smaller for braces and halyards. To all appearance they are still quite good and sound.

Collection of samples.

One of the most important duties remitted to the Commissioners was the collection of samples of all kinds of fibre produced in quantity, and by processes not precluded by their expense from being generally adopted. As a basis for

future reference, it is hoped that the collection which has been made will have great value, as care has been taken to procure the most reliable and accurate information with respect to every article exhibited. This collection has been temporarily placed in the Colonial Museum, and a classified and descriptive catalogue has been compiled (App. No. VII). The following arrangement has been adopted to illustrate those points it was considered most desirable to bring prominently under observation :—

Machine dressed. An extensive series of specimens of manufactured fibre has been procured, and great pains taken to ensure the collection of *bona fide* samples of the ordinary produce of the mills, such as is turned out in bulk. Wherever mills have been visited, samples of the fibre, as prepared for sale, have been brought away. Hanks have also been obtained from various bales that have been sold in the Colony, and, as far as possible, from all large parcels that have been exported to England or America. The Canterbury Flax Association have also materially assisted the Commissioners, by furnishing an excellent collection from most of the mills of that Province.

Relative strength. The breaking strains of a large portion of the fibres thus exhibited have been determined, and show that the strength of the several descriptions at present exported varies from 53 to 84, with an average of 69, as compared with Manilla, which is taken as the standard at 100. On the other hand the samples of Native-dressed fibre ranged from 70 to 122, with an average of 91.

Method of testing. It should be stated that in all experiments undertaken to test the strength of the different samples of fibre, the breaking strain was determined by the same apparatus that was in use last year, which applies a gradually increasing strain to the strand that is being tested; one end being attached to a spring balance, and the other to a frame that is carried steadily down by a screw. The indication of the balance shows the strain on the fibre at the breaking point, while the extension of the cord can be observed. The ends of the cord are carried over a smooth metal bar, and attached to an iron peg in the same manner as the strings of a violin. The quantity of each sample to be tested was carefully obtained by the weight of two portions of well cleaned fibre, cut to a constant length; these weighed quantities were then carefully "laid" in a machine planned by Mr. Kebbell, which ensured exact uniformity of twist in each cord. The breaks are all reduced to a standard of Manilla, to obtain which a series of thirty strands of that fibre, of the uniform weight, viz., 20 grains to one foot, were broken, and gave an average breaking strain of 347lbs. From this the strength of all the other fibres has been centesimally calculated.

Degree of uniformity in quality. One of the chief uses of the comparison which has thus been instituted is the observation of the degree of uniformity which is obtained in the quality of fibre placed in the market by the various shippers; this uniformity is more evident among the samples procured from the Northern and Central Districts. Those from the South show a greater difference of quality, testifying that some of the manufacturers in this district do not perceive the necessity of scrupulous care in every process of preparation, are behindhand in availing themselves of the improvements that experience has suggested, or are adopting methods that do not produce the most desirable results. Nevertheless, it is observable that there has been a general approach towards that uniformity of quality, without which the fibre can never attain to a permanent position in the English or Foreign markets; and there is now a marked absence of those inferior qualities which were formerly sent home in such abundance, and which, more than anything else, conduced to create the unfavourable impression so prevalent in the home markets with regard to the *Phormium* fibre.

Special samples. With a view of ascertaining what the manufacturers themselves considered the best quality to produce, and to test the merits of every variety of process, they were invited by notice in the *Gazette*, and in many cases by special application, to send specimens of their fibre, and to furnish an account of the mode and cost of its preparation. Only a few, however, have responded to this invitation, as there is an unwillingness on the part of many mill-owners to furnish samples of their usual manufacture lest they should be brought into unfavourable comparison with specially prepared parcels from other mills. Those which have been thus furnished have been placed in the exhibition by themselves, and afford a very

instructive proof of the condition to which the fibre may be brought by special care and attention.

Classification of fibres in market.

The next division of the collection illustrates the classification of the various qualities of fibre as adopted by the brokers in England. Taking as a guide tables A & B (App. No. XII) framed from information which was courteously afforded to the Commissioners by Messrs. McLandress, Hepburn, & Co., of Dunedin, it is found that there have been five recognised classes in the London market, during the year ending May, 1871. This classification is determined chiefly by the degree to which the fibre has been cleaned and freed from scull, but it is also influenced by considerations of colour and texture. Such terms as "mixed in colour," "harsh," "wiry," "poor colour," "green and brown in colour," "red ends," "croppy," "coarse," "rough," "much straw," "red colour," and "heeled," being of frequent use, any one of these depreciating the value of otherwise superior fibre, to the extent of several pounds sterling per ton.

This section also includes a series of samples from parcels that have been sold by auction in London, with the dates of sale, and prices obtained; these, of course, are not of very recent manufacture, as it is probably not less than eighteen months since they were despatched from the Colony, and they are certainly not equal in quality to much that is now exported; but they are useful as showing the exact staple which fetches certain prices in the home markets.

Results of sales in 1870.

Taking the proceeds of the sales of 6,000 tons of fibre at £140,500, as stated in table A, and assuming that each ton delivered in London has cost the manufacturer £25, viz., £16 for manufacture, and £9 for freight and other charges, there will have been a loss to the Colony of £9,500 on this export from May, 1870, to July, 1871. But as there would be a profit of £10,950 on the two first classes, the manufacturers of the remainder have lost over £20,000; whereas, if they could have produced fibre of good quality, there would have been a clear gain over cost of production of £15,088, or a total profit on the 6,000 tons of more than £26,000.

Quality improved.

The table shows clearly, as has already been stated, that the quality of the fibre sent to England has decidedly improved during the past year. A much larger proportion of the three first classes were received in April and May, 1871, than in the corresponding months of 1870; and the amount of "sea damage" appears to have been reduced to a minimum.

Competing fibres

In addition to the smaller samples previously referred to, this part of the collection includes bales from the several consignments of the fibre that have been sent by the Commissioners to the agents in England for distribution amongst manufacturers, together with two bales of *Phormium* fibre which were selected by Messrs. Noble, and sent back to the Colony by Mr. Morrison, as representing the class of fibre which is most in demand in the home market. In this part of the collection are also the bales of fibres with which *Phormium* has to compete, and which have been already mentioned as having been selected by Messrs. Noble. One of the most interesting of these is the Sisal fibre which is prepared in Yucatan, from a species of Aloe; and although an intrinsically inferior fibre, being harsh and deficient in strength, is so similar in appearance to Manilla, that it fetches within a few pounds of the average value of that fibre. So long as the chief application of the *Phormium* fibre is to the production of white rope, Sisal hemp is the only fibre that will really compete with it as a substitute for Manilla. As these different fibres have been obtained in sufficient quantity to allow of samples being supplied to all parts of the Colony, manufacturers will at an early date be afforded an opportunity of making themselves acquainted with their characters.

Consumption of white fibre.

An examination of Tables C. and D., given in the Appendix, which state the quantity of roping fibres and jute imported into England and America, is both interesting and instructive; although it has not been found possible to procure the information from both countries for corresponding periods. It appears that whilst in England, for the year 1870, 55,442 tons of roping hemp were received, only 6,467 tons of Manilla were included, being scarcely more than 11½ per cent. of the whole quantity, and very little in excess of the *Phormium* fibre that was introduced during that year. Whereas in the United States, in the year 1867,

the quantity of Manilla imported was 15,273 tons, out of a total of 19,853 tons of roping hemp, being 73 per cent. of the whole.

United States the best market.

The use of such a large proportion of raw material for the manufacture of "white rope" points to America as the market to which New Zealand exporters should especially direct their attention.

Native dressed.

A series of 81 samples of fibre, dressed by the Natives, exhibits the quality produced from the better varieties of the plant, as well as from leaves taken at different stages of their growth, illustrating the separate Report on Cultivation and Growth, given in the Appendix, No. IX., page 66. The relative strength of most of these varieties has been ascertained, and it is shown that the various fibres prepared in the same manner differ greatly, ranging from 70 in the *Tarariki* to 122 in *Rataroa*; Manilla being 100. On the other hand, the relative quantities and strength of fibre from the full-grown and immature leaves, taken from the same plant, do not exhibit that difference which might have been expected, for they appear to be nearly equal in these respects, and may therefore be used indiscriminately in manufacturing purposes.

The great superiority of the fibre dressed by the Maoris over all that is prepared by machinery, which even led to doubts being expressed in England as to their having been produced from the same plant (App. p. 19), rendered it desirable that a considerable quantity of the finest and whitest quality should be sent home, for the purpose of ascertaining whether a sufficient price could be obtained to encourage its manufacture. The Commissioners have, however, found it impossible to procure any quantity of this superior quality, though every effort has been made to obtain a few tons.

The Government endeavoured to stimulate the manufacture by offering rewards (App. p. 24) for the best prepared samples, and Natives in all parts of the North Island have been applied to, but with little effect. They have, in some instances, agreed to set to work and get a quantity ready, but have invariably failed to carry out their promises. All that could be obtained was six or seven cwt. from Waikanae, where the Natives had contracted to have half a ton ready for delivery by the 31st January, for which they were to receive a payment of £20, with such further amount as it might be valued at in England. They got tired of the work before it was half finished, then sold some of it to a third party at 1s. per lb., and demanded from the Commissioners 1s. 6d. for the remaining 7 cwt., which, however, was eventually obtained for 1s. per lb. The Commissioners have thought it desirable to append the correspondence on this subject in order to show how little any supply of fibre from the Natives can be depended on. (App. p. 28).

Varieties of the *Phormium* plant.

Seventeen of the best marked varieties of the *Phormium tenax* are exhibited with their respective names attached; and show that the difference of character which the species is capable of assuming, is to be found chiefly in the colour, especially of the edges and midrib. The seedlings of the same varieties, raised in December last, prove that the rate of growth of the plant in its earlier stages is exceedingly slow, and, as far as can yet be observed, it appears that they do not inherit the peculiar characters of the varieties from which the seed was obtained. This indicates that the only method of perpetuating varieties

Structure of the root.

must be by subdivision of the root. The structure and mode of growth of this root, or rhizome are explained by the sectional specimens and diagrams, which show that each fan forms a true underground stem with fibrous rootlets, which stem, after a growth of several years, with a succession of leaves, bears a flower stalk, and then decays; but also during the period of its growth gives off lateral buds, from which new fans proceed, acquire their own roots, and finally become independent plants, clustering together and forming large bushes such as are

Mode of propagation.

unusually seen. In the propagation of the plant, therefore, these lateral fans, as soon as rootlets have been formed, may be removed and transplanted in the same way as tubers, and will be vigorous in proportion to the amount of nutritious matter which has been accumulated in them. Further observation is yet required to determine how far the development of the flower stalk, the increase of the root, and the formation of new fans is affected by the repeated cutting of the leaves for manufacture.

It may be gathered from Appendix IX (p. 66), which refers especially to cultivation and growth, that the leaves of the *Phormium* have reached maturity when they are two years old, after which they begin to decay, and are unfit for manufacturing purposes; but these observations have been made only in the case of plants that have been prematurely deprived of their leaves. Much doubt still surrounds the subject of the normal growth of the species, on which point, without a series of observations extending over a lengthened period—for the plant takes several years to come to maturity—no reliable conclusions can be arrived at. Plantations have been attempted in more than one district, and various experiments have been commenced in order to ascertain the rate of growth and increase of transplanted sets; but so far they all prove that at the end of three years there is no adequate supply of full-grown leaves to give even a moderate rate of interest on the outlay that must be made, and there is no hope that plants grown from seed will be more productive. The Commissioners therefore cannot recommend that at the present time the *Phormium* should be cultivated on an extensive scale for manufacturing purposes, more especially as there is more than a sufficient supply of the raw material to meet a much larger demand than exists at present.

Useful age of leaves.

Cultivation not yet profitable.

The above experiments, are however, being continued by the Commissioners, as in the event of cultivation becoming necessary, it will be of great advantage to have a supply of the best varieties. A plantation has been established in the Botanic Gardens at Wellington, where seedlings are being raised, and all the useful varieties collected. Possession has also been obtained of a very useful nursery at New Plymouth, which was formed with much skill by Mr. Hulke, from whom it has been leased by the Government for a nominal rent (App., p.p. 31 and 32), Mr Hulke continuing to undertake its management. It contains 2,000 plants of fourteen of the best varieties, which are now available for distribution.

Further experiments in progress.

It has been ascertained that all large fields contain some plants of those kinds that are most esteemed by the Maoris, who were accustomed to transplant them to spots near their settlements. The list at page 69 of the Appendix gives fifty-five different names as applied to the *Phormium* plant by the Natives, but it is doubtful if more than twenty marked varieties can be distinguished.

Native names of varieties.

The European manufacturer cannot as a rule make any selection as the Natives do. He must take all that comes to hand, and, as the common sorts form a large proportion of most of the natural fields, the average of his fibre must, for the cause above-mentioned—apart from the inferior process of manuacture which he employs—be less valuable than that of the Natives.

Phormium that grows on high or dry ground, though smaller, is in general finer and more easily stripped than that found in swamps—colonial rope-spinners preferring it, and being willing to give a higher price for it on this account.

When two kinds are supplied in considerable quantities to any mill it would be worth the while of the manufacturer to dress and bale them separately.

Fibre from marked varieties should be kept separate.

In Appendix X will be found several miscellaneous reports containing practical hints upon various points relative to the manufacture. The letter from Mr. G. H. Gordon (p. 72) will be specially useful as a guide to the proper sorting, classification, and packing, of the manufactured article, concerning which it embodies the writer's practical experience.

The paper by Mr. Stewart (p. 78), giving the result of experiments to determine the power required to work stripping machines, is well worthy the attention of practical engineers who are engaged in fitting up mills.

A valuable lecture by Captain Hutton, which gives a comprehensive account of the manufacture of *Phormium*, will be perused with interest by those who desire general information on the subject, as it gives a very complete *resume* of all earlier investigations and the result of much personal observation.

From the evidence which has been thus reviewed relative to the *Phormium* fibre as at present prepared for rope making, the Commissioners feel confident that it has now secured a permanent hold on the market at a remunerative value, which will probably rise as shipments of the fibre become more uniform, and its qualities are better appreciated. It also appears that the failures hitherto in the attempt to make it a profitable industry, have not arisen from any fault

Phormium now established in the market.

inherent to the plant, but to the want of experience on the part of many of those who embarked in the manufacture.

Profitable only with natural advantages and care.

Fibre has been produced with profit, when labour has been procured at a moderate rate, and when there have been the natural advantages of abundant raw material, water for motive power and for washing.

But it must be borne in mind, that a good price is only obtained for the produce when every part of the process is carefully conducted, and when there is no false economy of labour, or undue haste in conducting the manufacture.

The very best parcels which have been sent to England, and which realized the highest prices in the London auction rooms, have generally been prepared by men of small capital, who, producing only a limited quantity, have found the necessity of minute care and attention to every detail. Experience has shown that under favourable circumstances and with water power, this description and quality of fibre can be prepared ready for delivery at the mill at a cost of £14 a ton. And, if this can be done on a small scale, much more should it be practicable when large operations give scope for systematic and economical division of labour.

Summary.

The chief points in the manufacture on which the production of a good quality of fibre depends, appear to be as follows.

Selection and preparation of leaves.

1. The careful selection of the leaves; which should, if possible, not be in any way damaged or decayed. In practice, after a mill has been established for some time, the leaves that have from fourteen to twenty months growth will be readily obtained and found to be most profitable. When the loss of the best fibre by tow, which is incurred by the excessive scutching required to get rid of the "croppy ends" and the "straw" is taken into account, it is a question whether it will not pay to split the leaves and strip off the midribs and hard margins. Neither should the strong butts ever be allowed to pass into the machine, as is too frequently in the case, the hope of getting a longer fibre, as the effect is to produce "coarse red ends," which materially deterioriate the value.

Attention to the machinery.

2. The machinery must be very carefully attended to, being kept clean and in perfect adjustment. The employment of a flow of water on the stripper has a very beneficial effect, both on the machinery and on the fibre produced.

If Mr. Kelly's improved contrivance for effecting the adjustment of the scraping machinery while in motion, should succeed in practice, it will admit of the adjustment being rendered more perfect than is possible under any present arrangement.

The use of a second stripper, through which the fibre passes direct from the first, facilitates the after treatment.

Washing.

3. Thorough washing of the fibre after it has been reduced to finely divided bundles, and immediately after leaving the stripper, is resorted to for the production of the best qualities. As any maceration is to be avoided which will tend to make the fibre soft and cottony, long soaking is not suitable; therefore, as the matter to be washed from the fibre adheres with considerable tenacity, mechanical force must be applied to effect the washing in a sufficiently short time.

This constitutes the essential feature of wet-scutching, but none of the forms yet proposed for the application of this process are either perfect or admit of universal application. The error appears to be in most cases in applying too violent a force. When there is an abundant supply of water, and sufficient pressure, the method that appears most promising is to wash the hank in a strong jet with slight percussion. On the other hand, if water is scarce the amount of percussion must be increased, but in no case must the breaking up of the fibre be carried to an extreme.

Rolling.

4. Bruising, excepting under water, and even handling of the liberated fibre, should be avoided as much as possible until it is quite free from the vegetable tissue. Rolling may then be used with advantage, but not till the washing is quite complete. The object proposed to be gained by rolling in this stage is not only to save time in drying, but also to consolidate and define the bundles of fibre. This latter point is a step in the process which does not appear to have attracted the attention it deserves. An examination of the Native-dressed fibre shows that it is extracted from the leaves in long delicate bundles of great

tenacity and strength; and when it is desired to make cordage these long fibres are kept distinct and prevented from fraying out by the application of a little oil. In the European method of preparing the fibre on the other hand, the action of the stripping machine is so imperfect as to leave adherent tissue, which expreience has shown cannot be removed without washing, which process, however, tends to entangle the bundles and deprive them of the clean defined form which is so characteristic of the best roping fibres.

5. The bleaching and drying of the fibre, if the washing has been thoroughly performed, should be effected with ease and rapidity; and in the Southern Districts especially this is a point of great importance during the winter months. Bleaching and drying.

If a pure white fibre were required the sun bleaching might be dispensed with altogether, as purity of colour can only be obtained by thoroughly washing out the *bitter* principle from the plant. As already stated, however, washing to such an extreme degree is not desirable when the fibre is intended for the rope maker.

The only course, therefore, is to employ the action of the sun to convert the residue of extractive matter that remains in the fibre (See Appendix, p. 94) into a form that is not prone to undergo further change.

The effect of the sun's light is therefore to change the nature of the substance producing a yellow red tinge, that varies in depth with the amount of extractive matter in the fibre. The action of boiling water on the flax is to darken this extractive matter to a gray tint, leaving it in the same condition as if it had been effected by the light. The macerating effect of the hot water on the fibre bundles is, however, prejudicial to the use of fibre thus treated for rope making.

6. If the early stages of the process have been carried out in the above manner, the fibre will contain little that requires to be removed from it by scutching, which should therefore be performed rather with the view of burnishing the fibre than of reducing the quantity by the production of a large proportion of tow. It is the saving thus effected that must cover the extra expense for labour in selecting and preparing the leaves, and in thoroughly washing the fibre. Scutching.

Experience shows that the application of a small quantity of oil to the *Phormium* fibre not only improves its appearance, but also reduces its liability to undergo further maceration in water. The samples exhibited by the Natives of fibre prepared for making their fishing lines and other cordage, show that they appreciate the value of this application. Oiling.

Oil is used by the rope maker to facilitate the spinning of the fibre, but the best time to apply the oil,—at least in the case of flax that is to be made into rope in the Colony—would be as a final stage of the scutching, as a much smaller quantity would then be sufficient. It may be suggested that after the dust and broken fibre has been removed from the hank, the fibre could be lightly varnished with oil in a second scutch, the beaters of which touch against a piece of felt passed through a slit in the roof of the box from a trough-shaped cistern of oil on the top. The kind of oil to be used will require to be experimented on, but the Natives use animal oil, and the result, so far as obtained of certain investigations that are in progress, indicates this kind to be the best, and that it is superior to the application of tar, which has an action on the fibre like that of acids. (See Appendix, p. 96).

When the fibre is intended for export, it is doubtful if the advantage derived from oiling before making it up in bales would be commensurate with the increased risk of combustion taking place in it, unless it were kept for a considerable time before being compressed.

Experience has shown that iron lashings for the bales, whether in the form of wire or hoop iron, do not meet with favour in the market, and should not therefore be employed.

Opinion now appears generally in favour of protecting the bales with covering of scrim or other light cloth, without which the wet, dirt, and chafing that occurs during the land carriage and whilst lying about on muddy wharves, cannot fail greatly to injure the fibre, and no doubt is the cause of much of the so-called "sea damage" from which so many of our exporters have suffered. Covering bales.

The information obtained by Mr. Chilman (App. p. 103) relative to sea damage is so far satisfactory that it relieves the fibre from the imputation that the damage is due to imperfection in the manufacture. It is, however, evident to anyone who has inspected the shipping of the fibre that the ends of the bales, where the centre of the hanks is exposed, are frequently stained and discoloured, even before they leave the Colony, and this is notably the case in the bales of New Zealand fibre which were re-exported for the Commissioners. The opinion expressed by Mr. Chilman, that the covering of the bales may be dispensed with, cannot therefore be endorsed.

The sample bales of the fibres which compete with the *Phormium* received from London were all well protected by such coverings, more care having been taken in packing them than is usual with New Zealand fibre. The Manilla bale was covered with matting made frem the plaintain leaves, and this suggests that the cheapest form of bale cover for the New Zealand fibre might be made from the refuse leaves which are rejected in the process of manufacture.

Size of bales.

Mr. Chilman's remarks, relative to the advisability of adhering to one uniform size of bale, are most important, but the Commissioners are of opinion that, instead of adopting as he suggests a size of bale similar to that of Jute, with which fibre *Phormium* does not compete, it would be better to adopt the dimensions of a Manilla bale, which measures 3ft. 3in. x 1ft. 8ni. x 1ft. 8in., and weighs about $2\frac{1}{4}$ cwt.

Until the reports have been received from the scientific gentlemen who have undertaken the chemical and microscopical examination of the fibre, and also till the result of experiments instituted in England has been made known, we need only call attention to the chemical reports of Mr. Skey, given in the Appendix (p. 91), as these relate indirectly to the preparation of the fibre for other uses than rope-making, on which subject it is better to defer forming any judgment till the above evidence has been obtained, and which will form the subject of a further Report.

Fibre should be named PHORMIUM.

In this report the Commissioners have intentionally abstained from applying the term *flax* to the New Zealand fibre, and have substituted the name PHORMIUM in the hope that it will come into general use for the roping fibre which is at present exported from New Zealand, as it avoids misconception, and will be more in keeping with the names applied to the other roping fibres with which it has to compete in foreign markets.

JAMES HECTOR, Chairman.
T. M. HAULTAIN.
JOHN KEBBELL.

Wellington, 6th October, 1871.

APPENDIX TO REPORT OF FLAX COMMISSIONERS, 1870-71.

[Extracts from Correspondence.]

I.—APPOINTMENT OF AGENTS IN ENGLAND.

(No. 2.)—Chairman of Flax Commission to the Hon. the Colonial Secretary.—21st November, 1870.

I have the honor to request that you will be so good as to inform the Flax Commissioners whether they can avail themselves of the services of Mr. John Knowles as their agent in England, to carry out their instructions, and to collect information with reference to the supply and manufacture of New Zealand flax.

(No. 9.)—The Hon. the Colonial Secretary to Dr. Hector.—28th November, 1870.

I have the honor to acknowledge the receipt of your letter, No. 2, of the 21st inst., and to inform you that while Mr. Knowles is in England in the service of the General Government, his services are at the disposal of the Flax Commissioners.

(No. 54.)—Chairman to Messrs. Robert Christie and Co.—29th December, 1870.

The attention of many of the settlers of New Zealand has for several years past been directed to the preparation of the fibre of the *Phormium tenax* for the English market, but they have not succeeded hitherto in inventing machinery which will do full justice to the plant, or produce an article equal to that which the Natives obtain by the simple but tedious process of hand-dressing.

The question is one of great importance to the Colony, as the raw material exists in vast quantities in many of the districts, and large sums of money have been expended in experiments and machinery; and with a view of more fully developing the industry, a Commission has been appointed by the Governor, at the instance of the Legislature, to make inquiries, and to take steps for improving the manufacture and for bringing it more generally to the notice of the English trade; and it is a part of the duty of the Commissioners to appoint agents in England to assist them in carrying out these objects. Being aware that you have already taken an active interest in this question, and that from your connection with the trade you will be able to bring the fibre under the notice of manufacturers, they request your aid in the following matters, in which they have been instructed to take action:—

1. To place in the hands of manufacturers supplies of the various kinds of flax fibre, with the view of ascertaining by practical tests to what purposes it can be profitably applied.
2. To submit samples to makers of flax machines, and invite suggestions as to the improvement of machines usually employed in the Colony.
3. To ascertain the market value of the fibre, and the reason for the different prices obtained; and, generally, what can be done to extend its use and increase its market value.

One of the Colonial-made machines and some seven or eight tons of flax from different manufacturers will shortly be sent to England for the purposes above mentioned; and should you consent to assist in these investigations, a portion of these latter will be handed over to you, and further instructions will be transmitted when they are shipped.

I now beg to enclose a variety of documents that have publised by authority of the New Zealand Government in connection with this subject.

Mr. John Morrison, the Colonial Agent, Adelaide Place, London, will be requested to communicate with you, and to assist you in procuring fresh leaves of the *Phormium tenax* for any machine-maker who may wish to make experiments.

(No. 64.)—Chairman to the Hon. Dr. Featherston, Agent-General.—23rd March, 1871.

The Flax Commissioners are required by the terms of His Excellency's Commission, in accordance with a Resolution of the House of Representatives, to appoint one or two agents in England, as they may think fit, to be in correspondence with them, and generally to carry out their instructions.

Unless they can obtain the services of a gentleman who has local knowledge and experience, a general acquaintance with the industry, and also that individual interest in the subject without which usefulness is hardly to be expected, they feel that they are working at a great disadvantage, and will not be able to fulfil one of the chief objects for which they were appointed.

Some time ago they were offered by the Government the services of Mr. John Knowles as long as he remained in England, but he has returned to the Colony, and the Commissioners have not up to the present time succeeded in meeting with another qualified person willing to undertake the Agency, as they cannot offer sufficient inducement to any one to go home specially for this purpose.

They now learn that there is a prospect of Mr. Buller shortly proceeding to England on other duties, and are anxious to secure his services, feeling sure that no more competent agent could be employed; but they find a difficulty in making any proposal to that gentleman, as the tenure of their Commission is only temporary, and may cease shortly after the meeting of the next Session of Assembly.

Assuming therefore, that the arrangements with Mr. Buller will be made through your Department, I beg that you will recommend to the Government that the Flax Agency should be included amongst other matters remitted to him.

(No. 40.)—The UNDER SECRETARY to Dr. HECTOR.—8th April, 1871.

I have the honor to acknowledge the receipt of your letter No. 64, of the 23rd ultimo, addressed to Dr. Featherston, Agent-General, in reference to obtaining the services of Mr. Buller in England, in connection with the Flax Commission, and, in reply, am directed by Mr. Gisborne to inform you that he has arranged with Dr. Featherston for the employment of Mr. Buller for the purpose indicated in your letter.

II.—INSTRUCTIONS TO AND REPORTS FROM AGENTS IN ENGLAND, &c.

(No. 35.)—CHAIRMAN to Dr. HOOKER, C.B., F.R.S.—27th December, 1870.

A commission, of which I enclose a copy, has been issued by His Excellency the Governor for the investigation of the New Zealand flax manufacture; and I have been requested to solicit the favour of your valuable assistance towards obtaining the information mentioned in paragraphs 2nd (2, 3, 4).

The manner in which you can be of special service is in the selection of a person competent to make the required microscopic and chemical examination, and to report thereon, and by procuring for him such fresh leaves as he may require for the purpose mentioned in these paragraphs. The samples of prepared fibres will be furnished to the person you select through the Government Agent in London, John Morrison, Esq., who is also instructed to defray all fees and charges, the amount of which the Commissioners have left to your discretion.

I beg to enclose you the following documents:—

"Report of the Flax Commissioners on the means employed in the preparation of New Zealand Flax."

"Report of the Joint Committee on Colonial Industries."

"A Lecture on the Manufacture of New Zealand Flax, by Captain Hutton, F.G.S."

"Report from the New Zealand Commissioners relative to the Manufacture of New Zealand Flax."

"Progress Report of Flax Commission, 1870."

Some of these will be, and others may be, required by the person selected to conduct the examination, in order that he may understand the points on which information is chiefly wanted; and his attention should be specially directed to those passages which I have marked, and also to those subjects which I have indicated in the memorandum accompanying these papers.

It would be hardly possible for me to exaggerate the importance to New Zealand of a satisfactory solution of the difficulties which now prevent the full development of this Colonial industry. Extensive fields of the raw material exist; we know that it contains a fibre of great beauty, strength, and value; abundance of coal and water power favour the manufacturer; very large sums of money have been embarked in the construction of mills and machinery, and hundreds of settlers have devoted their entire energies and attention to the subject;—and yet, hitherto, from want of sufficiently authoritative guidance, they have failed to derive those benefits which might reasonably have been expected. Under these circumstances, the Commissioners feel that they need offer no apology for applying to you for aid and co-operation.

(No. 38.)—MEMORANDUM, with Printed Papers, forwarded to Dr. HOOKER.

The accompanying printed papers contain almost everything that is known relative to the *Phormium tenax*, and the various opinions which are held as to the best means for preparing its fibre are sufficiently stated to guide any one taking up the inquiry afresh.

There is no doubt of the high value of the fibre as prepared by the Natives; and if a mechanical apparatus were contrived, by which their method of preparing the fibre could be inexpensively performed, the chief difficulty would be removed.

The objection to the Native method is its expensiveness, due to great amount of manual labour required, and the loss of raw material.

The essential feature of the method is—that portions of the fibrous bundles are torn from the parenchyma in which they are imbedded, together with the adherent gummy cuticle that covers the inner surface of the blade of the leaf. The Natives in some cases remove this cuticle by steeping, in other cases they merely let it dry, and then brush it off mechanically. The result of both methods of treatment on the fibre is the same—leaving it in a white lustrous condition, possessed of great strength and lasting properties.

The ultimate fibres in good Native-dressed flax are free and comparatively non-adherent laterally, which is the chief distinction between it and fibre dressed by machines that have been invented by Europeans, in which the ultimate fibres are firmly bound together in bundles which break with a short cross fracture.

The reason for this difference is not yet determined, and is in fact the chief point to which it is desirable that the attention of the chemist and microscopist should be directed.

Captain Hutton, in his lecture (p. 8), states that a peculiar cement exists which binds together the ultimate fibres, and argues for the necessity of preparing the fibre by a method that will not injure

this cement. Against this view it is urged that the hand-dressed fibre of the Natives which is extracted without chemicals, or even washing, is quite free from this cement, as in it the lateral adhesion of the ultimate fibres is at the minimum, while the longitudinal adhesion of the *fisculi* is at the maximum.

It is of course to be taken into account that the Natives use only a small proportion of the fibre in the leaf, but the quantity they can extract is greatly increased by the cultivation of the plant and judicious selection of the leaves.

The comparative examination, therefore, of the fibrous bundles which the Natives reject, or in other words those on the back of the leaf, with the fibre they take, is of great importance to the inquiry.

The investigations required may be subdivided under the following heads:—

1. Comparative microscopic analysis of the structure of different parts of the fresh leaf:—*a.* Butt; *b.* blade; *c.* tip; *d.* glossy surface; *e.* bloom surface; in each case showing the relative proportions and arrangement of the various tissues in the various parts.
2. Prepared fibres—microscopic comparison of the varieties of *Phormium* fibre, Manilla hemp, Irish flax, Russian flax,—showing relative form and dimensions of the ultimate fibre, and the mode in which they are in contact laterally.
3. Chemical analysis of the proximate constituents of the different parts of the *Phormium* leaf, for the purpose of determining the chemical reaction of the different gummy and extractive matter, and the relative proportion in which these exist in the butt and blade of the leaves. A most desirable point to determine chemically is whether any change analogous to ripening takes place in the juice of the leaf which would indicate the best period for cutting it.
4. The tables of the relative strength of fibres given in books being defective, it is desirable that a series of experiments should be undertaken to determine the breaking strain of all the different kinds of fibre in the market, tested both as straight fibre and when twisted into strands.
5. The investigation of the peculiar action of sea water on rope made of *Phormium* fibre, and the reason for its not absorbing tar, as has been alleged, will naturally form part of the third branch of the subject already indicated.

JAMES HECTOR,
Chairman of Flax Commission.

SAMPLES of FLAX, numbered from 1 to 15, accompanying this Memorandum.

Native-dressed.

No. 1. *Harakeke.*—Common swamp flax from Otaki; stripped and scraped with a shell, then washed for a few minutes in running water. Selected leaves of twelve or eighteen months old.

No. 2. The same as No. 1, but not washed at all.

No. 3. From the same plants as Nos. 1 and 2, but stripped from the opposite (or under) side of the leaf. The tissue obstinately adheres to and discolours these fibres.

No. 4. From the same leaves as No. 1, but further prepared for the manufacture of the *Kaitaki* or fine mats, by soaking in running water for several days, and then beating with a stone or mallet.

No. 5. Common swamp flax from Otaki; merely stripped with a shell, as sold to rope-spinners at 1½d. per lb. Neither scraped nor washed.

No. 6. Same as No. 5, but hand-hackled by rope-spinners. Shows that the fibre is discoloured by being allowed to remain in contact with the tissue in which it was embedded.

No. 7. A superior sample from the Waikato, furnished by Sir George Grey five or six years ago. Native-dressed, and further prepared by mechanical or chemical action. Process unknown.

Machine-dressed.

No. 8. Mr. Stonyer, Okoka Mills, Kaiapoi.—Passed twice through stripping machine, soaked in water for one hour, sun-dried, scutched, and hackled. (Took first prize of Canterbury Flax Association.)

No. 9. Captain F. W. Hutton, Waikato—Machine-stripped, then washed and sun-dried.

No. 10. T. S. Macfarlane, Auckland—Similar process to No. 9, but with more prolonged washing or steeping, and wet-scutched.

No. 11. G. Booth, Waikoura Mills—Three times passed through stripper, washed, and dried. (See page 53, D. No. 14.)

No. 12. Riky's process—Boiling with wood ashes, and combing when wet; prepared in four hours.

No. 13. McFarlane and Wilson, Whakatane—Stripped by machine, then passed through India-rubber rollers, and bleached by fumigating with sulphur.

No. 14. John Journeaux, Wellington—Steamed, rolled, and fermented. (See page 51, D. No. 114.)

No. 15. C. J. Pownall—Scraping, washing, and sun-drying. (See page 50, D. No. 14.)

(No. 40.)—CHAIRMAN to Mr. MORRISON.—29th December, 1870.

I have the honor to inform you that a further sum of £200 (in addition to the £50 that was sent to you last month) will be transmitted to you by this mail to meet expenses that you may incur on account of the Flax Commission, and I beg also to acquaint you that Dr. Hooker, C.B., F.R.S., has been requested to select a person to conduct a chemical and microscopical examination of the *Phormium* plant and fibre, to whom, when the work has been completed, you will have to pay such fees and expenses as Dr. Hooker may authorize.

The Commissioners have forwarded some samples for examination direct to that gentleman, and they are about to send home supplies of seven or eight tons of different varieties of the prepared fibre, with respect to which you will be further advised when they have been shipped.

Messrs. Fraser and Tinne of Auckland have been directed to send you a colonial-made flax-stripping machine for the inspection of any manufacturers who may wish to make improvements on our process; and Messrs. R. Christie and Co., of 4, Sermon Lane, St. Paul's, London, have been requested to act as agents for the Commissioners in carrying out certain parts of their instructions; and these gentlemen have been referred to you for such information as you can give them, and also for your assistance, if needed, in procuring fresh flax leaves for experiment, which I am informed may be obtained in many parts of Devonshire and Cornwall.

(No. 63.)—Mr. MORRISON to the CHAIRMAN.—14th March, 1871.

I have the honor to acknowledge receipt of your letter No. 40, of the 29th December last, acquainting me, *inter alia*, that a sum of £200 was to be placed at my disposal to enable me to defray any expenses that may be incurred on account of the Flax Commission.

In reply, I beg to state, that Dr. Hooker of the Royal Gardens, Kew, has communicated with me, as per enclosed copy letter, respecting the chemical and microscopic examination of the *Phormium tenax;* and I have agreed to pay to Dr. McNab and Mr. Church, the Professors of Botany and Chemistry respectively, in Cirencester College, a fee of £25 each on production of their report. It will be observed from Dr. Hooker's letter that he does not appear to have received the samples for examination which you state had been forwarded direct to him.

I shall be glad to receive from Messrs. Fraser and Tinne of Auckland the flax-stripping machine, which shall be open for the inspection of manufacturers and others interested in the flax industry.

I note also that Messrs. R. Christie and Co., of this city, have been invited to act as agents for the Flax Commissioners, and it will be my endeavour (if required) to furnish them with such information and assistance as it is in my power to render.

MY DEAR SIR,— Royal Gardens, Kew, 13th March, 1871.

I have received the enclosed from Dr. Hector, and immediately took steps in the matter by inquiring for proper persons to conduct the researches required.

Dr. Hector, in a private letter to me, suggests a fee of £30 to £50 for a report on the points alluded to. These points however embrace a thorough knowledge not of botany only but of chemistry, and should be conducted by a botanist and chemist working together. I therefore put myself into communication with Dr. McNab and Mr. Church, Professors of Botany and Chemistry respectively in Cirencester Agricultural College, and proposed to them the undertaking of the investigations for a fee of £25 each; a proposal they are prepared to accept.

Under these circumstances, before finally arranging with these gentlemen, I should be glad of your authority for the payment of the fees on the production of the report, and for defrayment of the expenses of carriage of samples of fibre, &c., which I understand you will supply.

The fresh leaves I will take care to furnish from the Royal Gardens.

I have, &c.,

John Morrison, Esq. JOS. D. HOOKER.

(No. 81.)—Dr. HOOKER, C.B., to the CHAIRMAN.—4th March, 1871.

Referring to your letter of 27th December, No. 35–70, together with its enclosures, I have to state that the subject shall have my best and immediate attention.

It appears to me that the best beginning would be, to obtain a joint preliminary report from a good chemist, and a botanist skilled in vegetable anatomy, working together; and for this purpose I have applied to Messrs. McNab and Church, respectively Professors of Botany &c., and Chemistry, at the Cirencester Agricultural College, who I believe to be competent men.

I shall report further when I have heard from the above-named gentlemen.

(No. 92.)—CHAIRMAN to Mr. MORRISON.—13th May, 1871.

I have the honor to acknowledge receipt of your letters (Nos. 93 and 117) of 4th and 14th March, enclosing copy of letter from Dr. Hooker, and reports by Messrs. Manning, Collyer, and Co.

With respect to the letter, the arrangements made by Dr. Hooker with Dr. McNab and Mr. Church, of Cirencester Agricultural College, and indorsed by you, meet with the entire approval of the Commissioners.

On referring to my letter to Dr. Hooker, I find that samples were forwarded to him numbered and described, which he will no doubt have received by this time.

With regard also to the £200, which did not appear to have reached you at the date of your letter, I beg to inform you that the Bank of New Zealand have had instructions from the Treasury to forward the same on 3rd January. There may possibly have been some delay in the Bank, which would explain your not having received the remittance when you last wrote.

(No. 117.)—CHAIRMAN to Dr. HOOKER.—8th July, 1871.

I have the honor to acknowledge your letter of 4th March, and am requested by the Commissioners to thank you for your trouble in selecting Messrs. McNab and Church, of the Cirencester Agricultural College, to report on the *Phormium tenax*.

The Commissioners will look forward to receiving the report of these gentlemen, which they have no doubt will be received in the Colony with the most implicit confidence.

(No. 9.)—CHAIRMAN to the Hon. the COLONIAL SECRETARY.—22nd November, 1870.

I have the honor to enclose to you the draft of a letter which I request you will be so good as to transmit to the Government Agent in London by the first opportunity.

The Hon. the COLONIAL SECRETARY to Mr. MORRISON.—22nd November, 1870.

I have the honor to request that you will procure and forward to the address of "The Flax Commissioners," Wellington, 3 cwt. of each of the under-mentioned fibres, and of any others that compete in the English market with the New Zealand *Phormium tenax*, viz.:—Russian, Manilla, and Italian hemp, Bombay Jute, and Irish and Continental flax.

The parcels should be carefully packed in separate bundles, and marked with the names of the fibre, and also with the English market price and the place of production.

(No. 49.)—Mr. MORRISON to the Hon. the COLONIAL SECRETARY.—20th February, 1870.

I have the honor to acknowledge receipt of your letter (No. 132) of the 24th November last, directing me to procure and forward, in separate bundles of 3 cwt. each, to the Flax Commissioners, Wellington, samples of all the fibres that compete in the English market with the New Zealand *Phormium tenax*.

In reply, I beg to inform you that Messrs G. and J. A. Noble, fibre-brokers, of George Yard, Lombard Street, have kindly agreed to execute this commission, and to furnish full particulars as to the English market price and place of production of each fibre, adding thereto any general remarks respecting each or any of the samples which might be of interest to the Government.

The samples will be forwarded by the "Edinburgh Castle," for Wellington, on or about the 1st proximo, and full particulars of the shipment will be transmitted by the mail following.

(No. 75.)—Mr. MORRISON to the Hon. the COLONIAL SECRETARY.—15th March, 1861.

IN continuation of my letter No. 65, of the 20th ultimo, I have the honor to inform you that Messrs. G. and J. A. Noble have selected samples of Russian, Italian, Bombay, Sisal, and Manilla hemp, Egyptian flax, and aloe fibre, being the fibres which compete in the English market with the *Phormuim tenax*; and that they, together with two samples of the latter, have been shipped per "Edinburgh Castle" for Wellington, packed in separate bales, addressed as in the margin ["The Flax Commissioners, Wellington, N.Z."]

I beg to transmit herewith duplicate bill of lading for this shipment, Messrs. Noble's invoice, copy of letter addressed to you per "Edinburgh Castle," and duplicate policy of insurance.

Enclosed herewith is also the report by Messrs. Noble on the several samples; together with copy of a further report received from them, in answer to a letter I addressed to them, copy of which is also enclosed.

With reference to the two samples of the *Phormium tenax*, I beg to state that I assented to their being forwarded, as Messrs. Noble considered it desirable that flax-growers in the Colony should understand what qualities are most in demand in the English market.

I venture to invite your attention to the enclosed copy of a letter from Mr. C. Thorne, of 16, Mark Lane, who has greatly interested himself in the manufacture of the New Zealand fibre into rope, and whose experiments have been tested by several ship-captains and others, who have used the rope made from the fibre by his process.

Messrs. Manning, Collyer, and Co. have likewise favoured me with a report containing some practical suggestions as to the mode of cleaning the fibre for export, of which I enclose a copy.

Any further particulars which I may be supplied with by any of the above-named gentlemen, shall be at once communicated to the Government for the information of the Flax Commissioners.

4, George Yard, Lombard Street, London, E.C., 11th February, 1871.

Mr. MORRISON, for the New Zealand Government Agency, bought per G. and J. A. NOBLE.

	£	s.	d.
No. 1. Russian hemp, 1 bale, nett 3 cwts., @ 34s. 6d.	5	3	6
No. 2. Italian hemp, 1 bale, nett 4 cwts., @ 41s. 6d.	8	6	0
No. 3. Bombay hemp, 1 bale, 3 cwts. 1 qr. 20 lbs., @ 27s.	4	12	7
No. 4. Sisal hemp, 1 bale, 3 cwts. 2 qrs. 5 lbs., @ 48s.	8	10	2
No. 5. Egyptian flax, 1 bale, 2 cwts. 3 qrs. 11 lbs., @ 55s.	7	16	8
No. 6. Aloe fibre, 1 bale, 2 cwts. 1 qr. 3 lbs., @ 22s.	2	10	1
No. 7. Manila hemp, 1 bale, 2 cwts. 1 qr. 19 lbs., @ 56s.	6	15	6
No. 8. New Zealand flax, 1 bale, 4 cwts. 1 qr. 19 lbs., @ 33s. ...	7	5	10
No. 9. New Zealand flax, 1 bale, 2 cwts. 11 lbs., @ 39s.	3	18	4
	54	18	8

	£	s.	d.			s.	d.		£	s.	d.
Discount on	21	8	9	@	2½ ℔ cent.,	10	8				
„	5	3	6	@	3¾ ℔ cent.,	3	10				
„	7	16	8	@	3¾ ℔ cent.,	5	10				
„	2	10	1	@	2½ ℔ cent.,	1	3				
„	7	5	10	@	3¾ ℔ cent.,	5	6				
„	3	18	4	@	3¾ ℔ cent.,	2	10				
								...	1	9	11
Carried forward									53	8	9

	£	s.	d.
Brought forward	53	8	9
Delivery, &c.	0	9	6
Wharfage, marking package, &c.	1	15	7
Cartage, &c.	1	10	0
Bills of lading	0	1	6
Commission, 1 ℔ cent.	0	11	0
Due cash	57	16	4

Mr. NOBLE to Mr MORRISON.—4th March, 1871.

In accordance with your instructions we have purchased and shipped per "Edinburgh Castle," for Wellington, nine bales of hemp and flax, and have now the pleasure to give our views on these different sample bales as bearing upon the fibre shipped from New Zealand as flax (which term we consider a misnomer), as this fibre can only come into competition, to any large extent, with roping hemps. It will be seen at a glance by comparing the Egyptian flax, which will show the nature of all other flaxes grown from linseed, as clearly as if we had sent Russian, Dutch, or English flax.

We will now take Nos. 1, 2, and 3: these, it will be seen, are entirely a different fibre from that of the New Zealand, or *Phormium tenax*. Nos. 1 and 2 are occasionally used to supplement flax for linen, and largely for the heavier fabrics of same class, but No. 3 is only used for common cordage, and will always have considerable influence on the value of the lower qualities of New Zealand flax, these being adapted to the same purpose.

No. 6. Aloe Fibre.—This will come largely into competition with New Zealand, but from being badly cleaned it has hitherto not taken its proper position in the market.

Nos. 4 and 7.—Sisal and Manilla hemp are the most important to keep in view in preparing the New Zealand flax, and the nearer this fibre can be brought to the quality of these two hemps the larger the consumption will become. You will please to call the attention of the Government to the great difference there is in the strength of the Sisal, and particularly the Manilla, as compared with the New Zealand flax.

Nos. 8 and 9.—We have sent these two bales of New Zealand flax to show the qualities most in demand. The low brown hard fibre is very unsaleable, and, unless it can be laid down at such a price as to become available for paper making, it will be better not to ship it. Any further information that we can give from time to time we shall be most happy in sending you.

Mr. MORRISON to Messrs. G. and J. A. NOBLE.—7th March, 1871.

I beg to thank you for your report of the 4th instant on the sample fibres shipped per "Edinburgh Castle," and I venture to avail myself of your kind offer to supply any further particulars. There are several points on which I am desirous of more detailed information, in order that I may transmit the same to the Flax Commissioners at Wellington; and I shall feel obliged if you will have the goodness to favour me at your convenience with such information as you can supply respecting the following:—

(1.) Are the samples you have selected of the first quality; if so, what would be the prices of inferior descriptions?

(2.) Are the present prices above or below the average English market value?

(3.) Is the difference in the prices between (1) Russian and Italian hemp, (2) Sisal and Manilla hemp, and (3) Bombay hemp and aloe fibre, caused by the quality of the "fibre," or by the way in which they are respectively dressed?

(4.) It is stated that Manilla hemp when made into rope resists the action of sea water better than a rope made of the New Zealand fibre. Can you offer any explanation as to the cause of this?

(5.) Can you ascertain from the trade what is the relative capacity of Russian hemp and the New Zealand fibre to absorb tar?

(6.) You send two samples of the New Zealand fibre "to show the qualities most in demand." For what purposes are they respectively used?

(7.) At what price should the "low brown hard fibre" be laid down so as to become available for paper making?

(8.) Can you make any suggestion as to the proper mode of dealing with the New Zealand flax so as to bring it as near as possible to the quality of Sisal and Manilla hemp?

Thanking you for the attention you have already bestowed on the matter, and apologizing for this further trouble.

Messrs. G. and J. A. NOBLE to Mr. MORRISON.—11th March, 1871.

In reply to the several inquiries in your favour of the 7th instant, we will take your numbers seriatim:—

(1.) The samples represent good average qualities, and such as are used in the largest quantities. There are finer qualities in Manilla, Italian hemp, and Egyptian flax, but we considered the quality of these samples best adapted for purpose required.

(2.) The prices are generally higher than the average, particularly the Manilla and Sisal hemps, both of which have declined since these sample bales were purchased—the former £3 per ton, the

latter £5 per ton. The other samples are £2 to £3 per ton higher than we should give for a parcel, as we were obliged to take them from different dealers, as importers would not break a parcel to give off sample bales.

(3.) The difference in price arises from the quality of the fibre and the purposes to which they are severally applied; in all cases, the freer from refuse the more valuable the fibre.

(4.) There is no doubt that the Manilla hemp has more resisting properties against the action of sea water than the New Zealand, and we think it is principally to be accounted for by the different nature of the fibre. Sundry experiments are now making, and so soon as we know the result we shall communicate it to you.

(5.) Very little New Zealand hemp has up to the present time been used for tarred rope purposes, and we cannot speak positively on this point. We will make further inquiries into this.

(6.) Both these samples are used for cordage, but the better quality is more eagerly competed for as it approaches nearer the appearance of Manilla hemp.

(7.) The price at which the low common quality would be largely available for making into paper will materially depend on the price of Esparto, a small sample of which is sent herewith; but at present price of the Esparto, £9 to £10 per ton, New Zealand should not exceed £11 to £12 per ton; but should Esparto fall to its average price, £5 10s. to £6 per ton, New Zealand would not alter in value to the same extent, but might fall 30s. to 40s. per ton.

(8.) We cannot answer this question very positively, but we believe a great point is the taking the New Zealand at a proper growth, and not allowing the fibre to become too woody and absorbent. We have seen samples prepared by the Maoris fully as strong as the Manilla hemp; this was taken from the young leaf about three feet long.

We believe, if attention is paid to the preparation of the New Zealand fibre, it will become a very important item in the commerce of the Colony; and anything we can do to foster this, we shall do, with much pleasure.

STATEMENT of Quarterly Average Price.

FIBRE.	1868.				1869.			
	March 1.	June 1.	Sept. 1.	Dec. 1.	March 1.	June 1.	Sept. 1.	Dec. 1.
Russian Hemp	39s.	36s. 3d.	36s.-37s.	39s.-40s.	40s.	36s.	34s. 6d.-35s.	34s.-34s. 6d.
Sisal Hemp	39s.-44s.	...	37s.-42s.	38s.-42s.	40s.-46s.	43s.-48s.	44s.-49s.	53s.-57s.
Manilla Hemp	44s.-49s.	43s.-53s.	43s.-51s.	42s.-51s.	45s.-51s. 6d.	43s.-51s.	47s.-54s.	53s. 6d.-64s.
Egyptian Flax	...	55s.-60s.	52s.-60s.	52s.-58s.	54s.-64s.	54s.-64s.	55s.-66s.	55s.-66s.
Riga FWPK Flax	56s.-58s.	56s.-57s.	58s.-60s.	60s.-61s.	65s.-66s.	61s.-64s.	52s.-54s.	51s.-53s.
Italian Hemp	36s. 6d.	...	36s. 9d.	...	41s. 6d.	41s.	42s.	...
Bombay Hemp	...	...	28s.	29s. 6d.	27s.	28s.	...	...

FIBRE.	1870.				1871.	
	March 1.	June 1.	September 1.	December 1.	March 1.	
Russian Hemp	34s. 6d.	31s. 6d.-34s.	34s.-34s. 6d.	35s. 6d.-36s.	33s.-33s. 6d.	...
Sisal Hemp	55s.-57s.	53s. 6d.-57s. 6d.	47s.-51s.	45s.-51s.	42s.-45s.	...
Manilla Hemp	54s. 6d.-62s.	50s. 6d.-55s. 6d.	51s. 6d.-56s. 6d.	51s.-56s.	51s.-53s.	...
Egyptian Flax	54s.-60s.	54s.-60s.	54s.-60s.	54s.-60s.	48s.-56s.	...
Riga FWPK Flax	48s.-50s.	48s.-50s.	48s.-50s.	48s.-50s.	...	...
Italian Hemp	39s. 6d.	39s. 6d.	...	40s. 6d.	37s.-44s.	...
Bombay Hemp	27s. 6d.	28s.	24s.	...	17s.-23s.	...

Aloe Fibre.—Prices not recorded. The range has been from 16s. to 31s., according to quality.

Mr. THORNE (Assignee for Steart's Patent) to Mr. MORRISON—21st February, 1871.

In December, 1867, I handed you some samples of fibre, extracted by a process in which I have an interest, from some rough leaves of dry *Phormium tenax* which you stated had been received from New Zealand. It may be interesting to you to learn that many of the difficulties experienced in the cleansing the gum from the New Zealand flax are overcome by the proper application of the process.

The principal objections raised by ropemakers against the use of the New Zealand flax were first —its tendency to rot when brought into contact with salt water, owing to the gum remaining in the fibre, thereby rendering it useless for sea-going purposes. Secondly, its tendency to chafe and cut, owing to the brittleness of the fibre; attributed to the same cause. New Zealand flax is now undoubtedly going into more general consumption, but it is only its cheapness, as compared with other fibres, that induces the demands, and importers are complaining bitterly of the heavy losses they are sustaining in their importations, and we now hear that several of the flax works in New Zealand have been closed in consequence.

I have been making various trials with the flax, with satisfactory results; viz., after dressing about half a ton of flax which was imported in a very roughly finished state, I sent it to Yarmouth, where it was made into rope, and this rope has since April last been in constant use on board fishing smacks.

The owner of the smacks writes that for most purposes he finds it wear quite equal to Manilla, as it does not pull out or become "long-jawed."

In June I sent to Mr. Nickels, F.C.S., a sample of flax as imported, and a sample of flax after it had been subjected to the treatment by the process. I did not inform him what had been done to these samples, but numbered them No. 1 and No. 2. The report he gave as follows:—

No. 1. "The fibre appears to be perished. It is very weak and is covered with gum. This gum readily dissolved on being submitted for some days to the action of water (the common retting process) but when the gum was removed the fibre remained harsh, was easily broken, and did not become cottonized. The retting process would not have dissolved the gum readily, if at all, had not the leaf been broken previously."

No. 2. "Had undergone some treatment which seemed to have removed the larger portion of the gum, the quantity left in it not being sufficient to cause any deleterious effect by fermentation. This fibre was submitted to the action of water same as No. 1. The whole of the fibre became freely cottonized, did not show any signs of weakness, was soft, and ready for use by manufacturers."

He gave an additional detailed account, which it is not necessary to repeat, although it led me to the conclusion the process is valuable for cleansing the *Phormium tenax*. After many attempts to get more rope made I at last induced the well-known firm of ropemakers, Frost Brothers, to promise to accede to my request, but they required not less than one ton. I therefore purchased two tons of fibre as imported, and, after dressing it, sent it to them; they spoke in the highest manner of the free way in which the fibre passed over the spinning frames. The rope I showed to several well-known shipowners, who liked its appearance so much that they readily consented to give it a trial. Messrs. Lister, Young, and Co. have taken several coils for their vessels, the "Dragon," bound to Adelaide, and the "Haddon Hall," bound to Bombay. I annex the certificate given by Captain Manning, with regard to a part used on board the former vessel in taking in her cargo. Messrs. John Willis and Sons have sent four coils in the "Lauderdale," to China, with orders that they are to be severely tried. Messrs. C. Shelton and Co. have sent two coils in the "Sheffield," to Honduras, to be used in taking in a cargo of mahogany there. Messrs. Shaw, Savill, and Co. have sent some in the "Crusader," to Canterbury, and in the "Caduceus," to Auckland; and Captain Scott, their manager, is arranging for four other coils to be despatched in other vessels. Messrs. Grinnell and Co. have taken one coil in the "Constantine," to New York.

All these gentlemen have given instructions for the captains to note carefully the manner in which the rope works and wears, so that I hope by this means to obtain various practical opinions on the real value of properly cleansed or dressed New Zealand flax.

Messrs. Frost Brothers speak most favourably of my fibre, and have given me a written report on some they are now making into rope for me. This lot was cleansed direct from the green leaf in the Canterbury Colony, under the management of Messrs. Miles and Co.; and from Messrs. Miles Brothers and Co. here I learn that this flax, which was sold on arrival in this market at £30 ℔ ton, leaves a large margin for profit.

It may be that the process for which I am the assignee may not possess any advantages over those used by others; but what I have been all along anxious to show is, that New Zealand flax can be so prepared that the reasons assigned for the prejudice against its use ought not to exist, and I think this is a fact which cannot be too widely circulated. There has been an endeavour to bring the New Zealand flax into disfavour; hence the necessity for carefully proving, by actual results, whether the faults registered against the fibre are real, or only made with a desire to depreciate the value of what, no doubt, must eventually become an important branch of New Zealand industry.

Captain Manning to Messrs. Lister, Young, and Co.—London, 30th December, 1870.

I have to report to you that the 2½ and 3 inch rope made from the New Zealand flax has been used as burtonfalls in taking in the cargo of the "Dragon," and that on the completion of her loading I find that it is nearly as good as new and quite fit to take in another cargo, which is most unusual. It appears to stand the friction of lowering goods better than either Manilla or hemp. It could not have had a fairer trial, as during the whole of the ship's loading it has been exposed to extremes of wet, frost, and snow, which have not caused any alteration in its appearance, as it has neither swollen nor got "long-jawed;" nor has the lay of the rope been disturbed as is generally the case, more especially with Manilla; in fact, it has stood the hard work better than any rope I have ever used.

P.S.—The "Dragon's" cargo consists of about 1,200 tons weight and measurement.

Messrs. Frost Brothers' Report to Mr. Thone on New Zealand Flax, dressed in Canterbury, New Zealand.—11th February, 1871.

The New Zealand flax we spun for you last week is of about the same character and is no way inferior to the parcel we made up for you in December last. We spun both lots by machine, and it ran very freely, was clean and free from dirt or shives. It works much better than the ordinary New Zealand Flax. The rope made from it is soft, pliable, clean, and looks well in every respect. We have no doubt that it will wear considerably better than rope made from the usual New Zealand flax. The difference in loss of weight in manufacturing is at least 3 lbs. per cwt. in favour of your flax. We have tested the strength of the two yarns with the following results:—

Yarn spun from your superior New Zealand flax broke at 139 lbs.

Yarn spun from your New Zealand flax broke at 164 lbs.

MANNING, COLLYER, and Co. to Mr. MORRISON.—21st February, 1871.

Referring to our conversation some days ago respecting New Zealand flax, we do not find that we can give you more precise information in respect to the requirements of consumers here than is contained in our last three Market Reports, of which you have copies.

The best process we are aware of for preparing the fibre is that of Mr. C. Thorne. A very satisfactory report has been received this week from one of our largest ropemakers, who finds the fibre treated by Mr. Thorne to be much superior to that ordinarily imported.

We think the very long flax leaves might have the butt ends cut off with advantage before the fibre is prepared. There is no practical advantage in sending flax over about 4 to 5 feet long. The butt ends might be utilized for paper material, together with any refuse produced in the preparation. These, with the raw leaves, are readily saleable at £8 to £9 per ton (if shipped dry) here. The gum might perhaps be expressed by heavy rollers, or some simple process of reducing the whole to half stuff before shipment to save freight, care being taken to have it thoroughly dry before packing. For paper, any pressure applied would not injure the material; for cordage purposes, a moderate pressure only is best.

Ultimately, we believe, the better qualities of flax will be taken by textile manufacturers. At present, the trials in progress are not sufficiently advanced to justify a decided opinion.

(No. 91.)—CHAIRMAN to Mr. MORRISON.—11th May, 1871.

I have the honor to acknowledge receipt of your letters of 26th February and 15th March, 1871 (Nos. 65 and 121), which have been referred to the Flax Commissioners by the Hon. the Colonial Secretary, informing of the shipment of sample bales of those fibres which compete with New Zealand flax in the English market, and enclosing duplicate bill of lading, Messrs. Noble's invoice, copy of letter per "Edinburgh Castle," and duplicate policy of insurance.

With regard to the invoice, the Commissioners beg to remind you that by the mail which left here at the end of December or beginning of January last a further sum of £200, in addition to £50 sent previously, was transmitted you to meet any expenses you might incur on account of the Flax Commission.

The reports by Messrs. Noble on the samples of fibres which they have selected are very full and interesting, especially the one in answer to your queries; and the Commissioners request that you will convey their thanks to these gentlemen for the way in which they have executed the commission intrusted to them.

The samples of *Phormium tenax* will doubtless be useful in guiding manufacturers as to what qualities are most in demand at home.

The letter of Mr. C. Thorne, and the reports by Captain Manning, Messrs. Manning, Collyer, and Co., and Messrs. Frost Brothers, are full of interest to all who are alive to the great importance to the Colony of the proper manufacture of flax.

The report by Captain Manning seems especially favourable, and appears to be founded on a good practical test of the rope made from New Zealand flax.

The measures taken by Mr. Thorne to discover the real qualities of New Zealand flax rope are very complete; but he does not say what is the cost of dressing flax by his process, nor does he give the price of the rope manufactured for him by Messrs. Frost Brothers. We shall look forward with great interest to the reports of the different shipowners and captains on the subject.

Herewith I beg to hand you duplicate bill of lading for one bale of flax shipped at Auckland per "Queen Bee;" also a duplicate bill of lading for a flax-stripping machine, by Messrs. Fraser and Tinne, of Auckland, shipped per same vessel.

(No. 18.)—CHAIRMAN to the Hon. the COLONIAL SECRETARY.—5th December, 1870.

The Flax Commissioners think it very desirable to procure the particulars of the preparation of the Manilla fibre, and request that you will be so good as to move His Excellency the Governor to apply to the Right Hon. the Secretary of State for any information on the subject that can be obtained from the Public Department of the Spanish Government.

(No. 22.)—CHAIRMAN to FORBES WATSON, A.M., M.D., &c.—8th December, 1870.

For several years the economical preparation of the fibre of the *Phormium tenax*, or New Zealand flax, has occupied the attention of the settlers of this Colony, and various machines and processes have been tried and invented for the purpose; but these have hitherto failed in producing a sample which can be sold at a remunerative price in the English markets, or which is equal to that obtained by the simple but expensive and tedious mode of hand-dressing by the Natives.

The Government of the Colony have now appointed a Commission to inquire and report upon the best mode of extracting and manufacturing the fibre, and the Commissioners think that it might assist them in their investigations if they could obtain the particulars of the process by which the Manilla hemp is prepared: but they scarcely know where to look for accurate information, and venture to apply to you for aid and advice, knowing how great an interest you have taken in all inquiries of this nature. They would feel much obliged for any information you could give them on this subject, and request that you will kindly furnish a list of publications referring to the cultivation and mode of preparation of the Manilla fibre to Mr. Morrison (Adelaide Buildings, King William Street, London), Agent for this Colony, who will procure and forward them to New Zealand.

P.S.—I beg to enclose copies of recent Parliamentary Papers of New Zealand bearing on this subject.

(No. 27.)—CHAIRMAN to H.B.M. CONSUL, Manilla, Philippine Islands.—19th December, 1870.

A Commission has been appointed by the New Zealand Government to inquire into and report upon the best mode of extracting and manufacturing the fibre of the *Phormium tenax*, and the Commissioners are desirous of obtaining the fullest information as to the processes by which the Manilla hemp is prepared. I have therefore no hesitation in applying to you to furnish me with any particulars which may be at your disposal, in the way of reports or publications that bear upon the subject, feeling sure that you will be ready to aid in solving a question which is of great importance to this part of the British Empire; and I beg to add that C. H. Warren, Esq., has been requested to defray any expenses that may be incurred in the purchase and transmission of pamphlets or books to this Colony.

(No. 91.)—Mr. J. C. RICKETTS, H.B.M. Consul, Manilla, to the CHAIRMAN.—6th April, 1871.

In reply to your letter of the 19th of December, 1870, relative to the processes by which the Manilla hemp is prepared, I beg to inform you that machinery has lately been invented by a Spaniard for the working up the hemp, but with what chance of success it is not as yet known.

Hitherto the hemp has been prepared entirely by manual labour. The process is simple enough, and somewhat as follows:—

The tree from which the hemp is made, *Musa textilis* or *Wild Plantain*, having attained the age of two and a half to three years, is cut down and stripped of its folds; these are then divided into pieces 3 or 4 inches wide, and the pulpy part separated by drawing them under a knife fixed in a block for that purpose. The fibre is thus laid bare, and is then placed in the sun to dry. It is then fit for commercial purposes.

If the plant be left for any length of time on the ground after having been cut down, the hemp assumes a reddish tinge and is not very suitable to commerce.

This process is somewhat laborious, and in the absence of all machinery very troublesome. The hemp is however of a good quality. The cordage is made in the same way as in Europe.

The hemp made in your Colony is apparently produced from the flax leaf; that made here is produced from the cortex of the wild plantain tree. The process, therefore, of manufacturing it would be very dissimilar, and the little information I have herein given you will I fear be of little service. I know of nothing published on this subject in Manilla.

Would the *Musa textilis* grow in New Zealand? If so, would it not be worth introducing? It is reproduced the same as any other plantain tree, and without any difficulty in this country—a plantation being formed fit to take a crop from at the end of the third year.

This plantain tree is also exceedingly prolific, yielding numerous shoots, which can if necessary be transplanted.

(No. 74.)—Mr. MORRISON to the CHAIRMAN.—15th April, 1871.

Adverting to my letter No. 93, of the 4th ultimo, I have the honor to transmit herewith copy of a letter from Dr. Forbes Watson, respecting certain publications having reference to the cultivation and mode of preparation of Manilla fibre; and I beg to acquaint you that the books mentioned therein cannot be procured through any bookseller, both being out of print and extremely carce. Under these circumstances I have caused them to be advertised for, but as yet without success.

Dr. WATSON to Mr. MORRISON.—24th March, 1871.

Referring to the subject of your letter of the 15th instant, I have now the pleasure to enclose a set of papers giving the necessary particulars regarding the effort which the Indian Government is making to procure a machine to prepare the Rheea or China Grass fibre.

I likewise take the same opportunity of replying to your favour of the 12th instant, requesting, on behalf of the the New Zealand Flax Commission, to be supplied with a list of publications referring to the cultivation of the Manilla fibre. This fibre, as you are probably aware, is not cultivated in India, and it so happens that the information respecting it is of a very imperfect description. The only references to which after a careful search I can direct you are to be found in Royle's "Fibrous Plants of India," pp. 64–69, and in the "Technologist," vol. iii. pp. 118 and 119.

Royle's work is out of print, but a copy of it could probably be obtained on application to Whelden, the second-hand bookseller, in Great Queen Street, Lincoln's Inn Fields; and it is likely that the required volume of the "Technologist" could be got through the same agency.

And with apologies for the delay in replying to your communications, &c.

RHEEA, or CHINA GRASS FIBRE.—India Office, 13th March, 1871.

The Secretary of State for India has received the following Despatch from the Government of India, announcing the farther postponement of the trials for the prizes offered for machinery for the preparation of the Rheea fibre for the European market.

Some parcels of dried stems have been received and more are expected, from which samples will be given to persons anxious to compete for these prizes. The Government of India wishes it to be distinctly understood by all persons to whom the samples are given, that the required machinery will have to operate on green and fresh stems, and that these dried stems are merely sent in order to give the manufacturers a better idea of the nature of the plant, and of the difficulties to be overcome, than could be obtained from a mere verbal description of them.

Applications for samples are to be addressed to the Reporter on the Products of India, India Museum.

The Governor-General in Council to the Duke of Argyll, K.T.

My Lord Duke,— Fort William, 8th February, 1871.

In continuation of our Despatch No. 130, dated the 28th December, 1870, we transmit herewith copy of an amended advertisement, in substitution of the one enclosed in your Despatch No. 4, dated the 11th January, 1870, offering prizes for the invention of machinery for separating the fibre and bark from the stem, and the fibre from the bark, of the Rheea plant.

2. We shall feel obliged by your Grace directing the same publicity to be given to this as was given to the previous advertisement.

3. Your Grace will perceive that the public competition of the machines will not be held until the 1st April, 1872, and that all machinery intended for trial must be brought by the competitors at their own charge to the Saharunpore Rheea Plantation, and kept ready before that date, to be there worked under their own supervision.

4. Your Grace will further observe that arrangements have also been made for affording to parties, whose machinery is in a sufficiently forward state, facilities for testing the same at the Government Plantation during the hot weather and rains of the present year.

5. We beg to call your Grace's attention to the 9th paragraph of the advertisement on the subject of the notices of intention to compete, which we wish to be submitted, as far as possible, prior to the 1st May, 1871. It is not our intention to exclude necessarily from the competition machines in regard to which notices may not reach us until subsequent to that date; but we desire to be as soon as possible in a position to estimate the quantity of material likely to be required for the trials, and, should the supply available at the time of the commencement of the trials prove insufficient for testing all the machines presented, priority will be given to those of which due notice was received on or before the date fixed.

6. We also enclose, for your Grace's information, a copy of our Resolution* dated the 26th ultimo, on the subject of the provision of Rheea stems for the use of intending competitors. Of the quantity mentioned in the 1st paragraph of the Resolution as intended for transmission to England, a portion has already been shipped, and the remainder will be forwarded as soon as possible, probably the whole of it during the course of the current month, and due notice given of its despatch.

Notification.—Fort William, 26th January, 1871.

The Governor-General in Council is pleased to direct the publication of the following advertisement, in substitution of the one published under Notification No. 145, dated the 11th January, 1870:—

Advertisement.

The Government of India, after communication with various Agricultural and Horticultural Societies in India, and with persons interested in the subject, has arrived at the conclusion that the only real obstacle to the development of an extensive trade in the fibre of Rheea, or China Grass, is the want of suitable machinery for separating the fibre and bark from the stem and the fibre from the bark, the cost of effecting such separation by manual labour being great.

2. The demand for the fibre is now large, and, no doubt, might be extended with reduced prices; and there is a practically unlimited extent of country in India where the plant could be grown.

3. The requirements of the case appear to be some machinery or process capable of producing, with the aid of animal, water, or steam power, a ton of fibre of a quality which shall average in value not less than £50 per ton in the English market, at a total cost, all processes of manufacture and allowance for wear and tear included, of not more than £15 per ton. The said processes are to be understood to include all the operations performed, after the cutting and transport of the plant to the place of manufacture, to the completion of the fibre of the quality above described. The machinery must be simple, strong, durable, and cheap, and should be suited for erection at or near the plantations, as the refuse is very useful as manure for continued cultivation.

4. To stimulate the invention or adaptation of such machinery or process, the Government of India hereby offers a prize of £5,000 for the machine and process that best fulfils all the requirements named above.

5. Rewards of moderate amount will be given for really meritorious inventions, even though failing to meet entirely all the conditions named.

6. Owing to the delay that has taken place in maturing the preliminary arrangements, the Government of India has decided that the competition will not be held until the 1st April, 1872, thus affording a much longer time than was originally intended for the preparation of machines and their transport to the locality appointed for the competition. The Government Rheea Plantation at Saharunpore, in the North-Western Provinces, has been fixed as the place where the public competition will be held, and the Government of India will provide one or more small steam-engines to work the machines during the public competition.

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* N.B.—Not given, as merely affecting the supply to competitors in India.

7. All machinery, &c., intended for trial must be brought by the competitors, at their own charge, to the Saharunpore Rheea Plantation, and kept ready before the 1st April, 1872, to be there worked under their own supervision, or under that of their representatives, for a sufficient length of time to enable the judges appointed by Government to determine whether all the conditions named have been complied with. The prize machine is to be transferred, if required, to Government at 5 per cent. above cost price; the patent right in any such machine to be also transferred, if required, to Government, on the latter securing to the patentee a royalty of 5 per cent. on the cost price of all machines manufactured under the patent during its currency.

8. Arrangements have now been completed for the supply of dried Rheea stems to intending competitors, both in this country and in Europe, to enable them to form a correct idea of the nature of the plant which their machinery will be required to deal with. Persons in Europe desirous to obtain small supplies of dried Rheea stems for the above purpose, should apply to the Secretary of State for India. Intending competitors in this country, desirous of obtaining supplies of the article, must submit applications to the Secretary to the Government of India in the Home Department, in the Form A,* hereto annexed, prior to the 1st of March, 1871; and those who are desirous of testing their machinery on the fresh Rheea at the Government Rheea Plantation at Saharunpore during the year 1871, must submit their applications to the same authority in the Form B, hereto annexed, prior to the 1st April, 1871. The former will have to pay the expenses that may be incurred in packing and despatching the stems. The latter will have to provide all labour and motive power necessary for, and to pay all expenses connected with, their experiments; the fibre turned out by their machines during such experiments to become the property of Government.

9. In order to enable the Government to arrange for the provision of a sufficient stock of fresh Rheea stems for the purposes of the formal competition in April, 1872, it is necessary to ascertain beforehand the number of machines that are likely to take part in it; and intending competitors are therefore requested to submit, prior to the 1st May, 1871, and in the Form C, also hereto annexed, notices of intention to compete.

(No. 92.)—Mr. Morrison to the Chairman.—3rd May, 1871.

In continuation of my letter No. 151, of the 15th ultimo, I have the honor to inform you that the following publications, "Technologist," vol. iii., and Royle's "Fibrous Plants of India," have been advertised for, but no copies are as yet forthcoming.

Further inquiries will however be instituted, and the result communicated to you.

(No. 113.)—Chairman to Mr. Morrison.—7th July, 1871.

I have the honor to acknowledge receipt of your letters (Nos. 151 and 166) dated 15th April and 3rd May respectively, informing of the efforts you were making to procure certain publications bearing on the subject of the cultivation and mode of preparation of Manilla fibre, and of your want of success up to the latter date, and enclosing copy of letter from Dr. Forbes Watson on same subject; printed papers respecting Rheea or China grass fibre; and market reports.

I hope to hear soon that your continued exertions to procure the works referred to may have been successful.

In the event of your being able to procure them, would it not be advisable to have an abstract made of those portions which give the particulars that would be of most interest and value to those engaged in the manufacture of New Zealand flax.

(No. 114.)—Chairman to Mr. Morrison.—7th July, 1871.

Referring to my letter No. 40, of 29th December, 1870, in which I stated that the Commissioners were about to send home some seven or eight tons of different varieties of prepared flax, I have to express my regret that an unavoidable delay occurred in carrying out this intention.

I now beg to inform you that bills of lading for twenty-three bales of New Zealand flax (shipped last week on board the "England" for London) have been forwarded you by Messrs. Levin and Co.

The object of sending this flax is explained in paragraph 3 of the Report of the Flax Commission Committee of 1870, as follows:—

"That the agents shall . . . . . ascertain—(1.) The market value of the fibre and the reason for the different prices obtained. (2.) To place in the hands of manufacturers supplies of the various kinds of flax fibre, with the view of ascertaining by practical tests to what purposes it can be profitably applied. (3.) . . . . (4.) To submit to makers of flax-machines in the mother-country samples of our prepared flax, and invite suggestions as to the improvements of the machines usually employed in the Colony. (5.) Generally, to ascertain what can be done to extend the use and increase the market value of the flax fibre."

Specimen bales of each kind have been retained for future reference when a report is received relative to the value in the home markets of the fibres now forwarded; the reasons for the difference, if any, in their values; and the opinions of those people who are qualified to speak on the subject.

These fibres represent the best qualities now prepared by machinery in the Colony, and one of the chief objects which the Commissioners have in view in sending home these samples is that they may be placed in the hands of manufacturers who will be able by practical tests to ascertain to what purposes the fibre can be applied; and I beg that you will defray any moderate expenses incurred in making such experiments from the funds in your hands.

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* Omitted, as referring only to competitors in India.

The Commissioners wish also to have samples sent out to the Colony of all articles that are prepared from the particular samples of flax.

Enclosed I beg to hand you copy of letter addressed to Messrs R. Christie and Co., of 4, Sermon Lane, E.C., on 29th December, 1870 (and of which I made mention in my letter to you of same date), in order that you may be exactly informed of the assistance we have requested at the hands of these gentlemen; and you will observe from it that a portion of the flax sent home by the Commissioners was promised to these gentlemen, to enable them to assist in furthering the objects which the Commissioners have in view.

I was in hopes that we would be able to send along with the machine-dressed fibre a large sample of the finest Native-prepared fibre, but it has only been received from the Natives since the "England" sailed, and must await another opportunity.

P.S.—I have the pleasure to inform you that the "Edinburgh Castle" arrived safely at this port on the 2nd instant, but is not yet unloaded. However, I hope by next mail to be able to state that the nine sample bales of fibre have come to hand in good order and condition.

(No. 42.)—CHAIRMAN to the Hon. Mr. VOGEL.—2nd January, 1871.

Three sets of printed papers accompany this, as there may be an opportunity of interesting some one in America on this subject, as well as in England.

The persons who have been communicated with in England are—

1. Mr. John Morrison: he has been asked to send out the samples of competing fibres mentioned in 3c. of Resolutions of the House of Representatives; £250 has been remitted to him for this purpose, and to defray the expense of chemical and microscopic examination. A colonial-made flax machine (by Fraser and Tinne, Auckland,) has been ordered to go to Mr. Morrison, to be submitted to machine makers at home.

2. Dr. Hooker has been asked to select an analyst, &c. (see letter, page 18 of Progress Report), also to furnish leaves. It would be desirable that he should be seen on this subject. Also, as to whether his opinion is favourable to offering a first and second prize (say £50 and £30), to be competed for by graduates in science for the year 1870–71 at the Universities that grant the degree of D.Sc., for essays founded on experimental researches and comparison of the *Phormium tenax* fibre with other textile fibres.

3. Messrs. Robert Christie and Co., 4, Sermon Lane, St. Paul's, E.C., who are the chief producers and dealers in bags and heavy fibre stuffs, have been asked to undertake the duty of seeing that the samples sent home for experimental manufacture are put into proper hands. They have been chosen because they show a great interest in the subject and sent out much useful information to the Colony. It would be desirable to see Mr. Christie, as he would be the best man to select some one to make the investigation in the industrial and manufacturing branches of the subject, and report to the Commissioners in the Colony.

They might suggest some simple machinery that could be sent out to the Colony for the manufacture of scrim-cloth, gunny bags, and the coarser kinds of sacking. They would also be the best persons to get a report on the recently invented machinery for working the Rheea and other fibres. (A prospectus of such machines is attached.)

In conclusion, it would be very desirable to get reports on any such machine used in America; also, to make inquiries as to the exact steps in the manufacture of white rope as followed in America, and how far the New Zealand machine-dressed flax suits that process. Particularly, do they use any oil, petroleum, or other stuff in making up the rope?

The Hon. Mr. VOGEL to Dr. HECTOR.—Washington, 28th February, 1871.

I have not as yet been able to do anything for you in respect to flax. In San Francisco they have no analogous manufactures, and I found there, as well as elsewhere, that it was a great mistake not bringing with me samples of the ordinary prepared flax. If you remember, I suggested to you to get me such samples, but that you thought I should be able to obtain them anywhere in the United States. The flax prepared by hand by the Natives I have with me, but that, of course, is not a fair sample of what the fibre of the plant is. Besides samples of ordinarily prepared flax, I think it most important that there should also be samples of the plant itself in its natural condition. If, as I expect, cut leaves would wither and shrivel up, I question whether it would not be well that you should send, both to the United States and to England, roots of the plant, with the leaves preserved as far as is possible.

At Chicago I was told, "If you will only show us the stuff to be dealt with, and tell us what is wanted to be done, there will be no difficulty in procuring or in making the necessary machinery for preparing the fibre."

I intend to have a search made through the Patent Office here for any machines which might possibly be of use. In New York, I hope I shall be able to obtain some information about the manufacture of white rope. There are no rope factories in Chicago, and in San Francisco there are none of any importance. But in San Francisco I was told, in reply to an inquiry you asked me to make, that a little whale oil is generally used in making the white rope, and that, as a rule, a very little cocoanut oil is used in making cords, &c.

I have promised to two gentlemen who have very nice country seats, and who take great interest in the introduction of foreign plants, that I will endeavour to obtain for them some roots of the flax plant. Those gentlemen desire to try whether the plant will grow well in California; and you will oblige me if you will send to Mr. Ralston, Bank of California, San Francisco, a dozen or two of the plants, with directions for dealing with them, and a statement that you have sent them at my request. I will prepare and will send by this mail an official minute, embodying such information as I have been able to obtain about flax while passing through the country.

(No. 65.)—The Hon. Mr. VOGEL to the CHAIRMAN, Flax Commission.

I beg to report the result of inquiries made in the United States respecting New Zealand flax, or *Phormium tenax* fibre. The inquiries have been made during the intervals, necessarily not long, which could be spared from the main object of my visit to this country, namely, the settlement of the terms of the mail contract. It is therefore not to be supposed that I am able to give anything like an exhaustive report upon the uses to which the *Phormium tenax* fibre is put, and the estimation in which it is held in America. The report must rather be regarded as a summary of information gained, and not at all as approaching a full report on the subject. I may add, that for most of the information gained I am indebted to the assiduity and industry of Mr. Fox.

In California, as far as I was able to judge, the flax seemed to be scarcely at all known. There as well as elsewhere it was found to be a difficulty that samples could not be shown, except those prepared by the Natives, which were supplied to me through the Native Department.

In Chicago, nothing relating to the subject could be ascertained, but one gentleman expressed to me the conviction that, if the material to be dealt with could be shown, there were machinists who could supply machines to do with it whatever could be done by hand.

In New York the fibre is well known to ropemakers, dealers in flax, hemp, &c. Samples were frequently produced, but as a rule they were not good. The fibre has been generally imported from England, but some dealers spoke of direct importation as within their knowledge. As a rule, the New Zealand fibre is considered here not fit to compete with average Manilla; and samples of Sisal, of good quality, as well as various hemps, including some American grown, were during the inquiries shown by dealers as articles which would be preferred to the New Zealand flax for use with or as substitutes for Manilla.

The present sale price of Manilla is about 10 cents gold per lb. During the war, and even since its close, the price has ranged from 13 cents to 18 cents; but that average was spoken of as "altogether unhealthy," and as preventing a free use of the fibre. Some years before the war, Manilla fetched no more than 5 cents per lb., and an old practical ropemaker expressed the opinion that for a steady market the fibre ought to be little if at all above 6 cents per lb.

Reference to the price of Manilla was necessary, because every person who was consulted stated explicitly, or clearly implied, that that is the standard fibre for ropes, cords, &c., and that its price must rule the prices of any others introduced. At the same time, almost every person consulted spoke of the fluctuations in the price of Manilla.

One of the samples of New Zealand flax, prepared by Natives of the Wellington Province, was exhibited during the inquiries. Invariably, the fibre was most highly praised; and, without an exception, the reports declared that if such an article could be had in quantity, it would certainly realize, at any time, as much as good Manilla. Amongst the opinions expressed were, "It is the very best fibre I have ever seen;" "It ought, in time, to beat Manilla out of the market;" or "It should compete with the best selected Manilla." But, in the absence of enough of such fibre to test the market, no manufacturer or dealer would venture a more definite expression of opinion as to value than that before stated. The representative of one large manufacturing firm (Messrs. Tucker, Carter, and Co.) said that he was most anxious to see such a fibre imported—that it was just what was wanted in the market; but he also said that if a bale of it was shown, the probable conclusion would be that it was Sisal specially got up, and that nothing but having a number of bales of the fibre on hand would enable it to establish its position, and a reliable opinion as to value, &c., to be arrived at. The same gentleman said that he had heard of whale lines having formerly been made of "New Zealand hemp," but that, knowing the "hemp" only as it had been imported during the last two years, he had simply laughed at the idea. The sample shown to him would, he believed, be found to be excellently suited for whale lines and boat ropes—if the fibre would stand water. At the same warehouse, a bale of "New Zealand hemp" nearly as good as the sample, was spoken of as having been "shown" amongst the trade not many months ago; and though offered at 50s. a cwt., it was stated not to have been sold. Further information as to this bale could not be obtained. An excellent sample of Sisal was stated to be at present worth, in the market, 9c. (gold) per lb.; and that, it was added, would certainly be an "outside price" for any lot of ordinary "New Zealand hemp," such as had hitherto been imported.

All the opinions before referred to were based on the assumption that the fibre equal to the Native-prepared sample would be used only for rope and heavy cordage. But the sample was shown to a firm engaged in the manufacture of twines, cords, &c. (Messrs. Hart and Co.), and their opinion was that a moderate constant supply would sell readily, if it could be had for about 15 cents (currency) per lb.

The practical head of a rope-manufacturing establishment (Mr. Marshall, of L. Conterbury and Co.), which was stated to be about the largest in the United States, showed the utmost possible interest in the subject. After he had examined the sample, the same as shown in each case, he declared, "This would make the very best rope known." It would, he said, rank up to first-class Manilla, and he was sure that a responsible firm in New York could be easily found to contract to make one thousand tons yearly, if it could be put down in New York for 10c. (gold) per lb. A year ago, fibre equal to the sample, would have fetched 13c. (gold). The twisting of the fibre into slim-skeins was objected to as necessitating labour to undo the twisting. The form in which the fibre should be sent out was stated to be in what is called "handfuls," the end doubled so as to bale well and all the rest left loose. The price stated was conditional on the bulk being quite as good as the sample, and longer if possible. Machine-dressed New Zealand fibre (an average sample), was stated to be worth, in the New York mark, 8c. (currency) per lb., duty paid. The recent fall in the price of New Zealand fibre was mentioned; and the gentleman referred to said he knew enough of the English market to feel absolutely sure that that fall did not result from any operations or combination of large dealers in Manilla, but was the direct result of very much of what was shipped from the Colony being coarse and harsh and unclean—not at all fit to compete with Manilla. He expressed a strong hope that the Government would not for a moment entertain the idea that the reduced price resulted from anything but "natural causes." He also expressed a hope that ordinary discouragements would not check

the production of the fibre. Dealers and manufacturers, he said, knew exactly what Manilla was, and what they could do with it; and though such fibre as the Native-dressed sample would certainly make better rope, the recognition of that fact would probably be slow. Until Manilla was substantially displaced, its price would rule the prices of other fibres.

The various figures I have mentioned are given substantially as replies made to Mr. Fox's inquiries; but I am of opinion that fibre such as that prepared by the Natives might be used for other than purposes of rope-making, and so realize much more than ropemakers might be inclined to pay for it. Mr. Brown, to whom reference is made subsequently, expressed the opinion that fibre such as the sample shown him would readily realize £70 per ton.

Fibre Machines.

Inquiries respecting machines that might prove capable—either as now made or when modified—of dealing with the *Phormium tenax*, soon showed that all machines made for dressing Ramie might be passed over; that they are essentially flax-breakers, and therefore useless in New Zealand.

Three or four machines were found which, though designed for preparing the fibre of plants indigenous to Central and South America, have certainly some qualities which appear to make them likely to be successful in New Zealand; and of them descriptions are appended:—

Sanford's Machine.—Mr. G. Sanford, a member of the firm of Sanford and Malloy, 98, William Street, New York, has patented various flax breakers and dressers, as well as machines for dealing with plants of the Agave, Plantain, &c. class. His latest invention, which he regards as his best for the latter class, has not yet been much tried. This machine may be said to be comprised within a stout upright frame of wood, 8 feet high, 30 inches wide, and 18 inches deep. Two pulleys, of iron, 12 inches diameter, and 12 inches wide, are fixed near the ends of the frame; and they carry a vulcanized India-rubber band, also 12 inches wide, upon which are mounted brass scrapers, 12 inches apart, alternately smooth-edged and slightly serrated, the band having close against its inner surface stout planks. Against the front of the machine there is fitted another plank or door which is peculiarly hinged, and is also held in place by an iron bar, which on the unhinged end is held in place by a catch fitting into a racket. Under the centre of the bar, there is a stout pad of leather. Three or four horse power, applied to the machine by means of a pulley near its base, will, it is believed, drive the machine at a speed of 150 revolutions a minute. As at present constructed, the material to be dealt with will have to be fed through a slot at the top of the front plank or door, the door being opened the material slipped in, and then held in place by a simple hand-catch. The fibre will thus hang on the inside of the door, and in close contact with the scrapers. Mr. Sanford believes that the direct down-scrape will more effectually remove the surfaces of the leaf, than anything like a breaking or rotary scraping motion. The upper portion of the leaf or leaves to be submitted to a separate dressing. The arrangements connected with the fore-plank or door will, it is believed, combine with and help the action of the India-rubber band which carries the scrapers, prevent difficulty from and secure clean scraping, despite of inequalities in the thickness of material put into the machine; the attachments being such, that the door has a play upon the leather pad, against the iron bar, which allows the door to give slightly on either side. The door itself is adjustable by screws, so that the space between the inner face and the edges of the scrapers can be regulated. The machine has not yet been tested, as regards its productive powers. Mr. Sanford says that he should think it would clean 300 lbs. of fibre per day, the leaves of the plantain being the raw material. Mr. Sanford, in reply to an objection that the feed-arrangements were cumbrous, described a modification which he contemplates making if necessary, or if required. He would fit near the feed-slot a pulley or wheel with its edge grooved, and a driving band working in the groove. The wheel would be geared so as to travel slowly. A few leaves being put on the strap, would be caught by the wheel, allowed to hang ready for scraping, would travel slowly across the fore-plank, and would be delivered by the strap, so far as to be ready for removal by an attendant boy. Some of the present fittings of the fore-plank would be removed, and India-rubber springs substituted. The cost of the machine, as at present constructed is, $300 currency; with the "self-acting" feed it would be "$400 currency, at the outside"—delivery in New York being understood in each case.

A second machine, by Mr. Sanford, has become to some extent an article of commerce. A disc 6 feet in diameter, and of 2-inch plank, has, fixed upon each side, radiating scrapers of brass, 12 inches apart at the outer end, alternately smooth-edged and serrated. The wheel is fenced, so to speak, by two planks 6 feet by 18 inches. Each plank has a slit in its upper edge, into which the material is placed, and there held by a hand-brake. The boards are pressed home by a lever, operated on by the knee of the attendant, or attendants—for both sides of the disc are effective—and thus the force of the action of the scrapers is regulated. This double-action machine costs $300; a single-action machine, $250; and the power required is about the same as for the upright machine before described. Sixteen machines of the disc pattern have been made and sold, but they have mostly been sent to South America; and Mr. Sanford confesses that he has not received information such as to enable him to estimate their power of production. As to the quality of their work, he says he has no doubt. The machine has mainly been used for Sisal. This (Mr. Sanford says) is the fibre of a species of Century plant, there being a marked resemblance between the leaves, but the latter having an elasticity which the former has not. The Sisal leaf is "three-cornered," 5 inches or 6 inches wide near the tip, and somewhat like the blade of an oar near the butt, where it is 2½ inches in diameter. It requires to be flattened, by being passed between rollers, before it is submitted to the action of scrapers.

"Patrullo's Machine for Separating the Fibre of Tropical Plants," is made by Messrs. R. H. Allen and Co., of Water Street, New York, at their factory, corner of Jay Street and Plymouth Street, Brooklyn. A brief printed description, in English and in Spanish, is forwarded herewith. A frame of wood, 6 feet long, 3 feet 6 inches high, and 20 inches wide, carries on Bulbett metal journals a cast-iron wheel, 4 feet in diameter, with an 8-inch wide rim, on which are fixed eight smooth-edged brass scrapers, 1½ inch deep. Within the frame there is a quadrant of maple, which has a treadle

movement, with counterbalance weight, and several ingenious appliances for enabling the quadrant to be easily raised from its initial position, and to be brought home towards the wheel. Steam power is necessary, and the wheel is driven at 300 revolutions a minute. The material to be dealt with is dropped between the journal and the wheel, and its outer end fastened by a double-shaped toothed catch, at the same end of the machine. When it is dressed, so far as it has been within the action of the machine, it is lifted out and reversed, the catch being now turned up, so that its handle becomes a bolt, round which the dressed portion is twisted, and held until the dressing is complete. The appliance shown in the engraving at the upper edge of the end of the machine, is not now used. The quality of the work done by this machine depends upon the regulation (by the treadle motion) of the position of the quadrant. It is admitted, of course, that it is easy to bring the quadrant up so sharply and closely that the scrapers become cutters, and would instantly cut through any fibre-yielding leaf but it is said that practically the regulation of the quadrant, so as to produce good work, is easy and (with the slightest care) certain. The quantity of dressed fibre which the machine will turn out, a man and a boy being required, is stated at 300 lbs. per day. The cost is $350, and the machine, as boxed for shipment, necessarily makes at least two bulky and heavy packages.

The samples of fibre, A, B, O, C, sent herewith, were dressed by this machine. A, is the product of the leaf sent with the fibre, and which is believed to be *Agave Sisilana*. The fibre, it is stated, has not been washed or otherwise dealt with since it left the machine. B is also accompanied by a sample of the raw material—*Agave Mexicana;* and C is the product of a great flabby fleshy leaf, believed to be of *Agave Virginica*.

The separate parcel of fibres forwarded was supplied by a gentleman named Brown, of the firm of H. A. Kruger and Co., of this city. He has taken, and is taking, very great interest in the question of utilizing the fibrous productions of Central America. It appears there are a great variety of fibrous plants and woods there, and a very large interest is taken in giving them commercial value. I gathered from Mr. Brown that these fibres were not so strong as our New Zealand flax; and that no machine yet employed has been sufficiently successful, although a considerable quantity of fibre still finds its way to market. In the case of Central America, as in New Zealand, the best fibre is produced by the Natives. Mr. Brown appears to be devoting both time and expenditure in investigating the subject, and I think it would be worth while for us to endeavour to arrange for a regular correspondence between him and the Commissioners.

In conclusion, I must express the opinion that it is an unfortunate error that we should have adopted the habit of speaking of the *Phormium tenax* fibre as "flax." The term is apt to create misapprehension; and as regards America, the term tends to excite the opposition of flax-growers to a reduction of the duty.

8th March, 1871. JULIUS VOGEL.

White Rope.

Several large makers of rope have been asked respecting the manufacture of "White Rope." In every case, the reply has been that probably what was meant was untarred rope of Russian hemp; and in every case, also, it has been stated that there are not any peculiarities in the manufacture of that rope. "We turn it all off the same machines, whether tarred afterwards or not;" "There is nothing to tell you—rope-making is pretty much the same all the world over;" and "Its made like any other rope," substantially represent the answers to questions as to the manufacture. Each manufacturer consulted said that whale oil was used—"just enough to make the hemp lay well."

J. VOGEL.

(No. 45.)—The Hon. Colonel HAULTAIN to the Hon. Mr. VOGEL.—2nd March, 1871.

Dr. Hector requests me to answer your letter of 26th January, written at Honolulu, as he would not reach Wellington in time to do so himself. . . . . As you offer to assist the Flax Commissioners in obtaining information on any matters that they think desirable, I would suggest that you should obtain from machine-makers, both in England and America, specifications and cost of machinery and plant for manufacturing rope, scrim-cloth, wool-packs, sacks, &c., and printing and packing paper; also statements of the number of hands required to keep each machine at full work, and of the quantity of the manufactured articles that can be produced within a given time.

It is also desirable that we should ascertain the nature of the "sea-damage" to which so many of our flax shipments are subject. Is it discoloration from steam or contact with dirt or iron, or from want of proper covering? What effect has it on the value of the flax? How can it best be avoided? What would be the best size and weight of our bales?

What are the maximum and minimum lengths of fibre used for rope-making and spinning purposes?

The opinion of a professional "sorter" would be useful on some of these points. We shall be glad to get as soon as possible copies of the reports of the competition for the prizes offered by the East Indian Government for the best machines to prepare the Rheea fibre, and of any publications you may obtain that refer to the dressing of Manilla hemp. It is the intention of the Commissioners to have some of the flax they send home made up into fabrics, but they have not been able to get any ready for shipment yet. You would be able to procure "fair average samples" of flax from any of the agents who receive it from New Zealand, and fresh leaves can be obtained from Kew.

We shall not be able to get any quantity (not even a ton) of the fine Native-dressed fibre of which you took home samples. It can only be procured from the young and unblemished leaves of the finer varieties of the plant, and the time expended in separating every particle of "scull" is so

great that a Native cannot dress more than two or three pounds weight in a day; and at that rate they could not earn anything like a sufficient sum to induce them to set steadily to work at its preparation. We shall never get it until the finer kinds are largely cultivated, and some quick process of cleaning it has been discovered.

(No. 101.)—CHAIRMAN to Mr. RALSTON, Bank of California, San Francisco.—10th June, 1871.

I have the honor to inform you that, at the request of the Hon. Mr. Vogel, I have forwarded to your address, by the mail which carries this, sixty-two plants of the Manunu, and others of the best varieties of the *Phormium tenax* (New Zealand Flax). They should be planted in a deep moist loam, and if possible by the side of a running stream.

A sample bale of flax, as ordinarily dressed in the Colony, is also forwarded to you, and the Commissioners will feel much obliged by your distributing it among manufactures and others who may take an interest in the subject.

(No. 63.)—CHAIRMAN to Mr. MORRISON.—23rd March, 1871.

The New Zealand Flax Commissioners are desirous of obtaining, for an Exhibition that is to be held at Wellington during the next Session of the General Assembly, a series of samples of all articles (except rope) manufactured from the fibre of the *Phormium tenax*, and I beg that you will be so good as to forward, as soon as you can conveniently procure them, small specimens of all such fabrics as can be transmitted through the Post Office.

(No. 141.)—W. RALSTON, Esq., Bank of California, San Francisco, to the CHAIRMAN.—19th July, 1871.

I have the honor to acknowledge your letter of 10th ultimo, advising that you had shipped to my address, at the request of the Hon. Mr. Vogel, sixty-two plants of the best varieties of New Zealand flax; also, a sample bale of flax, as ordinarily dressed in the Colony, which you desire should be distributed among manufacturers and other parties who may take an interest in the subject.

Allow me to thank you, on behalf of our people, for this manifestation of a wise and liberal policy, and to assure you of the great pleasure I shall take in complying with your request. I hope that by this means a market may be opened with us for your valuable product, and that the culture of it may be initiated on this coast.

As soon as the packages have passed through the hands of our Revenue Officers, I shall take charge of them, and attend carefully to your suggestions.

(No. 133.)—Mr. MORRISON to the CHAIRMAN.—16th June, 1871.

It is difficult, next to impossible, to comply with the request you officially made, for specimens of all articles manufactured from New Zealand flax.

The brokers who deal in the article, and should know the use it is put to, cannot get hold of any, inasmuch as the fibre is not manufactured into any article except rope. To mix with other materials it is used in making paper, but the quantity made use of is so small that paper made from the mixture cannot be said to be made from *Phormium tenax*. I am trying to get samples of the produce. I believe for paper making it will be, in time, more extensively used than it will be for ordinary purposes. It will not, so I am told, spin.

In the *Lyttelton Times*, of 3rd March last, there was an account from a Mr. Jones, who represented that shirts had been made from the flax, and that the officers of the 65th and 48th Regiments, stationed at Woolwich, used none other. This is, I believe, an imaginary account. I know, for a fact, that the regiment were never stationed at Woolwich, but as the Controller of the Royal Arsenal has privately undertaken to ascertain more about it, I may be in a position to tell you in my next the result of his enquiries.

Should you happen to have any seeds of the different kinds of flax, I would be greatly obliged if you would send me, by post, a little of each kind. I want to grow them, and see if they will do in the open air at my residence at Huntingdonshire; besides, being so often applied to for green leaves, I should like to cultivate some and have it in my power to furnish specimens of the leaf in its green state.

(No. 142.)—Mr. MORRISON to the CHAIRMAN.—29th June, 1871.

I have the honor to acknowledge receipt of your letter No. 63, of 23rd March last, directing me to procure and forward samples of all articles (except rope) manufactured from the fibre of the *Phormium tenax*.

In reply, I beg to acquaint you that I have made extensive inquiries on the subject, but have been unable to ascertain that any articles, with the exception of rope, are manufactured from New Zealand flax.

I enclose herewith copies of letters received from the following firms in reply to my inquiries, viz.:—

(1.) From Mr. C. Thorne, of 16 Mark Lane; letters dated 7th and 13th June, 1871, with printed circular attached.

(2.) Messrs. Manning, Collyer, & Co., of 141 Fenchurch-street, dated 14th June, 1871.

(3.) Mr. P. Carmichael (of Baxter Brothers) of Dens Works, Dundee, dated 13th June, 1871, and enclosing small specimens of yarn and cloth made from New Zealand flax in 1850.
(4). Messrs. G. & J. A. Noble, of George Yard, dated 28th June, 1871, and enclosing two small samples of paper made from the New Zealand flax five years ago.

All of the above-named are interested in the New Zealand flax, but they are unaware of its being used in the manufacture of cloth fabrics.

Immediately I am informed of the results of the experiments referred to by Mr. C. Thorne and Messrs. G. & J. A Noble, the same will be communicated to you.

DEAR SIR,— 16 Mark Lane, London, E.C., 7th June, 1871.

In reply to your letter of the 5th June, I do not know of any articles having been made from the *Phormium tenax* of late years, with the exception of rope. Some long time back Messrs. Baxter Brothers, of Dundee, manufactured some of the Native dressed New Zealand flax into cloth, and my friend, Mr. Robert Marshall, learned a few weeks back in conversation with Mr. Carmichael (one of the principals of the firm), that the cloth so made did not wear satisfactorily. I have had some dry leaves carefully worked, from which fibre similar to the accompanying sample has been prepared, and in December last, I sent about 6 cwt. to a friend of mine in Dundee, who is acquainted with some of the leading spinners. He showed the sample to them, and in his letter to me of 9th December, 1870, he states, "all the parties I have shown the samples to, admire the way the fibre has been treated; but declare they could not use it for their fine Nos. of yarns. I have already been refused by two of our best spinners on this ground." After this he succeeded in getting a firm at Arbroath to try it, and on 9th February sent me spinners report as under:—

"I have just got in report on the New Zealand flax as follows: 'Sample of New Zealand flax, coarse long fibre; oiled and softened 17 lbs., then hackled it hard over first and fine tools. It appeared worse after softening, and the tow is very nappie. Gave 165 lbs. drest into the mill, and got through preparing process to roving without difficulty. When the roves were put in the spinning frame it would not spin at all, being too long for the largest reach of frames we have, and too hard to draw. The frames were altered every conceivable way, but could not get it to spin; it might be got to spin if machinery were made purposely for it, all preparing and spinning frames very strong and long in the reach. It seems of that nature of material, that the fibres will not draw out of each other as flax does, it breaks rather; so that it is doubtful whether it could be spun at all, even with strong machinery and long reach. It appears more suitable for hard spinning or being used at rope works."

I have lately heard that my friend is still urging forward further experiments, that he hopes before long to be able to send me further particulars. I am now preparing another quantity of 2 cwt., which some London friends have promised to forward to their correspondents in Dundee, who think (from the sample) they will be able to manufacture some kind of fine duck or canvass from it for me; this lot will be sent to Dundee early next week.

The rope I have had made, from fibre dressed by the process in which I am interested, appears to have proved a great success. It has been tested in various ways, the most severe trial was on board Messrs. J. Willis & Sons ship "White Adder," for Bombay, where the rope was used as "Burton falls" in lowering over 700 tons iron rails besides other cargo. At the termination of the vessels lading the rope was but little chafed, and remained strong and useful for other purposes. Many other vessels have my rope in use. Messrs. Shaw, Savill & Co.'s overlooker, Captain Scott, and Messrs. Liston, Young, & Co.'s overlooker, Captain Manning, speak highly of the manner in which it wears. I handed to one of the gentlemen in your office, yesterday, a copy of some reports which may prove interesting to you, more especially the one of Mr. Nickel's the analytical chemist, as it shows the difficulty heretofore existing in getting rid of the gummy matter has been overcome. The samples to which he refers were taken from some *Phormium tenax* prepared by Messrs. Miles & Co., in Canterbury, New Zealand.

If I am successful in my endeavours to obtain a fabric from my fibre, I shall be pleased to communicate the particulars to you, and also to forward you samples, in the meantime.

I have, &c.,

John Morrison, Esq. C. THORNE.

DEAR SIR,— 16, Mark Lane, E.C., London, 13th June, 1871.

As you are aware that one of the great objections raised against the use of the New Zealand flax fibre, for sea-going rope, was its supposed tendency to rot when subjected to the action of salt water, it may be gratifying to you to learn that when the fibre has been properly prepared this objection no longer exists. The letter, of which I annex a copy, was received by me from Messrs. E. Shelton and Co., this afternoon, and I think it may prove interesting to your friends who are collecting information regarding *Phormium tenax* and its uses.

I have, &c.,

John Morrison, Esq., New Zealand Government Agent. C. THORNE.

P.S.—The rope referred to is that named to you in my letter of 21st February, 1871.—C.T.

DEAR SIR,— 34, Lime Street, London, 13th June, 1871.

By the mail which has just arrived from Belize we have a letter from Captain Shaw, the master of our vessel the "Sheffield," and in it he alludes to the rope which we purchased from you in the following terms:—

"The white rope sent on board of the "Sheffield," in London, has been well tested, as we have had it in use for taking in 360 logs of mahogany, some of them three and four tons weight, besides using it for winch ropes in the hold. I consider it superior rope to any we have had on former voyages that we have used for the same work."

The test which rope undergoes in loading a cargo of mahogany at Belize is really very severe indeed. The rafting lies constantly submerged in salt water during the night, and in the day exposed

to the scorching heat of the sun; and when the weight and size of the logs are taken into consideration, and that they have to be hauled through the surf a distance of some four miles, we should think that such a test of the quality of the rope could scarcely be exceeded. We therefore think you have every reason to be satisfied with the report which Captain Shaw makes upon yours.

We have, &c.,

C. Thorne, Esq., 16, Mark Lane. EDWD. SHELTON AND CO.

DEAR SIR,— George Yard, Lombard Street, London, E.C., 28th June, 1371.

We have been making inquiries respecting the use of New Zealand flax, and we do not find it is put to any other purpose at present than rope making; we hardly expected to find it employed in any cloth fabric. Some five years ago a small quantity was tried in paper making, and we have the pleasure to enclose you two small samples of the paper made.

We have been giving off some small parcels of the tow for mixing with paper material, but have not heard the result.

We have, &c.,

John Morrison, Esq. G. AND J. A. NOBLE.

SIR,— Dens Works, Dundee, 13th June, 1871.

In reply to your letter of 6th current, regarding the New Zealand flax, I experimented a good deal with it in 1850, and have still some small quantities of the yarn and cloth made at that time, samples of which I enclose.

My opinion is that it is not suitable for fine fabrics of cloth, and for common purposes it would have to compete with jute, which is much more easy to manipulate.

I have, &c.,

John Morrison, Esq. PETER CARMICHAEL.

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141 Fenchurch Street,

DEAR SIR,— London, E.C., 14th June, 1871.

Referring to your favor of the 5th instant, we have been unable to ascertain anything reliable about other articles than rope, as being manufactured from New Zealand flax. Several experiments are in progress, but nothing of commercial importance has yet been done.

There is a strong impression that the flax lately imported in large quantities, and the quality formerly imported, and now called Native dressed, are from a distinct species of plant. Can you tell us how this is?

Yours truly,

John Morrison, Esq., MANNING, COLLYER AND CO.

(No. 143.)—Hon. J. VOGEL to Hon. COLONIAL SECRETARY.—London, 16th June, 1871.

I forward to you, herewith, a report by Mr. E. Fox, as to the three machines for preparing hemp, flax, &c., which he has inspected in Yorkshire.

The report will, I hope, be of interest to the Flax Commissioners.

SIR,— Charing Cross Hotel, London, 16th June, 1871.

I beg to report that, as instructed by you, I have visited Leeds, for the purpose of seeing Collyer's machine for preparing hemp, flax, &c., respecting which a circular was handed to you in New Zealand by Dr. Hector, on behalf of the Flax Commissioners.

I have the honor to present to you herewith, a general description of that machine; and also of others shown to me, or which I was aided to see by Mr. Lawson, the head of the firm of Messrs. L. Lawson and Sons.

The samples referred to in the course of the descriptions cannot be sent by post, and I will, therefore, myself convey them to New Zealand.

I have, &c.,

Hon. J. Vogel, &c., &c. E. FOX.

MACHINERY FOR DRESSING HEMP, FLAX, &C., INSPECTED AT LEEDS AND HALIFAX.

1. *Collyer's Machine.*

2. *Lawson's Machine, with Fiskin's Motion.*

3. *Hodgkins's Machine.*

All these machines are made by Messrs. L. Lawson and Sons, of Hope Foundry, Mabgate, Leeds. The establishment is one of the largest for making machines for dealing with hemp, flax, jute and other fibres, if not the largest in the world; opinion in Leeds being divided as to whether it or that of Messrs. Fairbairn, Kennedy, and Naylor should be regarded as pre-eminent. Messrs. Lawson were employing about 1,000 hands when I visited their place, but 1,500 or 1,600 are needed for full work.

The three machines mentioned are essentially alike in principle; and each was evidently designed as an improved "break" for flax and hemp, and also, probably, as a "softener" of those and other fibres. The principal duty of a "break" is to crush the woody substance on the outside of which, as part of the bark or skin, or immediately underneath it, the fibre lies. The purpose of all such machines may therefore be said to be the opposite of that which has been kept in view in most, or all, of the New Zealand made machines for dealing with *Phormium tenax*, namely, to cut or scrape off the covering of the fibre.

The principle of the three machines is that known as the "reciprocating rotary motion," and the action of each is by a *backward* and *forward* motion of cylinders or rollers—the former being in excess

of the latter—to subject the stems, or the fibre, dealt with, to a nibbing as well as a crushing process. In details, the machines are very different.

1. *Collyer's Machine* has a cylinder, 30-inch diameter, set horizontally in a frame; and into the coarse flutings of the cylinder, the like flutings of four rollers, each 7-inch diameter, are geared. The rollers are fixed in a quadrantal frame, and secured by strong spiral springs, each held by a screw. Thus, free play, to accommodate inequalities of thickness in the substance passed through, is secured, without a loss of effective pressure in any part.* The machine is somewhat complicated in its motive portions; and it does not seem strongly designed. But I saw the first that was made, and there have been slight modifications of details. The roller frame is supported by a rocker; and, by a motion exactly similar to that first used in Whitworth's "shaping" machine, a crank is acted on, and a "quick return" is given to the frame, instead of its being allowed an "equal throw" in each direction. The frame and the cylinder thus work six inches forward and four inches backward, thence the reciprocating or rubbing action. The cost of the machine is £110, and a common scutcher would cost £15 more. A man to feed, and a boy to receive the fibre, are usually employed, or two lads can do the work. Of hemp, such as the sample marked A, the machine will produce from 25 cwt. to 30 cwt. per day of ten hours; and each machine used requires about one horse-power to drive it. As possibly affecting the appearance of sample A, it must be added that the machine was not driven as quickly as it should have been, the gearing having been affixed hastily, in order that the action of the machine might be shown. The sample was only lightly shaken before being wrapped up.

2. *Lawson's Machine with Fiskin's Motion,*—The principal motion of this machine was invented by the Rev. Mr. Fiskin, a Presbyterian minister in Leeds; but he failed to get it into practical shape, and he consequently consulted Mr. Lawson, who improved its arrangement and designed the machine. There is not a central cylinder used in this case; but there are six pairs of rollers, or an upper and a lower set, each of six, their diameter being 4½ inches, and the fluting being finer than in Collyer's machine. The rollers are set in a segmental frame, and held by highly tempered spiral springs, fastened by screw-heads. It is not easy to describe Fiskin's motion technically. In general language, it may be said that a toothed wheel is set within a rim, upon the inner edge of which teeth are cut. By means of an eccentric driven by a crank shaft, there is secured an alteration of motion; the wheel being thrown into and out of gear with the toothed rim; both having a forward motion while the gearing continues, but the wheel remaining stationary while out of gear, and the rim having a backward motion during that period. Thus, the reciprocating action of the pair of rollers is secured. The following advantages over Collyer's machine (and also over Hodgkins's) are claimed:—(1.) There not being a central cylinder, refuse can fall away freely, thus avoiding risk of clogging.—(2.) If desired, the fluting of the pairs of rollers might be graduated, the finest being on the delivery side, so that while there would not be difficulty in feeding, the fibre would, before delivery, be subjected to sharper, or intensified, action.—(.3) The forward throw of the machine as now made is 5 inches, and the backward throw 3 inches; but an alteration of one shaft only would enable the backward throw to be made greater, and thus a more prolonged action on the fibre would be secured. The cost of the machine is £110, without scutcher; and it requires the same attendance and power as Collyer's. It can, however, be driven much faster than (it is said) would be possible with Collyer's, and, with the same material would, with the present proportions of the throws, produce proportionately more fibre. Sample B. is fibre of Italian hemp, the stalks being taken from the same bundle as those used with Collyer's machine. This sample was lightly shaken before being packed.

3. *Hodgkins's Machine.*—This struck me as about a medium between the two already described. I was unable to see it in Leeds, but I saw it on the premises of the Yorkshire Fibre Company, Balne Lane, Wakefield. There, however, it was being used for softening the fibre of China grass; and the Company have never used it for any other purpose. The machine has a central cylinder; with six medium-fluted rollers in a frame above it, each held by a spiral spring. By a simple arrangement, a rocking (or backward and forward) motion is given to the cylinder, into the flutings of which those of the rollers are geared. There is a travelling platform for feeding and delivering. The machine can be worked at a high speed, and seems substantial. Its cost is £110 or £120.

This machine, as a "softener," has answered excellently, except that it sometimes fails effectively to deal with the ends of the fibre. In twelve months it saved its cost, as compared with what had been paid to boys and girls for "beating" the fibre by hand.

Has the "softening process" ever been applied to New Zealand flax? Is it likely, if the process was adopted, that the added market value of the fibre would be less than the added cost?

It is difficult to form an opinion whether the machines now described, or any of them, would prepare the fibre from the leaves of *Phormium tenax*. I think that the principle of the machines is a good one for the purpose; but I am not aware whether it has, in any form, been tried. I have not had an opportunity of seeing Booth's machine. If the principle is applicable, I believe that Lawson's machine with Fiskins's motion, or Hodgkins's machine, would do better than Collyer's, in the form in which I saw it; but the last-named, I feel sure, would do good work with flax proper, hemp, &c.

Samples of the China grass fibre, in its several stages, were given to me by Mr. Christian Berridge, the manager of the Yorkshire Fibre Company's works. They are interesting, and they will be taken to the Colony for the Flax Commissioners, or Dr. Hector.

In conversation with Mr. Berridge, I learned that the Company, some time ago, submitted New Zealand flax to their process, which includes steeping in a very strong chemical mixture, and that they found it useless for their particular purposes. In fact, Mr. Berridge said it became mere "pulpy stuff." Mr. Berridge showed me, as lumber, two or three bales of what was originally a good average sample of the flax. He said that while the Company was a limited liability Company, some shareholder caused the flax to be consigned for trial, with the result stated, and the bulk of what was

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* Mr. Lawson has used vulcanised india-rubber journals and bearings; but he has now discarded them, as being certainly inferior to springs.

consigned has since lain useless. Desiring to know something more respecting the "pulping" of the fibre, on my return to London I sent to Mr. Berridge a small sample of the Native-dressed *Phormium tenax*, and I asked whether he thought such fibre would be useful to the Company. Mr. Berridge has replied that he will pass the sample "through with the next tank," and will inform me of the result.

London, 15th June, 1871. E. Fox.

(No. 124.)—R. Christie & Co. to Chairman.—London, 8th June, 1871.

Your note of 16th March duly arrived, and in compliance with your wishes we have by this post sent you the Board of Trade tables, which show for the years 1868, 1869, 1870 and also for the first quarters of 1871, the fullest information to be obtained in quantities, and also in values, of all fibres imported from abroad under the names of flax, jute, and hemp, also the quantities and values exported, both of the raw material and manufactured goods. We also enclose you copy of a letter to the Hon. Julius Vogel on the subject of New Zealand flax. We think you should send seed of the flax over here to be sown, and then when green and in good condition have the leaves subjected to various processes for freeing the fibre from the gum and probably success would be arrived at. A fibre as white, soft and silky as the Natives produce, if in quantity, and 6 feet in length, would readily fetch here, £60 to £70 per ton.

Dear Sir,— 4, Sermon Lane, St. Paul's, London, 6th June, 1871.

As promised we have used every endeavour to induce manufacturers to make the attempt of spinning and weaving the New Zealand flax into corn sacks, woolpacks, Forfar sheetings, Hessians, and other low class goods, but have not succeeded in one single instance. In order to give the fibre a fair trial we proposed that the manufacturer should go into the market, and himself select whichever kind of New Zealand flax would suit his purposes best, of course purchasing the smallest quantity compatible with the object in view, then spin and weave it into any kind of cloth considered most suitable; then have it sold on our account and we would defray any loss which there might be on the transaction after compensating the manufacturer for his time and trouble, &c., &c. This offer, which we intended to be a liberal one, was made to several of the highest makers in various classes of goods, and each one states that they have never yet seen any New Zealand flax which could be considered capable of being spun into yarns at all, and consequently it could not be woven into any kind of cloth.

We applied to Messrs. Miles Brothers & Co., to give to us, or rather to you, the name and address of the purchaser of their flax, when it came over in the reed; and they stated that your name has been mentioned in their letters from New Zealand as having introductions to them, and that they would confer with you personally upon your calling.

By the last mail we have an application from James Hector, Esq., Chairman of the New Zealand Flax Commission, dated 16th March, Wellington, for full statistical information as to the supply and consumption of all fibres with which the New Zealand flax can compete, and we are forwarding by the outgoing mail the Boarn of Trade tables and any other documentary evidence that we may be in the meantime able to procure; but we feel convinced that attention should be paid to the preparation of the flax upon the spot where grown, so as effectually to get rid of all the growing matter under the most favourable circumstances. Scientific aid may be needful for this, but until this is accomplished the hopes and expectations of any benefit to be derived from New Zealand flax must be very limited. Could the flax be grown in England, and then be treated more successfully here than in the Colony, so as to attain the desired result? If so, this seems to us to be the quickest way of realising what benefits will accrue to New Zealand from the cultivation of this plant.

We have, &c.,

The Hon. Julius Vogel. Robt. Christie & Co.

III.—REWARDS AND EXHIBITION.

(No. 19)—Chairman to the Hon. Colonial Secretary.—5th December, 1870.

Although the question of offering rewards for the manufacture of a certain number of corn sacks, wool, or gunny bags, as directed by the resolution of the House of Representatives, has not been directly remitted to the Flax Commissioners by the terms of His Excellency's Commission, and does not indeed come within the limit of the funds placed at their disposal; yet, they deem it a matter of sufficient importance to justify their urging it upon the special consideration of the Government; and, if any funds can be made available for this purpose other than the £1,000 voted for the expenses of the Commission, they would recommend that a reward of at least £200 should be offered to the first person who shall manufacture within the Colony, from New Zealand flax, either 20,000 corn sacks, or 5,000 wool, or 20,000 gunny bags

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[Extract from Gazette.—3rd February, 1871.]

Colonial Secretary's Office,
Wellington, 3rd February, 1871.

In compliance with recommendations contained in the reports of the Flax Commission Committee * * * that the development of certain industrial pursuits would often be best promoted by

the offer of a bonus on production, the following rewards are offered. subject to the undermentioned conditions :—

* * * * * * * *

To any person or persons who shall manufacture, within the Colony, from New Zealand Flax—

For the first 500 reams of printing paper, a sum of £400; and a further sum of £250 for the first 500 reams of packing paper; and the like sum for the first 10,000 yards of scrim cloth, suitable for covering flax bales.

Conditions.

The required quantity of each article to be completed before the 30th June, 1872.

The weight of each ream of printing paper to be not less than 30 lbs; of each ream of packing paper, not less than 40 lbs ; and of each piece of scrim cloth, of 100 yards in length, and double width, not less than 30 lbs.

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

W. Gisborne.

(No. 21.)—Chaiman to the Hon. the Colonial Secretary.—8th December, 1870.

Referring to the 8th Resolution of the House of Representatives, affirming the desirability of exhibiting samples of flax in Wellington during the next Session of the Assembly, the Commissioners beg to recommend that the Government should request Superintendents of Provinces to procure samples for this purpose, and would suggest that a notice to the following effect should be inserted in the General and Provincial Government *Gazettes* :—" The House of Representatives having resolved that there should be an Exhibition in Wellington, during the next session of the Assembly, of all varieties of flax fibre prepared in the Colony, manufacturers are invited to forward to the Flax Commissioners through the Superintendent of their Province, samples of the fibre, ropes and sackings, or any other material prepared by them from the New Zealand flax. The samples of fibre should not be less than twenty pounds in weight, and ten or fifteen fathoms of each kind of rope will be sufficient. It is desirable that a statement of the processes and estimated cost of manufacture should accompany the samples."

(No. 18.)—Under Secretary to Chairman.—26th December, 1870.

I have the honor, by direction of Mr. Gisborne, to acknowledge the receipt of your letter No. 21, of the 8th instant, and to inform you that a copy thereof has been forwarded to the Superintendents of Provinces and to the Chairman of the County Council of Westland, with a request that they will concur in the suggestions contained therein.

The notice embodied in your letter will be inserted in the *New Zealand Gazette.*

(No. 53)—Chairman to Mr. W. K. Hulke, New Plymouth.—16th March, 1871.

A part of the duty that devolves on the Flax Commissioners is the collection of samples of all kinds of flax fibre, and of articles manufactured from it, to be exhibited at Wellington during the next session of the General Assembly. They are aware that you have in your possession a small collection of Native dressed and other fibre that is of considerable interest, especially in showing the value that has been placed upon the flax of different qualities in England, and that you also have a series of plants in pots of the varieties most esteemed by the Natives. May I request that you will kindly allow them to be included in the Wellington Exhibition? If you consent, I will arrange for their transmission by the " Luna " or other steamer, and will undertake that they are properly looked after, and duly returned to you at the termination of the session.

(No. 62).—Chairman to the Hon. Secretary Canterbury Flax Association.—21st March, 1871.

The Flax Commissioners are required by the resolutions of the House of Assembly, amongst other things, to collect samples of all varieties of flax fibre, &c., for exhibition at Wellington during the next Session of the General Assembly ; and are desirous that as complete a series as possible of the fibre, and of all articles manufactured from it, should be got together.

Every locality has probably some special modification or variety in the process of manufacture and improvements that have not hitherto been made known or adopted elsewhere in the Colony, and the collecting of these in one place for inspection, comment, and comparison will be a means of affording much information as to the progress that is being made in this industry, and will offer valuable suggestions not only to those who have the opportunity of inspecting them, but, by a descriptive catalogue, will be of service to all interested in the pursuit.

The Commissioners, therefore, have no hesitation in applying to the Canterbury Society for assistance in this matter, and request that you will be so good as to inform them whether they may calculate on the loan of such specimens and samples as have been collected by the Association.

If these will be lent for the purpose of exhibition, arrangements will be made in due time for their transport to Wellington, and I should be glad if you will inform me at once what space would be required for them.

Samples of all flax exported from the Colony are easily procured, and will be of considerable interest, and arrangements are being made to secure them from the other ports. May I request that you will obtain these at Lyttelton for the Commissioners, who will be glad to defray any small expense that may be incurred.

(No. 43.)—Hon. Secretary Canterbury Flax Association to Chairman Flax Commission.—April 13, 1871.

I have the honor to acknowledge receipt of your letter No. 62, of the 21st ultimo, applying to this Association for assistance in collecting samples of flax fibre, &c., for exhibition at Wellington during the next Session of the General Assembly, and, in reply, I beg to state that the Committee have anticipated the wishes of the Flax Commission in the matter by advertising for samples to be sent into the rooms of the Association, for transmission to Wellington, not later than the 17th May next. The Committee will only be too happy to afford the Flax Commission every assistance in their power in successfully carrying out so laudable an object, if the Flax Commission will from time to time make known its wishes on the subject.

(No. 58.)—Circular Letter from Chairman to Messrs. Cargill and McLean, Dunedin; Messrs. Kinross and Co., Napier; Messrs. Bates, Sise, and Co., Dunedin; Mr. E. C. Quick, Dunedin.—20th March, 1871.

The Flax Commissioners are desirous of obtaining specimens of the different kinds of *Phormium* fibre that are exported from the Colony for the flax exhibition which is to take place at Wellington during the next session of the General Assembly, and are making arrangements for procuring those from the different shipping ports.

May I request your assistance in securing a small sample, with full particulars attached, say a single hank, from each parcel that is shipped at Dunedin. I believe this may be done without difficulty, and the Commissioners will be glad to defray any expense that you may incur for this purpose.

(No. 53.)—Circular Letter from Chairman to Major Mair, R.M. Opotiki; Mr. Barstow, R.M., Bay of Islands; Mr. Buller, R.M., Wanganni; Mr. Parris, C.C., Taranaki; Mr. Campbell, R.M., Waiapu; Mr. Woon, R.M., Wanganui River.—21st March, 1871.

It was determined by the House of Representatives during the last session of the General Assembly that Flax Commissioners should be appointed to carry out certain Resolutions with reference to the flax industry; and amongst other things it was directed that there should be an exhibition of all varieties of flax fibre prepared in the Colony and in England. In furtherance of this object the Commissioners are desirous of collecting from the Natives specimens of all articles which they make from the flax, and request your assistance in procuring these things from the district in which you reside.

As the funds at their disposal are not large, they must limit you to an expenditure of £5, which sum is now enclosed to you. Of course it is not intended that such things as the paipairoa, kaitaka, or other costly mats should be purchased, but I give below a list of articles, amongst others that you may be able to get, that should if possible be represented:—

Single specimens of rough capes or mats, such as taupo, pureki, pake, or ngeri; floor mats and sleeping mats; thread, twine, cord, lines, ropes; baskets or kits of various patterns; fishing nets and lines, and eel traps; sails; samples of prepared flax showing the various dyes used by the Natives, and of the bark or other dyeing material.

The Commissioners think it likely that there may be valuable mats and other things made from flax in possession of Native chiefs which they would be willing to lend for the purpose of exhibition; they beg that you will use your influence to obtain these, and you may inform the owners that every care will be taken of their property, which will be duly returned to them when the session has terminated.

P.S.—A list of the varieties of flax that are cultivated by the Natives in your district, and of the particular uses to which they are severally applied, is much desired.

(No. 72.)—Chairman to the Hon. the Colonial Secretary.—27th March, 1871.

The Flax Commissioners think it desirable to bring again under the notice of Government, the question of an Exhibition at Wellington, during the next session of the Assembly, of all varieties of flax fibre prepared in the Colony and in England, as recommended by the House of Representatives in one of their resolutions of the 3rd September, 1870, and which Exhibition will be necessary to illustrate the experiments they are now making, and to show the general progress of the industry.

There has been already published by the Government, in a *Gazette*, a notice (which by mistake was printed with my signature) which was drafted by the Commissioners for your consideration, inviting manufacturers to forward, through the Superintendents of their Provinces, specimens of fibre and of all articles prepared from it.

The Commissioners, in furtherance of the action thus taken by the Government, have also requested a number of official and other persons to assist them in procuring samples of textile fabrics from England—of all flax exported from the Colony—and complete series of specimens of Native manufactures, and are incurring some expense in promoting these objects.

They further think it desirable that various machines now used in the Colony for stripping and preparing the fibre, should be represented at the Exhibition; but all this will require considerable space, and they have no room or building in which the numerous articles they expect to receive can be arranged so as to afford information to those interested, or even to be accessible to the members of the Legislature.

I have therefore the honor to lay these matters before you, in order that some place may be fixed upon with as little delay as possible.

(No. 110.)—Mr. Barstow, R.M., Bay of Islands, to Chairman.—15th July, 1871.

I regret having to inform you that as yet I have not succeeded in obtaining even a single article for the Flax Exhibition, though, both personally and by letter, I have applied to the leading settlers and Native chiefs. As far as mats are concerned, Ngapuhi have ceased for so many years to be a mat wearing tribe, that they no longer possess any. Three women who had promised to complete for me kits, and two "Taupos" which they had previously commenced, have, owing to sickness, discontinued their work. Of the three, one is now dangerously ill, another has lost a daughter, and the third is just recovering from a fever which carried off a sister. I believe that Ngapuhi are backward in the cause moreover through pride, being conscious that they would make but a sorry show in the "Muka" way in comparison with the Southern tribes.

Under these circumstances I have thought it advisable to return the money (five pounds) sent by you to me, but will nevertheless try still to procure something for the Exhibition.

I regret that I cannot even send my own mats, as these have been sent with my other goods and chattels to Auckland, in anticipation of shortly removing thither myself, and cannot be readily unpacked.

IV.—NATIVE DRESSED FLAX.

(No. 15.)—John Kebbell, Esq., to Mr. Thomas Bevan, Otaki.—22nd November, 1870.

At a meeting of the Flax Commissioners it was determined to obtain one ton of flax, Maori dressed, for the purpose of experiment. I was authorised to make an arrangement with you for the supply. For what sum will you contract to supply one ton of Maori flax, to be delivered dry in Wellington, the flax to be of the best quality, such as used to be obtained many years ago in the early days of your spinning at the Manawatu; a sample to be sent with answer. There is another condition of the contract which is most important that you should personally ascertain, so as to verify to the Commission, if required, the weight and length of green leaf, in order that the proportion of dressed fibre may be ascertained. Also, for what sum you would engage to deliver one ton, such as sample enclosed, subject to the same conditions as the one ton above.

Note.—The Natives refuse to prepare any flax, according to the sample, for less than 1s. per lb.

Circular addressed to Natives by the Native Minister.

To———— Wellington, 26th September, 1870.

Friend, Salutations to you. The time has now come when the cry of the *rirориro* is heard; I therefore consider it right to give you a few words of advice, lest the *rirориro* should cry in vain.

Pleiades is high in the heavens, the warm season has arrived, and the thoughtful man thinks it is time to cultivate food to enable him to live, and also to extend hospitality to strangers, lest he be in the same case as the thoughtless one who, when the season of the scarcity of food comes round, is in a very helpless condition. In former days, all descriptions of food used by the Maoris, such as the kumara, taro, and other things were largely cultivated; at present the cultivation of these articles of food has decreased. I therefore consider that you ought again to turn your attention to their cultivation lest they disappear altogether, and that the word of the proverb ought to be fulfilled, which says, "The fame of a man brave in war is uncertain; but the fame of a man diligent or brave in tilling the ground will always last."

Another work which you are able to do is the preparation of flax. Formerly that was a great industry among you, but now it does not exist, and you have allowed the flax to be burnt and to rot, without considering what a source of wealth this plant which is growing is. You know that the Europeans send flax to England to be sold; but, owing to the bad quality, it commands but a small price. Dr. Featherston has visited the principal towns of England and Scotland where they use flax and other such articles. He took with him some machine-dressed flax, but that did not find much favour. He also took a sample of Maori-dressed flax, which, though not dressed as well as it might have been, excited the admiration of the Europeans on account of its good quality and softness; and they said that if all the flax from New Zealand were as good as that sample of Maori-dressed flax, it would command a high price, and would always find a ready market in England.

Now you, the Maori people, should consider this, that the flax dressed by you is the kind preferred by purchasers, and that the machine-dressed flax is not nearly so good as yours; it therefore seems to me that, if you will turn your attention again to that industry, it will benefit you very much.

You must not forget to cultivate flax, so as to insure obtaining a superior quality to the dressed article.

Now, I have decided to give a prize to the best workman in each district. It will be in this way: the person who grows the best acre of flax in his district will get £10. The person who will produce the best ton of dressed flax in his district will get £10. The way in which a decision will be arrived at as to the best-cultivated flax will be as follows: a European and two Maori chiefs, in each district, will be directed to inspect the various fields of flax, and report to the Government, so that they may know to whom they are to give the before-mentioned prize, viz., £10.

The decision as to the best-dressed flax will be arrived at as follows: the flax will be sent to England, and there sold. The person who has dressed the ton which commands the highest price will receive the money before mentioned, viz., £10.

By and bye you will be told the districts in which prizes will be given.

In addition to the above, the Government will give to the person who cultivates the best acre of flax, over all the districts, £50; and to the person who produces the best ton of dressed flax over all the districts £50.

The above sums of money are only prizes, and are given with a view of ascertaining who can produce the best article. The people must not think that these amounts are the prices which the flax will bring. This matter is arranged in the same way as cattle shows, &c., are arranged, where the Europeans and Maoris send their beasts, &c., every year.

I know that you, the Maoris, are ignorant of the prices of flax, &c., in England; therefore I think that, if you will again turn your attention to these industries, you will obtain the benefit of prosperity. That is all.

Your friend,
DONALD MCLEAN.

(No. 29)—CHAIRMAN to the Hon. the NATIVE MINISTER.—21st December, 1870.

I have the honor to acquaint you that the Flax Commission have arranged with Wi Tako to procure from the Natives of Waikanae, half-a-ton of flax, dressed according to sample placed in the Museum by him; £20 to be paid on delivery, with any further nett balance, after valuation in the London market. The order to be completed by the 31st January, 1871.

Colonel HAULTAIN to CHAIRMAN.—6th December, 1870.

There are but two varieties of flax growing on the flat land about Otaki, Manawatu, &c., called by the Natives *Harakeke* and *Whaririki*. The latter is apparently a variety of *Phormium Colensoi*, found on the sand hills near the beach, growing from six to eight feet high, with a palish green leaf and edges of the same colour, and small flowers with yellowish-green sepals, but as it was not in fruit I could not determine whether the capsules were "twisted" or "drooping." It is not common (I had to walk more than a mile before my guide could show me a plant), and it is rarely cut by the Natives, who say that the fibre is weak and useless. An examination with the microscope proved that the quantity of fibre was very small in comparison with other varieties. The *Harakeke* is abundant, and the leaves are often twelve and thirteen feet long. It grows luxuriantly on any dry ground round the edges of swamps, or when away from stagnant moisture. It is subdivided by the Natives into *Tuhora* and *Tukura*, according to the length of the leaf, the former being the longer; but I could not perceive any difference between the fibres either in strength or in colour. It cannot be stripped without the aid of a shell, in which it differs from the *Tihore*.

There are no Native plantations of flax in this district; the choice leaves of the *Harakeke* are fine and white enough even for their best mats; and any *Tihore* that is wanted for special purposes is brought from the upper part of the Wanganui River or from Kawhia.

In preparing flax for the finer purposes, the Natives select clean unspotted leaves of a year's or eighteen months growth, and use the upper portion only, cutting off the leaf about six inches below the point where the two blades adhere togther, and rejecting the coloured edges and keel also. They strip the fibre from the upper surface only (that surface which is inside when the two blades are together), cutting the under side across, and then, with the round edge of a mussel-shell, tear up the whole row of upper fibres, bringing away the cuticle also, which has to be removed afterwards.

I asked the woman, Annie Kanara, who was working for me, to strip the other side of some of the leaves; she laughed at such an idea, but tried, and after failing several times succeeded with about a dozen leaves, and then objected to waste time on any more, This under fibre is not as abundant as the other, but extends the whole length of the leaf from the butt to the point; it is equally fine and strong, and there was apparently no difference in the ultimate fibres when microscopically examined, but it is too green in colour to mix with the other, as it is difficult to separate it from the cuticle and surrounding cellular tissue. The breaking strain of the only strands I could prepare was 198 lbs. *

After stripping the fibre of the upper (or right) side, it was well scraped with the edge of the shell to remove as much of the cuticle as possible; and when a small hank of a dozen or twenty leaves had been finished, it was thrown into a tub of water to be kept moist until a sufficient quantity was ready to be taken down to a running stream, where it was washed and scraped with the shell over and over again till all the cuticle, gum, &c, had been removed, when it was hung up to dry, and afterwards worked and twisted with the hand. It took Annie Kanara the greater part of two days to gather leaves and prepare four or five pounds weight, and she would not part with it for less than 1s. per pound.

It was very white and soft and bright, for the leaves had been carefully selected, and the breaking strain was from 210 lbs. to 275 lbs. But what an amount of hand-labour is necessary to produce a ton of this fine quality, and what a waste of fibre! At least one-half the leaf is discarded, and the fibre from one side of the other half is rejected, so that the Maori obtains from each leaf only one-fourth the quantity that would be secured in machine-dressing; and as he would not select more than one in four of the leaves of any full-grown bush, the European mill-owner, who cuts down the whole plant, could in the first year produce sixteen tons of his fibre from the same ground that would give only one ton of fine Native-dressed flax.

In preparing flax for their mats, the Natives take much more time and trouble than has just been described; they soak the fibre in running water for four days, and then beat it with a stone or mallet; and this process is repeated over and over again for four or five weeks, or even for much longer periods. But I have no doubt that this excessive manipulation weakens the fibre, though it makes it very soft and durable.

I dare say that a few tons of the ordinary washed fibre could be procured from the Natives for less than 1s. per lb., but not at Otaki. The Commissioners endeavoured to procure one ton through Mr. Bevan, an old settler and rope-spinner at that place, but he said he could not get it for less than 1s. per lb.; and the Rev. Mr. McWilliam, who kindly assisted me in securing the services of Annie

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* The breaking strain here given was obtained in the manner described in the experiments performed by Dr. Hector, the results of which were given in the Report of the Flax Commission, 1870.

Kanara, said that he had first applied to the Native woman who had lately prepared some for Bishop Hadfield, which was sent to England by Mr. Sewell, but she refused to work at any more, as she considered she had been insufficiently paid for what she had done. I believe she got 4d. per lb. for it. Annie Kanara got 5s. from me for her two days' work, and would have earned as much if she had been stripping flax for the rope-spinners. These pay 1½d. per lb. (£14 a ton) for fibre that has been merely stripped and tied up into bundles. Of course the Natives take all leaves as they come for this purpose, but they only use the upper portion, as they cannot strip the butts, and the spinners object to longer lengths than 3½ or 4 feet as being unmanageable. I got a sample from Mr. Dodds at Otaki, which he had prepared for rope-making by hand-hackling it, the labour and loss of weight bringing the cost up to £25 a ton (the breaking strain was 188 lbs). He had sent five or six tons to England, and it sold there at £25 a ton, leaving him to bear the cost of transport to Wellington, £6 a ton, and thence to England £8 or £9 a ton more.

Mr. Bevan is not making rope at present, as the Natives are demanding 2d. instead of 1½d. a lb. for the flax.

SAMPLES accompanying this letter.

1. *Harakeke* (Tuhora) fibre, washed.
2. *Harakeke* (Tukura) fibre, washed.
3. *Harakeke* fibre, unwashed.
4. *Harakeke* stripped for rope-spinners.
5. *Harakeke* stripped, hackled.
6. *Harakeke* leaves stripped on both sides, showing difference of colour.

Colonel HAULTAIN to CHAIRMAN.—Waikanae, 3rd January, 1871.

A number of women, and some of the old men are very busy preparing the half-ton that was ordered by the Commissioners. They do not consider that £20 is by any means a sufficient price for it, and they are under the impression that they are to receive 5s. a day, besides the price of the flax, from the Government. They tell me that they quite understood the terms proposed by yourself, viz., that they were to get £20 paid down, and also any balance on the home valuation after expenses had been paid; but that the women would not work on those terms; and Wi Tako and others asserted that Mr. Halse, Mr. Young, and Mr. McLean had promised them each 5s. a day, in addition to the amount to be paid by the Commissioners. I told them that I was sure this was a mistake on their part. I am, however, not surprised at their objecting to £40 a ton as not sufficient, for I do not believe they could earn an average of 1s. 6d. a day each at this rate for fine thoroughly cleaned flax, such as the Commissioners have stipulated for. It takes so much time to free it from all the scull, and the suitable leaves are not readily procured; they can get but little of it in the immediate neighbourhood of their settlement, and a party of them have gone off to-day some three or four miles to a better locality, taking their food and blankets with them, and are not to return till to-morrow. It is difficult to get any accurate estimate of what quantity a Native woman can prepare in a day. At a large meeting I asked the question, and Mary, Wi Tako's wife, said that some could do 1lb., some 2lbs.. and others as much as 4lbs., according as they were fortunate or otherwise in quickly finding the proper leaves. Wi Tako said he thought that a woman could do as much as 10lbs. in a day. Some others assented to this provided she had not to collect the leaves herself, and that it would take a woman two days to collect leaves enough for 10lbs. of the fibre, but it is evident that they have no clear idea as to weight in pounds. I examined the days work of several women, and they certainly did not average 5lbs. Wiremu Tamihana (the teacher) showed me what his wife, Penelope, one of their best workers, had got ready; it filled two 100lb. flour bags, but there certainly was not 1 cwt. of flax, and he said that she had been working steadily at it since the 10th of November, and had not missed a day, except Sundays, so that she had not averaged more than 2lbs. a day, but she was fully calculating on getting 5s. a day all this time in addition to her share of the £20.

The women here do not prepare the flax in exactly the same way as that I procured from Otaki. This is stripped and then allowed to dry before the scull is scraped off, and it is not touched with water. It has in consequence a harsher feel than the other, and is not so silky in appearance. I pointed this out to Mrs. Tako, and she admitted that the washing was an advantage, and showed me a few hanks that she had treated in this way. I enclose ticketed samples of both. It would add to the labour considerably if they took their flax down to the river here to wash it, and therefore they are adopting the dry process, which makes it white enough.

It is not every mussell shell that will strip well. They require one with a straight edge. The best come from Wellington, and Wi Tako on his recent visit brought them up a supply. A shell will not last more than two or three days, it then gets too smooth to strip, and is used only for scraping off the scull.

I observed that Mrs. Tako had three shells for completing her work, and others always used a different shell for the scraping part of the process, and occasionally roughened the edge of the stripper, if it was not working well.

The women use several of the sub-varieties indiscriminately, they will take any of those named by Wi Tako in his letter of the 19th December, viz., *Oue*, *Raumoa*, *Huhiroa*, *Ngutunui*, *Atiraukawa*, *Rataroa*, *Atewheke* and *Tarariki;* but I could find no one who had an accurate knowledge of all these varieties. No one could decisively point out to me which were which, from the parts of the leaves that the women were working at; and whilst discussing the question, a boy who had heard what was going on, went off to the swamp, cut a bundle of leaves, and threw them down before us, when there was immediately a dispute as to what varieties they belonged to. It was agreed that W. Tamehana, who was looked up to as an expert, and an authority, should go with

me and point out the different kinds. He was often puzzled, and more than once took two varieties out of the same clump, and pointed out distinguishing marks which did not always agree. I took tracings of all the kinds he named, which I enclose, but I was not satisfied that he had entire confidence in his own discrimination. Several of the varieties are named by Mr. Kelly, Rev. Mr. Taylor, and others, but the descriptions seldom agree; none are cultivated here, and all must be stripped with a shell. I think it is probable that under cultivation they would improve into *Tihore*.

The women preferred the *Oue* and the *Ngutunui*, the latter having a greater abundance of fibre, and the former being very white; the *Raumoa* is the most common about here. Wi Tako and all the natives agree in saying that this is a bad time of year to prepare flax, when the flower stalk is green. The fibre will strip out much easier when the stalks are dry. There is not much flax in flower this year in this district.

It is evident from the colour of the "scull" that is stripped away with the fibre, that the epidermis of the upper side of the leaf only appears green from the green tissue underneath, for it is in itself of a light buff yellow colour. The epidermis of the under side of the leaf is a decided green.

4th January, 1871.—I went out to-day to see the party who started yesterday to work; there were nine women and two men, and they had bivouacked fully five miles from Waikanae. As we rode along, W. Tamihana pointed out several clumps of flax bushes, which the party had tried on their way, and which had not satisfied them; and it is plain that only a small proportion of the flax is suitable for the fine fibre; and, where they did fix on a good clump, they did not select one in twenty of the leaves that were on it. They choose fully matured leaves, which are quite perfect, and have no signs of decay. They had no preference for any one of the sub-varieties in particular. I enclose small samples of the several kinds, which they dressed for me, cleaning the fibre from the scull before it was dry. They show, as far as I can judge, that there is little, or no difference in quality and colour.

I don't think that this party of eleven Natives will complete more than 50 lbs. of fibre for their two days work; but I could only form a very rough guess, from what I saw lying round them. They have no scales and weights themselves.

Manawatu, 5th January, 1871.

The Natives at Otaki are not preparing any of the fine flax; they think the price insufficient. I tried to induce T. Rauperaha to take it in hand; but he seemed to consider the attempt was useless. They are making a little at Waikawa, on the Ohau, some five or six miles further on, but I could not make any arrangement for the purchase of it, although I offered to take what they could get ready; they would not listen to £40 a ton, at which rate I told Rauperaha I was prepared to purchase. I did not go to the settlement, but several of the principal men were at Otaki. The Otaki Natives maintain that there are but two kinds of flax growing in this district, *Harakeke*, and *Whararíki*; and when I told them that a great many varieties were recognised by the Waikanae people, they said that it was only Ngatiawa "gammon," and that the *Oue Ngutunui*, &c., were not to be had nearer than Taranaki, that it was all *Harakeke*. They are again stripping common flax for Mr. Bevan, at 1½d. a pound; and I enclose a sample stripped with a piece of iron hoop, which they use for their own ropes, halters, &c.

Opunake, 13th January, 1871.

The Natives at Opunake, after some consideration, declined to prepare any fibre on the terms made with Wi Tako and the Waikanae Maoris. They said that the work was too much, and the price too little; and, moreover, that they had leased all their flax to the mills, and were busy making roads.

They produced samples of fibre from eighteen different varieties of flax, and gave me the names. I tested their knowledge in various ways, until I tired their patience, and they refused to answer further questions, but asserted that there was no "humbug." They were, however, anxious to prove that there was no mistake about the names, and more than once sent the sample in question to another hut, where it was referred to an old woman, who was considered an authority in these matters. Mr. Kelly, M.H.R., says that there is but this one woman in the whole district who has a good knowledge of the varieties.

I offered them 6d. a lb. for the samples, which they agreed to take, but on finding that the parcel weighed only fifteen pounds, they refused to let it go for less than 10s., and, on my objecting, carried it off. I had to accede to their terms the next day, as I wished to get the samples for experiment and comparison.

They consider the *Atiraukawa* the best plant in this neighborhood, but I have come to the conclusion that the varieties of flax have different names in each district, for I could not find the descriptions agree either with what I had seen elsewhere, or with those given in the Commissioners Report of 1869-70.

There are no varieties cultivated in this part of the coast, and the Natives all referred to Taiporohenui and Matangarara, in the Patea district, as the only places at which there are plantations. Ngahina informed me that they would be quite ready to prepare any quantity we might require *if they were allowed to go back to those settlements*—an inducement that is not likely to be accorded to them.

13th June, 1871.

I have found it impossible to procure any fine dressed Native flax from Waikato, Bay of Plenty, or Napier. The Maoris will not undertake the labor of preparing a large quantity. One of the replies from Waikato was, "that they did not care about money now as it would not purchase arms and ammunition."

I set a Native to work at some of the *Rataroa* flax, growing near St. John's College. He was tolerably expert, and wasted no time, but barely managed to prepare two pounds weight in a day of eight hours. There was no difficulty in stripping out the fibre, but a great deal of time was occupied in completely removing all the vegetable tissue that remained attached to it. It was only the unblemished first pair of leaves, next the centre, that yielded a pure white fibre, all the others were more or less stained or discolored.

What they require for making their fine mats is so trifling in quantity that they will take any pains in preparing it, and they sometimes keep it for years to improve its color and texture, placing a high value upon that which is very old; but to make several hundred weight would involve an amount of time and trouble that they do not care to encounter, unless guaranteed a remuneration far beyond its commercial value.

There are no flax cultivations at the Native settlements in the immediate vicinity of Napier. What they want for the finer purposes is selected in the swamp by those who are skilled in the art.

(No. 21.)—Assistant Native Secretary to Chairman.—12th January, 1871.

I have the honor, by direction of the Hon. Colonial Secretary, to acknowledge receipt of your memo. of the 9th current, transmitting the draft of a report from Colonel Haultain relative to flax which is being prepared under contract by Natives at Waikanae for the Flax Commissioners.

With regard to the statement made by Wi Tako and others, that they were promised 5s. a day each, in addition to the £20, I can only say that no such promise has been made by any person in the Native Office.

I beg to enclose a memo. by Mr. Young, and the translation of a letter addressed to Wi Tako on the subject of the alleged promise of 5s. a day in addition to the contract price.

Memorandum.

As Wi Tako has asserted that I told him that the Natives who are engaged dressing flax at Waikanae were to get 5s. a day each besides the £20 for which they agreed to dress half-a-ton of flax, I may be allowed to state that he is in error.

I was instructed by Mr. Cooper to see Wi Parata, a chief from Waikanae, and to endeavour to ascertain from him what the cost of preparation of flax of as good a quality as the samples brought in by Wi Tako would be. I accordingly did see him on the 29th December, 1870. He told me that he thought each person could produce 30 lbs. of fine flax a day, and that a fair equivalent for the labour would be 5s. a day. This was not in reference to the half ton of flax; I did not mention it, nor did he; I was not even thinking about it. We were merely discussing the question of the cost of production of flax in a general way; and nothing that I said could be taken to mean that 5s. a day would be given to them by the Government, in addition to their shares of the £20.

Wellington, 12th January, 1871. T. G. Young.

To Wi Tako,— Wellington, 12th January, 1871.

Friend, salutations to you. Colonel Haultain says that you stated to him that the Government consented to give the persons engaged in preparing flax 5s. a day, in addition to the £20 for the half-ton of flax. We know nothing about that 5s. You are probably mistaken. That is all. Your friend,

Wi Tako Ngatata, Waikanae. H. Halse.

(No. 97).—Memorandum for Under Secretary by Chairman.—22nd May, 1871.

The Flax Commissioners will feel much obliged if you can ascertain from Wi Tako, and the other Natives at Waikanae, the cause of the delay in supplying the flax, which they contracted to deliver in January last.

By Wi Tako's letter, of 14th March, it appears that a quantity had been already weighed, and more remained to be done.

(Telegram.)—Dr. Hector to Wi Tako.—11th March, 1871.

When will the half-ton of dressed flax ordered by the Commissioners be ready? It was promised by the 31st January.

(No. 30.)—Assistant Native Secretary to Chairman.—20th March, 1871.

I have the honor to enclose herewith a copy and translation of letter from Wi Tako Ngatata, in reply to a telegram sent him regarding the half-ton of prepared flax.

Mr. Halse,— Waikanae, 14th March, 1871.

Salutations. I have received your message by telegraph about the flax. It is true that the women have finished some time ago preparing flax; they say that they are very busy after their food (crops). It is also correct that we said that it (the flax) should be carried out by the end of January, but when they asked us about the price, we told them £20 for half a ton. They told us that they could not work at that rate, for it was heavy work. Hohepa and I were troubled at their reply; but enough of that.

When I received your message, I gave notice to those preparing flax to assemble at my place, as I wanted to weigh the flax; we weighed 590lbs., but it is not all weighed yet.

This is all. I shall go and tell you all about it. This is all.

From

To Mr. Halse, Native Office, Wellington. Wi Tako Ngatata.

Memo. by CHAIRMAN for Hon. Dr. FEATHERSTON.—23rd March, 1871.

I think the flax referred to in this letter must be the same as that which you informed me to-day has been purchased by you for the General Government. Will you kindly minute upon this the terms of the purchase, and instructions to the Natives to hand over the flax, as originally intended, to the Commissioners, to avoid mistake.

Memo. by Hon. Dr. FEATHERSTON.—23rd March, 1871.

I agreed to give the Natives 6d per lb. for all the flax they could send in at once, amounting, they said, to some six or seven cwt. They did not tell me they had already sold it to the Government; of course they must carry out the arrangement with the Government. My object in buying it was to send it to Messrs. Marshall, and other manufacturers in Leeds, to whom I promised to send a few cwt.

FRIEND WI,— Wellington, 22nd May, 1871.

Salutations. What is the reason why the flax, which you agreed would be done last January, is not ready yet? You said in your letter of the 14th of March that some of the flax had been weighed and that some had not been weighed. Sufficient.

Your friend,
H. HALSE.

Wi Tako Ngatata, Waikanae.

TO MR. HALSE,— Waikanae, 28th May, 1871.

Salutations to you. Friend, your letter of the 22nd May, addressed to Wi Tako, has been received, and Wi Tako has requested me to write in reply to your question as to the cause of delay in supplying the flax.

The reason why there has been so much delay is, that we have been engaged in performing the funeral ceremonies, &c., over Tamati Te Hawe, Oruiroa-anumutu and Te Tapeotu. All these were chiefs of the Ngatiawa and Ngatitoa tribes, and that is why that delay has occurred. Also, we are waiting for an increase in the price of the flax, and also to hear from England what the price is there. It is correct that the flax has been weighed. It has all been weighed, and now we are only waiting for a higher price.

From your friend,
WIREMU TAMIHANA TE NEKE.

FRIEND WI TAKO,— Wellington, 2nd June, 1871.

Salutations. The Government have received a letter from Wi Tamihana Te Neke, written at your request. He says: "The cause of delay is that we are only waiting for an increase in the price of the flax." It was thought that the price had long since been agreed upon; but now a higher price is being waited for. What is to be the final decision? Reply quickly to this letter. Sufficient.

Your friend,
H. HALSE.

Wi Tako Ngatata, Waikanae.

TO MR. HALSE,— Waikanae, 5th June, 1871.

Salutations to you. Friend, I have received your letter in reply to one written to you by Wi Tamihana. It is correct. I told Wi Tamihana to write to you, because he is the man who has the flax. When I saw you at your office, on the 25th April, 1871, you requested me to reply to your letter. I said, "Wait until I can see Hohepa Ngapaki, and Wi Tamihana Te Neke; when we agree, then your letter will be answered." This letter is the answer. Friend, I was correct when I told you that some of the flax had been weighed, and that some had not. The difficulty was caused by Dr. Featherston, and through that the eyes of the people who dressed the flax have been turned on one side (*i.e.* they have drawn back from the arrangement).

Friend, Wi Tamihana was correct when he wrote to tell you that all the flax was weighed.

Your friend,
WI TAKO NGATATA.

FRIEND WI,— Wellington, 7th June, 1871.

Salutations. I have received your letter of 5th June, but you have not answered the question put in my letter of the 2nd June. I asked "What is to be the final decision as to the price?" Wi Te Neke said that the cause of delay in supplying the flax was that they were waiting for a higher price. Be good enough to reply to my question. Sufficient.

Your friend,
H. HALSE.

FRIEND MR. HALSE,— Waikanae, 8th June, 1871.

Salutations to you. I have received your letter of the 7th instant on the subject of the question asked in your former letter not having been answered. It was not answered because the owners of the flax have taken the matter into their own hands, so I gave no opinion on that point. They will probably tell you what they want, and whether they are asking much or little. Friend, do not always keep referring to me; you should refer to the master of the cow or the pig; because I have unloosed my rope from the legs of this flax. That is all. Friend, this difficulty has been caused by Dr. Featherston, he having paid 1s. per lb. Sufficient.

Your friend,
WI TAKO NGATATA.

To Mr. Halse, Native Office, Wellington.

To Mr. Halse,— Waikanae, 8th June, 1871.

Salutations. Your letter to Wi Tako has been received, and he has requested me to write to you. I now answer your question as to the price. It is 1s. 6d. per lb. That is what we want, and only on getting that price will we give the flax. Sufficient.

Your friend,
Wi Tamihana Te Neke.

(No. 27.)—The Hon. the Native Minister to Chairman.—Alexandra, 28th February, 1871.

I have the honor to request that a sample of the Maori flax, for which the Government have undertaken to give £40 per ton, may be sent to Mr. Hunt, the Manager of the Waikato Navigation Company at Newcastle, together with a memorandum of what quantity of it the Commissioners would be prepared to take from Waikato.

(No. 45*.)—Chairman to Mr. Hunt, Manager Waikato Navigation Company.—
11th March, 1871.

At the request of the Hon. Mr. M'Lean, I transmit to you a sample of flax dressed by the Natives at Waikanae, for half a ton of which the Flax Commissioners have agreed to pay £20 on delivery, and, also, if valued at a higher rate in England, the nett balance after the expenses of transmission have been deducted.

The Commissioners would be glad to obtain a like quantity on the same terms from the Waikato district, if the Natives can be induced to prepare it, and authorise you to make the necessary arrangements, provided it can be delivered within three months from this date.

(No. 71.)—Mr. R. R. Hunt to Chairman.—5th May, 1871.

I have the honor to acknowledge receipt of your letter of 11th March last, enclosing samples of Native dressed flax, and authorising me to procure half a ton of a similar article from the Natives in this district, at £20, provided it can be delivered within three months from 11th March.

I have delayed replying till I could send you some definite information, which I now do, in the following extract from a letter from Mr. Searancke, R.M., through whose influence with the Natives I have been enabled to obtain a sample, and promises to produce *Muka*.

Extract from Mr. Searancke's letter:—"I hope to get the *Muka* dressed at Karakariki so soon as the Natives have finished their potato digging, maize gathering and drying, and wheat thrashing. I may tell you that this is not the right time of year to get Natives to go to work cleaning flax, at least to commence it, but let winter once set in and I believe that flax dressing will set in with it; until then I can hold out no hopes of your obtaining the article you require."

From the above you will see that unless you extend the time for delivery that the flax cannot be produced. I would, therefore, suggest the extension of time till next spring, when the half ton of *Muka* would be forthcoming, fully equal to your sample.

(No. 99.)—Chairman to Mr. Richard R. Hunt.—27th May, 1871.

I beg to acknowledge receipt of your letter of 5th instant, and to inform you that the Commissioners, though they regret your not being able to procure half-a-ton of Native dressed flax by the date they had formerly fixed, will still be glad to receive it as soon as, with your assistance, and that of Mr. Searancke, it is possible to be procured.

(No. 44.*)—Chairman to R. W. Woon, Esq., R.M.—11th March, 1871.

Referring to your letter of the 1st February, with which you transmitted two specimens of flax, dressed by the Natives of the Wanganui River, I have the honor to inform you that the Flax Commissioners will be glad to obtain half a ton of the same quality as the samples, if the Natives will supply it on the terms agreed to with Wi Tako, of Waikanae, viz.:—£20 to be paid on delivery of the half ton, which will be sent to England, and, if it is valued at a higher rate, the nett balance, after deducting expenses of transmission, will also be paid to the sellers.

The flax must be prepared before the 31st May next.

(No. 73.)—Mr. Woon to Dr. Hector.—26th May, 1871.

Natives have disappointed me at the last moment about the half-ton of flax; their excuse being deaths amongst the tribe.

(No. 102.)—CHAIRMAN to R. W. WOON, Esq., R.M., Wanganui.—13th June, 1871.

The Natives are very troublesome about flax dressing, and I am sorry to hear of your not being able to procure the promised half-ton. If you can still persuade them I shall be glad to get the flax, as we must have some to send to England.

(No. 128.)—R. W. WOON, Esq., R.M., Wanganui, to CHAIRMAN.—12th August, 1871.

With regard to the half-ton of flax, I find it impossible to get the Natives to scrape so large a quantity on account of the trouble, and I am afraid there is very little chance of procuring the quantity required.

If I see any prospect of getting that quantity, or less,—say a quarter of a ton,—on my next up river trip at the end of this month, I will let you know.

V.—CULTIVATION OF FLAX.

(No. 22.)—Mr. W. K. HULKE TO CHAIRMAN.—New Plymouth, 16th January, 1871.

Believing that the establishment in the various Provinces of nurseries on a small scale for the experimental culture of flax would be of the greatest benefit to all engaged in its manufacture or cultivation, as it would enable them to select only those varieties found after trial to be especially adapted to their respective requirements,—and as the names at the present vary in almost all localities, a classification is absolutely necessary,—I have the honor to submit, for the consideration of the Flax Commissioners, the following:—

1. The establishment of a nursery, on a limited scale, in the Province of New Plymouth, for the experimental culture of the *Phormium tenax*.

2. I offer to place at the disposal of the Commissioners, rent free, the nursery, about three-quarters of an acre, adjoining my residence in the town of New Plymouth, now used for the culture of flax. It contains 2,000 three to four year old plants of the best varieties of flax procurable. Also, several thousand seedlings, from seeds selected in the Taranaki and other districts.

3. I will superintend the cultivation, and carry out any experiments that the Commissioners may suggest, gratuitously.

4. That the expense of the nursery, such as for rates, manual labour, purchase of new varieties, stationery, &c., shall not exceed £20 per year. The greater portion of which will, after another year, be reduced by the sale of plants to those cultivating, should they be required.

5. That the Government allows me the actual cost (money paid) of the present plantation, say about £43 10s.

(No. 49.)—CHAIRMAN to the Hon. the COLONIAL SECRETARY.—13th March, 1871.

I have the honor to forward to you the copy of a letter which has been received by the Flax Commissioners from Mr. Hulke, of New Plymouth, offering to place at their disposal a nursery of flax plants, and gratuitously to superintend its management, on condition that a sum not exceeding £20 a-year be allowed for rates, labour, &c., and that he be repaid for the outlay he has already incurred in preparing and planting it. The Commissioners being of opinion that the establishment of nurseries in different parts of the Colony for the experimental cultivation and distribution of the finer varieties of the *Phormium* is necessary for the investigation of the growth, structure, and capabilities of the plant, and would be of advantage to all concerned in the industry, are desirous of accepting Mr. Hulke's liberal offer, and are willing to defray from the funds placed at their disposal the amount he claims in reimbursement of his outlay; but as it is beyond their power to undertake any annual payment, they recommend the Government to conclude the arrangement by leasing the land at a nominal rent, and by authorizing the necessary payment for the maintenance of the nursery.

(No. 71.)—CHAIRMAN to Mr. W. K. HULKE.—27th March, 1871.

In replying to your letter of the 16th January, 1871, I have, in the first instance, to apologize to you for the delay that has taken place in acknowledging it, but you have already been informed by Colonel Haultain that this was owing partly to a misapprehension, and chiefly to the absence of the Commissioners from Wellington. I now beg to thank you, on behalf of the Commissioners, for the very liberal offer you have made of placing at their disposal, on certain conditions, your nursery of flax plants adjoining your residence at New Plymouth, and of gratuitously superintending its cultivation and management.

The Commissioners at once accept your proposal, and will reimburse you for the outlay you have incurred in making the plantation; and as they could not themselves undertake to guarantee any annual payment they have recommended the Government to conclude the arrangement with you by leasing the land (say for a period of ten years) at a nominal rent, and by authorizing the necessary payment for the maintenance of the nursery. This they have consented to do; and I now beg that you will furnish me with a description and plan of the land, and with your own christian names and description, in order that a lease and agreement may be prepared.

(No. 81.)—CHAIRMAN to the Hon. the COLONIAL SECRETARY.—19th April, 1871.

I have the honor to forward a plan of the ground to be leased from Mr. W. K. Hulke, of New Plymouth, to be used as a nursery for flax plants; also a plan showing the flax as planted, required by the Attorney-General, for the purpose of drawing up a lease of the ground to the Government for a period of ten years.

I also enclose copies of preliminary correspondence on the subject with Mr. Hulke.

(No. 45.)—Mr. W. K. HULKE to CHAIRMAN.—11th April, 1871.

I have the honor to enclose, as requested in your letter of the 27th March, a plan of the ground leased, and, also a plan shewing the flax as planted. The rows being 4 feet apart, roots 3 feet.

The plantation was commenced on the 20th June, 1870, and finished in August, 1870; all now show most luxuriant growth, and the variegated variety has many young fans thrown up, having been previously transplanted. You will observe in the plan there is a space left for any new variety I may pick up, or any that the Commissioners might think proper to send to compare with those already planted. In reply to your letter of the 30th March, I shall have much pleasure in presenting to the Commissioners all my specimens of prepared fibre, and will only accept payment for the specimens planted in tubs, so as to cover expenses—say, packed and delivered on the beach, ready for shipment, 10s. each; of these, there will be about fourteen varieties, each, as far as leaf goes, quite distinct. As yet, I have not received either the *Korako* from Waimate, or the *Tepuna*; but as soon as these arrive, and which I daily expect, I will forward the plants previously ordered.

(No. 82.)—CHAIRMAN to Mr. W. K. HULKE.—19th April, 1871.

I have the honor to acknowledge receipt of your letter of 11th April, and to inform you that the plans of your flax nursery enclosed therein have been forwarded to the Government for the preparation of a lease as agreed upon.

On behalf of the Commissioners, I accept your offer of the flax plants in tubs—to be paid for at the rate of 10s. for each variety, packed, and delivered on the beach ready for shipment.

I also beg to thank you for the offer of your collection of flax fibres, which the Commissioners will have much pleasure in accepting.

(No. 50.)—CHAIRMAN to Mr. W. K. HULKE.—13th March, 1871.

The Flax Commissioners, on making application some weeks ago to Mr. Kelly for his assistance in procuring a variety of flax plants from the Taranaki Province for cultivation in the Botanic Garden at Wellington, were informed by that gentleman that he had made arrangements with you for the supply of such plants as you could procure. There has been a delay in communicating with you as the Commissioners have been absent from Wellington, but I now beg that you will be so good as to procure and ship to this place ten plants of each of such varieties as you can obtain, that are cultivated by the Natives, or esteemed by them as valuable.

When they are ready for shipment I shall be obliged by your allowing Mr. Kelly to see them, as he has promised to furnish the description of the several varieties; and on your informing me of the cost of the plants and the expenses of shipping them, I will cause the amount to be remitted to you.

(No. 16.)—CHAIRMAN to W. BULLER, Esq., R.M., Wanganui.—5th December, 1870.

The Flax Commissioners would feel much obliged by your obtaining for them, from that part of the Wanganui River where it has been planted by the Natives, about 100 sets of *Tihore* flax, for cultivation in the Botanic Gardens at Wellington.

They would also be glad to have, for the same purpose, twenty or thirty plants of each of any other varieties that are suitable for manufacturing purposes, with a short statement of the uses to which these varieties are severally applied by the Natives, and the name of the soil on which they are found to grow naturally.

(No. 41.)—R. W. WOON, Esq., R.M., to CHAIRMAN.—12th April, 1871.

I shall be sending you 100 sets of flax plants next week.

(No. 85.)—CHAIRMAN to Mr. R. W. WOON, Wanganui.—1st May, 1871.

I have the honor to inform you that the 100 sets of flax plants have arrived, and that a voucher for payment has been forwarded to the Colonial Secretary.

The amount of £5 10s. due for the plants will be forwarded to Wanganui on the first opportunity, and will be payable on your personal application to the General Government Paymaster at that place.

(No. 128.)—H. C. Field Esq., to Chairman.—Wanganui, 11th August, 1871.

It has struck me that the following notes as to the results of experiments in growing the native flax in this part of the Colony, and other matters connected with its growth, might not be uninteresting to one whose attention, like your own, was directed to the subject of the manufacture of the fibre.

Two years ago, in consequence of seeing in our local papers some statements, copied I believe from Auckland prints, as to the rapid growth of flax, which from my own experience I thought were exaggerated, I planted out a number of fans of a good variety on different soils to test the result. The present condition of the plants is as follows:—

No. 1. Twenty fans planted in pumice sand: One has now five fans, three have four, four have three, seven have two, four have still only one. The whole grew, but one, which had increased to three fans, had its roots exposed by the wind during the early part of last summer, and was uprooted and destroyed by the salt gale in February.

No. 2. Ten fans planted on strong clayey alluvium, which however had been some years under cultivation: Two have now two fans each, four have one, and four never grew.

No. 3. Twenty fans planted on a piece of boggy ground undrained: Two have now 2 fans each, seven have one, nine were killed by some sharp night frosts in the spring after they were planted, and two were buried under a slip of the neighbouring bank.

I also planted twenty fans on a piece of drained swamp, and they all grew and were doing well, but some cattle, which broke in in the summer during my absence from home, dragged the whole of them out of the ground.

At the same time as I planted the above, a neighbour who was embarking in the flax trade, planted 30 acres of flax, partly on shallow-drained swampy soil, resting on white clay, and partly on a slight rise (old manuka ground) where the soil consisted of vegetable mould, resting on yellow sandy clay. The whole area planted had been some years in cultivation, and in order to ensure the proper preparation of the ground, the superintendence of the work was entrusted to a professional nurseryman. The fans were planted 4 feet asunder, in rows alternately 4 feet and 10 feet apart. A very large proportion of the sets (in one paddock I should say nearly half) failed to grow, and those which are still living have certainly not more on the average than three fans to each plant; indeed I think it doubtful if the few which have more may not have been double fans when planted. In both the above cases no pains have been taken to keep the ground around the plants stirred or weeded; my own object having been to see how the plants would thrive with no more attention than similar ones put out by settlers would ordinarily receive, and my neighbour having been disappointed, and given up the business. In both cases the plants would not at the present time yield more than two or three leaves each without weakening them, and I observe that those which have not increased the number of their fans would yield the largest leaves, and nearly or quite as many as the others. There seems in fact an equal amount of vigour in the plants, though its development has taken a different direction, My own plants on the pumice soil are considerably smaller than the others, but I think this arises partly from their being close to the house, and consequently having often had leaves cut from them by my children.

At the St. John's Bush nursery, where the soil is of the richest possible description, well drained swamp, which was evidently formerly forest, and the mould of which is exactly like rotten tan, and from 2 feet to 4 feet deep, end of course highly cultivated, there are some bushes of variegated flax, planted four years ago. There were several fans in each set when planted, and at the present time each bush contains from twelve to twenty. In a part of the same nursery, which is irrigated occasionally in hot weather, some seed of reputed good flax was sown about 16 months ago. The plants are of course as yet only single fans of four or five leaves each, and these leaves average only about 2 feet long, by ¾-inch in width. In fact it is evident that they would require several years more to grow into a bush which would bear cutting for fibre.

A considerable breadth of land was planted early last spring by a flax company at Patea, but beyond the facts that the plants generally grew, and have not as yet apparently produced many new fans, I cannot get any very definite information as to the results of the experiment. The situation chosen was a moist flat among, or adjacent to, sandhills; the very sort of site which, as well as sandy alluvium, and pumice along the border of a swamp, I have observed always produces the rankest growth of flax; better even than cleared bush, in which last the plant always seemed to thrive better in places where the Natives had mixed a considerable proportion of sand with the soil, in order to grow kumeras. On stronger soils, flax does not seem to do well, except in spots where water lies in winter, and in these cases I have noticed that the roots spread laterally only just below the surface, and do not appear to penetrate to any depth. Drained swamp, particularly if the vegetable soil is deep, is no doubt the best suited to flax, as well as to most other soft-rooted plants, and next to this sandy soils, particularly if manured. On stronger soils the ground should, I am convinced, be often and deeply stirred, and it would probably be desirable to pay attention to drainage and weeding, if the increased production should, on trial, be found sufficient to compensate for the outlay. Many people seem to have an idea that it would pay to plant rows of flax at intervals across grass paddocks. My own impression is that this would result in failure, as I have seen large flats of flax utterly destroyed either by the bushes being choked by the clover, or by the cattle grazing on the latter, tearing the hearts out of the young fans when other feed was scarce. Horses and sheep also gnaw the ends of the leaves in such a way that it does not appear desirable to let them graze among cultivated flax. I do not know whether saline particles in the air are beneficial to the growth of flax, but it appears likely that this is the case, because while all the coast country along the north shore of Cook Strait, from the Tararua to Mount Egmont, contains abundance of good flax for manufacturing purposes, directly one gets among the hills a few miles inland, the only plants which will yield any appreciable amount of fibre are those growing in native cultivations. During the last two years I have traversed a very large extent of the country inland of this district, and have found everywhere only the most

utter rubbish in the shape of wild flax. Even in the old Native cultivations, bushes which are doubtless descendants of good ones planted by the Natives, have degenerated so as to contain no fibre worth extracting. The leaves are very thin, and the fibre so fine, and so firmly attached to the woody matter, that I believe the machinery generally employed at present would break it all to pieces. The soil of the region in question is everywhere extremely rich, and so deeply and universally rooted by the wild pigs that the difference cannot arise from any want of cultivation. The overgrowth of koromiko scrub may have something to do with it, but as splendid flax is constantly found similarly overgrown in the old cultivations near the coast, it would seem that this alone cannot account for the change. The absence of wind among the hills again can scarcely be the reason, as just as constant a calm prevails in sheltered cultivations near the Coast. From whatever cause it has originated, there can be little doubt that the degeneracy, in the case of the bushes in the old cultivations, has been accomplished in the forty or fifty years which have elapsed since that part of the island was abandoned by the Natives as a place of residence, and in some cases apparently in a far shorter period, if not actually in so short a space as fifteen years, which seems to have been about the time since one very extensive patch of cultivations was given up. I mention the matter because its cause may be worth investigating, though the natives whom I have questioned on the subject, seem unable to throw any light upon it.

(No. 31.)—Mr. James Hirst, Patea, to Chairman.—11th March, 1871.

In accordance with a promise made by me to Colonel Haultain, I now beg to forward, for the information of the Flax Commissioners, a statement of the cost of planting 25 acres *Phormium tenax* at Patea. I may mention that the carriage of some of the best sorts of flax cost 5s. per 100 plants, owing to distance.

Particulars of 25 acres Flax *(Phorminm tenax)*, planted near Patea for "The Patea Flax Company (Limited)."

The flax is planted in rows 6 feet apart, with a space for carting of 10 feet at every fourth row. Three plants are placed in each hole, well rammed, and the holes are 6 feet apart.

The contract for digging the holes and planting—the ground having been previously cleared but not ploughed—was 9s. 6d. per hundred holes.

The plants cost 6s. per hundred plants for procuring, and were gathered under the direction of an experienced gardener, who has devoted some time to attaining a knowledge of his business.

The cost for cartage varied from 5s. per hundred plants to 1s. 6d. per hundred, according to distance, costing for the 75,000 plants, £123.

In selecting the plants all plants which would throw out seed stems were rejected, or will have to be replaced at the contractor's expense.

The sorts planted consist of the following:—

Oue.	Red edge.
Atiraukawa.	Light bronze edge.
Huhiroa.	Black narrow edge.
Korako.	Black edge, light colour in back of leaf.
Atewhiki.	Scarlet edge.
Tihore.	Orange edge and keel.

The planting of the 25 acres, including the digging the holes, procuring and planting and cartage, but exclusive of clearing and fencing, amounts to about £467, or £18 13s. 6d. per acre.

VI.—CANTERBURY FLAX ASSOCIATION.

An application to the Hon. Colonial Treasurer from the Canterbury Flax Association having been referred to the Commissioners, the following reply was transmitted:—

(No. 13.)—Chairman to Hon. Secretary Canterbury Flax Association.—30th November, 1870.

Your letter of the 16th September, 1870, addressed to the Hon. Colonial Treasurer, requesting that a grant of £200 may be made to the Canterbury Flax Association, to enable them to assist inventors of new or improved flax machinery, having been referred to the Flax Commissioners, I have the honor to inform you that the Commissioners find the funds at their disposal to be so limited that they cannot give assistance of this general nature to local associations; but, should application be made to them in any particular case, they will be glad to take it into their consideration.

(No. 14.)—Secretary Canterbury Flax Association to Chairman.—19th December, 1870.

During the last session of the General Assembly a suggestion was made by Mr. Macandrew that the Government should offer a reward of £5,000 for separating the gum from the flax, would you kindly inform me whether the General Assembly authorized any such reward; if so, what amount was agreed to?

I find from the instructions issued to the Flax Commissioners, that a portion of their duties will be to visit the chief districts in the Colony where flax fibre is prepared; and as I presume Canterbury is comprised in their programme, the Commissioners may rest assured that every attention will be paid to them on their visit here by the Committee of this Association.

(No. 34.)—CHAIRMAN to HON. SECRETARY Canterbury Flax Association.—27th December, 1870.

In reply to your letter of 19th instant, I have to inform you that no reward was authorized to b^{e} offered for removing the gum from the flax; the suggestion to that effect, to which you refer, having merely been made in debate.

With regard to the latter part of your letter, the Commissioners intend that one of their number will visit the Canterbury flax districts during the summer, who will be glad to avail himself of the assistance kindly offered by your Committee.

(No. 90.)—HON. SECRETARY Canterbury Flax Association to CHAIRMAN.—19th June, 1871.

As the Committee of the Canterbury Flax Association have leased one acre of land for the purpose of experimental flax growing, which it is proposed to subdivide into four equal sections, one-fourth of which it is intended to plant with fiax, the produce of this Province, and the remaining three sections with the best fibre-producing plants procurable from other districts. I have the honor to request that the Flax Commission will assist the efforts of the Association in this matter, by furnishing them with a sufficient quantity of plants of the best known varieties suitable for the purpose. Whatever steps the Flax Commission may think proper to take in the matter, it should be an instruction to have the plants very carefully lifted, and properly packed for transmission to Lyttelton.

Trusting that this request will receive early attention.

(No. 108.)—CHAIRMAN to HON. SECRETARY Canterbury Flax Association.—23rd June, 1871.

In reply to your letter of 19th instant, I beg to inform you that the Government are now concluding the purchase of a flax nursery at New Plymouth, and if you will be good enough to inform the Commissioners how many plants you desire to have, and at what time you will be ready to receive them, they will have great pleasure in directing their shipment from Taranaki to your address at Lyttelton.

No. (93.)—HON. SECRETARY Canterbury Flax Association to the CHAIRMAN.—30th June, 1871.

Referring to your letter of the 23rd instant, I am instructed by the Committee to make application for about 300 or more flax plants, and also to convey their thanks for the readiness with which the Flax Commission has complied with their wishes on the subject.

I presume due notice will be given of the shipment of the plants.

VII.—CATALOGUE OF THE SAMPLES OF FIBRES AND MANUFACTURED ARTICLES PREPARED FROM THE PHORMIUM TENAX, EXHIBITED BY THE FLAX COMMISSIONERS IN THE COLONIAL MUSEUM, WELLINGTON, AUGUST, 1871.

THIS Exhibition was organised in accordance with a resolution of the House of Representatives, of 2nd September, 1870, directing "that samples of all varieties of flax fibre prepared in the Colony, and in England, should be exhibited in Wellington during the next sitting of the Assembly."

ANALYSIS.

A.—NATIVE FIBRES.

CLASS I.—*a.* Live plants and seeds.
b. Diagrams, showing the structure of the plant.

CLASS II.—Machine-dressed fibre.
a. Ordinary machine-dressed.
b. Prepared by special processes.
c. Collection of 1870.
d. Samples sent specially for exhibition.

CLASS III.—Native-dressed fibre.

CLASS IV.—Manufactures.
a. Native:—
Garments.
Floor, and Sleeping Mats.
Baskets and Kits.
Ropes, &c.
Fishing gear.
Dyed flax.
Barks used in dyeing.
Miscellaneous.
b. European:—
Ropes, Twine, &c.
Miscellaneous.

CLASS V.—*a.* Broker's classification of fibres.
b. Samples of flax sold in London, with prices attached.

B.—FOREIGN FIBRE, &c.

CLASS VI.—*a.* Museum collection.
b. Sample bales of those fibres which compete with New Zealand flax in the English market.
c. Other fibres.
d. Ropes, &c.

CLASS I.

A.—Live Plants and Seeds.

Series of plants in tubs, showing the chief varieties of the *Phormium tenax* distinguished by the Natives. Collected for the Commissioners by Mr. W. K. Hulke, Taranaki. The names and descriptions are chiefly by Mr. T. Kelly, M.H.R.—(See Report Flax Commissioners, 1870.)

1. *Atewheke,* Bay of Islands.—This plant is easily distinguished; the leaf is narrow, has a reddish tinge, and a narrow line of bright scarlet on the edge and keel; the fibre is very white.
2. *Oue.*—This leaf is narrow, of an olive green, and the edge and keel orange-coloured.
3. *Rataroa.*—Taper, acuminate, bronzy-green leaf, dark purple keel and edge, fading on upper side.
4. *Raumoa.*—Light green leaf, reddish brown keel and edge on upper side; narrower underneath.
5. *Ngutunui.*—The leaf stands erect, has a brown edge, a blunt point, and is red at the butts when split.
6. *Tarariki.*—Tapering acuminate leaves of a dull olive green, lighter on the under side. Dark red keel and edge, the latter gradually shaded away, forming a coloured band $\frac{1}{8}$ to $\frac{3}{8}$ inch broad on the upper side. Two or three inches of the points of the leaves of the same dark colour.
7. *Parekoritawa.*—This is a very beautiful plant; the leaf is of a bright green, striped longitudinally by a sulphur colour; the edge and keel is of an orange colour. This is a sport, as some of the leaves of the plant are often found green or very partially striped; the fibre is very good.
8. *Atiraukawa.*—This plant is said by the Natives to produce the best and most abundant fibre; it is not large as compared with *Huhiroa,* but it is said to be a quick grower. The leaf is inclined to bronze colour when at maturity, when young of a bright olive green; the young leaf is Gothic pointed, and the edge of a dull dark brown, a shade lighter on the inner margin; sometimes leaves are seen with the brown relieved by a bright red line.
9. *Tutaewheke.*—Leaf streaky bronze colour, black keel and edge, shaded on the upper side.
10. *Variegated.*—Thames.—Like No. 7.
11. *Taiore,* Opunake.—Is abundant in the Opunake district; the leaf is a light green, and has a wide black edge; it is easily distinguished.
12. *Takaiapu.*—The leaf stands erect, has a brown edge; the fibre is very strong, and is used by the Natives for making fishing lines.
13. *Tito-o-moe-wai,* Opunake.—Has a long red-edged leaf, the point of which falls over.
14. *Huhiroa.*—This plant has a blueish green-coloured leaf, which narrows gradually to the point, and a narrow edge of black or very dark brown; the keel has a reddish chocolate colour; it grows very luxuriantly and produces good fibre; it is easily separated from the green gummy matter by the Native process of stripping.
15. *Tihore,* Auckland.—Same as that from the Waikato.
16. *Tihore.*—Cultivated flax from a Native plantation in the Waikato, per Captain Hutton.
17. *Rataroa,* Auckland.—From a plantation established by Bishop Selwyn about 1851, from plants got in East Cape District, per Colonel Haultain.

Seedlings reared in the Colonial Botanic Gardens from seed supplied by Mr. T. Kelly, M.H.R.:—

18. *Atiraukawa.*
19. *Korako.*
20. *Variegated.*
21. *Raumoa.*
22. *Takaiapu.*
23. *Manunu.*
24. *Huhiroa.*
25. *Parekoritawa.*

26. New dwarf variety of *variegated* flax from Auckland.—Exhd. by Lady Bowen.
27. *Variegated* flax.—Exhibited by Mr. A de B. Brandon, M.H.R.
28. *Aspidistra lurida*, China.—Exhibited by Mr. G. Hall.
29. *Ti-tawhiti*, edible cabbage tree. *Cordyline* (species), per Hon. W. D. Mantell.
30. *Ti-rauriki. Cordyline pumili*, do.
31. Leaf of aloe. *Agave americana.*
32. Seeds of *Phormium tenax* (New Zealand Flax).

CLASS I. B.—Diagrams.

Diagram A.—Section of compound rhizome or prostrate stem of *Phormium tenax*, showing—

a. Main axis or central stem, from which a flower stalk (the terminal axis of the plant) has been given off at *b.*

c. Lateral shoots forming new leaf buds, and ultimately fans that accumulate nourishment at the base of their leaves, throw out rootlets and finally become independent of the parent plant, as at *d.*

e. First stage of buds from which lateral shoots spring.

Diagram B.—Section of root of *Phormium tenax* in best condition for transplanting showing—

a. mass of fibrous, starchy and resinous matter accumulated for the nourishment of the future flower-stalk and lateral buds.

b. Cortex layer, formed from the bases of the old leaves.

c. Rootlets.

Diagram C.—Underground stem of *Manunu* (one of the best varieties of *Phormium tenax*) showing—

a. Main axis that has flowered and completed its life.

b. Lateral shoot by which the life of the plant is continued.

Diagram D.—Sections showing the microscopic structure of the leaf of the *Phormium tenax*, by T. Nottidge, Esq.—

a. Bundle of fibre.

b. Cellular tissue containing chlorophyle, &c.

c. Polished upper surface of leaf.

d. Spiral tissue.

Diagram E.—Sections showing the microscopic structure of the leaf of the *Phormium tenax*, by Dr. Knight.

Diagram F.—Showing the way in which different samples of flax broke.

Diagram G.—Sections showing the microscopic structures of the leaf of the *Phormium Tenax*, by Captain F. W. Hutton:—

Fig. I. Half of young leaf x 16.
II. Portion of leaf when one inch in length x 25.
III. End of fibre x 300.
IV. Section through butt x 3
V., VI., VII. } Portions of fig. IV. x 34.
VIII. Section of leaf x 34.
IX. Margin of leaf x 34.
X. Section of vascular bundle and cellular tissue with passages at base of leaf x 34.
XI. Section of part of a bundle of fibres.

CLASS II.

MACHINE DRESSED FLAX.

Northern District.

A.—Ordinary Machine-dressed.

1. Joseph Thompson, Queen's Redoubt, Waikato. Hank from bale sold by auction at Auckland. Average strength, 83.
2. Bates & Dunn, Waikato. Hank from bale sold by auction at Auckland. Average strength, 80.
3. Drumgool, Tuakau. Hank from bale exported to Sydney. Price paid in Auckland, 1871, £15 to £17 per ton. Average strength, 79.
4. Holmes & Crisp. Hank from bale sold by auction at Auckland, 1871. Average strength, 79.
5. Thompson Brothers, Waikato. Hank from bale sold by auction at Auckland, 1871. Average strength, 75.
6. Thompson Brothers, Waikato. Same as No. 7, but hackled.
7. Thompson Brothers, Waikato. Hank from bale sold to Mr. Neil Lloyd for rope-spinning. Price £20.
8. D. Burnside, Drury. Hank from bale sold by auction at Auckland. Average strength, 74.
9. Webster, Hokianga. Hank from the mill. Average strength, 60.
10. G. Twidle, Pukekohe, Auckland. Wet-scutched. Hank from bale sold by auction in Auckland for £21, in May, 1871.
11. G. Twidle, Pukekohe, Auckland. Hank from bale sold by auction in Auckland for £16, in November, 1870. Average strength, 64.
12. T. Macffarlane, Auckland, Dry-scutched. Hank procured at the mill. Actual cost, £16 per ton, delivered in Auckland. Water power. 20s. to 25s. per ton paid for the green leaf.
13. T. Macffarlane, Auckland. Same as No. 12, but wet-scutched. Hank procured at the mill. Average strength, 64.
14. Hamlin, Waiuku. Hank procured at the mill. Stripped with Price's machine. Average strength, 73.
15. J. Wallace, Wairoa. Hank from bale sold by auction at Auckland for £21, in February, 1871. Average strength, 75.
16. J. Jenkins, Point Russell. Hank from bale sold by auction in Auckland. Average strength, 73.
17. Mellsop, Waiuku. Hank from the mill. Made from 18 months old flax. Stripped with Price's machine, improved by Dugald. £20 a ton in Auckland would give a fair profit. Average strength, 71.
18. Thompson, Waikato. Hank from bale sold by auction at Auckland, for £16 10s., in November, 1870. Average strength, 70.
19. Bell, Ngaruawahia. Hank from bale sold by auction at Auckland, for £20. Average strength, 69.
20. Walker & Douglas, Waikato. Hank from bale sold by auction at Auckland, in November, 1870. Average strength, 67.
21. Richmond Flax Company, Whakatane, Bay of Plenty. Prepared from *Oue.* Average strength, 64.
22. Richmond Flax Company, Whakatane, Bay of Blenty. Scutched with great care, at a cost of £10 per ton. Eight or nine tons of leaf required for one of fibre. Cost not less than £30 a ton. Hank from bale sent to England by Commissioners per "Queen Bee." Average strength, 80.
23. Richmond Flax Company, Whakatane, Bay of Plenty. Same as No. 22, but not so much scutched. Six tons of leaf required for one of fibre. Cost about £24 per ton. Hank from bale exported to London in "Queen Bee," 1871. Average strength, 60.
24. Scherff, Waikato. Hank from bale sold by auction at Auckland for £21. Average strength, 64.
25. Miss Cox, Mauku. Hank from bale sold by auction at Auckland, 1871. Stripped with Price's machine. Average strength, 63.
26. J. Dickey, Auckland. Hank from bale sold by auction at Auckland, 1871. Average strength, 65.
27. Walter Runciman. Hank from bale sold by auction at Auckland, 1871. Average strength, 80.

28. Dugald, Waikato. Hank from mill. Stripped with Price's machine, improved by Dugald. Chiefly long swamp flax. Actual cost of fibre delivered in Auckland, £16 per ton. Average strength, 74.
29. Jenkins, Mere-mere. Hank from bale sold by auction at Auckland, 1871. Average strength, 61.
30. Constable, Waiuku. Sample from the manufacturer (not taken from the mill). Average strength, 57.
31. H. Williams, Waiuku. Hank from bale sold by auction at Auckland, February, 1871. Average strength, 64.
32. Matthews and Butler, Mongonui. Hank from bale sold by auction at Auckland for £11 on 5th May, 1871.
33. Sinclair, Riverhead. Wet-scutched. Hank from bale exported to Sydney. Price in Auckland, £20. Average strength, 65.
34. Vause, Raglan. Hank from export bale. Average strength, 53.
55. Leitham, Pokeno. Hank from bale sold by auction at Auckland in February, 1871. Average strength, 56.
56. Albert Potter, Henderson's Mill, Auckland. Not scutched—put through stamping-machine. Sample procured at the mill. It requires eight tons of leaf to make one of fibre. Average strength, 76.
37. J. Clarke, Waikato. Hank from bale sold by auction at Auckland.
38. Riverhead Mill. Ordinary machine dressed.
39. F. W. Hutton, Waikato. Not scutched. Made from common swamp flax. Price in London, £19. Average strength, 70.
40. Reed, Waiuku. Hank from bale sold by auction at Auckland, February, 1871.
41. Murray, Mauku. Procured at the mill. Not scutched. Sells for £20 at Auckland when finished. Stripped with Price's machine. Seven tons of green leaf to one of fibre. Actual cost, £19 a ton, delivered in Auckland. This includes 30s. a week for rent of mill. Green leaf, 22s. a ton.
42. Murray, Mauku. Sample showing fibre contained in immature leaf, rejected at the mill as too short and weak.
43. Dixon, Hokianga. Hank from parcel sent to Lloyd's mill to be hackled. Valued at £12 or £13. Average strength, 55.
44. Dugald, Waikato. Hank from bale sold by auction at Auckland for £22. Stripped with Price's machine (improved). Actual cost, delivered in Auckland, £16 per ton. Cost of green leaf, 16s. per ton, but wages below the average. Average strength, 70.
45. Dugald, Waikato. Hank from bale sold by auction in Auckland, February, 1871. Similar to 44. Average strength, 73.
46. G. Twidle, Pukekohe. Wet-scutched. Hank from bale sold by auction at Auckland, 1871. £22 a ton.
47. Walker and Douglas, Waikato. Hank from bale sold by auction at Auckland, February 1871.
48. Hamlin Brothers, Waiuku. Hank from mill. Stripped with Dugald's improved Price's machine. Average strength, 77.
49. Richmond Flax Company, Whakatane, Bay of Plenty. Rolled, prepared in 12 hours; bleached with sulphur fumes. Average strength, 48.

CENTRAL DISTRICT.

50. Rees & Richardson, Rangitikei. Sample from the manufacturer. Prepared from leaf three years old. The flax is classed for age and length; passed through Gibbon's or Price's machines; dry and wet-scutched; then passed through rollers weighted to three tons; bleached, again scutched and baled.
51. Rees & Richardson, Rangitikei. Prepared from leaf two years old. Sample from the manufacturer. Same process as No. 50.
52. Rees & Richardson, Rangitikei. Sample from the manufacturer. Prepared from leaf six months old. Same process as No. 50.
53. Rees & Gibson, Rangitikei.
54. Rees & Gibson, Rangitikei.
55. Nelson Brothers, Napier. From a bale as exported. Stripped with Price's machine and squeezed between wooden rollers. Steam Power. Actual cost delivered in Napier about £16 per ton. Cost of cutting green leaf, 12s. per ton.

56. Nelson Brothers, Napier. Hank from the mill, showing first part of process, stripped and rolled.

57. Nelson Brothers, Napier. Hank from the mill, showing second part of process, bleached in the sun.

58. Nelson Brothers, Napier. Hank from the mill, showing third part of process. Scutched. Cost of manufacture, £16 per ton.

59. Nelson Brothers, Napier. Hank from the mill same as No 58, but hackled. Cost of manufacture, £23 per ton, and value of tow, £12. Twelve tons of green leaf gives one ton of fibre and one ton of hackled tow. Price's machine.

60. Nelson Brothers, Napier. Hank from the mill. Twice stripped and bleached in the shade.

61. Opunake Flax Company. Hank from the mill, where Price's, Gibbon's and Murray's machines are all in use. Seven tons of green leaf required for one of fibre. Average strength, 73.

62. Cape Egmont Flax Company, Opunake. Hank from the mill. Price's, and Fraser & Tinne's machines. Water-power. Seven tons of green leaf to one of fibre. Cost of manufacture about £16 per ton. Average strength, 73.

63. Scrivener, Wanganui. Hank from bale sent to England by the Commissioners for experiment. Price paid, £20 in Wanganui. A three-horse machine supplies the power. Price's machine. Average strength, 78.

64. Musson, Wanganui. Wet-scutched. Bleached in four days. Hank from the mill. Price's, and Fraser's and Tinne's machine.

65. Rees & Gibson, Rangitikei. Milled, dry and wet-scutched and rolled. 2nd quality cost £15 per ton. Price's and Gibbon's stripping machines. Hank from the mill.

66. Rees & Gibson, Rangitikei. Worth £28 to £32 in London. Average strength, 64.

67. RG in diamond, B. Hank from export bale. Per Messrs. Levin & Co.

68. RG in diamond, C. Hank from export bale. ,,

69. FT. Hank from export bale. ,,

70. JG in diamond. Hank from export bale. ,,

71. F in circle. Hank from export bale. ,,

72. CHB in diamond. Hank from export bale. Average strength, 66. ,,

73. Cornelius Murphy, Blenheim. ,,

74. J. S. M. Jacobsen, Nelson. Average strength, 53.

75. M. Hank from export bale. Average strength, 61.

76. Cyrus Goulter, Wairau, Marlborough. "Average of best quality." A parcel of this brand stated to have sold for £35 in London, in 1871.

77. Logan & Sinclair, Kaituna, Marlborough. Prepared from young leaf, centre shoot. Average strength, 83.

78. Logan & Sinclair, Kaituna, Marlborough. Sample bale from parcel exported to England. Average strength, 84.

78a. Logan & Sinclair, Kaituna, Marlborough. Hank from the mill.

79. F. Harrison, Paki-paki, Hawke's Bay, per Messrs. Kinross. Average strength, 68.

80. Joshua Cuff, Wairoa, Hawke's Bay. Average strength, 63.

81. Grover, Wanganui. Hank from the mill. Wet-scutched. Prepared from young leaf. Price's machine.

82. C anchor E. Hank from export bale, per Messrs. Levin & Co. Average strength, 76.

83. O in diamond. Hank from export bale. Average strength, 83.

SOUTHERN DISTRICT.

84. Benn & Walker, Canterbury. Hank from the mill. Short fibre. Hackled from the tow produced in scutching.

85. Benn & Walker, Canterbury. Hank from the mill. Wet-scutched. Steam power. Cost of cutting green leaf, 12s. per ton. Cost of manufacture, about £18 per ton. Five and a half to six and three quarter tons of green leaf to one of fibre, according to the variety used. Price's machines.

86. Ashley Gorge Mills, Canterbury. Hank from bale sold to Lennon & Co., rope-spinners. Price's, Fraser & Tinne's and Anderson's machines. Six tons of green leaf to one of fibre. Cost of manufacture, about £16 11s., besides £2 per ton for carting to Lyttelton. Steam power.

87. Ashley Gorge Mills, Canterbury. Hank from bale sold to Lennon & Co., rope-spinners. Hackled for rope-spinning.
88. Ensor, Canterbury. Hackled and soaked in warm water.
89. Stonyer & Co., Canterbury. Prepared and sold in London in 1869 for £36.
90. Stonyer & Co., Canterbury. Hank from the mill. Twice stripped and scutched. Water-power. Anderson's stripping machine. Seven and a-half tons of green leaf to one of fibre. Cost of manufacture, about £16 per ton.
91. Stonyer & Co., Canterbury. Twice stripped. Not scutched.
92. Stonyer & Co., Canterbury. Sample from the bale which took the first prize of the Canterbury Flax Association, 1870.
93. Stonyer & Co., Canterbury. Sample from the bale which took the second prize at the Canterbury Flax Association, 1870.
94. Stonyer's Mill, Canterbury. Per Major Gray. Average strength, 65.
95. Reed, Waihola, Otago. Hank from export bale.
96. Blueskin Mills, Dunedin. Hank from the mill. Steam-power. Kincaid and McQueen's stripping machines. Six and a-half to seven tons of green leaf to one of fibre. Cost of green leaf, 18s. per ton. Cost of fibre, delivered in Dunedin, £16 10s. per ton.
97. Bell, Blueskin, Otago. Hank from export bale.
98. Souness, Dunedin. Hank from the mill. Kincaid and McQueen's stripping machines.
99. Fraser, Dunedin. Hank from export bale.
100. Miller, Dunedin. Hank from export bale.
101. M'Gill, Molyneux. Hank from export bale.
102. Sample of first quality exported for American market by Messrs. Bates, Size & Co., Dunedin.
103. Sample of second quality exported for American market by Messrs. Bates, Size & Co Dunedin.
104. J. M. Menzies, Southland. Ordinary unscutched. Sample from manufacturer.
105. J. M. Menzies, Southland. Ordinary scutched. Sample from manufacturer.

Exhibited by the Canterbury Flax Association.

107. Isaac Wilson, Rangiora.
108. Benn & Walker. Agricultural Show, 1870. First quality; twice through the stripper; not hackled.
109. Benn & Walker. Agricultural Show, 1870. First quality; twice through the stripper; not hackled.
110. Benn & Walker. Agricultural Show, 1870. Second quality; once through the stripper; not hackled.
111. Benn & Walker. Through Price's stripper; water-scutched; bleached on the ground.
112. Benn & Walker. Through Price's stripper; water-scutched; bleached on poles.
113. Styx Mills. £22 a ton.
114. Styx Mills, Not hackled.
115. Richardson & Co. Ashley Gorge.
116. Richardson & Co. Ashley Gorge.
117. Richardson & Co. Ashley Gorge.
118. Exhibited at the show by Loughnan & Co.
119. Stonyer & Co., Ohoka Mills. Twice through the stripper; soaked one hour; scutched and hackled.
120. Stonyer & Co., Ohoka Mills.
121. Booth.
122.
123.
124.
125.
126.
127.
128. Rough hackled by Lennon & Co.
129.
130. Eckersly & Co. Flaxton.
131. Merton. Dumerque's Mill, Cust Valley.

132. C. Dumerque, Cust Mill. Stripped once; washed in breast of water-wheel; steeped three days and scutched. Cost of manufacture, £13 per ton.
133. A. & E. Brown, Mount Thomas.
134. Cooper & Co., Oxford.
135. Stonyer & Co., Kaiapoi. Twice through Price's machine; washed; dried on lines; not scutched.

Samples in Bulk.

136. Logan & Sinclair, Kaituna, Marlborough. Bale sent from England to show the qualities most in demand. Price of this sample in London in February, 1871, 39s. per cwt.; auction price of this brand in London, 24 January, 1871, £36 10.
137. Rees & Gibson, Rangitikei. Bale sent from England to show the qualities most in demand. Price of this sample in London, February 1871, 33s. per cwt.; auction price of this brand in London, January 1871, £32 10s.
138. F. W. Hutton, Waikato. Sample bale of bulk sent to England for experiment.
139. Scrivener, Wanganui. Sample bale of bulk sent to England for experiment
140. Benn & Walker, Canterbury. Sample bale of bulk sent to England for experiment.
141. A. P. Seymour, Wairau, Marlborough. Sample bale of bulk sent to England for experiment.

QUANTITY OF NEW ZEALAND FLAX OF THE FOREGOING QUALITIES EXPORTED.

1868	... ...	534 tons.
1869	... ...	2,027 „
1870	... ...	5,470 „

Average price in London for year ending May, 1871, £23 8s. per ton.

CLASS II.

B.—FLAX DRESSED BY SPECIAL PROCESSES.

1. Bentham, Wellington. Machine-dressed. The colour, which is of a distinct brown shade, seems to indicate that some chemical has been employed in the process.
2. James Dunn, Wellington. No water applied. Finely divided; colour, greenish; soft, cottony, but only half clean. Yarns spun from it also shown.
3. do. do.
4. J. S. M. Jackson. Prepared for linen; hardly differs from ordinary machine-dressed. Sample per Johnston & Co.
5. Macfarlane & Co. New process; three days drying; harsh and half-dressed.

5*a*. Exhibited by Major Gray. Retted.

6. H. H. Coggins, Oamaru. Resembles Native dressed.
7. Rikys, Wellington. Prepared by chemicals; June, 1870. Per Hon. W. B. D. Mantell.
8. Bertram, Wanganui. Special process; like ordinary machine-dressed, but soft and lustrous.
10. Noding. Boiled in soap and water two hours, then put through Noding's machine. Also, sample of Manilla, half in state as received; half partially cleaned by Noding.
11. Wai-nui-omata. Steamed. Harsh, bright, half-cleaned.
12. Rees & Gibson, Rangitikei. Stripped; soaked in boiling water a few minutes; rinsed in cold water; bleached in the sun four or five days, and scutched.

12*a*. Steamed for twelve hours and rolled; scutched before dry; bleached with chlorine, and dried in three or four hours; then scutched. Cost about £30.

13. Rees & Gibson. Per Messrs. Levin & Co.
14. Rees & Richardson. Steamed and rolled. 10th August, 1871.
15. Ollivier. Process not disclosed. Bright; white; strong.
16. Ollivier. *Tukura.*

17. J. C. White, Auckland. *Rataroa.* Not soaked; merely brushed and stripped. White's machine used.
18. J. C. White, Auckland. *Rataroa.* Soaked in running water five hours before being hung up to dry.
19. Ensor Brothers, Canterbury. Boiled. Price in Christchurch, £25 a ton. Colour bad, but otherwise good.
20. Ensor Brothers, Canterbury. Boiled. Price in Christchurch, £20 a ton.
21. Richmond Flax Company, Matata, Bay of Plenty. Stripped; washed; passed twice through india-rubber rollers, with a pressure of one ton; bleached in sulphur fumes two hours; sun dried and scutched. Cost about £20, delivered in Auckland.
22. Richmond Flax Company, Matata, Bay of Plenty. Stripped; washed; sulphured four hours; sun dried and scutched. Cost about £20 a ton, delivered in Auckland.
23. Chatham Islanders. Hand-dressed, and scutched afterwards. Exhibited by Canterbury Flax Association.
24. W. Skey, Wellington. Hand-dressed. Scraped with a knife and washed keeping it constantly wet until the operation was finished. No chemicals used.
25. A. R. Menzies, Southland. Prepared from cabbage tree.
26. A. R. Menzies, Southland. Prepared by new process.
27. A. R. Menzies, Southland. Tow from No. 26.
28. W. T. L. Travers, Wellington. Boiled; passed through grooved rollers and running water and dried.
29. Ensor, Canterbury. Yarn; dressed at a less expense of £3 8s. than the ordinary process:—

Drying Ground, per ton	£2	0	0
Scutching	1	0	0
Baling, Iron, Canvas	0	6	0
Freight	1	0	0
Extra Expense—	4	6	0
1 ton Green Leaf	0	18	0
	£3	8	0

30. Enson, Canterbury. Yarn. do. do.

CLASS II.—c.

Collection of 1870.

Extract from Report of Dr. Hector.

1-70. Russian hemp, clean and long; average strength, 96.
2-70. Manilla, very fine sample. Average strength, 100.
3-70. Maori dressed; half a hank; length, 4 feet; uniformly white, with silky lustre; fibre, downy. Microscopic—fibres free, rough in outline, form adherent, cellular tissues; fasciculus broken up. Average strength, 101.
12-70. Prepared by a steaming process; small hank; length 6 feet; colour red at base, yellowish white at tips; soft and flexible, but the sample appears to have been rubbed; fibres moderately downy; very free from boon; lustre deficient. Microscopic—Fibres free and hair like; fasciculus broken up; no adherent tissue. Average strength, 63.
13-70. Prepared by modified retting process; small hank, length 4 feet; greenish; flexible but harsh with little lustre; fibres downy; no boon. Microscopic—Fibres straight and adherent, rough by the attachment of dark bands of connective tissue. Average strength, 51.
14-70. Scraped by machinery and soaked; very small sample; length 3 feet; tips and buts cut off; soft, flexible and downy, but deficient in lustre. Microscopic—Fibres broken into short lengths; not free; rough from adherent tissue. Average strength, 72.
15-70. Machine dressed, and then treated with chemical reagents; very small samples; soft but dull, like cotton waste. Microscopic—Fibres divided freely; very flexible, but breaks short, with ragged ends. Average strength, 47.

16-70. Passed through the stripping machine, steeped, sweated, and scutched; one hank, length 7 feet; very bright and soft; white, with a gray tint; glossy; fibres downy. Average strength, 88.

17-70. Prepared from dried flax straw (chemically) in London in 1869, and valued by Messrs. Noble at £35 per ton; small sample cut to a short length; soft, dull, even in quality; dark green, gray. Microscopic—Fibres free, but arranged in non-adherent bundles; tubular structure of the minute fibres preserved; no connective tissue. Average strength, 79.

21-70. One hank; length 5 feet; colour, reddish yellow, bright but harsh; young flax. Microscopic—Fibres adherent, drawing out slightly, but at last breaking short; band of connective tissue adherent. Average strength, 72.

22-70. One hank; length, 9 feet; colour, reddish, bright, but harsh; breaks short. Average strength, 70.

23-70. One hank; length, 4 feet; colour, yellowish white; bright and soft, but great difference in the fibre from the butt and that from the tip, which is like tow; breaks short. Microscopic—Fibres adherent, breaking short in bundles of five or six fibres; cross-barred by tissue. Average strength, 68.

24-70. One small hank, unscutched; length, 9 feet; colour, reddish yellow; fibres unequal in size, bright, but harsh; breaks short, without down. Microscopic—Fibres adherent; snaps in bundles, with cross-bands of connective tissue. Average strength, 67.

25-70. Half-hank; length, 6 feet; colour, reddish; soft and bright, but unequal; breaks short, without down. Average strength, 63.

26-70. Small hank; length, 4 feet; colour, red; harsh, and unequal; not well scutched; larger fibres divide freely. Microscopic—Fibres adherent; breaking short in large bundles. Average strength, 58.

27-70. Half-hank; length, 6 feet; colour, yellowish white; bright, but slightly harsh; breaks short. Average strength, 54.

28-70. Half-hank; length, 5 feet; colour, pale reddish yellow; fibres coarse, downy, but do not divide freely. Microscopic—Fibres adherent, and break short in bundles, but they pay out along the sides; much connective tissue. Average strength, 54.

29-70. One hank; length, 6 feet; colour, reddish yellow; harsh, unscutched, breaks short. Microscopic—Adherent in granular bundles, which break short in unequal lengths. Average strength, 51.

31-70. Fourteen hanks; length, 6 feet; colour, reddish yellow; bright, but stiff; quality, unequal in the length; breaks short. Average strength, 88.

32-70. Small sample, in short length; white, transparent, and flexible, in hair-like fibres, which fluff in breaking. Average strength, 77.

33-70. Small sample; length, 6 feet; colour, reddish white; bright, and soft tips; breaks short, but splits. Average strength, 77.

34-70. Small hank; length, 6 feet; colour, white, with red stains; bright, but harsh and stiff; breaks short. Average strength, 76.

35-70. Half-hank; unscutched (?); length, 5 feet; colour, reddish; harsh, breaks short. Microscopic—Fibres adherent in granular bundles, which break short across. Average strength, 76.

36-70. Half-hank; length, 6 feet; colour, reddish yellow; bright, but harsh; breaks short. Microscopic—Fibres adherent in bundles, which snap across; much adherent tissue. Average strength, 75.

37-70. Small sample; short lengths; colour, greenish yellow; soft, but coarse, and unequal in the length. Average strength, 73.

38-70. Fifty pounds weight; length, 5 feet; colour, reddish yellow; light and equal, but great difference between the fibre of tips and butts; breaks short in slender fibres, but no down. Microscopic—Fibres adherent in small granular bundles, but snap across. Average strength, 72.

39-70. Small hank; length, 6 feet; colour, reddish yellow; bright, harsh, breaks short without down. Microscopic—Fibres adherent in small bundles, which are coated with granular tissue. Average strength, 63.

40-70. One hank; length, 6 feet; colour, reddish yellow at butt, greenish yellow at tips; very bright, and soft; breaks short. Microscopic—Fibres adherent; breaks into short lengths, with bands of connective tissue. Average strength, 63.

41-70. Unscutched—one hank; length, 6 feet; colour, red; very harsh; brittle, but strong on a straight pull. Average strength, 82.

42-70. One hank, length 4 feet; colour, pale yellow; bright and soft; divides freely in breaking. Microscopic—Fibres free, but breaks into short lengths. (Young flax steeped?) Average strength, 71.

43-70. Hackled; length, 5 feet; colour, reddish; moderately harsh, but has been rubbed; divides freely but breaks short. Average strength, 70.
44-70. Scutched. Average strength, 78.
45-70. Second cutting. Average strength, 59.
46-70.
47-70. Fermented. Average strength, 72.
48-70. Steamed. Average strength, 84.
49-70. Hand dressed. Average strength, 92.
50-70. Natives, Wainui. Hand-dressed.
51-70. Nelson Brothers, Napier.

CLASS II.—D.

Samples sent for Exhibition.

1. Richmond Flax Company, Matata, Bay of Plenty. Stripped in Gibbon's machine; washed; passed through india-rubber rollers; again washed; bleached in sulphur fumes three hours; sun dried and scutched; cost about £20 delivered in Auckland.
2. Richmond Flax Company, Matata, Bay of Plenty. Stripped in Gibbon's machine; washed; bleached in sulphur fumes two hours; dried in the sun six or eight hours and scutched; cost about £20 delivered in Auckland.
3. Richmond Flax Company, Matata, Bay of Plenty. Washed, sulphured, and scutched.
4. Richmond Flax Company, Matata, Bay of Plenty. Washed, sulphured, and scutched.
5. Logan & Sinclair, Kaituna, Marlborough. Specially prepared. Average strength, 78.
6. Logan & Sinclair, Kaituna, Marlborough. Specially prepared. Average strength, 89.
7. Souness, Dunedin.
8. Benn & Walker, Canterbury. Twice stripped; specially prepared.
9. Joshua Cuff, Wairoa, Hawke's Bay.
10. Urunui Mills. Machine-dressed; cultivated flax.
11. Blueskin Mills, Dunedin.
12. Keleher, Waiuku.
13. Sinclair, Kaukapakapa.
14. W. Reid, Tamahere Mills, Cambridge.
15. Albert Potter, Henderson's Mill, Auckland. Young flax.
16. Collins, Tuakau.
17. Constable, Waiuku. *Ngarowaka, a Tihore*; cultivated, two years planted; mill-dressed. Average strength, 61.
18. Constable, Waiuku. *Okaoka, a Tihore*; cultivated, two years planted; mill-dressed. Average strength, 76.
19. Constable, Waiuku. *Rataroa, a Tihore*; cultivated, two years planted; mill-dressed. Average strength, 83.
20. F. Harrison, Pakipaki, Hawke's Bay.
21. Campbell, Ashburton Mills, Dunedin.
22. Joshua Cuff, Whakaki, Wairoa, Hawke's Bay.
23. Nelson Brothers, Napier. Sample bale from the mill.
24. Hathaway, Wairau. Twice through Anderson's machine and dried in the shade
25. J. S. Macfarlane, Auckland. Hank from bale.
26. Hathaway, Wairau. Average of good dressed.
27. J. Journeaux, Canterbury. First-class; leaf nine months old; retted.
28. J. Journeaux, Canterbury. Second-class; leaf twelve months old; retted.
29. J. Journeaux, Canterbury. Third-class; full-grown leaf; retted. Average strength, 68.
30. Natives, Urunui; cultivated flax. Presented by Mr. Hulke.
31. A. P. Seymour, Wairau.
32. Ashley Gorge Mills, Canterbury.
33. Ashley Gorge Mills, Canterbury.
34. Dugald, Queen's Redoubt, Waikato.
35. John Lawrie & Sons, Karaka, Auckland.
36. G. Twidle, Pukekohe.

37. Norman Campbell, Havelock, Marlborough.
39. J. C. White, Auckland. *Rataroa*—stripped, and wet-brushed, hung out to dry, soaked in a tub five hours, the water being changed every half hour during that time, then hung up to dry. White's machine used.
40. Cape Egmont Flax Company, Opunake. Sample bale; wet-scutched; the ends hackled.
41. Constable, Waiuku. *Oka-oka*; whole and half-leaf. Price's machine used. Wet-scutched.
42. Constable, Waiuku. *Oka-oka*; half-leaf. Booth's machine used. Dry-scutched.
43. Ensor, Canterbury, from Canterbury Flax Association.
44. Ensor, Canterbury, from Canterbury Elax Association.
45. W. A. Fitzherbert, Wainui-o-mata; 6 feet long; about three years old. The leaves are sorted, put through Gibbon's machine, soaked in cold water one hour, soaked in hot water, 190° Fahrenheit, bleached from five to eight days, and scutched. Cost of preparation, £15 per ton. Fetches £25 in Melbourne.
46. W. A. Fitzherbert, Wainui-o-mata. Hank, 5 feet long; about three years old; same process as 45. Fetches £25 in Melbourne.
47. W. A. Fitzherbert, Wainui-o-mata. Hank, 4 feet long; about one year old. Same process as No. 45.
48. W. Fitzherbert, Wainui-o-mata. Hank, 2½ feet long; six to eight months old. Same process as No. 45.
49. W. A. Fitzherbert, Wainui-o-mata. A bundle of mixed lengths and ages. Same process as No. 45. Fetches £23 in Melbourne.
50. Souness & Taylor, Dunedin.
51. Campbell, Bros., Waikari, Otago.
52. J. Bell, Blueskin,
53. J. Miller, Silver-stream, Dunedin.
54. Constable, Waiuku. Bale containing *Rataroa, Oka-oka* and *Narowaka.* cultivated. 12 months old leaf; dressed in Price's three roller machine. Prepared in four days.
55. Constable, Waiuku. Made from *Ngarowaka*; the leaf split. Dressed by Price's three-roller machine. Prepared in four days.
56. Constable, Waiuku. Same as No. 41, but prepared from the whole leaf.
57. Constable, Waiuku. Same as No. 41. Unscutched.
58. Constable, Waiuku. Same as No. 41. Scutched.

CLASS III.

Native-dressed Flax.

1. Natives, Taranaki. Samples from several varieties—*Takaiapu, Tihore, Rataroa, Tarariki, Raumoa, Tutaewheke.*
2. Natives, Hawkes Bay.
3. Hone Pihama, of Oeo, Taranaki. *Atiraukawa.*
4. Hand-dressed, by a new and rapid process. Presented by Mr. Halcombe.
5. Natives, Lyell's Bay. Scraped with a shell.
6. Natives, Waikato, Taranaki, Wanganui, and Otaki. Various kinds of *Tihore.*
7. Ruakere, of Parihaka, Taranaki. *Atiraukawa*; also, the outer skin of the leaf, called *Pureki*, used in making mats.
8. Porikapa, of Kaihihi, Taranaki. *Atewheke*; scraped with a piece of iron hoop.
9. Natives, Taranaki. *Raumoa.* Presented by Mr. Hulke, New Plymouth.
10. Natives, Taranaki. *Huhiroa.* „ „
11. Natives, Urunui. *Arotara.* „ „
12. „ „ *Huhiroa.* „ „
13. „ „ *Raumoa.* „ „
14. „ „ *Oue.* „ „
15. Tahana of Hua, Taranaki. *Tipuna.*
16. Natives, Urunui. *Huhiroa.*
17. Karipa of Waiongona, Taranaki. *Ngutunui.*
18. Natives, Otaki. *Harakeke.* Scraped with a shell, and washed; price, 1s. a lb.
19. Natives, Otaki. *Harakeke.* Scraped with a shell, and washed; price, 1s. a lb.

20. Natives, Waikanae. Small samples from *Atiraukawa*, *Ngutunui*, *Rataroa*, *Turepo*, and *Atewheke*; not cultivated, but growing in the swamps and sand hills; scraped wet and dry.
21. Natives, Wanganui River. *Huhiroa.* Cultivated. It requires eight men to work for a week to produce a cwt. of this quality.
22. Natives, Wanganui River. *Mataroa.* Cultivated.
23. Natives, Waikanae. Sample of half-ton, ordered through Wi Tako.
24. Natives, Waikanae. Sample from parcel of seven cwt., obtained for export to England; price, 1s. per lb.
25. Natives, Taranaki. *Manunu.* Hand-dressed, oiled, and washed. Presented by Mr. Hulke.
26. „ „ *Taiore* „ „ „
27. „ „ *Takaiapu* „ „ „
28. „ „ *Atiraukawa* „ „ „
29. „ „ *Kowri* „ „ „
30. „ „ *Ngutunui* „ „ „
31. „ „ *Korako* „ „ „
32. „ „ *Raumoa* „ „ „
33. „ „ *Ngatotomawe* „ „ „
34. „ Opunake. *Tapoto*; price, 6d. a lb. Average strength, 101.
35. „ Raglan. *Tihore.* Average strength, 100.
36. „ Whakatane. *Paretaniwha*, cultivated. Average strength, 98.
37. „ Opunake. *Huhiroa*; 6d. a lb. Average strength, 98.
38. „ „ *Tiheru* „ „ 98.
39. „ „ *Kura* „ „ 96.
40. „ „ *Motuparera* „ „ 96.
41. „ „ *Ngutunui* „ „ 95.
42. „ „ *Taiore* „ „ 95.
43. „ „ *Atiraukawa* „ „ 92.
44. „ Whakatane. *Oue* cultivated „ 91.
45. „ Opunake. *Huru-huru-hika*, 6d. a lb. „ 90.
46. „ „ *Manunu* „ „ 90.
47. „ „ *Paheke* „ „ 87.
48. „ „ *Ngatotomawe* „ „ 84.
49. „ „ *Paretaniwha* „ „ 83.
50. „ „ *Parekoritawa* „ „ 79.
51. „ „ *Takaiapu* „ „ 76.
52. „ „ *Atewheke* „ „ 74.
53. „ „ *Hewara* „ „ 74.
54. „ „ *Raumoa* „ „ 74.
55. „ „ *Tarariki* „ „ 70.
56. Natives, Auckland. *Rataroa.* From St. John's College. Washed in warm water with soap; soaked twelve hours in cold water; immature leaf; centre shoot. Average strength, 104.
57. Natives, Auckland. *Rataroa.* From St. John's College. First pair of leaves. Average strength, 122.
58. Natives, Auckland. *Rataroa.* From St. John's College. Soaked in water four or five days; first pair of leaves. Average strength, 104.
59. Natives, Auckland. *Rataroa.* From St. John's College. Washed in warm water with soap; first pair of leaves.
60. Natives, Auckland. *Rataroa.* From St. John's College. Boiled in soap and water one hour; first pair of leaves.
61. Natives, Auckland. *Rataroa.* From St. John's College. Second pair of leaves. Average strength, 116.
62. Natives, Auckland. *Rataroa.* From St. John's College. Soaked in water four or five days; second pair of leaves. Average strength, 104.
63. Natives, Auckland. *Rataroa.* From St. John's College. Washed in warm water with soap.
64. Natives, Auckland. *Rataroa.* From St. John's College. Third pair of leaves. Average strength, 113.
65. Natives, Auckland. *Rataroa.* From St. John's College. Soaked in water four or five days; third pair of leaves. Average strength, 110.
66. Natives, Taranaki. *Rataroa.* Scraped and oiled, not washed. Presented by Mr. Hulke.

67. Natives, Taranaki. *Atewheke.* Scraped and oiled, not washed. Presented by Mr. Hulke.
68. Natives, Taranaki. *Pekokotuka.* Scraped and oiled, not washed. Presented by Mr. Hulke.
69. Natives, Taranaki. *Raumoa.* Scraped and oiled, not washed. Presented by Mr. Hulke.
70. Natives, Whakatane. *Oue.* Afterwards scutched at Richmond Flax Company's Mills; cost of scutching about £2 a ton.
71. Natives, Otaki. *Harakeke.* Stripped with a shell, and sold for rope spinning at Otaki for 1½d. a lb.
72. Natives, Otaki. *Harakeke.* Same as No. 71, but hackled ready for rope spinning by Mr. Dodds, Otaki. Cost about £25 a ton.
73. Ropata of Pahitere, Taranaki. *Atiraukawa.*
74. Matina of Henui, Taranaki. *Atewheke.*
74*a*. Porikapa of Kaihihi, Taranaki. *Ngutunui* and *Raumoa.* Scraped with a piece of iron hoop.
75. Tahana of Hua, Taranaki. *Atiraukawa.*
76. Chatham Islanders; exhibited by Canterbury Flax Association. Scutched at Stonyer's mill.
77. Ihaka, of Taranaki. *Parekoritawa* (variegated).
77*a*. Te Kahui, of Opunake. *Oue.*
77*b*. Porikapa of Kaihihi, Taranaki. *Huhiroa.* Scraped with a piece of iron hoop.
78. Natives, Urunui. Dressed and baled by them. Presented by Mr. Hulke.
79. Natives, Urunui. Dressed and baled by them. Presented by Mr. Hulke.
80. Natives, Wairoa, Hawkes Bay. Stripped with a mussel shell, from selected leaves.
81. Natives, Wairoa, Hawkes Bay. Stripped with a mussel shell, from selected leaves, and then carefully cleaned of all vegetable tissue.

CLASS IV.

A.—Native Manufactures.

Garments.

1.	Exhibited by Sir G. Grey, K.C.B.	
2. *Parawai.*	,,	
3.	,,	
4.	,,	
5. Child's mat.	,,	
6. *Pota*—a waterproof mat, from Wanganui District.	Commissioners.	
7. *Ngeri,*	,,	,,
8. *Parawai,*	,,	,,
9. *Korowai*—a child's mat,	,,	,,
10. *Pureke*—a rough mat,	,,	,,
11. *Para*—plain,	,,	,,
12. *Para*—dyed,	,,	,,
13. *Korowai,*	,,	,,
14. *Kiwi* mat,	,,	Major Kemp.
15. ,, ,,	,,	,,
16. ,, ,,	,,	,,
17. *Pekerangi,*	,,	,,
18. *Parawai,*	,,	Captain Wilson.
19. ,,	,,	,,
20. *Parawai,*	,,	Captain Toma.
21. *Kiwi* mat,	,,	Haimona Hiroti.
22. *Parawai,*	,,	Mei Hunia.
23. ,,	,,	,,
24. *Ngatata* mat,	,,	Poma.

25. *Kahukura,*	Wanganui District.	Rini Hemoata.
26. *Parawai,*	,,	Karoneho.
27. ,,	,,	Ratana Urumingi.
28. *Paipairoa,*	Taranaki.	Epiha, of Onaero.
28*a*. *Taha Paipairoa,*	,,	,, ,,
29. *Taringa,*	,,	Karipa, of Waiongona.
30. *Kaitaika,*	,,	Paratene, of Henui.
31. *Korowai,*	,,	Te Pare, of Taranaki.
31*a*. ,,	,,	,, ,,
32. ,,	,,	Poharama, of Moturoa.
33. ,,	,,	Hone Pihama, of Oeo.
34. *Neko,*	,,	Epiha, of Onaero.
35. *Hana,* made of *Manunu,*	,,	Porikapa, of Kaihihi.
36. ,,	,,	Tahana, of Hua
37. ,,	,,	Heni, of Tikorangi.
38. *Ngeri,*	,,	Te Pare, of Taranaki.
39. *Pureki,*	,,	Te Kepa, of Taikatu.
40. ,,	,,	Piripi Toki, of Parihaka.
40*a*. *Toi,* made from the *Toi* plant,	,,	Ropata, of Pahitere.
41. *Piupiu,*	,,	Te Pare, of Taranaki.
42. ,,	,,	Epiha, of Onaero.
43. ,,	,,	Heta, of Henui.
44. ,,		Mr. C. Gillespie.
45. *Ngaitahu Parawai.*		Hon. W. B D. Mantell.
46.		,,
47. *Pota.*		,,
48. *Korirangi.*		Mr. W. T. L. Travers.
49. *Korowai.*		Dr. Hector.
50. *Kereru,* made of pigeon feathers.		Colonial Museum.
51. *Eheru-heru* ,, kiwi ,,		,,
52. *Kaka* feather mat.		,,
53. Dog-skin mat.		,,
54. *Parawai.*		,,
55. *Torotoro Korowai.*		,,
56. *Parawai.*		,,
57. *Korowai.*		,,
58. *Kine-kine.*		,,
59. ,,		,,
60. *Parawai.*		,,
61. *Pota.*		,,
62. *Piupiu.*		Dr. Hector.
62*a*. Garment, dyed black and red.		,,

Floor Mats, and Sleeping Mats.

63. Floor mat, plain.	From Wanganui District.	Commissioners.
64. ,, dyed	,,	,,
65. Sleeping mat.	,,	,,
66. Floor mat.	From Tupara, East Coast.	,,
67. ,,	,,	,,

Baskets and Kits.

68. Ornamental bag.		Sir G. Grey, K.C.B.
69. *Porero.*	Taranaki.	Waiti, of Hua.
70. *Kete*—bag.	,,	Ihaia, of Opunake.
71. *Kete* ,,	,,	Hemi Puhata, of Opunake.
72. ,, basket.	,,	Te Pare, of Taranaki.
73. ,, ,,	,,	Paratene, of Henui.
74. ,, ,,	,,	Te Kahui, of Opunake.
75. ,, ,, (5)	,,	Ihaka, of Taranaki.

76. Basket	Wanganui.	Mr. R. W. Woon, R.M.
77. „ dyed.	„	Commissioners.
78. „ plain.	„	„
79. Bag plain.	„	„
80. „ dyed black.	„	„
81. „ ornamental.	„	„
82. „ plain.		Dr. Hector.
83. „ dyed black.		„
84. „ dyed red.		„

Ropes, &c.

85. Rope. Wanganui District.	Commissioners.
86. *Kahawaka*—rope used in lashing the sides of canoes. Taranaki.	Ihaka, of Hua.
87. *Taura*—small rope or line. Taranaki.	Ruakere, of Parihaka.
88. *Miro*—twine for making mats „	Ropata, of Pahitere.
89. Rope. Tupara, East Coast.	Commissioners.

Fishing Gear.

90. Eel net, complete. Wanganui.	Commissioners.
91. Fishing net „	„
92. „ „	„
93. Fishing line „	„
94. *Aho*—Fishing line. Taranaki.	Matina, of Henui
95. „ „ „	Henere te Hori, of Hua
96. *Kupenga*—Fishing net „	Te Kahui, of Opunake
97. *Piko*—Fish hook, lashed with Muka. Taranaki.	„ „
98. Shell and bone fish hooks. Wanganui.	Mr. R. W. Woon, R.M.

Dyed Flax.

99. *Piki korowai*—Made from *Tarariki*. Taranaki	Ropata, of Pahitere
100. *Muka-pango*—Flax dyed in mud „	Tahana, of Hua
101. „ Dyed with *Hinau* bark only „	Karipa, of Waiongona
102. „ „	Epiha, of Onaero
103. *Muka-whero* „	„ „
104. „ Stained with *Toa-toa* bark „	Ruakere, of Parihaka
105. „ Scraped flax, stained with *Toa-toa*, Taranaki	Tahana, of Hua
106. *Miro-whero*—Twine stained with *Toa-toa* bark, Taranaki	Tahana, of Hua
107. Flax dyed with *Toa* and *Hinau*. Wanganui.	Commissioners

Barks used in Dyeing.

108. *Kiri Toa-toa*—The *Toa-toa* does not grow south of Mokau. Taranaki	Matui, of Hua
109. *Kiri Toa-toa*— „	Tahana, of Hua
110. *Kiri Whawhakou*—Used for dyeing black. Taranaki	Matina, of Henui
111. *Kiri Hinau*—Used for dyeing black. Taranaki	„ „
112. *Toa-toa*. Wanganui	Commissioners
113. *Hinau*. Wanganui	„

Miscellaneous.

114. *Kawerapa*—Shoulder sling for burdens. Taranaki	Te Waka of Henui
115. „ „ „ „	Ropata of Pahitere
116. „ „ „ „	Te Watene, of Matarikoriko
117. *Kawenga* „ „ „	Karauria, of Puketotara
118. *Kawarangi*—Part of border for a mat „	Epiha, of Onaero

119. *Patu Paraoa*, called "Te Oha"—a whalebone weapon. Wanganui.	Wikiriwhi
120. *Patu Paraoa*, called "Te Aomarama"—a whalebone weapon. Wanganui.	Wiripo
121. *Taiaha*—Spear. Wanganui.	Paora
122. Carved top of *Taha* Calabash, called "Parokurangi;" very ancient. Wanganui.	Aropeta of Ranana
123. *Papa-huahua*—A bark box, ornamented with feathers, used to hold preserved birds. Wanganui.	Mr. R. W. Woon, R.M.
124. Belt. Wanganui.	Commissioners.

CLASS IV.

B.—European Manufactures.

Ropes, Twine, &c.

1. One coil 6 inch hawser; lubricated; 514 lbs. Price, 45s. per cwt. Manufactured at Lloyd's Patent Rope Factory, Auckland. Exhibited by J. S. Macfarlane & Co.
2. One coil 2½ inch rope; lubricated; 120 fathoms; 108 lbs. Price, 45s. per cwt. Manufactured at Lloyd's Patent Rope Manufactory, Auckland. Exhibited by J. S. Macfarlane & Co.
3. One coil 2¾ inch rope; Lubricated; 120 fathoms; 110 lbs. Price, 45s. per cwt. Manufactured at Lloyd's Patent Rope Manufactory. Exhibited by J. S. Macfarlane & Co.
4. One coil 2½ inch rope; white; 120 fathoms; 114 lbs. Price, 45s. per cwt. Manufactured at Lloyd's Patent Rope Manufactory, Auckland. Exhibited by J. S. Macfarlane & Co.
5. One coil 2¾ inch rope; white; 120 fathoms; 141 lbs. Price, 45s. per cwt. Manufactured at Lloyd's Patent Rope Manufactory. Exhibited by J. S. Macfarlane & Co.
6. One coil of rope; white. Made from machine-dressed flax. Exhibited by Rees & Richardson, Rangitikei.
7. One coil of rope; white. Made from flax that has been steamed and rolled. Exhibited by Rees & Richardson.
8. One coil of rope; tarred. Exhibited by Canterbury Flax Association.
9. One coil of rope; tarred. „ „
10. One coil of rope; tarred „ „
11. Two coils of rope; white. Manufactured by T. Lennon, Christchurch, from Stonyer's flax. Price, 6d. a lb. Exhibited by Canterbury Flax Association.
12. One coil of rope; white. Manufactured by T. Lennon, Christchurch, from Stonyer's flax. Price, 6d. a lb. Exhibited by Canterbury Flax Association.
13. One coil of 3 inch rope; white. Manufactured by T. Lennon, Christchurch. Price, £46 per ton. Exhibited by Canterbury Flax Association.
14. One coil of 4 inch rope; white. Manufactured by T. Lennon, Christchurch. Price, £46 per ton. Exhibited by Canterbury Flax Association.
15. One coil of rope; white. Manufactured by T. Lennon, Christchurch. Price, 6d. per lb. Exhibited by Canterbury Flax Association.
16. Small coil of rope and twine; white. Manufactured by T. Lennon, Christchurch, from J. Journeaux's flax. Exhibited by Canterbury Flax Association.
17. One coil 2½ inch rope; white. Manufactured by H. Maitland, Auckland. From Albert Potter's flax. Exhibited by Albert Potter, Auckland.
18. One coil of 3¼ inch warp; white. Manufactured by H. Maitland, Auckland, from Albert Potter's flax. Exhibited by Albert Potter, Auckland.
19. One coil of rope; white. Manufactured by T. Davis, Waipawa, Hawkes Bay. Price, 8d. per lb. Exhibited by Thomas Davis, Waipawa, Hawkes Bay.
20. One coil of rope; white. Manufactured by T. Davis, Waipawa, Hawkes Bay. Price, 8d. per lb. Exhibited by Thomas Davis, Waipawa, Hawkes Bay.

21. One coil of 2 inch rope; white; 11 fathoms. Manufactured by T. Bevan, jun., Otaki. Price, £43 at the rope-walk; £49 in Wellington. Exhibited by Thomas Bevan, jun., Otaki

22. One coil of 1½ inch rope; white; 17 fathoms. Manufactured by by T. Bevan, jun., Otaki. Price, £43 at the rope-walk; £49 in Wellington. Exhibited by Thomas Bevan, jun., Otaki.

23. One coil 1½ inch rope; white; 7 fathoms. Manufactured by T. Bevan, jun., Otaki. Price, £43 at the rope-walk; £49 in Wellington, Exhibited by Thomas Bevan, jun., Otaki.

24. Clothes line; 7 fathoms. Price, 13s. 1d. per dozen, delivered in Wellington. Manufactured by T. Bevan, jun., Otaki. Exhibited by Thomas Bevan, jun., Otaki.

25. Tether rope; 11 fathoms. Price, 13s. 1d. per dozen, delivered in Wellington. Made by T. Bevan, jun., Otaki. Exhibited by Thomas Bevan, jun., Otaki.

26. Lead line; 15 fathoms. 3s. per lb. like sample. Made by T. Bevan, jun., Otaki. Exhibited by T. Bevan, jun., Otaki.

27. Fishing line; 11 fathoms. 13s. per dozen. Made by T. Bevan, jun., Otaki. Exhibited by T. Bevan, jun., Otaki.

28. Fishing line; 13 fathoms. 18s. per dozen. Made by T. Bevan, jun., Otaki. Exhibited by Thomas Bevan, jun., Otaki.

29. Fishing line; 15 fathoms. 13s. per dozen. Made by T. Bevan, jun., Otaki. Exhibited by Thomas Bevan, jun., Otaki,

30. Small fishing line. Price, 13s. per dozen. Made by T Bevan, jun., Otaki. Exhibited by Thomas Bevan, jun., Otaki.

31. Two samples of whip-cord. Made by T. Bevan, jun., Otaki. Exhibited by Thomas Bevan jun., Otaki.

32. Five balls of twine. Price of single twine in Wellington, 10d.; double twine, 1s. 2d. Made by T. Bevan. jun., Otaki. Exhibited by Thomas Bevan, jun., Otaki.

33. Sample of flax, scraped with a shell, from which all the smaller articles of Mr. Bevan's manufacture in the above list, are made. Exhibited by Thomas Bevan, jun., Otaki.

34. Three samples of rope, manufactured in London by Messrs. Frost, Brothers, from New Zealand flax prepared by Mr. E. Thorne's process; used on board the "Crusader" on her last voyage from England to Lyttelton. Exhibited by Captain Kerr, ship "Crusader."

    a. Sixty girders, weighing about 3½ tons each, were discharged with the rope of which this is a sample. Part of the same coil was used for main sheets.

    b. Two samples, tarred; used for braces and halyards during the voyage, and seemed to answer well, being good yet.

35. Small sample of rope. Colonial Museum.

Ropes experimented on by Mr. J. Kebbell, to compare their qualities with those of Manilla rope.

36. Untarred rope; tested dry; run through pulleys for 28 days, travelling a distance of 242 miles before it gave way. Maximum stretch, 3.5 per cent.; shrink, 1.5 per cent.

37. Untarred rope; saturated with salt-water every four days; run through pulleys for twenty days; travelling a distance of 173 miles before it gave way. Maximum stretch, 6.1 per cent; shrink, 6.0 per cent.

38. Tarred rope; tested dry; run through pulleys for fifteen days; travelling a distance of 129 miles before it gave way. Maximum stretch, 7.6 per cent.; shrink, 0.3 per cent.

39. Tarred rope; saturated with salt water every four days; run through pulleys for nineteen days: travelling a distance of 164 miles. Maximum stretch, 7.9 per cent.; shrink, 3.8 per cent.

40. Untarred rope. Sample from which Nos. 36-7 were taken for testing.

41. Tarred rope. Sample from which Nos. 38-9 were taken for testing.

41*a*. J. A. Gray, Kaiapoi. Rope made from Stonyer's flax; used in Californian pump for thirteen weeks and four days, before first strand gave; made from inferior flax; 2nd quality.

41*b*. J. A. Gray, Kaiapoi. do. Same as No. 41*a*. Used in hoisting sacks in the mill for over four months.

Miscellaneous.

42. Halter. Manufactured by T. Bevan, jun., of Otaki. Colonial Museum.
43. Halter. Made from single twine by T. Bevan, jun., of Otaki. Price in Wellington, 15s. per dozen. The yellow dye is from the root of green flax; the black, from the bark of the hinau; the blue, from the tutu berry. Exhibited by Mr. T. Bevan, jun., Otaki.
44. Halter. Made from double twine by T. Bevan, jun., of Otaki. Price in Wellington, 15s. per dozen. Dyed in the same way as No. 43. Exhibited by Mr. T. Bevan, jun., Otaki.
45. Door mat. Price, 1s. 6d. to 2s. per square foot. Manufactured by Symons & Malcolm, Richmond, Nelson. Presented by Sir D. Monro. Colonial Museum.
46. Door mat. Price, 2s. per foot. Manufactured by Lang, Auckland. Colonial Museum.
47. Three coloured mats, manufactured at Timaru. Exhibited by Canterbury Flax Association.
48. Samples of stuffs, made from New Zealand flax. Presented by Mr. L. Nattrass, Nelson.
49. Cushion worked in flax of various dyes, by Miss McTavish, Auckland. Exhibited by Miss McTavish.
50. Flax of various dyes, chemically prepared in 1859-60, by Mr. T. W. Tatton, Nelson. Exhibited by T. W. Tatton, Nelson.
51. Sample of cloth and yarn, manufactured in 1850, by Mr. Carmichael, of Messrs. Baxter Brothers, Dundee. Commissioners.
52. Two samples of paper, made in London in 1866. Commissioners.
53. Unbleached paper, made of *Phormium tenax*. Presented by Dr. Ferdinand von Mueller, Melbourne.
54. Flour sack, made by Nash, of Manawatu, about 1857, from the finest Maori-dressed flax, mixed with a portion of hemp. This sack has been four or five years in constant use, carrying meal to the top of the mill by hooks and tackle, and would apparently last as long again; other sacks, made at the same time, are still in use at Mr. Kebbell's mill. Presented by Mr. Kebbell.
55. Tatting, crochet, netting, and fine work, in New Zealand flax. Exhibited by Mrs. J. A. Bird, Christchurch.

CLASS V.

A.—Brokers Classification of Fibres.

These samples were obtained by reference to the brands that are described in the sale lists as having realised the prices mentioned.

		Price during 1870.	Average.
1st. class.	Good to superior ...	£28 to £36 15s.	£34 10s.
2nd. „	Fairly cleaned ...	23 to 30 10	26 15
3rd. „	Fully ¾ dressed ...	18 to 26 0	22 0
4th. „	Half to ¾ dressed ...	14 to 22 10	18 5
5th. „	Common to rough ½ dressed	11 to 18 5	14 10

B.—Samples of Flax sold in London, with the Prices at which they sold.

1. Hand-made in Waikato, in 1867. The leaf boiled and hackled. Sold in Auckland at £18 per ton, for export to Sydney.
2. Wilford & Co., Wairarapa. Shipped to Melbourne, and sold there at £22 a ton, on 10th January, 1871; per Messrs. Levin & Co., Wellington.
3. Sold in London in November, 1870, at £35 per ton; per Mr. F. Sidey, Wellington.
4. Sold in London in November, 1870, at £30 to £30 10s.; per Mr. F. Sidey, Wellington.
5. O and G—Wallis, Raglan. Sold in London in June, 1870, at £31; per Messrs. Kinross & Co., Napier.
6. O and G—McDonald. Sold in London, June, 1870, for £30; per Messrs. Kinross & Co., Napier.
7. O and G—McDonald. Sold in London, June, 1870, for £27; per Messrs. Kinross & Co., Napier.

8. S S in diamonds. Sold in London, June, 1870, for £30 to £30 10s.; per Messrs. Kinross & Co., Napier.
9. Sold in London, November, 1870; per Messrs. Kinross & Co.
10. D & H.—No. 1, from Auckland; standard sample; value, £50 in London, November, 1869.
11. D & H.—No. 2, from Auckland; standard sample, value, £40 to £45 in London, November, 1869.
12. D & H.—No. 3, from Otago: standard sample; value, £36 to £38 in London, November, 1869.

CLASS B. VI.—A.

Foreign Fibres, &c.

Museum Collection.

I.—Fibres Suited for Spinning and Manufacturing Purposes.

a. Flax (*Linum usitatissimum*).

1. Flax, *Linum usitatissimum*, from acclimatised Riga seed, Sealcote, Punjab.
2. Flax, *Linum usitatissimum*, Punjab.
3. Flax, *Linum usitatissimum*, from acclimatised seed, Lucknow.

b. Rhea (*Bœhmeria nivea*, also *Urtica nivea* and *U. tenacissima*).

Of all Indian fibres, the one which at present attracts most attention in this country is that of the Rhea. As soon as arrangements have been effected for its production, along with that of other species of nettle which abound in various parts of India, it is anticipated that fibres from this class of plants will eventually occupy a position second only in importance to that of cotton and flax. Late experiments have shown that the fibre of the Rhea can be turned to account for the manufacture of a variety of fabrics of a very valuable and useful description; and its extended cultivation in India is worthy of every attention and encouragement. The great desideratum is an efficient machine for the separation of the fibre from its parent stem.

4. Rhea, *Bœhmeria nivea*, Gowhatty.
5. Rhea, *Bœhmeria nivea*, softened.
6. Rhea, *Bœhmeria nivea*, bleached.
7. Wild rhea, Assam.

c. Puya (*Bœhmeria puya*).

Although botanically a different species, the fibre of this plant is almost identical with that furnished by the Rhea. It flourishes at Darjeeling and other places in the north of India. Its commercial value is the same as that of Rhea.

8. Puya, *Bœhmeria puya*, North-West India.

d. Nilgiri Nettle (*Urtica heterophylla*).

This nettle abounds in the Nilgiri Hills and also in some other parts of the country. It furnishes a fibre of such a nature that the term "vegetable wool" has been applied to it.

9. Nilgiri Nettle, *Urtica heterophylla*, from old wood, valued at £60 per ton.
10. Nilgiri Nettle, *Urtica heterophylla*, from new wood, valued at £65 per ton.

e. Mudar or Yercum (*Calotropis gigantea*), also Ak (*C. Hamiltonii*),

The stems of these two species furnish a valuable fibre, which is, however, very difficult of extraction.

11. Mudar or Yercum, *Calotropis gigantea*, Madras.

f. Bedolee Sutta (*Paederia fœtida*).

This excellent fibre is the produce of a creeper which grows abundantly on grass alluvial deposits along some parts of the banks of the Brahmaputra in Assam. It is particularly worthy of attention, as its fibre is of a very valuable description. From its appearance it has been named "vegetable silk."

12. Bedolee Sutta, *Paederia fœtida*, Upper Assam.

II.—Fibres suited for Spinning and Manufacturing Purposes, but of Inferior Durability to the Preceding.

a. Jute.

There are two species which afford this well-known article of commerce, viz., *Corchorus olitorius* and *C. capsularis*. Both are largely cultivated.

13. Jute, *Corchorus olitorius*, valued at £24 per ton, Darjeeling.
14. Jute, *Corchorus olitorius*, Hooghly.

b. Sufet Bariala (*Sida rhomboidea*).

This fibre is very similar to jute in appearance; but it is considered to be intrinsically so superior that it is worth from £5 to £6 more per ton, and it has accordingly been placed next to that fibre, in order to attract to it that attention which it deserves.

15. Sufet Bariala, *Sida rhomboidea*.

c. Ambaree or Hemp-leaved Hibiscus (*Hibiscus cannabinus*).

This plant furnishes a portion of the so-called "brown hemp," exported from Bombay. It is readily cultivated, and, with more attention to its preparation, is calculated to compete with jute.

16. Ambaree, *Hibiscus cannabinus*.

d. Roselle (*Hibiscus sabdariffa*).

Commonly cultivated in gardens for the sake of its leaves, which are eaten in salads. Worthy of extended cultivation on account of its fibre.

17. Roselle, *Hibiscus sabdariffa*.

e. Other Malvaceous Fibres.

18. Indian Mallow, *Abutilon indicum*, Rohilcund.
19. Bun-okra, *Urena lobata*, Burmah.

III.—Fibres Chiefly Suited for the Manufacture of Cordage, Twine, etc.

a. Hemp (*Cannabia sativa*).

It is cultivated in many parts of India for the sake of the "Bhang" or intoxicating resin of its leaves, but as yet only occasionally for its fibre.

20. Himalayan hemp, *Cannabis sativa*, Kangra.

b. Sunn Hemp (*Crotalaria juncea*).

This plant furnishes the vast proportion of the so-called hemps exported from India.

21. Sunn hemp, *Crotalaria juncea*.
22. Sunn hemp, *Crotalaria juncea*, Hooghly.
23. Sunn hemp, *Crotalaria juncea*.
24. Sunn hemp, *Crotalaria juncea*.

c. Jubbulpore Hemp (*Crotalaria tenuifolia*).

25. Jubbulpore hemp, *Crotalaria tenuifolia*.
26. Jubbulpore hemp, *Crotalaria tenuifolia*, Chota Nagpore.

IV.—Fibres for Miscellaneous Purposes, adapted for Twine, Cordage, and Paper, occasionally capable of Manufacture into Fabrics suited for Women's Dresses, Imitation Horsehair Cloth, etc.

This division embraces the fibres furnished by the leaves and stems of endogenous plants.

a. Pine Apple (*Ananassa sativa*).

This plant supplies the only fibre of the group which is at all likely to be employed for spinning by machinery. Its fibres are fine and very divisible.

27. Pine apple, *Ananassa sativa*, valued at £30 per ton, Madras.

b. Moorva, Marool, or Bow-string Hemp (*Sanseviera zeylanica*).

This plant supplies a fibre in point of strength and other qualities well calculated, when properly prepared, to compete with the "Manilla hemp" of the Phillipine Islands.

28. Moorva, *Sanseviera zeylanica*, valued at £36 per ton, Madras.

c. Agave or Aloe Fibres (*Agave americana*, also *Agave vivipara* or *Fourcroya gigantea*).

Although neither of these plants is indigenous, both are now cultivated in many parts of the country. After suitable preparation, the agave fibre is usually employed for the manufacture, amongst other things, of an imitation "horsehair cloth.

29. Agave, *Agave americana*, Meerut.

30. Agave, *Agave americana*, Madras.

d. Adam's needle (*Yucca gloriosa*).

This plant, although not yet cultivated for economic purposes, produces fibre of very considerable value when properly prepared.

31. Adam's needle, *Yucca gloriosa*, Madras.

e. Plantain (*Musa paradisiaca* and other species).

Universally cultivated for its fruit. Its leaves afford a fibre suited for certain purposes. Ordinarily it is inferior to Manilla hemp (*Musa textilis*) in point of strength.

32. Plantain, *Musa paradisiaca*, Madras.

33. Manilla hemp, *Musa textilis*, Madras.

f. Screw-pine, (*Pandanus odoratissimus*).

The leaves of this plant furnish a fibre which can be turned to account for the manufacture of paper and some common purposes. It is, however, in every respect inferior to those in this group above entered.

34. Screw-pine *Pandanus odoratissimus*, valued at £4 per ton, Madras.

V.—Fibres Suited for the Manufacture of Mats, Brushes, Coarse Cordage, Imitation Horsehair for Stuffing Purposes, etc.

a. Coir.

This well-known material is furnished by the fibrous envelope of the nut of the cocoa palm (*Cocos nucifera*). It is exported from India in considerable quantities.

35. Coir, *Cocos nucifera*, Madras.

b. Gomuti (*Arenga saccharifera*).

This fibre is considered superior to all others yet made use of for the manufacture of artificial bristles for brushes, imitation horse-hair for stuffing, and such like purposes.

36. Gomuti, *Arenga saccharifera*, Singapore.

c. Moonj (*Saccharum munja*).

This grass supplies a strong good fibre, which is beginning to attract attention in this country, and is now being exported from Kurachi, in Sinde.

37. Moonj, *Saccharum munja*, Lahore.

38. Palmyra, *Borassus flabelliformis*, Madras.

Fibres from Kew Museum.

39. *Musa sapientum.* Mauritius.

40. *Kydia calycina.* Jamaica.

41. *Helicteres pulchella.* Mauritius.

42. *Crotalaria juncea.* Jubblepore hemp. East Indies.

43. *Malvaviscus arborea.* Jamaica.

44. *Paritium elatum.* Jamaica.

45. *Fourcroya tuberosa.* Mauritius.

46. *Agave angustifolia.* Mauritius.

47. *Abutilon bedfordiana.* Mauritius.

48. *Lecythis idatimon.* Guatecare tree fibre. Trinidad.

49. *Agave americana.* Alves.

50. *Fourcroya tuberosa.* Mauritius.

51. *Musa textilis.* Manilla.

52. *Fourcroya gigantea.* Mauritius.

53. *Hibiscus sabdariffa.*
54. *Sida floribunda.* Mauritius.
55. *Agave angustifolia.* Mauritius.
56. *Abelmosus esculentus.* Jamaica.
57. "*Buaze*" fibre. Lophostyles. Central Africa.
58. *Triumufetta semetriloba.*
59. *Dracæna, sp.*
60. Cocoa nut fibre Net. Fiji Islands.
61. *Ureka* hair. United States of America.
62. *Pulo.* Honolulu.

CLASS B. VI.

B.—Sample Bales procured from England of those Fibres which compete with New Zealand Flax in the English Market.

1. Russian Hemp; prepared from *Cannabis sativa.*
Price of this sample in London, February, 1871, 34s. 6d. per cwt. Auction price in London, February, 1871, £31 to £39 per ton.

Imported into England in—

1868.	...	...	... Tons	23,754	Average price	£37 9s.
1869.	...	...	...	28,180		32 18
1870.	...	...	...	30,641		33 0

2. Italian Hemp; prepared from *Cannabis sativa.*
Price ot this sample in London, in February, 1871, 41s. 6d. per cwt. Auction price in London, in February, 1871, £37 to £44 per ton.

Imported into England in—

1868.	...	...	... Tons	12,275	Average price	£36 15s.
1869.	...	...	...	11,253		40 19
1870.	...	...	...	10,433		42 4

3. Bombay Hemp; prepared from *Crotalaria tenuifolia.*
Price of this sample in London, in February, 1871, 27s. per cwt. Auction price in London, February, 1871, £17 to £25 per ton.

Importations of East India Hemp into England—

1868.	...	...	... Tons	989	Average price.	£28
1869.	...	...	...	2,142		25
1870.	...	...	...	2,179		24

4. Sisal Hemp; prepared in Yucatan, from Henniquin—*Agave sisalana.*
A native can prepare 6 lbs. in one day. Price of this sample in London, February, 1871, 48s. per cwt. Auction price in London, February, 1871, £46 to £48 per ton.

5. Egyptian Flax; prepared from *Linum usitatissimum.*
Price of this sample in London, February, 1871, 55s. per cwt. Auction price in London, February, 1871, £40 to £48 per ton.

6. Aloe Fibre; prepared from *Agave americana* or *Agave vivipara.*
Price of this sample in London, February, 1871, 22s. per cwt. Auction price in London, February, 1871, £18 to £25 per ton.

7. Manilla Hemp; prepared from *Abaca* (*Musa textilis*), of the Phillipine Islands.
Price of this sample in London, February, 1871, 56s. per cwt. Auction price in London, February, 1871, 46s. to 80s. per cwt., according to quality.

Imported into England—

1868.	...	...	... Tons	8,756	Average price	£47 8s.
1869.	...	...	...	4,632		52 19
1870.	...	...	...	6,467		54 16

8. Italian Hemp; dressed by Rawson's machine; deposited by Hon. Mr. Vogel.
9. Italian Hemp; dressed by Collyer's machine; deposited by Hon. Mr. Vogel.
10. Rhea or China grass; deposited by Hon. Mr. Vogel.
11. Italian Hemp; raw material. Deposited by Hon. Mr. Vogel.
12. Fine Hemp; out of bale. Average strength, 83.
13. Hemp; dressed fine. Average strength, 91.
14. Italian Hemp; out of bale. Average strength, 93.
15. Italian Hemp; dressed. Average strength, 124.
16. Riga; rough; out of bale. Average strength, 76.

17. Riga; rough-dressed. Average strength, 90.
18. Archangel; rough. Average strength, 89.
19. Archangel; dressed. Average strength, 112.
20. Pita. Presented by Mr. Vogel.
21. Escoba. Presented by Mr. Vogel.
22. Plaintain fibre; a poor sample, having heated on the voyage. Presented by Mr. Vogel.
23 Ramie; grown in New Orleans, but has been for several months lying under a shed. Presented by Mr. Vogel.
24. *Agave sisilana(?)*. Dressed in Patrullo's machine. Presented by Mr. Vogel.

CLASS B. VI.—.

C.—Rope, &c.

Manilla Rope Experimented on by Mr. Kebbell, to compare with Rope made of New Zealand Flax.

1. Manilla Rope. Tested dry; run through pulleys for twenty days; travelling a distance of 173 miles before it gave way. Maximum stretch, 2·6 per cent.; maximum shrink, ·47 per cent. Commissioners.
2. Manilla Rope. Saturated with salt water every four days; run through pulleys for twenty-two days; travelling a distance of 190 miles before it gave way. Maximum stretch, 1·9 per cent.; maximum shrink, 11·0 per cent. Commissioners.
3. Sample of 2-inch Manilla Whale Line. W. Gibson, Wellington.

Samples, lent by the Auckland Institute, to Illustrate Mr. Tinne's Lecture (See Appendix.). The Numbers are those used in the Lecture.

No. 1. New Zealand Flax Rope. New.
No. 2. Rope. Same as No. 1. Used on a voyage to New York.
No. 3. New Zealand Flax. Yarns from an old rope, to show that they will not work up for the centre of new rope like Manilla.
No. 4. Leaves cut near Christchurch, in 1866. Were used as "dunnage" for a cargo; lay about for two years, and then £7 a ton was refused for them.
No. 5. Same as No. 4. Steeped in a solvent, and cleansed by patent machinery. Fetched £22 a ton, and yielded 55 per cent. of fibre.
Nos. 6, 7, 8. Received for treatment in Brazier's softening machine. No. 6, quite intractable. No. 7, softened to the condition of No. 8.
No. 9. Sacking, woven in Dundee.
10. Same as No. 9. Heavily rolled.
11. Cloth, made some years ago.
12. Irish Flax. Raw.
13. „ Cleaned and softened.
14. Manilla.
15. Dutch Flax.
16. Swiss „

VIII.—MEMORANDUM FURNISHED BY COLONEL HAULTAIN ON THE FLAX MILLS VISITED BY HIM.

THOMAS MACFFARLANE, Henderson's Mill, Auckland, November, 1870.

Was formerly a large saw mill, driven by water power. Six machines can be kept at work, but only two were in operation. After stripping, the flax was steeped on wooden floats in the mill pond for two hours and a half, and occasionally beaten with a wooden rammer. Each machine could turn out more than one ton per week. The green leaf was brought by boat from all parts of the Waitemata harbor, at a cost of 20s. to 25s. per ton, according to distance. Men's wages were 5s. a day, and boys' from 1s. 3d. to 2s. 6d. The cost of scutching was 22s. a ton, and of packing and screwing, 22s. 6d.; and the total expense per ton, delivered in Auckland, was about £17 16s. Some flax had been planted in a cleared gully, and also amongst some manuka scrub; the former was doing well, but the other was getting choked up, and could not thrive.

MURRAY, Mauku, near Auckland, May, 1871.

The fibre from this mill is considered as good as any that comes into the Auckland market; its good quality is due to the care taken in its preparation, and to an abundant supply of water for washing purposes. There is a 12-foot water wheel, 5 feet broad, which works one of Price's machines, and the scutching is carried on at another mill a little lower down the stream. After passing through the stripper, the hank of flax is hung on to a peg in the mill race, where it remains for some minutes. The stripping machine (Price's) has been running for two years, and has required little or no repair; about 26 cwt. of green leaf, per day, can be passed through it. It takes about seven tons of green leaf to one of fibre, and he pays 22s. a ton for it, delivered at the mill; and has to give 30s. a week as rent for the mill site and machinery, and cannot turn out more than one ton per week; so that his flax costs him £19 a ton, delivered in Auckland, where it sells at from £18 to £20; but as he works himself, and is assisted by four or five of his children, it gives the family good wages; and the tow, which sells at £5 a ton, is some further profit.

POTTER, Henderson's Mill, near Auckland.

Is not at work at present, as a recent flood has broken the mill dam, and done other damage. Has tried wet-scutching, but did not find it answer, and there is an extra loss of 25 per cent. in hackling, which the rope-spinners object to, although they consider the fibre superior, and will pay £3 a ton more for it; but it costs from £8 to £10 a ton to wet scutch as, in addition to the labour, it requires more green leaf. After hackling, as an experiment, there were only 74 lbs. left out of 1 cwt. It takes eight tons of green leaf to make one ton of ordinary fibre; if the flax is young it will take more—as much as ten tons. The bleaching requires from four to fourteen days, according to the weather; but the shorter time it is exposed to the sun the better, as the fibre is injured by too long exposure. Instead of wet-scutching, he has now put up a set of stampers, under which the flax is passed, after coming from the stripper, with a flow of water over it, being carried under the stampers by a travelling band.

KELEHER, Waiuku, May, 1871.

Uses a water wheel 14 feet in diameter, and 4 feet broad, which cost him £200, and one of Gibbon's double machines; has also one of Price's, but prefers the former. Carefully washes the fibre in the mill race after stripping, and then soaks it for an hour; bleaches in the sun for about five days in summer, and seven in winter, and finishes with a barrel scutch. All his hands are paid by the day, and he employs twenty for the double machine—eight men, at 4s.; six women, at 2s. 6d.; and six boys, at 1s. 6d.; besides two men cutting the flax. He gets £20 a ton for his fibre, delivered in Auckland, which pays all expenses. Flax which was cut eighteen months ago, has now six full grown leaves; and that cut seven months ago has three leaves, besides the centre one. His flax is chiefly from high ground, and is preferred by the rope-spinners on that account.

DUGALD, Queen's Redoubt, Waikato.

Uses the machinery of an old flour mill, belonging to the natives, and has plenty of water, but a limited supply of flax. Has a machine of his own construction, an improvement on Price's, and can put through 30 cwt. a day, or more; and makes 1½ tons of fibre in the week. Washes in the mill race with the assistance of a small wheel, which is turned by the stream, and beats the flax which is held underneath. Employs only eight hands, and pays the men £1 a week, and the boys 10s. and 12s. The green leaf costs about 16s. a ton at the mill, and it is chiefly long swamp flax; cartage into town is £1 10s; and the fibre costs him about £16 a ton delivered in Auckland, where he gets from £20 to £22 a ton. Is himself a good mechanic and engineer, so can keep his machinery in good order and repair.

MELLSOP, Waiuku, May, 1871.

Uses water power, and has a wheel 18 feet in diameter, and 2 feet 10 inches broad, but has not sufficient water in summer, nor sufficient green flax to keep the mill constantly going; makes 25 or 30 tons a year, and finds that he must receive £20 a ton for his fibre to pay fair wages. His flax is chiefly from the Karaka hills, and is of better quality than that which grows in the gullies. It takes seven tons of green flax, now nineteen months old, to one of fibre, and he pays 12s. a ton for cutting it. He uses one of Dugald's machines, made by McIntyre, of Onehunga, which will put through 30

cwt. a day, and has been six months at work without requiring repairs. Pays men 4s. a day, and boys 2s., without food.

Messrs. Drungoold and Hamlin have also got mills in this neighborhood, but their process is very similar to Mellsop's. They have Price's machines, and the latter has one of Dugald's, also.

REES & GIBSON, Rangitikei, January, 1871.

Use steam power and both Price's and Gibbons' stripping machines, but prefer the former, as they clean the flax better and wear longer; they are, however, more wasteful than Gibbons'. Immediately after having been passed through the stripper, the flax is placed in a wooden vat, and a stream of boiling water is poured on it; it remains soaking for two or three minutes, and is then taken out and rinsed in cold water; then bleached in the sun for four or five days and dry-scutched. The boiling water takes the red colour out of the butts, but does not otherwise improve its appearance or texture. Mr. Rees thinks highly of the wet-scutching process, and will try it when they get over the difficulty of scarcity of water. The limited supply of this requisite, which is one of the chief essentials in profitable flax-dressing, certainly deteriorates the quality of their fibre. The shorter leaves are separated into bundles by the boys who take the flax away from the stripper, and it is packed separately. Mr. Rees finds that most of the fourth pair of leaves are unfit for stripping, and that even some of the third are defective and have to be rejected. He has tried a small quantity of the centre and immature leaves, and the fibre is fine and of good colour, and has considerable strength, but it cannot be procured in any quantity. He wished that some Natives should, by way of experiment, prepare after their own fashion a small quantity of fibre from the flax leaves that he was using at his mill, but after looking over the whole bundle, about eight tons, they declared that there was none suitable for their purpose, so particular are they in the selection of leaves.

MUSSEN, near Wanganui.

Has a twelve-horse power steam-engine and abundance of water, but he has to pay a very high price for the raw material. He gives the owner of the ground on which he cuts the leaves, 12s. a ton, and it costs him 10s. a ton for cutting, and another 5s. for carting to the mill; so that, assuming he requires 6½ tons of green leaf for one of fibre (and it can hardly be less, though he only estimates 5½ tons), the raw material stands him in £8 15s. 6d., which at the present price of the manufactured article can hardly leave him a profit, although he turns out a particularly good sample, mainly due to his wet-scutching, which softens the fibre and gives it a good colour. It is not left out on the bleaching field for more than three days in fine weather, being once turned in that time. He has two stripping machines at work, one of Price's, and the other, Fraser and Tinne's. He considers that the latter wear better, but that Price's dresses the flax more evenly. He employs nine men and three boys for the two machines, and pays the latter 6s. and 7s. 6d. a week besides their food. He uses a beam 36 feet long and 18 inches square at the larger end as a lever to press his bales, and manages to get 4½ cwt. of fibre into a bale measuring 3 feet square and 5 feet long. Plants that were cut quite down twelve months ago, have thrown up several leaves 5 and 6 feet long.

RITCHIE, Wanganui.

Uses the engine of a steam-threshing machine, and one of Price's strippers, which he considers the best that is made. The green leaf only costs him 13s. a ton delivered at his mill; but there is a scarcity of water for washing purposes, otherwise he would use a wet-scutcher, believing that that process materially improves the fibre, besides reducing the time necessary for bleaching from fourteen to four days. He has three varieties of flax growing on his land, and plants that had been cut five months previously had thrown up fresh leaves five feet long. The best variety strips more easily than the other kinds.

SCRIVENER, Wanganui.

Produces a fibre of superior quality, and took the first prize at the Wanganui Flax Show. The reason is obvious; every part of the process of manufacture is conducted with special care. All damaged leaves are rejected, and the larger ones are split before they are passed through the machine; they are also cut high up, so that the coarse and discoloured portions of the butt are not used. He works only on a small scale, and has but an ordinary three horse wheel for driving purposes. With the assistance of one man to cut the flax, and a lad to drive the horses, he and his three sons manage the whole of the operations, and can turn out 2 cwt. of fibre per day, and as he can readily get £20 a ton for his fibre in Wanganui, it pays him very well. In feeding his horses, he mixes the strippings from the flax leaves with their oats, and they eat it greedily. He uses one of Price's machines, which he considers the best he has seen. Had he more driving power, he would not think it necessary to split the leaves, and would wet-scutch if he had plenty of water. There are several varieties of flax in the neighborhood, some of which are more easily stripped than others, but they are used indiscriminately.

GROVER, Wanganui.

Has a small steam engine, and one of Price's machines, and adopts the ordinary process of washing, bleaching, and dry-scutching. He has not sufficient water, or would try wet-scutching.

CUMMINS, Wanganui.

Has also a small steam engine, and one of Price's machines, which he finds to work satisfactorily. After stripping, he soaks the fibre in warm water, at about 90°, and then bleaches and dry-scutches in the ordinary manner. Has tried boiling water, but finds that it hardens the fibre. He thinks that wet-scutching could be advantageously used, if he had abundance of water.

OPUNAKE, Taranaki, January, 1871.

There are two flax mills at Opunake, belonging, one to the Cape Egmont, and the other to the Opunake Company; both companies have extensive flax fields, leased from the Natives. The sites for their mills are excellent, with abundance of water for motive power, and for washing purposes. Considerable capital has been expended, and the buildings and drying grounds are good and sufficient; in fact, there are few other mills in the North Isltnd equally good, and possessing such natural advantages; and Opunake Bay is a convenient and safe shipping place. The fibre turned out from the Cape Egmont mills is the better of the two, because greater pains are taken in scutching; but in neither is sufficient care taken to reject old and damaged leaves; consequently the sample is not so equal and good as it ought to be, and it can hardly realize a fair price in the London market. The green flax on this part of the coast is much damaged by a small "looper" caterpiller, about an inch in length, which attacks the under side of the leaf, aud eats quite through the fibre, in patches from a-half to two inches long, and a-quarter of an inch broad. As these patches are numerous, the fibre is cut into short lengths, so that in scutching there is a great loss in tow. The plants growing in sheltered places were the most damaged, as the insect cannot so readily attach itself to leaves that were kept in motion by the wind. The caterpillars appear to have come to their full growth about the month of December, and they must have been very numerous at that time. The Opunake Company use Price's, Gibbons', and Murray's machines, and consider the small ones made by the first, preferable to any others. After stripping, the flax is washed by hand, and then floated down the tail race, at the end of which men are stationed to take up the flax, which is soaked for an hour in a trough, through which the water flows freely, and is then kept on the drying ground for twelve or fourteen days in the summer season, and for a longer period in the winter. The color is good, and it would be above the average if damaged leaves were rejected. The plant of the Cape Egmont Company is first class, and has been erected at considerable outlay. A 16 feet water wheel, 8 feet broad, set upon masonry supports, works smoothly, and puts in motion four of Price's smaller machines, and one of Fraser & Tinne's, besides two scutchers. After stripping, the flax is well washed by hand in the mill race, and then placed in cradles in the water for a couple of hours, being pressed down and trodden on by one or two men, so as to squeeze out as much gum, etc., as possible. It is intended to use wooden stampers for this purpose, and the colour and softness of the fibre would be much improved by this, or by any other beating process. Twenty-four hands are employed, the men receiving 5s., and the boys from 1s. 6d. to 3s. per day. A few Natives are at work, but European labour is preferred, as the former cannot be depended on for regular, steady work. About one ton and a-half of green leaves can be passed through each machine daily, and it takes at least 7 tons of leaf to produce one of fibre. The manager, Mr. Kelly, thinks that Price's machines are not strong enough, or sufficiently large; and that it would be an advantage if they could be set from the back, so that they might be adjusted by the engineer when necessary, without stopping the machine.

NELSON BROTHERS, Napier, 29th May, 1871.

The mill is ten miles from Napier, with about fifty acres of good flax swamp. It is worked by steam power, and two of Price's machines are kept going; water is abundantly supplied from two artesian wells, 57 feet deep. A constant flow is kept on the flax whilst passing through the stripper, and it is then put between wooden rollers, and washed in tubs in which fresh water is continually pouring, so that much of the gum or cement is seperated before it is put out to bleach. It remains out for a week or more, according to the weather, and it is then scutched by a barrel scutch, and the uncleaned tips are cut off by a knife, which is fixed to the scutcher at one end of the beaters. Great care is taken in sorting and cutting the leaves, which are from three to five feet long, only, and these are separated into bundles of the three sizes, and the edges and keels are stripped off before passing through the machine. The leaves now used are of twelve months growth; the flax was cut fifteen months since, the three centre leaves of each set being left. Within that time there has been a fresh growth of four full-sized leaves to each set; and at the second cutting, the three centre leaves were again left, the four outer ones only being taken, and of these the two first were frequently rejected, as too much spotted and decayed for manufacture; proving that, under these conditions, after a second years growth, the leaves have passed their prime and begun to decay. This ground was formerly very wet, but from draining and treading it is now comparatively dry, and the growth of the plant is much improved, for the younger leaves are invariably longer, and more luxuriant than the older ones. This field of Mr. Nelson's affords an excellent opportunity for further observations, as the plants are most carefully cut, and it is under the constant superintendence of the proprietor. From those already made here, and in other flax fields, we may conclude that each set from an established vigorous plant, in suitable soil, will yield four good leaves for manufacture every year. Mr. Nelson pays 12s. a ton for cutting the leaves, and estimates that 5½ tons give him a ton of fibre; and he prepares about 1 ton a week, with 5 cwt. of tow. He pays his men £1 a week, and his boys 7s., besides their food; and estimates that the total cost (not including wear and tear, his own superintendence, interest on outlay, &c.) is about £15 a ton for scutched flax, besides 12s. for carting into Napier. He has been hackling some three tons of fibre, after scutching, and has produced a beautiful sample; but half of the fibre passes into tow, and he calculates that from 12 tons of green leaf he gets—

1 ton of fibre costing	£23	0	0
1 ton of hackled tow, valued at	12	0	0
5 cwt. of scutched tow	2	0	0
	£37	0	0

If the tow is worth the money above stated, the fibre would yield a good profit, as it is perfectly clean and uniform. Mr. Nelson sends a bale of this hackled fibre for the exhibition at Wellington.

STONEYER & Co., Kaiapoi, Canterbury, June, 1871.

Use a water-wheel of 14 feet diameter, and the same number of feet broad, which works two double stripping machines and one scutcher, and raises water sufficient for washing the fibre. It is about equal to a 20-horse power steam engine, and therefore could keep more machines at work. At night it drives a flour mill. They have tried Williams,' Howarth's, and Barnes' machines, but they did not work so well as Anderson's; Barnes' was constantly blocking up. They have plenty of flax in their neighborhood, and it costs them 10s. a ton for cutting. It is passed through two of Anderson's strippers, one fixed below the other, and the two are fed by one operation, the leaf passing from one machine to the other without a second handling. A stream of water flows through the strippers, falling into a shoot below, into which the fibre drops, and is carried along some 20 feet, where it is picked up by a boy, put into hanks, and hung on hooks fastened to a pole that stretches across the mill stream, and remains there for an hour. It is then put out on lines to dry, and in summer will bleach in twenty-four hours, but in winter it will take as much as a week. The second stripper is of great advantage, when sufficient power can be easily obtained, for this fibre is soft and of very good colour, and took the 1st prize at the exhibition of the Canterbury Flax Association, in 1870. The expense of preparation is not increased, and flax baled, and covered with cloth, ready to be shipped, could be produced at this mill for £16 a ton (exclusive of interest, wear and tear), as the raw material is easily obtained, and the water power is abundant, and wages are moderate. It takes 7½ tons to produce a ton of fibre from one machine; and the various expenses are as follows:—

7½ tons of green leaf, at 10s.	£3	15	0
1 feeder, 7½ days, at 4s.	1	10	0
2 washers, „ at 4s. 6d.	3	7	6
2 men taking and bringing in from field, at 5s.	3	15	0
Baling and pressing		10	0
Covering	1	0	0
Total,	£13	17	6
Scutching	2	0	0
	£15	17	6

They have sold it to Lennan, for rope spinning, at £27 and £30 per ton. Flax cut on the road-side in December, 1869, and December, 1870, has now (June, 1871) four and five leaves to each set, and is four and five feet high. They use an American lever cotton press for baling, which is very simple, and more powerful than a screw. White New Zealand rope will barely last a week in their "Californian pump," always wet; but when prepared with whale oil, it will last several weeks, though constantly under water.

BENN & WALKER, Kowai Mills, Leithfield, Canterbury.

Have two mills, worked by steam power; one engine of 18 working up to 25-horse power, and driving four of Price's large machines, two water-scutching wheels, and three arm-scutchers; the other, of 6-horse power, working up to 8, and driving two of Price's large machines, and a water-scutcher. They have tried Howarth's, Anderson's, and Williams' machines, but prefer Price's. Cutting the green leaf costs 12s. a ton. After passing the stripper, through which a flow of water passes, it falls on to a travelling band or table, from which one expert man can pick up from the four machines (but an ordinary boy cannot pick up from more than two). It is then wet-scutched under a barrel scutch of 4 feet diameter, with 2½ inch beaters of rounded wood, revolving at a rate of 250 revolutions per minute. It is then soaked for twenty-five minutes, and bleached a fortnight or more, according to the weather. It is dry-scutched by an arm or Irish scutcher. The quality of the raw material is good. Of one variety it requires only 5½ tons for one ton of fibre; of another variety, it requires as much as 6¾ tons of green leaf. The former is equal to any *tihore* flax that grows in the North Island. The other variety grows in the same locality, and is more luxuriant, reaching a height of 10 or 12 feet, and is of a darker green color. The best flax grows on a black peaty soil, with shingle about 2 feet from the surface, and is about 7 feet long. The flax can be cut every year, and the centre leaves are not taken; 30 cwt. of green flax can be passed through each machine during the day. Sold 100 tons at £20 and £21 15s to go to Boston, America. The actual cost of preparation is about £18 a ton, with 25s. for cartage to Lyttelton. The six machines employ fifty men and boys, and turn out 6 and 7 tons a week. The cost of the steam engine is £3 per ton. 113 lbs. of fibre lost 25 lbs. in dry-scutching (20 lbs. of tow, and 5 lbs. waste); 20 lbs. of tow, when hackled, yielded 15 lbs. of fibre, and 5 lbs. of tow. Floor mats made from the fibre have been in use at the hotel at Leithfield for two years, and are still in good condition.

ASHLEY GORGE MILLS, 38 miles from Christchurch.

Not visited, but Mr. DeBourbel states that they have a 20-horse power steam engine, working up to 30, which drives four of Price's one of Fraser & Tinne's, and three of Anderson's machines, besides three dry-scutchers, and a small turning lathe; and about 120 hands are employed, including wood-cutters for fuel for the engine. It requires 6 tons of green leaf to one of fibre, and the flax is passed through the stripper with a flow of water, and is taken away on a travelling band or table, two boys being able to pick up from the eight machines. It is washed by hand, and soaked for one hour, and scutched with an arm-scutcher. The cost of the preparation may be set down as follows:—

6 tons of green leaf, at 13s.	£3	18	0
Stripping, soaking, washing, bleaching, and scutching ...	8	5	0
Pressing, baling, hooping, and covering	1	8	0
Steam engine	3	0	0
Delivery in Lyttelton	2	0	0
	£18	11	0

Besides wear and tear, and interest on capital.

BLUESKIN MILLS, Dunedin.

Use one steam engine of 16-horse power, working up to 23, and a water-wheel of 8 or 9-horse power. Also, six of Kincaid & McQueen's machines (improved), making 160 revolutions per minute, each of which will pass through 32 or 33 cwt. per day of green leaf; it takes 6½ or 7 tons of leaf to produce one of fibre; and the leaf costs 18s. per ton, delivered at the mill. The owners are introducing a wet-scutcher, and also have a pair of iron rollers for pressing out the moisture after scutching. The water-scutcher will make 110 revolutions, and the dry-scutcher 300 per minute. The rates of wages vary from 10s. to £1 16s. per week. The machines can turn out 2¾ tons of fibre per week, at the following cost:—

Engine and stripper	£9	16	0
Washing	2	10	0
Bleaching	6	15	0
Scutching	5	15	0
Firewood	1	13	0
Green leaf	13	13	7
Total for 2¾ tons	£40	2	7
Or, per ton	£14	11	0
Carting to town		18	0
Oil, &c.	1	0	0
	£16	9	0

Besides interest on capital, wear and tear, &c. Drying ground, not good.

MILLER, Silver Stream, near Dunedin.

Has a water-wheel 14 feet by 4, and drives one of Price's machines. Pays 12s. a ton for the green leaf, delivered at the mill, and requires 6½ tons for one of fibre. Washes by hand, and turns out only half a ton a week, as the mill is not kept constantly at work. Pays from 5s. to £1 a week for boys and men, besides their food, and gets £19 a ton in Dunedin for his fibre, for rope-spinning; paying 22s. a ton for carting it in. He takes great pains in the different processes, and makes a very good sample.

SOUNESS & Co., near Dunedin.

Have an 8-horse power steam engine, which drives two or three Kincaid & McQueen's strippers. They pay 17s. a ton for the green leaf, and require 7 or 8 tons for one of fibre. The flax is hand-washed, and requires three weeks to bleach and dry, when it is passed through a barrel-scutcher. Wages vary from 10s. to £1 a week, with food for boys and men; and they can produce two tons of fibre a week, when keeping two of the machines constantly going.

CAMPBELL, Ashburton Mills, near Dunedin.

Uses a water-wheel 30 feet by 2, and one of Kincaid & McQueen's, and another of Barnes' stripping machines, which can each put through 30 cwt. of leaf per day. Employs boys only at the mill, besides the grown up men of the family. Pays 13s. a ton for the green leaf, and requires 7 tons to make one of fibre; washes in boxes, and supply of water is limited. After bleaching in the sun, it is put through an arm-scutch, the imperfectly stripped ends having first been cut off. The cost of preparation is between £13 and £14 per ton, including 10s. cartage to Dunedin.

SEYMOUR, Wairau, 21st December, 1870.

There are very large flax fields in the valley of the Wairau, and it is profusely in flower this year. The settlers only recognize one species, though it varies in size and colour of the leaf according as it grows in wet or drained land. Mr. Seymour states that he preferred the shorter and yellower variety, as it passed more easily through the machine, and supplied an equally strong and a better looking fibre. His mill is not at work at the present time, but it is likely that he will soon resume operations. His buildings and plant are very complete, but the supply of water for washing is deficient, and he will never produce a good sample until this want has been provided for. He has used Price's, Anderson's, and Mills' stripping machines, but greatly prefers the first, as working better, and being less liable to get out of order. He has had one of these in constant use since March, 1870, that has never required repair. Has made 80 tons of fibre at a cost of £20 per ton, including interest on capital. It would cost 30s. a ton extra to split the leaf. The flax plants that were cut five or six months ago have sent up several good leaves, three and four feet long, and will be ready to cut again by the time the twelve months has expired. The fans that had thrown up a flower stalk have invariably died away after having been cut; and the fan that produced seed last year, whether cut or not, has died this season. Whether this is constant should be carefully noted in other flax fields.

Mr. HATHAWAY is dressing flax at his mills on the Wairau River, close to the ferry. He prefers Anderson's machines, and advertises them for sale; but the fibre, as it comes from the strippers, is very insufficiently cleaned. He has, however, abundance of water for washing purposes. Mr. Ninnis, the manager, has a seed bed, in which were some young flax plants, four and five inches high, which were four months old; these had been sown in September. He had planted in every other month of the year without success.

Mr. HOWLAND, about two miles higher up the river, was about commencing work. He has magnificent water-power, and a centrifugal pump supplies him with volumes of water for washing the flax. He uses Anderson's machines for stripping, and has, besides, a stamping machine of his own invention, under which the flax is passed by an endless band immediately after coming from the stripper, whilst a stream of water flows over it. I have no doubt that his fibre will be cleaned in a very superior manner; but one set of stampers will not be able to keep pace with his five or six stripping machines. He uses a peculiar scutcher, with toothed or scolloped beaters.

Sale of Flax in Auckland.

Much of it is sold by auction by Mr. A. Buckland, and the best brands now realize as much as £20 and £22 a ton. Inferior qualities are sold sometimes as low as £11 and £12, which cannot pay the working expenses of any mill.

Mr Roberts is buying agent for a Sydney rope-making company, and has paid as much as £13,000 for the fibre within the last three years. He does not think that the fibre can be made available for spinning purposes. He pays from £15 to £20 a ton at Auckland, and prefers Murray's and Keleher's, of the Mauku, and Thompson Brothers, of Tuakau, to any other manufacturers. A soft fibre, though of inferior colour, is best suited for tarred rope-making; and the hill flax is much superior to that which is taken from swampy low ground. Has seen a variety of superior small samples from different inventors, and has offered as much as £40 a ton for quantities of the same quality, but has never succeeded in getting any.

Tarred rope, made from New Zealand flax, is sold at £36 a ton in Sydney, and white rope at £42. The Manilla hemp imported into Sydney fetches £49 a ton there.

IX.—ON THE CULTIVATION AND GROWTH OF PHORMIUM TENAX.

The Maori never cultivated the *Phormium* with the view of improving the quality or quantity of its fibre. It was only those who lived in the bush, or at inland settlements, where flax did not abound, who took the trouble to make plantations near their villages. Those within easy reach of any large flax field were able to procure what they required from the choicer varieties that are always to be found growing in those places. At the present time flax is rarely transplanted by them, as they no longer depend on this material for their ordinary clothing, and require but very little of the better qualities for their fine mats and other ornamental purposes.

The majority of Europeans who are concerned in the flax industry have paid little or no attention to its cultivation. The extensive flax fields, in their natural state, have hitherto been amply sufficient to supply all that they have required; and the low prices in the English markets have so limited the production that there has been no prospect of a scarcity of the raw material; and the manufacturers are unwilling to invest more capital than is barely necessary for machinery, plant, and working expenses. But there are a few who have thought it worth while to expend time and money either in planting considerable tracts of land, to prepare for a future greater demand, or in making experiments on a small scale to observe and note the growth, and to test the possibility of improving the plant; or of raising a supply by cultivation with profit and advantage.

European Cultivation.

Mr. Finnimore planted some thirty acres, near Wanganui, at a considerable expense; and Mr. Hirst states that the Patea Flax Company expended £457 in cultivating 75,000 plants of the best varieties, on twenty-five acres of land; but in both instances the outlay was so great and the prospect of pecuniary success so small, that the plantations have subsequently been neglected, and it is doubtful whether they will be maintained.

Mr. Constable of Waiuku, near Auckland, in September, 1868, planted about half-an-acre of land, of fair quality (though rather dry for flax), which he had carefully prepared and manured, with three varieties of *Tihore*; and in May, 1871, these were healthy and vigorous, and, in some cases, had thrown out twelve and thirteen, and in one instance, twenty-two fresh fans; but the majority would not average more than five or six. When two years old a few leaves were dressed by the ordinary mill process, but the fibre was not superior to that obtained from common swamp flax, as it was harsh and brown. The breaking strains were—*Rataroa*, 86; *Oka-oka*, 77; and *Ngarowaka*, 61.

There is a plantation of the same age in the Domain Gardens at Christchurch, the plants having been procured from the North Island; but these have not been so prolific, owing either to colder climate or to the growth of the sets having been retarded, by having been carelessly removed and kept a long time out of the ground during transit. One variety (name not known) has been quite cut down by the frosts, showing that it is too tender for that part of the Colony.

Mr Hulke, of New Plymouth, has formed a nursery of 2,000 plants, of the best varieties, in three-quarters of an acre of ground, which he offered to make over to the Government on condition of being re-imbursed for his outlay, and he undertook to superintend its management if a sum not exceeding £20 a year was provided for working expenses. This offer, on the recommendation of the Commissioners, has been accepted, and the plants are now at their disposal for distribution and experiments. There are also a qnantity of seedlings, which have grown very well, but cannot be depended on as useful varieties, and they will take a much longer time in coming to maturity than those plants that have been raised by off-sets from approved and established bushes. Other persons have also sown flax seeds, with no more favorable result. In many private gardens a few plants have been introduced, and carefully attended to. In Dr. Hector's and Mr. Mantell's gardens at Wellington, sets of variegated flax that were planted two years ago have now from three to six fresh fans, and one of *Manunu* that has been in the ground seven or eight years has forty-four. Some plants of the same variety, which were planted more than twenty years ago in the garden now belonging to Mr. Quick, have increased one hundred fold.

Messrs. Nelson, at Napier, have also planted flax, and sets that had been in the ground seven months had sent up four and five leaves, and occasionally two or three fresh fans. But in all these cases of recently planted sets, they have not reached the length of leaf and vigour of the old bushes, though the leaves become larger as the roots increase, and are better established. This proves that increase is not sufficiently rapid, nor vigorous and luxuriant enough to justify a hope that cultivated flax will yield a fair crop of leaves within four years, which opinion coincides with that expressed by many of the Natives themselves.

A portion of the Botanic Gardens at Wellington has been set apart for the cultivation of flax, at the cost of the Commission. Seeds from seven varieties, from Taranaki, were sown on the 4th November, 1870, and were above ground on the 24th of the same month. In April they were planted

out, being then 5 inches high. On the 1st of August, *Manunu* had four or five leaves of an average height of 9 inches. *Parekoritawa* (variegated) had as many leaves, which were stronger, being 1 foot in length and half-an-inch broad, but there were no signs of variegation. *Huhiroa*, same number of leaves, but weaker and membranous, and not more than 4 inches long. *Takaiapu* and *Raumoa*, leaves 5 or 6 inches larger, and a-quarter of an inch broad. *Atiraukawa* and *Korako*, same as *Huhiroa*.

300 sets, of fourteen varieties, from Mr. Hulke's nursery, at New Plymouth, were planted in April, after having been out of the ground for nearly three months, and they are now beginning to sprout; but 100 sets from Wanganui, planted a little later, in very wet ground, have not yet made a start.

At St. John's College, near Auckland, there is a quantity of *Rataroa*, one of the strongest varieties of *Tihore*, procured by Bishop Selwyn, from the East Cape, some twenty-five years ago. It was planted in a gully, which had been drained; the upper part was quite dry, but a small stream of water flowed from springs lower down. All the sets have multiplied greatly, and now form large bushes, with as many as 100 fans; but there are rarely more than six perfect leaves on each fan, the seventh and eighth being quite unfit for manufacture. The leaves of those sets that were planted in the moister ground are very much longer and stouter than the others, reaching a length of 8 and 9 feet, whilst those in the driest parts, and by the side of the hill, are barely 3 feet high. There does not appear to be any difference in the quality of the fibre, and both large and small leaves are stripped with equal facility by the Maoris. The more luxuriant leaves have a deeper and richer green colour, but in shape and colour of the edge and keel they remain alike.

As this plantation afforded a good opportunity for making experiments as to the strength and quantity of fibre, from leaves of different ages, a Native was employed to dress some of the flax; the leaves were cut for him, and kept in separate bundles, so that they should not be mixed.

Strength of Fibre from Leaves of Different Ages.

After stripping and cleaning, some of the hanks were boiled in soap and water for an hour, without improving the appearance and texture in any way; some were washed and rinsed in warm soap and water for a few minutes, and this both softened the fibre and improved the colour; others were soaked in cold water (repeatedly changed) for different periods, from twelve hours to five days; but the longer they were kept in soak, the worse the colour became.

A few of the centre immature leaves were stripped, and the fibre was very white, soft, and silky, equal to any of the best samples of Native-dressed, which have probably been prepared from young leaves of this kind, and could not, therefore, be obtained in any quantity, even if the natives were disposed to supply it. On being tested for strength, twisted tightly into a double strand in the usual manner, it was found that the fibre of these half-grown plants bore a greater average strain than any of the others, as follows:—

Centre leaf; breaking strain	81
1st. pair leaves „	70
2nd. „ „	72
3rd. „ „	78

As it was impossible that these immature fibres could be as strong as those that were fully grown, it was conjectured that their softness had enabled them to bear a greater torsion, and the strands were then tried without being twisted at all; and though the young fibre proved, as was expected, to be the weakest, yet the whole of the strands bore a considerably greater strain than when in their twisted state, so that it was found necessary to reduce the fibre to one-half, as the spring balance then in use, which weighed up to 300 lbs. only, was not strong enough to break the full quantity of 20 grains to 1 foot. The result was, that an untwisted, single strand, of 10 grains to a foot, broke as follows, the results, as in former cases, being reduced to the standard of Manilla, equal to 100.

Fibre of centre immature leaf; breaking strain	104
1st. pair of leaves	122
2nd. „	116
3rd. „	113

Since then, a different adjustment has been made with the machine, and double strands of Native-dressed *Rataroa*, slightly twisted, have borne the following strain before breaking:—

1st pair of leaves; breaking strain	104
2nd. „ „	104
3rd. „ „	110

These are averages of many trials. The maximum strain was 129, showing that some of the *Phormium* is far stronger than Manilla, or any other fibre of the hemp class.

Another trial was made with fibre of the same variety, stripped by White's machine, with the following result:—

1st. pair of leaves; breaking strain	87
2nd. „ „	79
3rd. „ „	81

Quantity of Fibre in different aged Leaves.

To ascertain the relative quantity of fibre, seven leaves of each growth were taken from the same plants, weighed, and passed through White's stripping machine.

1st. pair leaves, weighing	16 oz., gave 4 oz. of fibre ...	25	per cent.
2nd. „	20 oz., gave 4½ oz.	22 5	„
3rd. „	12 oz., gave 2¼ oz.	18.7	„

As these fibres were not thoroughly cleaned, and a great deal of vegetable tissue still adhered to them, this experiment only showed that the relative quantity was greatest in the youngest leaves; and a more exact trial was made in the laboratory with leaves of the *Manunu*, which gave from the half of the

1st. leaf, weighing	50.1 grammes,	7.77 grs. of fibre ...	15.51	per cent.
2nd. leaf „	60.0 „	10.50 grs. „ ...	17.18	„
3rd. leaf „	54.3 „	8.30 grs. „ ...	15.28	„

The advantage of quantity was in favor of the second leaf this time, and another trial gave from—

1st. leaf, weighing	58.55	grammes	...	...	16.26 per cent.
2nd. leaf „	52.68	„	...	...	17.89 „
3rd. leaf „	36.35	„	...	...	19.06 „

Here the third leaf had the largest relative quantity of fibre, but was little more than 3-5ths the weight of the first leaf.

Although these various experiments do not give invariable results as to the relative strength and quantity of fibre from leaves of different ages, yet it may be concluded from them that they are nearly equal in both respects, and may be used indiscriminately in manufacture.

Growth of Plants.

The growth of *Phormium* depends chiefly on the soil and position in which it is placed. In a large flax field of equable soil and moisture, where scarcely two bushes are exactly alike, and the finest varieties are to be found, there is great difference in the length of the leaves, while the same kinds that are stunted and yellow on dry and poor clayey ground, or in stagnant water, will flourish and rapidly increase if planted in a more congenial soil. The *Phormium* luxuriates in rich, moist, and well-drained ground, and reaches its greatest size on the banks of running streams, where the roots are abundantly supplied with nourishment by water that never stagnates about them. Wherever swampy ground has been drained (and not made too dry), there the flax increases in size, and becomes of a deeper green colour. This has been satisfactorily demonstrated by several manufacturers, and especially by Mr. Constable, at Waiuku, and Messrs. Nelson, at Napier.

The flax transplanted by the Natives does not appear to have improved in quality of fibre. The finest and whitest samples of Native-dressed flax, procured by the Commissioners, have been prepared at Waikanae and Otaki from plants growing naturally in and around the swamps; and the Natives never plant an inferior flax by way of improving it.

When every leaf has been cut quite down, as is generally the practice with those who supply the mills, the fan will send up within the first year from four to six full-sized leaves. Captain Hutton says that "swamp flax that had all the outer leaves taken off in January, had so many young leaves full grown by the end of April, that the casual observer would not have known that the plants had been cut at all." Mr. Keleher, of Waiuku, says that flax cut eighteen months ago has now six full grown leaves, and that cut seven months since has three leaves besides the centre one. Mr. Ritchie, of Wanganui, states that the growth of flax between August, 1870, and January, 1871, has been 5 feet. Mr. Seymour, of Picton, says that he can cut leaves every twelve months, and that several from each fan had grown 3 or 4 feet long in five months. Messrs. Benn & Walker, of Canterbury, find that flax can be cut every year, but they take care never to cut the centre leaves. Messrs Stoneyer & Co., of Kaiapoi, say that they can cut every twelve months; and that flax cut in December, 1870, and again in December, 1871, had in June following four and five leaves to each fan, from 4 to 5 feet in height. How long the roots will continue to bear this treatment cannot yet be determined, for it has not been observed that any plants have been killed by constant cutting; but it is reasonable to conclude that if cut down year after year the plants will gradually be weakened, and die out. (If cattle have access to a flax field that has been cut, they will destroy the plants altogether, by drawing out the young leaves to chew the butts, of which they are very fond).

At a few of the mills, where the supply of water is limited, more prudence has been exercised, and the two or three centre leaves of each fan have been left standing. Messrs. Nelson, of Napier, adopt this plan, and they find that in twelve months, after cutting all but the three middle leaves, four fresh ones have sprung up, and they have four outer ones so completely matured that, if left standing for three or four months longer, many of those on the outside will be so decayed as to be unfit for manufacture, and they have lost a considerable quantity of leaves in this way.

Assuming that there is a similar growth in every flax plant, whether cut or not, *i.e.*, that four fresh leaves will start from the centre each year; and that there are on the average but eight or nine leaves on each fan, we arrive at the conclusion that after two years old the leaf, having reached maturity, commences to decay, and is not fit for manufacture.

Whether well-established plants, annually cut, will send out as many new fans as a bush that is left entire, remains yet to be observed and noted; but probably they will not.

The length and bulk of each leaf depends partly on the season of the year in which it makes its growth; for the flax grows all the year round, but more rapidly of course in the spring and summer. Mr. Rees found that after plants had been burnt down, the first leaves were shorter and less vigorous than those that grew after the plants had recovered the effects of the fire.

The centre fan, that bears a flower stalk, produces no more leaves, but dies away the following year; it may therefore be cut quite down without disadvantage.

The cultivated *Tihore*, flowers very sparsely, and often fails to perfect seed.

The Natives suppose that the best time of the year for dressing is the winter and autumn, and that the fibre is more easily stripped out at those seasons; but none of the manufacturers have observed any difference, and it is doutful whether any exists in the matured leaves. The Natives strip flax in winter because they are engaged with their crops at other seasons.

Varieties of the Flax Plant.

The named varieties of flax are very numerous, but they are not generally and accurately distinguished even amongst the Natives themselves; and there is no doubt that the same variety has often a different name in different districts.

Tihore is usually a generic term for cultivated plants that have so fine an epidermis that the fibre can be torn out with the fingers only, and without using a shell.

There has been no opportunity yet of satisfactorily fixing the varieties; and it will be only when plants from all parts of the island have been collected at one place that they can be compared, and an accurate list compiled.

In Waikato and the Bay of Plenty, the *Oue* is the favourite variety; on parts of the West Coast, the *Atiraukawa*; at Napier, the *Tapoto* (probably the same as the *Oue*, as Major Heaphy suggests); at Wanganui, the *Huhiroa*; and at other places the *Ngaro*, *Manunu*, and *Rataroa*.

The accompanying list of plants has been collected from different sources, with such information as can be gathered with regard to the quality, strength, texture, and uses of their respective fibres.

LIST of NAMES of the VARIETIES of the PHORMIUM TENAX distinguished by the NATIVES.

Name.	District and Authority.	Remarks.
Aonga	Bishop Selwyn ...	A variegated flax.
	East Coast, Heaphy ...	*Awanga (?)*
Arotara ...	Waikanae, Native	Poor fibre. Yellowish-green leaves; dark brown edge.
Ate	Hauraki, Bishop Selwyn ...	*Haro* Requiring to be scraped by a shell.
	... ...	do. do. do.
	Wanganui, Woon	Strong fibre. Used for Eel nets, and baskets.
Atewhiki ...	Taranaki, Kelly	Fibre, very white. Used for best garments; leaf narrow; reddish tinge; edge and keel narrow; bright scarlet line.
	Ditto Hursthouse	First-rate quality.
	Opunake, Native	Breaking strain, 77.
Atiraukawa ...	East Coast, Heaphy	*Hatiraukawa?* Used for finest mats, probably same as *Oue.*
	Taranaki, Kelly	Best, and most abundant fibre, not large, but a quick grower. Leaf, bronze, when mature; light olive green, when young; rather pointed; edge, dull dark brown, lighter in inner margin; sometimes brown, relieved by a bright red line.
	Ngatiruanui, Woon	Lengthy and strong fibre.
	Opunake, Native	Breaking strain. Maximum, 90.
	Christchurch Domain, Armstrong	Leaf broad; light green; abrupt at the points; edges, light brown.
Harakeke ...	Mantell ...	Also, *Haraheke.*
	Waikanae, Native	Common swamp flax.
	Otaki, Native	Name for all flax, except *Whahariki.*
	Waikato, Hutton	Strip of leaf $\frac{1}{8}$ inch broad; broke at 42 lbs.
Hewara ...	Opunake, Native	Breaking strain, 77.
	Waikanae, Native	Broad, buff green leaf, with dark narrow edge.
Huhiroa ...	Mantell	or *Uhiroa (?)*
	West Coast, Heaphy	Yields best fibre; probably *Oueroa.*
	Wanganui, Woon	Long fibre. Used for fine and *porae* mats, fishing lines, nets, ropes, &c.
	Taranaki, Kelly	Good fibre, easily separated from gum. Leaf, blueish-green; narrow edge, black, or very dark brown; keel, reddish chocolate; leaf gradually narrows to a point.
	Opunake, Native	Breaking strain, 98.
	Christchurch Domain, Armstrong	Leaf very long, tapering at the point; edges, light brown.
Huruhuruhika ...	Taranaki, Kelly	Used for rough garments. Bears a general resemblance to *Takaiapu.*
	Opunake, Native	Breaking strain, 87.
Karuamoa ...	Waikanae, Native	Good fibre; tapering leaf; dark chocolate edge.
Kauhangaroa ...	Hawke's Bay, Nairn	Used only for baskets and matting; easily breaks with a jerk.
	Ditto Native	Good white fibre, soft, and silky.
	Government Domain, Christchurch, Armstrong	Two variegated forms. Per centage of fibre, 19.6; leaves, large coarse edges, and base, dark brown.
Kohunga ...	Maungatautari, Bishop Selwyn...	*Tihore.*
	Ditto Mantell ...	Fine kind.
Korako ...	Taranaki, Kelly	Used for best garments. Dark green leaf; edge, a narrow line of dark brown; keel, a pale yellow.
	Ditto Hursthouse ...	First-rate quality.
Koura ...	Wanganui, Buller	Best fibre for *Korowai*, or shaggy mats.
Kuroa ...	Christchurch Domain, Armstrong	Per centage of fibre, 17.8.
Kuru ...	Opunake, Native	Breaking strain, 95.
Manunu ...	Taranaki, Kelly	Used for rough purposes.
	Opunake, Native	Breaking strain, 90.
	West Coast, Heaphy	or *Manunui* (?). Good for cordage.
	Ditto Mantell	Best variety.
Matoroa ...	Pipiriki, Woon	Strong and durable; short fibre, used for borders of fine mats.
Motu-o-rui ...	East Coast, Heaphy ...	Also, *Awanga*—a variegated kind; fibre unserviceable for manufacture.

LIST of NAMES—*continued.*

Name.	District and Authority.	Remarks.
Ngaro ...	Taranaki, Kelly	Used for rough garments.
	Waikato, Jenkins	Good fibre; blueish green leaf; black edge.
	Raglan, Snackenburg... ...	Best of all the kinds, for all purposes.
	West Coast, Heaphy	Stiff fibre.
Ngarowaka ...	Waikato, Jenkins	Good fibre for mill purposes; leaf, bright green; red edge.
	Waiuku, Constable	Cultivated; soft, fine fibre.
Ngatotomawe ...	Opunake, Native	Breaking strain, 84.
Ngutunui ...	Taranaki, Kelly	For best garments; quick grower; leaf similar to *Takaiapu*, but has a blunt point, and is red at the butts.
	Opunake, Native	Breaking strain, 95.
	Waikanae, Wi Tako	Much esteemed leaf; dark olive green, with dark red edge.
	West Coast, Heaphy	
Ngutuparera ...	Taranaki, Kelly	For rough garments.
	Opunake, Native	*Parera* (*?*). Breaking strain, 95.
	West Coast, Heaphy	or *Ngutuparura* (*?*).
Oka Oka ...	Waiuku, Constable	One of the best varieties; cultivated.
Oue	Christchurch Domain, Armstrong	Leaf, narrow, very strong; edges, orange coloured; per centage of fibre, 34.1.
	Taranaki, Kelly	Leaf narrow, of an olive green; edge and keel, orange coloured; used for best garments.
	Hawke's Bay, Locke	Fine fibre, next to *Tapoto*.
	Whakatane, Native	Best variety, white and soft. Breaking strain, 91.
	Waikato, Hutton	Typical *Tihore*.
	Ditto Mantell	A fine fibre. Also, *Ouhe*.
	East Coast, Heaphy	Also, *Tapoto*, cultivated at Coromandel, Kawhia, and Waikato; glossy leaves, rather red at the edge; has a general orange-green appearance at a distance.
	Maungatautari, Bishop Selwyn...	*Tihore*.
Paheke ...	Opunake, Native	Breaking strain, 87.
Parekoritawa ...	Taranaki, Kelly	Variegated variety; leaf, very bright green longitudinal stripe, of brimstone colour; fibre very good; edge and keel orange colour.
	Opunake, Native	Breaking strain, 79.
	Waitara, Woon	Very white, and strong fibre.
	West Coast, Heaphy	Yields best fibre.
	Christchurch, Armstrong ...	Per centage of fibre, 18.8.
Paretaniwha ...	Whakatane, Native	Strong fibre for fishing lines, nets, &c. Breaking strain, 95.
	Opunake, Native	Breaking strain, 83.
	Maungatautari, Bishop Selwyn...	A *Tihore*.
	Ditto Mantell ...	Fine kind.
	Waikato, Hutton	Yellow, hill flax. Strip of leaf $\frac{1}{8}$ inch broad, broke at 42 lbs.
Pato ...	Taranaki, Kelly	Used for rough purposes.
	West Coast, Heaphy	Stiff fibre.
Poitaniwha and *Ngutukaka*	Waikato, Jenkins	or *Paretaniwha* (*?*)—Good fibre for mill purposes; dark green leaf.
Papu ...	Waikato, Jenkins	Yellowish-green; brown butts, red edge. Good fibre for mill purposes.
Rataroa ...	Taranaki, Kelly	Said to be used for best purposes. Taper, acuminate, bronzy, green leaf; dark purple keel and edge, fading on the upper side.
	Waiuku, Constable	Best *Tihore*; varies from 3 to 8 feet, according to soil; red edge.
	St. John's College, from East Cape	The strongest of all the fibres. Breaking strain, 117.
	Christchurch, Armstrong ...	Per centage of fibre, 21.6.
	Waikanae, Native	Scarce. Very taper, light yellowish green leaf; narrow, dark edge.
Ratawa ...	Hauraki, Thames, Bishop Selwyn	A *Tihore*. Probably misprinted for *Rataroa*.
Raumoa ...	Taranaki, Kelly	Used for rough garments; light green leaf, reddish brown keel and edge; narrower underneath.
	Opunake, Native	Breaking strain, 76.

LIST of NAMES—*continued.*

Name.	District and Authority.	Remarks.
Raumoa ...	Waikanae, Native	Darkish green leaf; broad, red-brown edge on upper side, narrow do. below.
	Taranaki, Bishop Selwyn ...	*Raro.* Requiring to be scraped with a shell.
Rerehape ...	West Coast, Heaphy ...	Yields best fibre; good for cordage.
	Maungatautari, Bishop Selwyn ...	A *Tihore.*
Rongotinui ...	Mantell ...	Fine kind.
	East Coast and Bay of Plenty	Used for fishing nets, and cordage; best fibre
Tihore ...	Heaphy	for mill purposes.
	Taranaki, Kelly	Light green leaf, with wide black edge.
Takaiapu ...	Opunake, Native	Breaking strain, 95.
(*Kiapu*) ...	Taranaki, Kelly	Fibre very strong; leaf erect, brown edge.
	Opunake, Native	Breaking strain, 76.
Tapoto ...	Hursthouse ...	First-rate quality.
	Hawkes Bay, Nairn ...	Leaves narrow, erect, deep purple margin; strong, lustrous fibre, used for sewing threads or weft of fine mats.
	do. do. Locke ...	Sometimes called *Tihore* or *Takiri*; best variety.
	East Coast, Heaphy ...	Also, *Oue*—fibre, glossy, silky, but brittle, used for *Kaitaka* mats.
	Opunake, Native	Breaking strain, 101.
	Christchurch, Armstrong ...	Similar to *Tihore.* Per centage of fibre, 18.7 tapering at the points; edges red.
Tararíki ...	Taranaki, Kelly	Used for rough purposes.
	Opunake, Native	Breaking strain, 70.
	West Coast, Heaphy ...	Stiff fibre.
	Wanganui, Woon	Fine and soft texture, used for *Potas*, or ornamented mats; tapering acuminate leaves; dull, olive green, lighter on the outer side; dark red keel and edge, and keel on the upper side gradually shaded away, forming a dark coloured band $\frac{1}{8}$ to $\frac{3}{8}$ of an inch broad; 2 or 3 inches of the point of the leaves of the same dark colour.
Tawai kakako ...	Napier, Native	Dark colour when first scraped, but it is put into baskets, and kept to improve its colour.
Tiheru ...	Opunake, Native	Breaking strain, 98.
Taihore ...	Taranaki, Kelly	Plant or variety?
	Christchurch, Armstrong ...	Leaves linear; very strong; dark red edge. Per centage of fibre, 19.8.
	Raglan, Native	Breaking strain, 99.
	West Coast, Heaphy ...	Best fibre.
	Waikato, Hutton	Best variety, cultivated. Strip of leaf $\frac{1}{8}$ inch broad, bore a strain of 48 lbs.
Tipuna ...	Taranaki, Kelly	Used for rough garments.
	Hursthouse	*Tepuna (?).*
Tito-o-moe-wai ...	Taranaki, Kelly	Used for rough garments.
Tuau	Waikanae	Coarse plant, not used for fine work.
Tuawhitu ...	Bay of Islands	Fine and soft fibre. Leaf tapering, thin texture, bronzy colour, lined and smeared at the upper end, narrow, dark red edge.
Tumara ...	Waikato, Jenkins	Good fibre for mill purposes.
Turepo ...	Waikanae	Small yellow variety, grows in wet swamps, and has a white silky fibre; brown edge and keel.
Tutaiwiki ...	Taranaki, Hursthouse ...	
Wararika ...	East Coast, Heaphy	Also, *Mangaeka*—Fibre of ordinary character.
Wharanui ...	Hawke's Bay, Nairn ...	Soft fibre, used for fine mats.
	do. do. Locke ...	Next to *Oue.*
	Mantell ...	Or *Waranui (?).*
Whararíki ...	Hawkes Bay, Nairn	Weak fibre, only used for kits, &c.; very broad and tall leaf; grows in richest soils.
Phormium Colensoi	Taranaki, Kelly	Used for rough garments.
	Waikanae, Native	Never used.
	Heaphy	Stiff fibre.
	Mantell	Also, *Wharaeki.*
	Bishop Selwyn	*Whararipi.*
	Waikato, Hutton	Strip of leaf $\frac{1}{8}$ inch broad; broke at 34 lbs.
Witau ...	East Coast, Heaphy	Poor fibre.

X.—MISCELLANEOUS REPORTS.

In continuation of Mr. Fox's Report (See Ante. p. 21).

The accompanying samples of China Grass (*Rhea*)* were given to me by Mr. Christian Berridge, Manager of the Works of the Yorkshire Fibre Company, Balne Lane, Wakefield.

The Company's object is to produce, in the best possible condition, fibre for use in making handkerchiefs, umbrella and parasol materials, &c., so that capability of very fine "drawing" is required. The company has not found, for its purpose, any fibre comparable to that of China grass. It is roughly prepared in Shanghai, where it is worth, at present, from £110 to £120 per ton. The Company submits the fibre, so prepared, to a very strong chemical solution; afterwards subjects it to a softening process, by passing it through one of Hodgkins' machines; and subsequently dries it, and puts it into the form of hanks, upon bobbins, &c.

E. Fox.

London, 22nd June, 1871.

Mr. E. Fox to Mr. C. Berridge, Yorkshire Fibre Company, Wakefield.—Charing Cross Hotel, London, 9th July, 1871.

Dear Sir,—

When I called upon you on Tuesday last, for the purpose of seeing Collyer's fibre machine, you showed me some New Zealand flax, which you said had proved wholly useless for the purpose of your Company.

I think you will be interested in seeing of what the New Zealand Flax is capable; and I therefore send you, by this post, a small sample of it, which was prepared by hand, by Native women, and which has certainly not been chemically treated.

If you think that fibre, such as the sample, could be dealt with by your processes, will you add to the obligation of your kindnesses when I was at your mill, by writing me a few lines.

I am, &c.,

E. Fox.

Mr. C. Berridge to Mr. E. Fox.—Bradford Mills, Balne Lane, Wakefield, 24th June, 1871.

Sir,—

I now beg to hand you a small piece of your New Zealand fibre, that has been through our chemical process. Our solutions have evidently been too strong for it, and with such a small sample we could not experiment much; but if, at a future period you could let me have a larger sample, I should like to try it once more.

Yours truly,

Christian Berridge.

(No. 28.)—Extract from Letter of Mr. G. H. Gordon to the Hon. Wm. Gisborne.

Having just read the Report of the New Zealand Flax Commission, and owing to my having been ten (10) years, five of which I was practically employed sorting and preparing for sale by the London brokers, flax, hemp, jute, coir, cotton, &c., I am emboldened to offer a few remarks and suggestions on the matter at issue. One great fault has been to call an article flax, and at the same time to represent it by what the trade would term a low quality of Bombay hemp. I may state while at home a small parcel of flax, ex the "Wild Duck" from Wellington, passed through my hands. The buyers on the day of sale were surprised that it should have been quoted flax, when it was really hemp. Having an idea of going to New Zealand, I asked their opinion on the merits of the article. They said it was folly to call it flax, as it was no use to flax-buyers. To use it for flax purposes it would require to be passed through rollers, and that would probably destroy it. That, if carefully dressed and properly packed (the parcel in question being all touseled), it would to a very great extent compete with Manilla hemp. There is one great thing that must be borne in mind by all those engaged in flax manufacture; that is, on landing in the home market it passes through the hands of entirely disinterested persons, who on account of their employers being responsible to the buyer for their sorting and classification, make a point of exposing all its defects. Any appearance of inferior quality, false and bad packing, is at once exposed. The buyer accordingly values the goods at such a price that protects him from the risk that the appearance of the goods indicate. Whereas a very ordinary attempt at sorting and dividing into two or three qualities, and a better system of packing, would often leave a good margin of profit, that now in many cases creates a loss. Manufacturers seem little aware of the importance of a uniform system of packing, some bale up one weight, some another, and some different weights; some secure the bales with fencing wire, some hoop-iron, and some with a rude sort of rope of one strand, about one inch in thickness, of very doubtful strength. The result of all this is a great diversity of tares, causing a great many more bales to be tared than would be otherwise necessary, and as the bales would not be pressed again, but only temporary secured, the flax gets out of condition and much touseled, every operation causing loss to the seller. With regard to securing the bales with iron, it is decidedly objectionable, unless the bales are first covered with gunny made from flax, scrim, or some coarse material, for this reason, all bales so packed after being stowed in the ship's hold, should there be the least steam (and some ships steam a great deal), it is bound to collect on the iron and cause rust, which damages the flax, and when landed it is passed as first, second. or third class sea and iron damaged, according to the

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* Now in the Flax Exhibition.

amount of damage received. The loss in consequence would more than double repay the cost of placing some coarse material between the flax and the iron. Independent of that, the covering on the bale protects it in many ways; through handling with hooks the short ends get drawn out, making the bales unsightly, besides picking up the dirt when rolled over; and also through being shipped in damp and dirty weather the bales get in such a mess that on landing no sorter would be able to pass them as good order, but only as first-class damaged. Then with regard to false packing, that is placing the best looking flax outside the bale and the inferior in the middle, a more suicidal practice could not be attempted. Should it not be detected by the sorter before the sale, it will destroy the confidence of the buyer for some time to come, besides destroying its reputation and lowering the price of really honestly packed parcels. I am informed by a manufacturer that inferior got up flax pays better in proportion to sell here than the best dressed; if that is the case, it is a great fault of the colonial buyer, and one of the surest means to prevent manufacturers from making that improvement that is so desirable. Buyers, in all cases should look only at well-dressed parcels, and only take inferior at very low prices; by so doing they would induce the manufacturer to persevere and ultimately produce a better quality. When once a regular system of sorting is commenced by the manufacturer, no matter how rude, with a uniform system of packing, say same weight of bale, same tare, in fact same in every detail all over the colony, then will commence a gradual improvement in the production, a steady rise in price in the home market, creating confidence in the home buyer and a remunerative enterprise, and the beginning of a great national industry. In the meantime, if companies were formed in the different provinces to buy flax of the manufacturers, sort and classify it, and send it home with their own brand upon it, the result would soon induce manufacturers to commence the same. With regard to that portion of the Report stating that Customs officers should be appointed to sample the bales before shipment, it would I think to a certain extent be unworkable, because it would be impossible to draw a fair average sample without unlashing the bales, and that would necessitate the sample bales being sent back to be re-pressed, or the officers would have to go round to the different warehouses and draw the sample before pressing, which would be inconvenient. But the principal objection would be that unless the officers had some experience, and knew how to draw a fair average sample that would represent the whole parcel, the samples would be of little use. It seems very simple to draw a sample, but not so to draw one that would enable a buyer of raw material to a very great extent to judge the quality and value of a large parcel of goods without seeing the whole bulk, in fact persons at home serve a regular apprenticeship to it.

Copy of a Letter from Captain FAIRCHILD to Hon. Colonel HAULTAIN.—Bay of Islands, 2nd February, 1871.

SIR,—

In reference to some conversation I had with you concerning New Zealand flax, I have the honor to state that in 1863 and 1864, when master of sailing vessels on the New Zealand Coast I used New Zealand flax rope on one side of the vessel, and Manilla rope on the other side of the same vessel, and at the same time.

My object was to ascertain which rope would last the longest for running gear on board a vessel.

I found that two of Manilla would last as near as possible the same length of time as three of New Zealand flax of the same size. The New Zealand rope used to break or twist short off in several places, when other parts of the rope would be quite good. I found the New Zealand rope, without tar, to last quite as long as that with tar, so that rope without tar would be the cheaper of the two, as it would be lighter.

I have, &c.,

JOHN FAIRCHILD,
Master of the p.s. "Luna."

(No. 103.)—Captain KERR, ship "Crusader," to CHAIRMAN.—Lyttelton, 17th July, 1870.

I am in receipt of your favor of the 12th instant, and have much pleasure in forwarding samples of the rope made in London of New Zealand flax. The largest piece is what I have been discharging sixty girders with, weighing about 3½ tons each. I have part of the same coil for main sheets, in use since leaving London last December.

The smaller samples *are tarred*, and have been in use for braces, and halliards, all of which you will observe, seem to answer well, and are, to all appearance, quite good yet.

Copy of a letter from the Hon. JULIUS VOGEL to Commander R. F. R. LEWIS, U.S.N.

SIR,— General Government Office, Auckland, 1st October, 1870.

As you were good enough to say that, if a small quantity of rope manufactured from New Zealand flax were sent on board the Resaca, you would make a trial of its use as running gear on the voyage home to Valparaiso, and make a special report of the result, the quantities undermentioned have been procured, and are now placed at your disposal, viz.:—50 fathoms 4in. rope, 50 fathoms 2¾in. rope, 50 fathoms 2¼in. rope. These samples of rope are of Auckland make, spun and laid by steam machinery imported from America. Rope of like quality could be supplied here at the price of £45 to £50 sterling per ton of 2,240 lbs. The flax used in making this rope received a slight dressing of whale oil. In addition, you will receive a small quantity of 3¾in. and 2½ inch rope, spun by hand, laid in the ordinary way, and without oil dressing, and also samples of the flax in its several stages of preparation by different processes. The attention of European settlers in New Zealand has within the last two or three years been turned to the preparation of the fibre of *phormium tenax* for local use and for exportation. The supply of the raw material may be said to be unlimited, and the process of manufacture is being

gradually improved. If you should be able, as I hope you will, to report favorably of the rope which is submitted to you for experiment, it may be expected that a market for that product, and for the flax itself, will be found in the United States, and commercial relations between that country and this Colony be extended.

I have, &c.,
(Signed) JULIUS VOGEL.

[Extract from *Gazette* of 27th March, 1871.]

Colonial Secretary's Office,
Wellington 27th March, 1871.

The following reports by Commander Lewis, and Mr. Rhoades, Master and Navigator of the United States steamer "Resaca," on the strength and durability of the New Zealand flax used on board during the voyage between New Zealand and Chili, are published for general information.

In the absence of Mr. Gisborne. W. FOX.

U.S. steamer "Resaca" (3rd Rate),
SIR,— Valparaiso, Chili, 24th November, 1870.

In obedience to your order, I have the honor to make the following report regarding the strength, endurance, &c., of the New Zealand flax rope sent on board at Auckland for trial on the passage over to this port:—

It has been rove off for tacks, sheets, staysail halyards, jib sheet, whips, &c.; and, as well as I have been able to judge after so short a time, although it has been in continuous use for fifty-four and a-half days, and the passage a wet and excessively stormy one, I consider it fully equal to any Manilla rope I have ever used, after a long experience at sea with it. What effect long and continuous hot and dry weather may have upon it, after its exposure to wet, &c., just experienced, I am unable to state, but am of opinion that it will in all probability prove a durable and excellent cordage for vessels.

I have, &c.,
Commander R. F. R. Lewis, W. W. RHOADES,
Commanding U.S. steamer "Resaca." Master and Navigator.

Mr. Rhoades, as an officer of long experience both in the Merchant Service and the Navy, was given the especial charge of the trial of the strength, endurance, &c., of the rope mentioned above, on the passage over from New Zealand to this port, and I fully concur with him in his report.

R. F. R. LEWIS,
Commander, U.S.N.

(No. 130.)—Major J. A. GRAY, Kaiapoi, to CHAIRMAN.—August 12, 1871.

You wished me to let you know how long the rope on the Californian pump lasted; I have, therefore, to inform you that the first break occurred this day. It has been at work thirteen weeks and four days; the other portion looks as if it would last some weeks longer.

This, I think, you will allow, is very satisfactory; we have never had one of ordinary New Zealand flax to last more than eight days, and the best Manilla twenty-eight days.

I am going to have a quantity of the same quality made up, so that it can be tried for various purposes; and I intend to send some to Wellington and the various other ports. If it will maintain anything like this superiority over ordinary kinds, one great difficulty in the flax problem will be solved; and it will be only requisite to go on improving the quality, and lessening the cost of production, if possible.

We have made a slight alteration in our double machines since you were here, by putting a pair of rollers under the bottom machine to catch the flax as it comes down, which prevents it ever going round the spindle; and we have one roller about half as big again as the other, this gives the flax a rubbing squeeze, and, I think, much improves it. A sample shall be sent you in a few days.

(No. 107.)—Mr. JOHN PEARCE, Christchurch, to CHAIRMAN.—20th July, 1871.

Having noticed in public print a report of yours on yarns spun from New Zealand Flax, after near thirty years experience as a manufacturer of different sorts of fibre into rope, &c., I beg to offer you a scale of difference of weight of same size yarn spun from Russian Hemp and New Zealand flax:—

FROM RUSSIAN HEMP:

Yarn 160 fathoms long	16	18	20	22	25
	lbs. oz. drs.	lbs. oz. drs.	lbs. oz. drs.	lbs. oz. drs.	lbs. oz. drs.
	4 0 0	3 8 14	3 3 3	2 14 9	2 8 15

FROM NEW ZEALAND FLAX:

Yarn 160 fathoms long	16	18	20	22	25
	lbs. oz. drs.	lbs. oz. drs.	lbs. oz. drs.	lbs. oz. drs.	lbs. oz. drs.
	3 0 0	2 10 11	2 6 6	2 2 15	1 14 11

The above are the most general size yarns used for the manufacture of cordage from Baltic hemp, and mean any one number of these yarns to a strand will make a three-strand shroud laid rope, from which the number of yarns either for shroud or hawser laid, of any required size or number of strands, are to be ascertained, and show a difference of one-fourth more weight in the European over New

Zealand of the same size yarn, which cause the more elasticity in the latter. I have proved this scale from actual experience.

The testing qualities of Russian hemp rope when properly manufactured are 1 cwt. for a 25 spun yarn, or 3 tons 15 cwt. for a 3-inch rope, to stretch one-twentieth of its length with this pressure. I have seen a 25 spun yarn stand a strain of 1 cwt. 1 qr., if spun from the same material (as a rule the larger the yarn the coarser the fibre); they do not increase in strength in proportion to size, which proves the larger the yarns the weaker the rope, and would not recommend yarns to be spun larger than 18ths from any fibre.

Oiling for this country's flax, I think, will be preferable to tar; when the best sort is ascertained for the purpose, if not already in your possession, will it be amiss on my part to suggest for you to find by scientific means the preserving qualities of the different sorts of oil, and shall feel obliged if you will favour me with the result.

Extract from a Letter addressed by a large Lancashire and Yorkshire Manufacturer to Major J. A. Gray, Kaiapoi, dated 16th September, 1870.

I will now give you the result of our numerous experiments, and all the information I can gather.

You are aware we have spent a considerable amount of money in trying to work up the New Zealand flax, and I may at once state that the only lots we have been able to do anything with advantageously are the Native-dressed, and even in those some are much better than others—that is, in the openness of the fibre. In all the Colonial-dressed, even after sorting and cutting and trimming, there is so much left that will resist any bleaching action that does not destroy the fibre, that we can make nothing of it, and it is perfectly clear to me you must do the cleaning part at once in its green state. Whatever means you find for smashing up the leaves and getting rid of the coating, do it if possible in water, but certainly never let it get anything like dry before it is clean. (Would not a common Irish wheel suit well for washing after smashing it up?) If you once let it get dry, no amount of bleaching, scutching, and hackling does it any good, except just to break off the tips and shake out the dust.

You are no doubt aware that the fibre, as it is usually called, is in reality a bundle of very fine fibres enclosed in a casing. Now this casing must be well broken up, so that the water can get in and clear out the gum, and open the fine fibres; it is only in that state we can make use of it for fine work. You will probably find warm water clean it better than cold, but beware of having it too hot or boiling, for in all the samples that I have seen boiled there is a quantity of the gum or some other impurity, especially at the bottom ends, which is converted into an almost insoluble substance, and resists all the tests I have applied for gum, and cannot well be got rid of. You will notice this in the hard feel and discoloured appearance of the ends of boiled flax.

When you take a bundle of fibres and break it, they ought as it were to draw out, not break short off. If you will take a thread out of a piece of good linen, and take the twist out of it, you can easily draw it asunder. This is exactly what we want in the long fibres, as they are usually called.

With regard to colour, the real fibre is a good white; get it as near that as possible—any shade of brown is a sign of impurity. What bits of scull there may be left on after well dressing and washing, ought to be quite loose; and we would rather see them a green than a yellow colour,—not brown. If you find it requisite to submit it to a retting process, the colour will not of course be so good, but we can easily get that When you have got it into the state I mention, I should not advise you to scutch or hackle it, for you will lose a great deal of the finest and best fibre; and with wages at one-third of yours, and all the advantages of machinery, we can do that a great deal cheaper than you can.

Do not be led away with the notion that you scutch and cord your flax up like you can the English, unless you get rid of the impurities in the first stage.

I have now told you pretty well what we want for spinning purposes. Now, as to price, if you can get it to the state I recommend, you may safely reckon on as much as the best Irish flax when fit for carding; but my own opinion is that it will ultimately range much higher, on account of its finer quality. The Native dressed has been in such uncertain supply, it never fetched anything like what it would if sent in large and regular quantity.

With regard to rope-making, I have to depend on information from others, which I have been at a good deal of trouble to get from the best sources, and the result is, that rope made from fairly good flax will bear as great a strain as any other, and it appears to be wearing well for a time; it then goes all to pieces almost at once, like as if cut up. Whenever a thread gives in a strand, it appears to cut the others right off; and, from microscopic examination of old rope, it appears to be worn more from the casing round the small fibres giving way and cutting the fibres short off than from any other cause; and in salt water this casing seems to dissolve in time, and leave the fibres loose, and the rope, as you may say, rotten. In rope made from flax of the very best quality, in which this casing has been well broken up, the spinning of the yarns, if they are done fine enough, twists the small fibres hard up together, and it then makes a very pliable, strong, and lasting rope; and it is only this kind that will ultimately fetch a price worth troubling about.

Many of the hard-rope makers like the casing unbroken, as it hackles and works easier for them, if perfectly clean from scull, but then they want to buy at a low price.

What ever will be done with the brown hard rubbish you Canterbury people in particular are sending in such profusion, I can't think; the paper-makers say it is not near as good as Esparto grass at £8 per ton.

I should not advise you to send any of the ordinary kinds, unless you can afford to sell a fair quality at from £20 to £25 per ton, and wait your market. Let me strongly advise you to stick to the best qualities, especially that for spinning purposes, if you can manage it; the sale for that will be unlimited. Don't touch the rubbish, either to manufacture or send home; it is a great drug in the market, and will be lower, unless some new use can be found for it.

Copy of Letter received by Major GRAY from Flax Extension Association.—1871.

I was favoured with your letters of 1st August, and 31st December, 1870: the latter accompanying a sample of New Zealand flax, but no sample was received with your letter of August.

With reference to this fibre, it is more analagous to hemp than flax. Some time since one of our spinners procured a bale of best quality New Zealand flax from London, which he tested in every possible manner, and the following was his report to me on the subject:—"We have tried a variety of experiments on New Zealand flax, but in no way can we find it beneficial for spinning in connection with flax; it is more difficult than Russian hemp, and, at best, is only fit for heavy cordage."

I sent the sample which I received from you to a fibre merchant in London, and the following is his report on it:—"The sample you have received from Canterbury and sent to us, is badly prepared. You will find, on examination, that the gum has not been got out of it, while the fibre has been broken and injured, and its strength greatly impaired. In spite of its good colour we could not value it over £26 per ton, and in such a state it would be unsaleable in quantity." My correspondent continues:—"It cannot be too strongly impressed on those engaged in the preparation of the article, that if they injure the strength they take away the most valuable property of the fibre. We are inclined to believe that if the plant were cut young, and a proper mode of preparation adopted, it might be made fit for spinning into coarse numbers of yarn. Considering, however, the prices at which Italian hemp and coarse flaxes are sold, although we think the experiment deserves to be tried, we doubt whether it would be more remunerative to prepare the fibre for spinning than to prepare it perfectly for rope making. In preparing the article for rope making, the points to be kept in view are: to have the fibre of good colour, as thoroughly as possible cleaned from straw and from the gum which exists in it, and to preserve its natural strength."

This fibre is chiefly used for rope making, and varies in price, according to quality, from £36 10s. to £20 per ton; and lower qualities, called half-dressed, from £18 down to £14 per ton. During the year 1870, over 3,000 tons were imported into London.

I hope this will give you the required information. And now, let me direct your attention to the cultivation of flax used for the manufacture of linen fabrics, which varies in value from £240 to £40 per ton. I send you by post instructions for the culture and preparation of this fibre, which, I think, would answer in New Zealand admirably. I enclose you a small sample of the seed. Would you kindly mention what method is adopted for the separation of the woody matter from the fibre in the New Zealand flax. We find the process by fermentation the best for flax; this you will find described under "Retting," in Instructions. If it has not been done, I would suggest that this method should be tried with your flax, choosing *soft* water and warm weather. I send you the annual report of this association; and, if you wish for more information, I shall endeavor to procure it for you.

From DEVITT & HETT'S Report.—London, 31st May, 1871.

New Zealand Flax.—* * The demand has prevailed almost exclusively for the well-dressed kinds, and the common half-dressed sorts (which now, happily, seldom appear amongst new imports), are quite neglected.

* * * * *

It is a fact worthy of notice, that the deliveries have steadily kept pace with the imports all this year, shewing that there is a regular consumption going on.

* * * * *

The time has now arrived for calm consideration of this fibre as an article of commerce, and we are very happy to speak most confidently of its future prospects. We have all along advocated *regular* shipments of one uniform well-dressed quality, and are now able to speak from practical experience of the advisability of such a course. We do not look for anything like fancy prices, but we certainly count upon a steady continuance of demand for the quality we recommend, at our quotations, which we are pleased to learn will leave a good result to shippers.

There is no doubt whatever that rope-makers have taken a liking to this fibre, and that Manilla hemp has suffered from the competition; but it is to be regretted that supplies are likely to fall for some months to come, as it is of vital importance that a regular supply should be kept up, as otherwise, consumers will lose their interest in the article, and their orders will be diverted into other channels.

NOTES on *Phormium tenax*, or New Zealand Flax, delivered before the Auckland Institute, 5th November, 1870, by THEODORE F. S. TINNE, Esq.

During a visit I lately made to England, I made a point of gaining whatever information I could about the so called New Zealand flax. The result of my enquiries I now lay before you in the form of the present report, and the samples I collected.

The first sample, numbered 1, is a piece of new rope made by an extensive firm of rope-spinners in Liverpool. A part of this rope was put on board a vessel, on which it was used during one voyage only, to New York and back, in a pulley block in the running rigging. An inspection of the sample No. 2, will show that the yarns that have been exposed to friction are entirely worn away, owing to the want of something in the substance of the flax to make the ultimate fibres adhere more firmly together, as they do in Manilla. It may also be seen that where the strands have "ridden" over each other, in the centre of the rope, they are somewhat chafed in the same way.

Sample 3, is a bundle of yarns from an old rope; they were given to me to show that one inferiority of New Zealand flax is that the old yarns will not work up for the centres of new rope, as they will in Manilla.

I certainly do not see from the present sample that the complaint has any ground whatever, as the yarns appear sound and good. I, however, merely hand over to you the complaint as I received it. No doubt strands in rope like No. 2 *are* ruined for rope-making, and would have to be sold for making paper, for which purpose they might probably bring an equal price to refuse Manilla, namely, £10 a ton.

I was shown some samples of fibre in which the leaves had merely been split down by hand hackling, after straining. So far from being injured (as we were led to believe would be the case) by contact with the intersticial matter during the voyage to England, these samples were stronger than any other I saw; whilst those most thoroughly whitened were the most liable to fraying, as in sample No. 2. This fraying *can* be prevented by *tarring*; "*but, then,*" the rope makers say, "you may as well send us a *coarser article at a lower price*;" but it seemed to me that the extra price obtainable for the better dressed fibre, was more than sufficient to compensate for the additional labour necessary to bring it up to the required condition.

No. 4, is a sample I received (while still in England) from a Mr. Anstey, a large land-owner in Canterbury Province. These leaves were cut near Christchurch in 1866. They lay "kicking about" for two years, no one being willing to strip them; till they were used as dunnage between the cargo of a vessel going to London. They were, there (in about September, 1868), withdrawn from sale for £7 a ton, and subjected to a process of steeping in a solvent, and then cleaning by patent machinery. The result, of which No. 5 is a sample, was sold in a parcel of some tons, for £22 a ton. The transaction, I am told, was not a profitable one; in fact, it left a decided loss, though the yield of fibre was 55 per cent. in weight of the dry leaves.

Nos. 6 and 7 are samples of flax as it was received for treatment in Brazier's softening machine; No. 6 was found almost, if not quite, intractable; but No. 7 was softened to the condition of sample No. 8. The machine consists of a number of corrugated rollers, working in a peculiar manner into each other, by which the fibre is bent to and fro.

No. 9 is a piece of sacking, woven in Dundee. The makers of it assured me they would never take the trouble to work it again; they had the same complaints as every other spinners I met who had tried the flax—"That it would not twist, that it was too harsh, and not *regularly* cleaned;" but an inspection of sample No. 10 will surely satisfy any one that an article useful for many purposes is capable of being made from our fibre. This sample is from the identical parcel with No. 9; the difference being that No. 10 has been subjected to the immense pressure between iron rollers, which is the finishing operation through which all sack material is put.

No. 11 is a clipping of cloth made some years ago in England, and was given to me before I started on my voyage. I believe the piece from which it was cut was used by a settler near Matakana to make a pair of trousers of, and he never could wear them out!

I have also to show you two towels made of New Zealand flax, of the texture called, I believe, "huckaback." I have been unable to ascertain where they were woven, the nearest information being that they were made by a hand-weaver in a little country village in England. They bear a mark, 1863, and they are part of a set, the other part of which have been in use, as "kitchen and bedroom" towels, ever since that date. The fact of these present towels never having been used, is pretty conclusive evidence that those *in use* must have worn well!

Samples 12 and 13 are merely those of Irish flax, in the raw and cleaned state, before, and after passing through the Brazier softening machine; and I bring them forward, together with the samples of Manilla numbered 14, and of Dutch and Swiss flax, numbered 15 and 16, simply to show the relative position New Zealand flax may take in the list of fibres with which it has been compared. I regret that I omitted to obtain a sample of Bombay jute, which is the fibre New Zealand flax is supposed most likely to supplement in the sack manufacture. Jute is very much softer than any sample of New Zealand flax I have ever seen, though of course not so strong. The difference of fineness between New Zealand flax and jute will be understood from the fact that enormous quantities of jute are prepared in Glasgow to supply the London market with materials for false hair and chignons, a purpose flax is hardly delicate enough for!

Jute sells for £30 a ton; Manilla for about £45; and it was impressed upon me that New Zealand Flax would always, if well cleaned, bring the same price as Bombay jute; but, to command a high price the cleanest article must be sent forward, and even then only the best samples would be chosen in the presence of the large quantities expected.

The conclusions I draw from my examination of the matter, and which I wish to offer, are, that a genuine article must be produced; that the bales sent home must resemble each other in general outward appearance, in size and in form; and the marks put on the bales must be a guarantee that the quality is uniform, and can be depended upon. And if—when we have done all we can to recommend our flax, by careful manufacture and honest sampling—it is still rejected through prejudice, the only thing that is left for us is to manufacture it for our own use, on our own soil, with our own capital and skill, and for our own profit. When the world sees that it serves our purposes well, they will be ready enough to share it with us.

[Extract from the *Southern Cross*, 25th April, 1871.]

Mr. J. C. White's Patent Flax Machine.

The process which forms the subject of this notice is one which commends itself to the favourable notice of flax dressers. It is a great improvement on many of the old machines, but whether in the right direction or not it is hard to say, as it is impossible to decide what the right principle of flax cleaning will yet prove to be; but it is certain that it will prove as efficacious as simple when once discovered. Some time ago we briefly referred to the existence of Mr. White's machine, but, the invention being then unsecured, no description of it was published. By the last mail from the South Mr. White received the necessary documents to secure his right, and longer secrecy need not therefore be maintained. Yesterday it was set in motion, driven by a belt from the engine in Mr.

Hawkeswood's foundry in Chapel street. The machine consists first of a strong wooden frame, upon which the moving portions are fitted. In front of the workman is an iron feeding mouth, about 3in. broad by half an inch deep. This leads close to a pair of horizontal fluted feed-rollers, about 6in. long. These work into each other, so that the flax blade is thoroughly bruised before it comes to the stripping horizontal cylinders, two in number, and which are immediately behind the feed-rollers. These cylinders are about six inches long, with an equal diameter. After being adjusted in a turning lathe, grooves are cut along their surface, about a quarter of an inch deep, and at an angle to the length of the cylinder of about 35 degrees. There are about three grooves to the inch, and the outer surfaces of the ribs thus left are about one-eighth of an inch wide. These cylinders are placed one above the other, and revolve outwards from the feed-rollers at the rate of about 2,200 per minute. The feed-rollers revolve at about one-eighth of this speed. Hence, after the leaf has been subjected to a thorough bruising by the feed-rollers, it is next subjected to the stripping action of the cylinders, which clears both sides of the leaf at once. Both cylinders have a slow reciprocating action, and thus the possibility of a hollow being worn out in the centre of the cylinder is prevented, the reciprocating action causing them to be worn evenly. When the angle ribs on the cylinder have been worn down the grooves can be re-cut, and any irregularities in the wearing of the cylinders removed in the lathe. Thus, at small cost, partly worn cylinders can be made as good as new. The necessary gearing to produce the different motions, and the reciprocating action of the cylinders, is fixed upon the shafts of the two cylinders. Under each of the bushes of the lowermost feed-roller is placed a vulcanised indiarubber spring, so that the rollers bruise both thick and thin leaves of flax equally without injuring the fibre. After the flax has passed through this machine, it is put into one consisting of a pair of plain feed-rollers, and two circular hair-brushes. These strip off all the fleshy matter of the leaf which the ribbed cylinders have brought to the outer surface, and pass the fibre out very clean. The fibre is next passed between another set of plain feed-rollers, which guide it between two smooth cylinders, having a rapid reciprocating action. This is found to divide the fibre into very fine filaments, and to make it particularly soft. These two machines can keep four of the first kind in constant work. The fibre is next soaked in water for some time, thon taken out, dried, baled up, and is ready for the market. This is Mr. White's whole process of flax-cleaning. To many it may seem a somewhat cumbruous system but it necessarily looks more so from a minute verbal description than seeing the process carried out. Although the cost of producing a ton of fibre by this process would be somewhat greater than by many of the more imperfect machines now in use, it will be seen that the cost cannot be very great when leaves travel through the machine at the rate of 200 feet per minute. It must also be remembered that flax dressed on this principle is valued at a high figure. By the last British mail Mr. White received advices from several extensive manufacturers in Scotland, to whom samples had been sent for valuation, stating that if flax equal to the samples sent could be supplied in quantity, it would readily sell at from £70 to £120 per ton. This then is a figure which will allow a handsome profit upon careful preparation. We were glad to learn that one of these machines had been sent to the Piako district, and that orders for three others must be executed this week. A few leaves, as they came through the first machine, and which have neither been soaked in water, shaken, nor rubbed, but are just as they are turned out by the machine, are now on view at our publishing office, where those interested in the matter can see them. There are two samples: No. 1 is from leaves cut in the Domain on the morning they were dressed; and No. 2 is from leaves which had been lying cut from a month to six weeks and were comparatively dry and hard. Mr. White has promised to furnish us with three other samples, showing the condition of the fibre after the brushing, the rubbing, and soaking processes, which, when received, will be placed on view at our publishing offices.

On some EXPERIMENTS to determine the POWER required to WORK the FLAX MACHINES in common use in Auckland.—By James Stewart, Assoc. Inst. C.E.—Read before the Auckland Institute, 11th July, 1870.

The following investigation was entered into with the hope, not only of being able to determine exactly the power absorbed by the flax machines, but of comparing in this respect those of two rival makers. It was also intended to ascertain the full indicated power of the engine, and evaporating power of the field boiler, by which it was supplied with steam.

So far as a comparison of the machines went, the trials had only commenced when it was seen that even had a considerable difference of power really existed between the two designs, the variation in the size of flax leaves would render it difficult of exact determination, unless a number of machines of each kind, sufficient to take up nearly the full power of the engine, were run together and repeated diagrams taken to insure a fair average.

The machines under trial were—one made by Messrs. Price, of Onehunga, and two by Messrs. Fraser & Tinne, of Auckland, and were of the designs in common manufacture by those firms in the beginning of this year. Both firms have, however, made considerable alteration in their designs since then.

The maximum power of the engine and boiler was left undetermined, as the three machines above were all the apparatus then fixed in the mill ready for use, and it was evident that in driving these the engine was working considerably within its ultimate power.

The cylinder of the engine is 6 inches diameter and $10\frac{1}{2}$ inches stroke, cutting of steam at $6\frac{1}{16}$ inches, opening the exhaust at $8\frac{3}{4}$ inches, and beginning compression at $9\frac{3}{8}$ inches.

The valve is set so that in both up and down strokes the same distribution of steam takes place exactly, with the exception of the lead, which is $\frac{1}{4}$-inch at the lower end and nothing on the upper end. This variation being necessary to effect absolute equality in the more important points of the distribution. The maximum pressure of steam is 120 lbs. per square inch. It will be seen that the highest indicated power obtained with three machines is 10·5 horse-power. The mill is that of Messrs. Thomson Brothers, of Purapura, Lower Waikato, and is now furnished with four machines and two scutchers.

The indicator used was Richards', which is specially adapted for application to every class of engine, from the lowest to the highest pressures. Fourteen diagrams were taken—five (Nos. 1 to 5) with three machines, two of Fraser & Tinne's and one of Price's; five (Nos. 6 to 10) with two machines, one of each kind; two (Nos. 11 and 12) with Price's machine; and lastly, two with no machines running, the engine merely running on the loose pulleys. Of these latter, No. 13 has been taken to represent the power absorbed by the engine, main shaft, and loose pulleys.

The results of the whole are worked out and tabulated as under:—

No. of Diagram.	Load on Engine.	Revolutions of Engine per Minute.	Revolutions of Machines per Minute.	Indicated Horse-power.	Reduced Powers.			
					I.	II.	III.	IV.
1	Three machines	200	1,100	10·5	4·09	6·41	2·14	·195
2	„ „	184	1,012	10·2	3·76	6·44	2·15	·212
3	„ „	175	962	8·28	3·60	4·68	1·56	·162
4	„ „	155	852	8·12	3·17	4·95	1·65	·194
5	„ „	145	797	7·40	2·96	4·44	1·48	·186
6	Two machines, one loose pulley ...	188	1,034	8·30	3·84	4·46	2·23	·215
7	„ „ „ ...	172	946	7·33	3·52	3·81	1·90	·201
8	„ „ „ ...	175	962	7·33	3·60	3·73	1·86	·193
9	„ „ „ ...	152	836	5·24	3·11	2·13	1·06	·127
10	„ „ „ ...	150	825	5·26	3·07	2·19	1·09	·132
11	One machine, two loose pulleys...	176	968	6·06	3·60	2·46	2·46	·254
12	„ „ „ ...	178	979	5·59	3·64	1·95	1·95	·200
13	No machine, three loose pulleys...	172	...	3·52	3·52	...	...	...
14	„ „ (pump full on) „ ...	50	...	·90	1·02	...	...	...

The reduced column I. is the proportion of the indicated power which may, without much error, be charged to that absorbed by the engine, main shaft, and loose machine pulleys, when less than three were at work. As the basis of this calculation, diagram No. 13 is taken, and the others are worked in direct proportion to it, and their number of revolutions per minute respectively. It will be seen that the result of this calculation for No. 14 is, considering the extra work of pumping being performed, identical with the indicated power.

Column II. is the net tpower chargeable to the machines, found by deducting column I. from the indicated horse power.

Column III. is the power per machine, as shown in each experiment, and is seen to vary from 1·06 horse-power per machine, running at 836 revolutions, to 2·46 horse-power, at 968 revolutions. This is a good instance of the difference of power required by short and long flax.

Column IV. is the nett horse-power which each machine required in the relative experiment to run at the rate of 100 revolutions per minute, and when the experiments are taken at different rates of speed affords the only fair means of comparison.

It is natural to look for the most correct results in the experiments with three machines, being the heaviest load, and the irregularities of feeding being compensated to some extent by each other. And hence, if we accept No. 3, which was at the time marked doubtful on account of the number of revolutions being so, we find the other four, in column IV, almost identical, and closely supported by most of the remainder. Nos. 9 and 10 were taken with light flax, and No. 11 with the heaviest on the feeding platform, purposely fed in to arrive at the full power required by one machine.

The amount of flax being put through during the trials, was, according to experiment, at the rate of from 2½ tons to 3 tons of green leaves per day of ten hours.

I have only to add that the whole machinery was new, the machines and engine had only worked about one day before the experiments were made, hence the results may be taken to be somewhat in excess of the power required after the machinery has taken its proper bearings.

COPY of LETTER from the SECRETARY to Chamber of Commerce, Dundee, to the SECRETARY, Board of Trade.—Dundee, 1st May, 1871.

SIR,—

In reply to your letter of the 20th ultimo, I have the honor to transmit the following remarks on the Progress Report of the Flax Commissioners, (Wellington, New Zealand):—

1. It must be borne in mind that the plant named "flax" grown in New Zealand (*Phormium tenax*) and the plant named "flax" grown in Russia, Belgium, Holland, France, &c., &c., (*linum usitatissimum*) are altogether different plants, and the fibres procured from them are totally dissimilar and not at all suitable for the same purposes.

2. In appendix No. 6 it is stated that New Zealand flax was almost unknown in London till 1869, but a series of most important and careful experiments were made on it in Dundee by the first house in the Linen trade, nearly twenty years ago. It was examined chemically, and was spun both into yarns, and manufactured into cloth, and the result then arrived at was that it was quite unfit to compete with, or be suitable for such manufactures as are produced from European flax. I may state that the same firm have gone over the Progress Report, and their opinion is still the same as that arrived at when the above experiments were made.

3. It is unfortunate that practical firms were not consulted along with brokers in London, for looking at letter, Appendix No. 1, it is to be regretted that such a value as £65 to £70 should have been quoted, and a comparison made with Algerian flax, this being the true flax (*linum usitatissimum*), and fit for the same purposes as European flax. The writer of these notes had an opportunity of carefully examining Algerian flax in its respective department in the Paris Exhibition of 1867, and many of the samples there were equal to good Russian flax.

In Appendix No. 4 a comparison is made with Irish flax (also the real flax), and the price of New Zealand flax is spoken of as "it will ultimately range much higher, on account of its finer quality."

It is not very apparent on what grounds this result has been arrived at, and such a statement cannot be endorsed from what is mentioned. If this opinion is at all correct, the New Zealand flax must have been used for some purpose, or manufactured in some manner quite unknown in Scotland.

4. From the experience of persons in Dundee, endorsed also by the information generally given in the Progress Report, New Zealand flax is a harsh fibre, unsuitable for general manufacturing purposes such as into linens which are made from the real flax (or even manufactures made from Indian jute). Looking at the cost (supposing it was suitable in other respects) as spoken of in Appendix No. 2 *for good*, namely 1s. per lb., or £112 per ton. the price alone would render it impossible to compete with European flax, at this time used in the manufacture of linens in Forfarshire at prices varying from £28 to £58 per ton. Even 4d. per lb. for New Zealand flax, as stated in appendix No. 2, is £37 per ton.

5. In conclusion it must be repeated, as mentioned in Appendix No. 6, page 10, lecture by Captain F. W. Hutton, "that all attempts to produce an article to compete with European flax will only result in disappointment," and that the point should be (page 11) "to aim at a strong fibre suitable for the manufacture of rope, and not attempt to produce an article to compete with European flax." Even on this head, the quality sent to this country has produced only very inferior rope, and Russian hemp must be competed with. It may be also stated that Manilla hemp is considered a superior fibre in many respects.

It is well known in Dundee that the late attempts to make New Zealand flax take the place of, and be suitable for the purposes of European flax, have been a failure, and have only resulted in the loss of money.

6. In connection with this subject, it may not be out of place to state that as regards *all new fibres* considered fit for manufactures similar to those made from flax or jute, for jute manufactures have now taken the place which coarse linens formerly held, and which are also frequently spoken of as linens, it must be kept in view that these two fibres are to be competed with both in price and quality.

The present price of the first has been already mentioned, and the manufactures from it are well known. The quality of jute is such as to be suitable for all coarse purposes, as packing cloths, sackings, bags, &c., &c., and it is the cheapest fibre presently known fit for these manufactures, ranging on an average at a price from £15 to £25 per ton. Dundee is the seat of this trade, and fully 80,000 tons were imported there in 1870.

The Progress Report is herewith returned.

I have, &c.,
(Signed) R. Sturrock,
Secretary.

The Secretary Board of Trade, London.

A Lecture on the Manufacture of New Zealand Flax, delivered before the Auckland Institute, July 12, 1870, by Captain F. W. Hutton, F.G.S.

It was not until the year 1869 that New Zealand Flax began to be known in the London market; for although it had been exported to England for many years previously, it was only shipped in small quantities at a time and sold privately, so that few manufacturers knew anything about it except from report. Ever since the foundation of the Colony the value of the plant has been recognized, and many people have spent considerable sums of money in trying to produce from it a fibre that could be sold at a profit. Failure, however, followed failure, until at last, in 1867, a machine was produced which was brought so far towards a state of perfection that it reduced the time and cost of producing the fibre to such an extent that it was apparent that, where circumstances were favourable, *Phormium* fibre could be produced at a profit. I do not here mean to attempt to trace the early history of this manufacture, nor to discuss the question as to whom belongs the credit of inventing the present machine; my object is to look forwards and not backwards—to explain the system at present in use, and to point out where improvement seems most wanted.

All our knowledge is derived from observation and experiment. Observation or the noticing of occurrences, may be either the haphazard observation of things that happen to fall in our way; or it may be the scientific observation of examining closely and minutely those things that we desire to have information about. Experiment, or the noticing of effects produced by causes under our own control, may also be either the haphazard experiment of trying what will be the effect produced by any agent that happens to be easily available; or it may be the scientific experiment where the experimenter has carefully considered what is the effect he wishes to produce, and what is the agent most likely to fulfil his purpose.

In all the arts and manufactures these two methods have been followed, unconsciously perhaps, in arriving at the processes to be employed, in order to produce the best results. Haphazard observation and experiment come first. They are the means employed in the earlier stages, and by all savages and uncivilized nations. Scientific observation and experiment follow after, when civilization has trained the minds of men to inquire more curiously into cause and effect. Haphazard observation, when extending over a long series of years, may sometimes arrive at processes of such perfection that the best scientific observation and experiment cannot improve upon them. The European flax manufacture furnishes us with a good example. The value of retting flax, or causing it to undergo

fermentation, was no doubt discovered ages ago by haphazard observation. Scientific observation has shown that the original object for which flax was retted—namely, the separation of the fibres from the woody tissue—is not in reality so important as its further object of separating the ultimate fibres from one another; and; in order to avoid the delay and loss occasioned by retting, scientific experiment has invented machines to detach the fibre from the wood. But all these machines have proved failures, because science cannot discover any process equal to retting for separating ultimate fibres; all it has done is to improve on the process, and reduce the time required for the operation. On the other hand, science is sometimes able in a few years to arrive at results which would have taken centuries of haphazard observation to accomplish—as in the cotton manufacture, where the processes of carding and drawing out may be instanced as triumphs of scientific experiment; and also in the art of bleaching, where the scientific observation and experiment of a few years entirely altered the whole system. In commencing, therefore, the study of any manufacture with the view of trying to improve it, it is advisable, indeed necessary, to examine carefully the processes which have been formerly used, and try to understand the reasons for each; and, when we turn to the manufacture of New Zealand flax, we find much to guide us in the haphazard observations and experiments of the Maoris, for they produced a fibre from their best plants of a purity of colour that we cannot yet approach; neither are our machines capable of producing a material of that oiliness of feel and glossiness of appearance which is seen in their best hand-prepared *Tihore*.

The Maoris used two different processes for different kinds of flax. With the best kinds (*Tihore*) they simply tore out the fibre, rubbed it together in their hands to open the bundles, and removed the small quantity of tissue that remained, by scraping it with their nails. The inferior kinds (*Haro*) they first scraped with a shell, having sometimes previously steeped it in water to soften the skin; they then soaked it in water for from two to four days, then beat it with stones while it was wet, and scraped it again; then soaked it again, and then bleached it and dried it on poles; and they then beat it with sticks to remove the remaining tissue. For this information I am indebted to Mr. Preece's paper in the *New Zealand Church Almanac*, 1848, and to Mr. J. A. Wilson, who has lately taken great trouble to ascertain from the Thames Natives their former mode of preparation. It will thus be seen that the main features of the systom they employed for the commoner kinds of flax are very similar to those which we now employ; for in both the fibre is first cleaned by mechanical means from the tissue of the leaf, it is then soaked in water, dried, and beaten before being sent to market; and those mills which depart from this systom, either by boiling their flax or by only rinsing it in a stream, instead of soaking it, produce an inferior quality of fibre. We have, however, no process as yet that answers to beating on stones while wet, and I have not yet satisfied myself as to the object which was intended to be attained by this process. It might have been to break up the fibrous bundles and make them more silky, or it might have been to break up the cellular tissue that remained, so as to allow their contents to escape in the second soaking; or it might only have been to help the removal of the tissue by the second scraping. If the first was their main object, it would be worth while to try to discover a process by which we could also effect it, but in a more economical manner; but if either of the latter was the object, it would be unnecessary for us, as our machines by one process clean the fibre much better than both the scrapings of the Maoris.

If, however, science has not as yet improved upon the system, it has greatly improved upon some of the processes that they followed, and the speed with which the fibre is cleared from the tissue has converted an unprofitable employment into a profitable one. There is, however, still a wide field for scientific observation and experiment in the manufacture of *Phormium* fibre, and I propose to-night to lay before you such few observations and experiments as I have made, in the hope that they may be of use to others who have not the same means at their disposal for making a microscopical examination of the fibre, and also with the hope that the facts I shall describe, and the suggestions I may throw out, will give rise in time to practical applications that will improve the process of manufacture; and to this end I also hope that others will make their observations and experiments public also.

One of the most important results of a scientific investigation is to show us what we cannot do, and what, therefore, we should not attempt; and although these results are never so popular as those which show a new or improved way of doing a thing, they probably, on the whole, save as much money to those that will be guided by them as is made by the employers of the new processes. With this in view, I have divided my lecture into two parts, the first of which is more or less scientific, being an endeavour to give you as clear an idea as I can of the plant, fibre, gum, &c., with which we have to deal, and to show you what appears possible for us to do, and what impossible; while the second part will be more practical, as in it I shall discuss the various operations through which the leaf goes before it is ready to be exported as fibre. But as I do not wish to weary you by making you listen to information that you can get from the *Interim Report on the Growth, Culture and Manufacture of New Zealand Flax* (Auckland, 1870), and from other easily available sources, I shall avoid touching upon any point on which the information seems sufficient, unless I think that I can throw a new light on it, or that I can correct what appear to me to be errors.

Varieties of Plant.

To a New Zealand audience I shall hardly be expected to give a description of the flax plant itself, for we all know it well; and I shall therefore confine myself to a few remarks on the principal varieties, and on the internal structure of the leaf.

The flax plant is well known to be highly variable, but no attempt has as yet been made to describe these varieties in a scientific manner, and consequently great confusion exists among the names. Much of this confusion apeears to me to have arisen by supposing that those varieties which were considered nearly alike by the Maoris, and for which they sometimes used indifferently the same name, are really allied from the scientific point of view, whereas the Maori svstem of classification was founded on one feature alone, namely, strength of fibre. All those varieties, the fibre of which was so strong as to enable them to draw it out in long ribbons, without breaking, they called "*Tihore*;" while those inferior kinds which had to be soaked and scraped with a shell in order to get length of staple,

they called "*Haro*," and it is evident that many varieties would thus get grouped together, which, under a better arrangement would be more widely separated. Thus the *Paritanewha*, or yellow hill flax, was called a *Tihore* (*Report on Growth, Culture, and Manufacture of New Zealand Flax*, Appendix p. 13,) although it is much more nearly allied to the common swamp flax, and is very different from the *Oue*, or typical *Tihore*.

At present, the colour of the leaf, and more especially the colour of the midrib and margins of the leaf have been taken almost exclusively as the distinguishing marks of the different varieties; but these are altogether unreliable, for not only does the colour of the margin differ in old and young leaves, but often different leaves of the same plant, and even different parts of the same leaf, have differently coloured margins. The attempt, for instance, to distinguish *Tihore* by a red or orange margin would certainly lead to many mistakes, as many of the varieties of the common swamp flax have margins identical in colour with the true *Tihore*; and it appears to me that habit of growth, shape of the leaf, size of the flower-stalk, and shape of the seed-pod, are of far more importance than colour of margin, or even colour of leaf.

There can, I think, be no doubt that at least two distinct species of *Phormium* exist in these Islands. Dr Hooker, in his *Handbook of the New Zealand Flora*, admits two; although at the same time he expresses an opinion that both are but races of one plant. The opinion of so distinguished a botanist must carry with it great weight, but it is quite possible that even he may have fallen into error through not having had sufficient opportunities of examining the plants in their living state, and by having had dried specimens sent to him with wrong names attached to them. Indeed, it seems almost certain that such has been the case, for he describes the pod of *P. Colensoi* as similar to that of *P. tenax*, but smaller. It is of considerable importance that the existence of these two kinds of *Phormium* should be recognised; for, as will be seen, they produce fibre of very different strengths. I must leave to some person better acquainted with botany than myself the difficult task of bringing into order the numerous varieties that are found under various names in different parts of these Islands; but I will briefly describe the two species, and the four most important varieties known to me in the Waikato.

Phormium tenax, *Forst.*

Seed-pod erect or inclined; 1½ to 3 inches long, straight or curved. Leaves very long. Flowers red.

1. *Harakeke* (Common Swamp Flax).—Leaves coarse, loose, drooping, point generally blunt. Flower-stalk large—11 to 14 feet high, and 1 to 2 inches in diameter. Pod short, erect. Grows almost everywhere, but attains its largest size (14 or 15 feet) on rich alluvial soil, by the banks of streams. Many sub-varieties are found, some with leaves dark blue-green above, and glaucous below, and some pale olive-green or bronzy. Some varieties have also the butts of the leaves coloured red for some distance up, while others are yellowish green almost to the very base. When the plant is stunted the flower stalk is also small, and the best characteristic is the blunt point to the leaf.

2. *Paritanewha* (Yellow Hill Flax).—Leaves erect, slightly drooping at the tip, yellowish green, generally with red or orange margins, slightly glaucous below, point acute. Flower-stalk small, 4 to 8 feet high, and ½ to 1 inch in diameter. Pod short, erect. Fibre very good, soft and glossy. Plant seldom more than 5 or 6 feet in height; grows generally on clay hills. Passes into common swamp flax, but best distinguished by its nearly erect acute-pointed leaves. Probably often mistaken for *Tihore*.

3. *Tihore*.—Leaves stiff, erect, narrow, never drooping at the tip, olive-green, glaucous below, points very acute or cuspidate, pink at the butt. Flower-stalk 9 to 10 feet high, and 1 inch in diameter. Pod erect, or inclined; seldom flowers, and still more rarely seeds. Plant seldom over 6 feet in height. Grows in rich, dry alluvial land, never in swampy places. I have never seen it except where planted by the Maoris. I have here applied the name to that variety called *Tihore* by the Maoris throughout the Waikato, and which is probably identical with the *Oue* and *Tapoto*. It is best distinguished by its narrow, tapering, sharp-pointed leaves, and erect, close habit. It grows so thickly together that I obtained 186 sets for planting from two bushes.

Phormium Colensoi, *Hook. f.*

Seed-pod pendulous, 3 to 7 inches long, twisted. Leaves not so strong, sometimes quite brittle. Flowers red, yellow, or greenish.

1. *Whaririki*.—Leaves erect or slightly drooping, generally rich green, not glaucous below, margins and midrib generally green, or yellowish white; butt white, never red, point acute. Flower-stalk 9 to 10 feet high, and 1 inch in diameter; flowers red. Plant seldom more than 7 feet high. The best and strongest variety of *P. Colensoi*.

2. There is also a yellow-leaved variety, which has sometimes yellow flowers, with which I am not so well acquainted. Its leaves are very brittle. It grows at Coromandel, between Kapanga and the Waiau.

3. The same, or perhaps another variety, grows on hills or precipitous places. Its leaves are of a yellow colour, and often so brittle that a man can break a strip more than an inch in breadth with ease.

In the Province of Auckland *P. Colensoi* is rare, in comparison with the abundance of *P. tenax*, but in some parts of the South Island I am informed that the reverse is the case. The Rev. N. Codrington told me that the flax plant in Norfolk Island grows generally on the sea cliffs, and it is therefore possible that it may be *P. Colensoi*, and not *P. tenax*; which would be sufficient to account for the failure experienced in trying to produce fibre from it, for the fibres of *P. Colensoi* break off so short that the Maoris never attempt to prepare it.

In order to ascertain the relative strength of the different varieties, I took strips of one-eighth of an inch in breadth from the middle parts of young but full-grown leaves and broke them, by means

of a spring-balance, which I had previously tested, and the following are the average results of many trials made on the leaves of four different plants of each variety:—

Tihore	broke with a strain of		48 lbs.
Harakeke	„	„	42 lbs.
Paritanewha	„	„	42 lbs.
Whararíki	„	„	34 lbs.

That *Tihore* is stronger than swamp flax, is contrary to the opinion of many. Major Heaphy (*Trans. N.Z. Inst.*, Vol. II. p. 116) expresses the opinion that the fibre of the *Oue* (*Tihore*) is of "so brittle a character as to require a mode of preparation in which a knife or scraping instrument may not be used;" but I conceive that the real reason for the difference in the preparation was that the fibre of the *Tihore* is so strong that the Maoris were enabled to pull it away from the tissue so completely, that scraping with a knife or shell was unnecessary. I also made some experiments on the strength of prepared fibre of the different varieties, but found that the small scale on which I was obliged to experiment gave results so discordant that they were of no value. This was probably owing to the difficulty of dividing the strain equally among the different fibres; and useful results can be only obtained by twisting the different varieties up into rope, and then breaking them.

It appears to me, therefore, that *Tihore* is the most valuable variety for all purposes; but the kinds that should be cultivated would depend upon the nature of the soil; for swamp flax of excellent quality could be grown in places where the superior *Tihore* could hardly live. But all the varieties of *P. Colensoi* should be carefully avoided, or, if manufactured into fibre, should not be sent into the market under the same name as fibre from *P. tenax*, or the latter will fall in the estimation of the public, from the inferior strength of the former.

The leaves of the different varieties of New Zealand flax vary from 3 feet to 14 feet in length, and from ½ inch to 5 inches in breadth, in the widest part of the leaf. They appear to grow all the year round, but more rapidly in spring and in summer than in autumn and winter. Swamp flax, that had all the outer leaves taken off in the end of January, had so many young leaves full grown by the end of April that the casual observer would not have known that the plants had been cut at all. The stumps of the leaves that are left on the plant still continue to grow also, but the younger leaves grow quicker than the older ones. Of four leaves cut down in the end of April, the outer one had grown 2 inches by the end of June, the next one to it, on the opposite side, had grown 3 inches, the next 6 inches, and the inside leaf 17½ inches. Of those sets of the plant that do not flower, the leaves last probably three or four years and then decay, new ones taking their place; but when a set produces a flower-stalk, the set itself, and all the leaves upon it, die down the following spring.

DESCRIPTION OF FIBRE.

Throughout the whole of the leaf, bundles of fibres are found lying parallel to the midrib. These fibrous bundles are composed of numerous elongated cells, called the ultimate fibres, which lie parallel to one another in the direction of the length of the bundles. These cells are not joined together end to end, but are quite distinct from one another. They are in the form of long, hollow cylinders, tapering towards each end, which is pointed, and closed in by the cell wall; they do not vary much in thickness in the different varieties, or in different parts of the same leaf, being from 1-2,500th of an inch, to 1-1,500th of an inch in diameter, and from 1-8th to 4-5th of an inch in length; the average length being about 3-8ths of an inch. They lie closely packed side by side, with the ends overlapping each other, and adhere together by means of a kind of gum or cement, which will be more fully mentioned presently. (For further particulars, see *Trans N.Z Inst.* Vol. II. p.p. 109 and 111.)

The fibrous bundles differ considerably in size, both in different varieties and in different parts of the same leaf. They are in the form of more or less flattened ribbons, varying from 1-250th of an inch to 1-16th of an inch in breadth, and from 1-250th of an inch to 1-100th of an inch in thickness. The number of bundles in a strip of leaf an inch broad varies from 40 in the coarsest varieties to 66 in the finest, which will give from 150 to 250 bundles in the whole breadth of the leaf. In the upper and narrower parts of the leaf the bundles are nearly together, so that there are nearly as many bundles there as in the broader parts. Besides these ribbons, there are also in the central parts of the leaf about an equal number of small, nearly cylindrical bundles, about 1-350th of an inch in diameter, so that the whole number of fibrous bundles in the central parts of the leaf is from 300 to 500. The fibrous bundles are pure white until the leaves get old, when they turn brown, especially near the butt, or get spotted with brown all over the leaf.

GUMMY PRODUCTS.

I will now pass on to the consideration of the gummy and mucilaginous products that are found in the leaf, and which are generally considered as the chief cause of all our misfortunes in endeavoring to produce a high quality of fibre. What is ordinarily spoken of as the "gum," is, in realty, at least three different products, viz.:—1. The gum on the outside of the lower parts of the leaf.—2. The bitter principle and mucilage contained in the cells of the leaf, and which, no doubt, is a mixture of several different substances, but which I shall treat as one here. 3. The cement that binds the ultimate fibres together into bundles. And as I go on I shall show that these three substances differ essentially in their chemical properties, and must be carefully distinguished from one another when considering the best processes to be employed in preparing the fibre.

GUM.

Taking first, then, the gum, which is found only on the outside of the inner surfaces of the lower parts of the leaves, we find it to be colourless or pale yellow when pure; semi-solid and viscous. It softens and swells up slightly in cold water, but does not dissolve; soaking in water for an hour or two and exposure to rain for three weeks does not affect it. It dissolves easily in boiling water, and in acids, but not in alkalies. It will not dissolve in alcohol, but neither will alcohol precipitate it from solution, although, on the addition of large quantities, it turns the solution milky white. It is

precipitated by basic acetate of lead, chloride of tin, and by nitrate of mercury, but is not affected by neutral acetate of lead. These reactons show that it is unlike any gum or mucilage hitherto known but that it has properties intermediate to both. As it occurs only on the outside of the leaves it is easily removed by mechanical means, and does not give the slightest trouble in the present method of preparing the fibre.

BITTER PRINCIPAL AND MUCILAGE.

These are contained in the cells of the leaf, along with chlorophyll, &c. It is well known that all parts of the flax leaf have an intensely bitter taste; and when a bruised leave or broken tissue, knocked off by the machine, is placed in water, this bitter principal is dissolved out, leaving little in the cells but chlorophyll, or the green colouring matter. The solution is brown and turbid, but when filtered is of a deep claret colour, and with a slight acid reaction. On evaporation it yields a thick reddish-brown sticky gum, of bitter taste, and readily soluble in cold water. That this solution contains little or no gum, similar to that found outside the leaf, is shown by its chemical reactions; for no change takes place on the addition of alcohol, neither does any precipitate fall when nitrate of mercury is added, but the solution is rendered turbid. On the addition of neutral acetate of lead, a large brown precipitate is formed, leaving the solution clear and almost colourless. It is also precipitated by chloride of tin, while the solution is left clear and golden yellow; and also by basic acetate of lead. No change takes place on the addition of alkalies, but acids turn it yellow and slightly turbid. It is coloured black by oxide or chloride of iron, owing perhaps to its containing some tannin. These reactions show that this mucilage is essentially different from the gum. In its original state in the cells of the plant it is colourless, but on exposure to water or moisture it rapidly turns reddish-brown, and stains the fibre; it can, however, be entirely removed by soaking the fibre in running water for three or four hours. It must not be confounded with the red colouring matter found in the butts of some leaves, for the two are quite different, as I shall point out when discussing the advantages of soaking flax. The bitter principle might perhaps be used as a dye or stain for wood, for on allowing a strong solution to stand for some days, a brown insoluble substance falls to the bottom much in the same manner as indigo; and if it should prove of any value at all, the cheap rate at which it could be prepared at or near the mills ought to secure it an extensive sale.

CEMENT.

The ultimate fibres are held together by a cement which is quite different from either of the foregoing. It is insoluble in cold water and acids, but dissolves slowly in boiling water, and more quickly in alkalies. Pure soaked fibre, when boiled for three hours in water, yields a perfectly clear pale yellow fluid, with an acid reaction but no bitter taste, and which on evaporation leaves a brownish gummy substance, which is insoluble in alcohol or acids, but dissolves readily in alkalies or cold water. This solution undergoes no change on the addition of alcohol, or of basic acetate of lead, acetate of lead, nitrate of mercury, chloride of zinc, or perchloride of iron. On the addition of chloride of tin, a pale yellow precipitate is formed, and the solution is left perfectly clear and colourless. Alkalies darken the tint of the solution, but acids bleach it.

It is therefore evident that this cement differs entirely from either the gum or the mucilage, but these differences will probably be made clearer to you if I bring together the effects produced by some of the re-agents.

Alcohol has no effect on the mucilage, or the cement, but turns a solution of gum white.

Acids dissolve the gum, and turn the mucilage yellow. They do not dissolve the cement, but bleach it.

Alkalies have no effect on the gum or the mucilage, but dissolve the cement and turn it yellow.

Acetate of lead has no effect on the gum or the cement, but precipitates the mucilage brown.

Nitrate of mercury has no effect on the cement, and only renders a solution of the mucilage turbid, but precipitates the gum yellow.

We can now understand some of the results arrived at by Dr. Hector and Mr. W. Skey *(Interim Report on Flax)*, Appendix, p.p. 10-13), as for instance the action of alkalies on the fibre, which they showed always weakened it very much; for although they have no effect on the gum they dissolve the cement which binds the ultimate fibres together, and so diminish their coherence; while acids, although they dissolve the gum, do not affect the cement, and therefore do not injure the strength of the fibre unless used in such quantities as to attack the ultimate fibres themselves, or the cement is dissolved by the boiling water.

It will thus be seen that the strength of the fibrous bundles depends entirely upon the cement that holds the ultimate fibres together; and if this is dissolved, either by hot water or alkali, the whole would separate into a mass of fluff, with no coherence or strength, the fibres of which it was composed being half an inch in length.

Having now, I hope, given you a tolerably clear idea of the structure of the fibre of New Zealand flax, and some knowledge of the gum, mucilage, and cement that are found in the leaf, I will next inquire what are the probable uses to which the fibre can be applied, or, in other words, will it be limited to the manufacture of rope and other articles where coarse fibres are used, or is it capable of being worked up into the finer textile fabrics? I shall probably here be met with the statement that this is already proved, as cambrics and drills have been produced from *Phormium* which rivalled the finest flax in appearance, but at a cost that would not allow of its competing with the European article. Such I know has often been stated, but I am not at all satisfied with the truth of those statements. At the Dunedin Exhibition, in 1865, Mr. J. A. Smith, of Napier, exhibited "beautifully white cambric," "white twilled stuff for cavalry trousers," and "sewing thread," all stated to be made from *Phormium* fibre; and Mr. Murray, of Hull, quotes a Captain Harris that "it (*Phormium*) may be woven into fabrics of any description, and made into lace." Still, however, I am not satisfied, for some white drill sent to me by Mr. T. Macfarlane, who had received it from Mr. Luke Nattrass, of Nelson, and which was said to be made from *Phormium*, proved on examination to have been made from flax (*Linum*) or some very similar fibre.

The ultimate fibres of *Phormium* are so like those of Manilla, that I do not think it possible to distinguish one from the other by means of the microscope; while jute is also very similar in appearance, but rather coarser, and the central hollow is in places altogether filled up. These three fibres are, however, easily distinguished from flax and hemp. The ultimate fibres of hemp are from 1 inch to 2½ inches in length, and from 1-1,000th to 1-500th of an inch in diameter. They are nearly solid, having only a very small central hollow. The ultimate fibres of flax (*Linum*) are cylindrical tubes, articulated or jointed end to end. They are from 1-3,800th to 1-800th of an inch in diameter, and, like hemp, are nearly solid. I have not been able to ascertain their length with any accuracy, but I have measured several, which, although broken at both ends, were still from 1½ to 2 inches long; and I judge from their taper that they are sometimes twice that length, or from 3 inches to 4 inches.

I found also, on unravelling a piece of calico, that the fibres of the cotton of which it was composed were one or two inches in length; although, as many of them were broken, this is probably an under-estimate. We thus see that the ultimate fibres of cotton and flax have an average length from three to perhaps eight times greater than that of *Phormium*. It is the opinion of some that the ultimate fibres of *Phormium* might be separated by retting or some other process, and that they could then be spun like cotton. There certainly would not be much difficulty in reducing it to its ultimate fibres, but I do not think that it would then be possible to spin them together, at any rate with the present machinery, as the thread would probably not have more than a fourth of the strength of the cotton.

Mr. Bonser, Manager of the China Grass Company in Wakefield, in a letter to Messrs. Brown, Campbell, & Co., dated 25th September, 1869, says—"I can do nothing with the New Zealand Flax. It breaks up indefinitely, and there is no ultimate fibre long enough to be of any use. As soon as it is steeped even in water the whole strength is taken out of it, and it won't bleach even by the strongest process." Now, I find on examination that the materials of which all textile fabrics are made, that are of a finer texture than bagging, are divided into their ultimate fibres, which have been spun together, and therefore, according to Mr. Bonser, they are beyond the capabilities of *Phormium*. Even if we should succeed in dividing the fibrous bundles mechanically into such delicate threads that they would draw out and could be spun into the finer numbers of yarn, still the cement would be sure to decompose in the boiling in alkaline lye when bleaching, and, even if the threads did not come to pieces, it would be impossible to get a compact web. I also find that when white soaked flax is boiled in a solution of soap it takes a pale yellow colour, which is not removed by sun-bleaching, so that, if it is not reduced to its ultimate fibres and all the cement removed, this alone would perhaps be sufficient to condemn its use as a substitute for linen, or any white material that requires washing, for it is the cement and not the ultimate fibre that takes the colour. I do not therefore think it likely that *Phormium* will ever be used for the finer textile fabrics, or for any articles that require bleaching, and I quite endorse the remark of the jurors in their report on the fibrous substances exhibited in the New Zealand Exhibition in 1865, "that all attempts to produce an article to compete with European flax will only result in disappointment."* *Phormium*, however, may perhaps be used in the manufacture of articles that do not require bleaching, but in my opinion its principal use will always be for rope, in which manufacture its great strength will make it, when properly prepared, superior both to Manilla and hemp. Of course, if the cement is left in the fibre, decomposition will sooner or later take place, and the rope will rot if kept wet for any length of time; but in this respect it ought to be no worse than Manilla or hemp rope, in both of which the cement is still left in.

The rotting of *Phormium*, especially in sea water, would be a most fatal objection to its coming into general use, and it is of the greatest importance that the subject should be carefully inquired into, and if found to be true, both with the hand-washed and soaked fibre, every endeavour should be made to discover means for preventing it. At present we are working in the dark, for we do not know whether the fault lies with the cement, or with some azotized substance adhering to, or inside of, the fibres, and which has not been removed by the soaking or the bleaching in the sun. If the latter was the cause, some means might be found for removing the substance, or for changing its nature by heat or fermentation, so as to make it less prone to decay; but if the former, our only resource would be to employ some agent that would preserve the cement from rotting—such as chloride of zinc, or corrosive sublimate. I certainly think that the best possible analyses should be obtained in Europe, not only of the best *Phormium* fibre that we can manufacture, but also of Manilla, so as to ascertain what substances exist in each, and in what the difference consists, that makes Manilla resist the action of sea water better than *Phormium*. I am not aware that it has ever been stated that tarred New Zealand rope rots sooner than tarred Europe rope.

An objection has also been made against New Zealand flax, that it is easily broken when tied in a knot, and Dr. Hector and Mr. Skey have suggested (*Interim Report*, Appendix, p. 13) that this is caused by small sharp pieces of hard dry gum cutting through the fibres like knives; but that this explanation is not the true one may be proved by taking some dressed fibre and steaming it slightly, so as to soften any gum that might be there, when it will still be found to be just as easily broken on the knot as before. Besides, chemical reactions show, as I have already pointed out to you, that no gum remains in properly prepared fibre, for, if any was there, the liquor obtained by boiling it in water would give a precipitate both with basic acetate of lead and with nitrate of mercury, which is not the case. It will be found on trial that coarse fibres from the butt of the leaf are weaker on the knot than the finer ones from the blade, but that if we split up the coarse fibres into fine threads the strength of both will then be equal and this gives us the clue to the real reason for the weakness on the knot, which is, that the ultimate fibres are cemented firmly together longitudinally without any twist, so that when bent sharply, as in a knot, the outside fibres alone bear all the strain. The remedy for this is a finer division of the fibre.

* Jurors' Reports, p. 117.

Another complaint against New Zealand flax, as at present prepared, is its uneven quality. This is owing to different causes, which will all disappear in time. One of the causes lies in the leaves that are used, all varieties being passed indiscriminately through the machines; and young, old, and sometimes half-decayed leaves are mixed up together. This evil will be in great part cured when the whole of the first crop of old leaves has been cut, for then young leaves of from one to two years will alone come to the mill; but it will not be entirely got over until mills are supplied with cultivated flax carefully selected and looked after, and I do not think that it will pay to do this at present. Another source of uneven quality is owing to the various processes employed in different mills to prepare the fibre; but this will also gradually disappear as the subject gets ventilated, and the best method adopted throughout the Islands.

The objection that New Zealand rope easily chafes is one that I am afraid we cannot cure, as it arises from the gradual separation of the ultimate fibres from one another; but the more the cement is removed or weakened by retting, boiling in water or in alkali, the more it will be liable to chafe, and the greater the diameter of the rope the less will be the proportionate wear. I do not, however, see why New Zealand rope should chafe more than Manilla.

One other objection remains to be noticed, namely, the alleged liability of the fibre to spontaneous combustion. Spontaneous combustion is caused by easily decomposable bodies absorbing oxygen under such circumstances that the heat cannot escape as quickly as it is generated, and it accumulates until it is sufficient to set the substance on fire. All organic bodies which contain albumen decompose spontaneously when kept in a moist condition; but those bodies that do not contain nitrogen are much less liable to decay, and therefore to spontaneous combustion. Well-cleaned fibre, quite dry when packed, is not in the least liable to such a change; but badly-prepared, or unscutched fibre, packed damp, would probably rot before long, and the heat thus given out might be sufficient to set it on fire. Unwashed flax, which still contained the mucilage and bitter principle, would be still more liable to spontaneous combustion; but as moisture is absolutely necessary before decay can commence, even the unwashed and unscutched fibre, if it was quite dry when packed, and pressed with a pressure of forty or fifty tons or more, would be free from danger, for if the outside got wet afterwards, the damp could not penetrate further in than it could evaporate out again; and it is only in the centre of a bale that the heat could accumulate so much as to cause it to catch fire. In my opinion, therefore, any kind of flax, if quite dry when packed, and well pressed, is safe; but any kind, even the best prepared, if packed damp, or loosely pressed is unsafe, but not nearly so dangerous as wool or hay. The proof of this is the large quantity that appears to be damaged by sea water on its way to England, and yet we have not heard of a single case of heating or spontaneous combustion with Auckland-made flax.

I will now pass on to the second part of my lecture, in which I shall discuss the different processes which are known to me to be employed in extracting the fibre from the leaf, and in preparing it for export. All our accounts from England agree in saying, that what is required is a good white fibre, bright and fresh looking, and well cleaned from the tissue in which it is enclosed; and from what I have said, you will see that, in my opinion, we have to aim at a strong fibre, suitable for the manufacture of rope, and not attempt to produce an article to compete with European flax.

Machining.

In preparing New Zealand flax, whatever may be the subsequent processes followed, the first must always be a mechanical one. This is owing to the tough varnished skin which covers the leaf on both sides, and which prevents solvents or chemicals acting on the mucilage and fibre until it has been broken up; this has been clearly shown by Dr. Hector and Mr. Skey in their paper already referred to. The object, therefore, of this process is to separate as much as possible the cellular tissue of the leaf from the fibrous bundles, and that without cutting or breaking them. Another object is to remove the gum which adheres to the leaf.

Many and various have been the means tried to effect these objects, and large sums of money have been spent in vain endeavors to produce a good fibre that could be sold at a profit. I will not say, however, that these endeavors were fruitless, or that the money was wasted; for out of them have arisen the machines so largely used at present in this Province, and which are certainly capable, with proper management, of producing an excellent article at a sufficiently low price.

It will, I think, be instructive to group together the various methods that have been tried at different times and pronounced failures; for, judging from letters that occasionally appear in the papers, it seems to be very little known in the Southern Provinces how numerous have been the experiments in Auckland, and how many thousands of pounds have been expended in trying them.

Hackling.

This appears to have been the first method tried, for Mr. Holman, of the Bay of Islands, invented a machine on this principle in 1849. Subsequently, Mr. Murray, in 1865, and Messrs. Macfarlane and Cox in 1866, all tried different modifications, but without success. Mr. S. Brown, of Newmarket, advocated in 1867, hackling by hand.

Percussion.

The next principle tried was that of percussion. In 1850, Mr. Dent beat the leaves with flails, and in the same year Baron de Thierry used wooden stampers; while Messrs. Purchas and Ninnis introduced iron stampers in 1860.

Friction.

This principle was tried by Mr. Whytlaw in 1854.

Pressure.

Squeezing the leaves by passing them through rollers under heavy pressure was tried by Baron De Thierry about the year 1856, and subsequently Mr. Honeyman, of Dunedin, introduced fluted rollers.

SCRAPING.

This was tried by Mr. Cole, of Papakura, in 1860, who used a revolving drum, scraping the leaf against wood. Lastly, in 1866, was commenced the invention of the present machine, which combines the principles of percussion, friction, pressure, and scraping. In this machine, the leaf is first pressed by iron rollers, then struck by the beaters, which break the skin across, and loosen the tissue; then, by rapidly changing its direction as the drum revolves, the beater acts as a scraper, while it moves in the direction of the length of the leaf, and tears off the greater portion of the tissue and the whole of the gum, while at the same time the beaters, by their diagonal position, push the loosened fibres first to one side and then to the other, and so open them out. The truth of this can be easily proved in those machines like Gibbons' or Fraser's which admit of experimental plates or bars for beating against being put in. If the face of the plate is made sharp and convex to the beaters, they act only as hammers and break up the tissue, but do not remove it; but if the face is flat, or slightly hollowed, so that it is concentric with the drum, and this flat or hollowed surface has a breadth of two or three times the distance at which the blows are delivered on the leaf, the tissue will not only be broken, but almost entirely torn away from the fibre.

The fault of the pressure principle was that the leaves were not sufficiently broken up, especially near the tip; the fault of the hackling and scraping principles was the great wear and tear on the machine, and the hackling principle was also found to tear or cut the fibres across; while the fault of the friction and percussion principles was that the process was too slow to pay, The present machine probably reduces all these faults to a minimum. Pressure is used only to break up the thick butts of the leaves, and to hold them while being scraped by the drum. The wear is reduced by the percussion of the beater first breaking the skin across before the tissue is scraped away, and by dressing the flax between two strong smooth metallic surfaces; while the speed is so great that a single machine can easily dress 5¼ cwt. of green flax, or about 2,000 leaves, in an hour; whilst the fastest hackling machine could only dress 4½ cwt., and the fastest percussion machine 3 cwt. per hour. The speed with which the leaves can be passed through a machine is of the greatest importance, for the machining is the only process in which each leaf has to be handled separately. In the machines now in use, the speed could be greatly increased, if mechanical means were devised for taking away the leaves as they pass through and arranging them in hanks, with the butts all laid together. A difficulty consists in the leaves being of different lengths, but this will no doubt be overcome in time. It is thought by some people that machines by some makers can pass more leaves through in a certain time than those of other makers. This, however is a mistake, if no stoppages occur, as the feed-rollers of any machine can be run at any speed the manufacturer wishes, provided the machine is strong enough to stand the strain. It is simply a question of size of pulleys.

What I have already said about slightly hollowed beating-plates making the best flax, makes me prefer soft iron plates to hard ones, for they quickly wear to the same curve as the beaters follow, which is the best shape they can have, while they also save the wear of the beating-drum. I have kept a soft cast-iron plate in a machine for a week, and at the end of that time it was making just as good flax as when it had been in only for an hour or two. The face, when I took it out, was about five eighths of an inch in breadth, and hollowed to the curve of the beaters. Of course it will take rather more power to drive a machine with a hollowed plate, but our object is to turn out good fibre Constant attention is necessary to see that the machines do not get out of adjustment, otherwise an uneven quality of fibre will be produced. I find that when a machine is in proper adjustment, and running with considerable speed, it will strip off nearly the whole of the tissue from the leaf without injuring the fibre, but that if the speed is reduced it will cut the fibre. However, I prefer the fibre being slightly cut to being under-dressed. No doubt there will be greater waste and more tow made, but the remaining fibre will be soft, while, if under-dressed, it will always be harsh and wiry: and manufacturers should never forget that their best policy is to produce as good an article as possible, even if it should be at a less immediate profit. *Phormium* fibre is now suffering an undeserved depression in the London market, owing to the quantity of trash that has been sent there. Badly dressed, badly washed, and badly dried, it looked, when shipped, more like a material for brooms than for ropes, and when landed in England it was fit for nothing but manure. It is the manufacturers of this inferior material who have caused the cry of spontaneous combustion, who have raised freights and lowered prices, and who have caused the strongest and whitest of prepared fibres to be classed with coir and jute.

SOAKING.

After machining, the leaves, now reduced to the state of fibre, must be placed in water, but different opinions obtain as to the proper mode of doing this; while in some mills, I believe, the fibre is not washed at all. This, however, is a great, indeed, a fatal mistake.

We have seen that the interior cells of the leaf contain a bitter principle which is readily soluble in water, and it is this principle which, if allowed to dry on the fibres, stains them to a reddish brown. It is found in all parts of the leaf, but is most plentiful in the butts, where larger quantities of cellular tissue exist; and it must not be confounded with the red colouring matter found also at the butts of some leaves, and which can also be removed by soaking in water, but with greater difficulty. The bitter principle is colourless while in the cells of the leaf, but turns reddish brown on exposure to water or moist air, and dries up of the same colour, while the red fluid is red when in the cells of the leaf, but loses its colour when exposed to the air and sun, and dries pinkish-yellow. That such is the case, may be shown by taking a quantity of leaves, some of which are red at the butt and some white, running them through the machine, and drying them without any washing, when it will be found that, notwithstanding their different colours when fresh from the machine, they will all dry to nearly the same reddish-brown colour, and this colour will extend more or less to the tips of the leaves; while, if they had no bitter taste, the fibre will be found to dry nearly white, although red at the butt when taken out of soak.

Simply washing, however much the fibre may be manipulated, will not altogether remove this bitter principle; time is absolutely necessary to accomplish it, and, unless it is entirely removed, the

fibre will not have that purity and brightness of colour which belong to it when properly prepared My experience is that from three to four hours is the best time to allow the fibre to remain in the water. The best test is tasting it, for as soon as there is no bitter taste on chewing a portion of the tissue still remaining on the fibre, the soaking has proceeded long enough. Less than three hours will scarcely remove the whole of the bitter principle, while twelve hours' soaking takes the gloss off some kinds of flax and gives it a dull appearance; but I prefer leaving the flax that has been run through the machines for the last two hours of the day, in the water all night, to taking it out of soak too soon

The water in which flax is soaked should be clear and free from iron, or the flax will turn black; for this reason water running from swamps is inadmissible. Running water is certainly the best, the clear rapid current of the Waikato being admirably adapted for the purpose. I have not tried whether a slight current running through tanks or ponds would be sufficient to remove the colouring matter; but judging from the large quantity that escapes, I should fancy that the current ought to be strong enough to change the whole of the water in them every five or ten minutes. Of course, loss of weight is experienced by soaking, but the quality of the fibre will be so much improved that this loss will be well repaid.

The beneficial effects of soaking may readily be made apparent, by boiling in water portions of soaked and ordinary hand-washed or rinsed fibre. The former will be found to yield a perfectly clear fluid, of a pale yellow colour, and without smell or taste, while the latter will yield a liquor of the colour of the mucilage or liquid gum sold in shops, of a slightly bitter taste, and smelling when hot something like barley-water. This would be a good test for purchasers.

Besides the bitter principle, a green fluid also escapes while washing or soaking. This, on being examined by a powerful microscope, is seen to be water, coloured by minute granules of chlorophyll (the substance that colours leaves green) floating in it. These granules are so small as to pass through filter-paper, but they are precipitated by chloride of tin and by acetate of lead, the solution in both cases being left clear and colourless. These granules have escaped out of the cells broken by the machine, and this has led Mr. Nottidge, of Canterbury, to object to the Auckland machines, as he supposes that when "the leaf is broken and bruised, the cellular tissue is completely broken up, the fluid contents of the cells set free, and, by the same cause, openings would be forced in the tubular cells of the fibre, whether those cells contained fluid or air, and if they contained fluid some of that fluid would be forced out. The result is obvious—the fluid juices would be drawn into the tubular fibres, and into the minute canals between the ultimate fibres, by capillary attraction, and the tubes being so minute the capillary attraction would act very rapidly and with great force."—(*Trans. N.Z. Inst.*, Vol. II. p. 110.) I cannot, however, agree with these opinions, for the following reasons: If a leaf is carefully examined with a microscope immediately after having been passed through the machine, the bundles of fibres will be found quite white and unbroken, if the machine is doing its work properly. Small particles of green tissue will be seen scattered loosely through the leaf, and others will be seen sticking to the bundles. I have often closely examined the ultimate fibres to see if they contained any chlorophyll or other colouring matter, and I have cut quite dry dressed fibre across, and plunged the ends into the green fluid, but I have always found the ultimate fibres quite empty, except when broken, in which case they generally contain water. As chlorophyll generally exists in small grains, and always in a semi-solid or viscous state, it could not possibly penetrate through the sides of the fibres; but if the machine was "cutting" it might certainly be possible for small portions to penetrate into the cut fibres; but, as we have seen that these fibres do not average more than half an inch in length, that would be the limit to which it could penetrate. As for the minute canals between the ultimate fibres, I have always failed to see them, and have already suggested (*Trans. N.Z. Inst.*, Vol. II., p. 112) that they do not exist in the leaf, but were made by the knife of the observer when cutting fine sections. If a portion of stained fibre is taken and boiled in water, or in a dilute solution of soda, until the ultimate fibres can be separated as fluff, they will be found to be quite white, although those parts of the fibrous bundles that have not been separated still keep their colour. This shows that it is the cement that binds the ultimate fibres together that is stained by the juices of the plant, and not the ultimate fibres themselves. The fact, also, that no precipitate is produced when neutral acetate of lead is added to the liquor obtained by boiling soaked fibre in water, shows that little or none of the green fluid and mucilage has remained in or on the fibres. I think, therefore, that this objection to the Auckland machines is unfounded, but I agree with Mr. Nottidge that passing a stream of water through the machine is beneficial to the fibre.

Not having experimented myself with steaming flax, nor with iron or india-rubber rollers, I shall say nothing about them, but shall leave it to others to give us their experience.

Retting.

Nothing is more likely to lead to mistakes than to assume, without inquiry, that those processes which have been proved to be best for one manufacture must necessarily be the best for another similar, but not identical, manufacture; and as many people are now advocating the retting of New Zealand flax after it has passed through the machines, I think it may be advisable to make a few remarks on the subject.

Dr. Hector and Mr. W. Skey, in their paper already referred to, describe several experiments that they made on retting, and speak very highly of them; indeed, they say that there can be no doubt as to the success of the process. Although hesitating to express an opinion against such high authorities I am bound to confess that the few experiments I have made are not at all favourable, for in all cases I found the fibre so discoloured that its value would be greatly deteriorated. I found that pond retting not only blackens the fibre, but that the ultimate fibres rotted as quickly as the cement, so that when broken the ultimate fibres broke off short, and did not pull out, as is the case when the cement is dissolved by an alkali. In fact, the ultimate fibres seemed to get rotten before the retting was sufficiently advanced to produce any useful result. Schenk's process I have not tried, owing to the expense: but I find that any action of hot or warm water on the cement turns it gray; and although

Schenk's process may offer advantages over pond retting, I do not think that either can be introduced unless some means are found for preserving the colour of the fibre. Indeed, *a priori* reasons lead me to think that retting will never be applied to *Phormium* fibre with the same success as it has been to European flax and hemp. In the first place, the object to be attained in the two cases is different. With flax, the object is to weaken the cement, and to remove a large portion of it; while with *Phormium*, the only object would be to weaken slightly the cement to enable the fibrous bundles to be split up more readily; and it is more than probable that mechanical means will be found for effecting this without weakening the fibre or spoiling its colour.

In the next place the cell walls of the ultimate fibres of *Phormium* are much more tender than, and not much more than one-half as thick as those of flax or hemp, and they would therefore be more readily weakened in the process; and, further, any colour imparted to flax by retting can be removed by bleaching, while *Phormium* fibre will not stand the boiling in alkali necessary for that operation. Also, the retting of European flax is the first step in the manufacture, and consequently if the crop is spoiled by under or over retting, the loss is as small as possible, but with New Zealand flax we should have had to incur the previous expense of machining, and the chances of spoiling would be greater. However, as I have already hinted, a slight fermentation might be useful as a preservative if means can be found for accomplishing it without discolouring the fibre, or if a process can be found for bleaching *Phormium* without the use of alkali, or long boiling in water.

BLEACHING AND DRYING.

I have said that the greater part of the tissue, and the whole of the gum, is removed by machining, and the mucilage and bitter principle by soaking. The next step is to remove the green colour of those parts of the tissue that still adhere to the fibre. This is accomplished by sun-bleaching. If the fibre, after coming out of the water, is once dried, without exposure to the sun, it will dry green, which colour it will retain for a great length of time if kept dry. This green colour is, however, no great detriment, as it can at any time be removed by wetting the fibre and exposing it to the sun; and I have not heard of any complaints from England on this score. Still, as it spoils the appearance of the fibre, and as it will have to be removed some time or other, either by the manufacturer or by the purchaser, it is better to do so at once. In summer this is easily accomplished by spreading it thinly on grass for four or five days, then turning it over and letting it lie two or three days more; when, if dry, it will be ready for storing; but in winter or in wet weather a much longer time is necessary.

The green colour is removed most quickly by alternately wetting the fibre and letting it dry in the sun several times. In the summer this is accomplished naturally by the dews. If the fibre has dried green, and there is no moisture, a long exposure to the sun is necessary to bleach it, while on the other hand if it is kept constantly wet it retains its colour much more obstinately than when alternately wet and dry. During the winter months flax never gets thoroughly dry on the ground, even in fine weather; and in wet weather it has often to be left on the bleaching-green for several weeks, and even then green hanks will be found in it. To obviate this, after the fibre has lain for a fortnight or three weeks on the ground, it has to be hung on wires or poles to dry, when the wind, sun, and rain will finish the bleaching nearly as well as in summer. My experience is that well-dressed soaked flax may be safely left out for three weeks without ever getting dry, but that in about five weeks it begins to lose strength. Badly-dressed flax will deteriorate much sooner, for wherever the tissue is left adhering to the fibre putrefaction soon commences.

Each row of wires should consist of three arranged in a triangle, so as to keep the flax open and let the air in. The rows should be ten or twelve feet apart so as to allow a cart or dray to go between them. I find that a ton of fibre may be spread on about a mile of wires, so that in winter a mill would require a mile and a half or two miles of them, which would cover from two to two and a half acres of ground. In summer they will not be used at all. About fifteen acres of bleaching ground will also be necessary for a mill running three or four machines.

Considerable storage room is absolutely essential to the successful carrying on of a mill, for often after a succession of wet weather a few dry days may come, and eight or ten tons or more of fibre may require to be stored almost at the same time; while without large stores the scutching and packing would have to be stopped. In my opinion a mill ought always to have about ten tons of fibre in store, and to do this in winter would require storage room for from fifteen to twenty tons, or about 12,000 cubic feet.

SCUTCHING.

The next process is that of scutching, the object of which is to straighten out and clean the fibre thoroughly from the dry pieces of tissue still remaining on it, as well as from the dust and dirt picked up in the drying-ground. There is perhaps no part of our machinery that wants more improvement than the scutch, for not only do the present ones clean the flax badly, but they also make more tow, or in other words, break more fibre than necessary. The great length of our fibre makes it much more difficult to scutch than European flax, which is only from two to three feet in length; and it would much facilitate the process if the hanks were cut in two, so as to make it into lengths of four or five feet; but I do not know what value is attached to length of fibre in England. The barrel-scutch is much better adapted for our long flax than the arm scutch, and consequently is almost everywhere used. The faults of the present scutches appear to me to be—first, that the hardest blow is delivered in the middle of the hank, where it is least wanted; second, that the ends of the hank hang away from the scutch, and do not get properly cleaned; third, that the ends of some of the fibres get round the arms or beaters of the scutch, and so get drawn out of the hands of the scutcher; and fourth; that the hanks are not sufficiently opened, and the outsides get well beaten while the inside is untouched. To try to remedy these faults, I am having an iron scutch made like a large scraping drum, with diagonal beaters, and I propose to make it revolve the opposite way to the usual one, and scutch over the top.

Baling.

After the fibre is scutched, it is ready for baling at once.

Such is all the information I am able to give about the manufacture of New Zealand flax. The newness of the subject must be my excuse for the many mistakes which I have probably made; and I wish it to be understood that I have only told my present opinions, which are quite liable to change, for I well know much remains yet to be learnt. But if I have helped to distinguish between the New Zealand flax plants, which produce fibre of such different quality, or if I have helped to dispel any illusion as to the uses to which *Phormium* fibre can be applied, or if I have helped to bring the process of soaking in running water into more general use, I shall be satisfied.

Note by Captain Hutton on the means of distinguishing the fibres of New Zealand Flax from those of Manilla or Sizal, by the Microscope.—Read before the Wellington Philosophical Society, 26th August, 1871.

To an experienced eye, the difference between Manilla fibre and New Zealand flax, when in any quantity, is so great that I do not suppose that any mistake would occur in distinguishing between them; but when a small portion only is available for examination, as when Manilla rope is sparingly adulterated with *Phormium*, the case is different, and unless the easily recognised marginal or mid-ribs of *Phormium* are present, the microscope will have to be resorted to before a satisfactory determination of the nature of the fibre can be made. Sizal, again, is still more difficult to distinguish by the unassisted eye from *Phormium*, than the latter is from Manilla, and I therefore propose to give the characteristics of each fibre, when examined with a microscope:—

In *Manilla*, the fibrous bundles are oval, nearly opaque, and surrounded by a considerable quantity of dried up cellular tissue, composed of rectangular cells. The bundles are smooth, very few partly detached ultimate fibres are seen, and no spiral tissue.

In *Sizal*, the fibrous bundles are also oval, and surrounded with cellular tissue. They are also smooth, and very few ultimate fibres project from the bundles. They are, however, more translucent than Manilla, and can always be recognised by the large quantity of spiral fibres mixed up in the bundles.

In *Machine-dressed Phormium* the bundles are translucent, and irregularly covered with tissue, being in places quite free from it. Spiral fibres can also be detected among the bundles, but not in the same quantity that is seen in Sizal. Many more ultimate fibres stick out from the bundles, which are flat instead of oval. In those places where the bundles are entirely freed from tissue, they are generally divided longitudinally into two or more smaller bundles, or *fasciculi*, and in these places the nnmber of half-detached ultimate fibres is greatly increased; these are, however, rarely broken, most of them having the end perfect. Spiral fibres are here absent.

In *Maori-prepared Phormium* the bundles are almost entirely free from tissue, and quite so from spiral fibres. They are always broken up into many fasciculi, which average, perhaps, some twelve or fifteen ultimate fibres in each fasciculus. Many ultimate fibres are semi-detached, and they are much more broken than in machine-prepared fibre.

If an examination of the fibrous bundles fails to give a satisfactory result, resource must be had to the size of the ultimate fibres which compose the bundles, and this will always give a certain proof of the nature of the fibre under examination, provided enough measurements are made to strike an average, and this can always be done, as one fibrous bundle a couple of inches long will yield an ample number of ultimate fibres.

In order to accomplish this, the fibre must be first boiled for two or three hours in a weak solution of potash, by which means it will be decomposed. It will then be found possible to isolate individual ultimate fibres from the rest of the bundle by careful dissection with needles under a microscope, the decomposed bundle being placed on a glass slide, in a drop of water. When thus prepared, it will be found that the ultimate fibres of Sizal will separate easily, those of *Phormium* with more difficulty; while it will require great care to prevent breaking those of Manilla when endeavouring to detach them. In fact, Manilla requires four or five hours boiling in a tolerably strong solution of potash, before the ultimate fibres can be detached readily.

The following table gives the average dimensions of the different ultimate fibres, made from a considerable number of measurements of each kind:—

	Length of ultimate Fibres, in inches.			Diameter of ultimate Fibres, in Inches.			Thickness of Cell Wall in inches.
	Max.	Min.	Mean.	Max.	Min.	Mean.	
Sizal	·25	·20	·21	·00140	·00098	·00112	·00028
Manilla	·25	·17	·21	·00098	·00060	·00083	·00024
Phormium ...	·80	·13	·39	·00070	·00035	·00045	·00015

It will be thus seen that the average length of the ultimate fibre of *Phormium* is nearly twice that of either of the others, while the average diameter is not much more than half that of Manilla, which again is much less than Sizal. The cell wall also of *Phormium* is also much thinner than that of either of the other two.

NOTES on Captain HUTTON'S LECTURE on FLAX, by WILLIAM SKEY, Government Analyst.—Read before the Wellington Philosophical Society, 17th September, 1870.

IN this interesting and valuable lecture, embodying as it does so much of the practical experience of one occupying the position of a large manufacturer of this fibre, and who is, besides, well qualified by scientific training to observe and to pass opinion upon such a subject, there occur in those portions of it bearing upon the structure of the plant, and the nature of its predominating principles, one or two statements which are, I think, neither supported by the evidence adduced for them in the question, nor can be by any that we are able to gather elsewhere.

With all proper rospect, therefore, for Captain Hutton, and with a high appreciation of this lecture generally, I beg to remark upon these statements for the purpose of having them either corrected or substantiated, as nothing would tend to throw us so far back from the attainment of excellence in the manufacture of this fibre as erroneous or uncertain opinions in regard to these points. It will be remembered that Captain Hutton, for the especial purposes of his lecture, distinguishes three or four principles out of the many occurring in this plant; and it is in relation to the chemical properties and reactions he assigns to one or two of those, and especially to the supposed identification of a cement he affirms to exist round the fibres of the plant, that my remarks will mainly apply.

The first principle discussed there is the *gum*, and of this he asserts, from the result of experiments he describes, that "it is unlike any gum or mucilage hitherto known;" but this is scarcely borne out by the actual results of the experiments instanced, for it does certainly comport itself with all those re-agents specified by Captain Hutton, precisely as does common gum or gum-arabic.

Captain Hutton does, indeed, state that this gum (flax gum), when dissolved in water, is not precipitated by alcohol, a statement which, if correct, would certainly place it in a very different chemical group to that which common gum occupies; in fact, it would not be a gum at all, but rather a resin, or something nearly assimilating.

It appears from my own experiments, however, that flax gum *is* precipitated from its aqueous solution by alcohol, and completely, but only if the proportion of alcohol largely preponderates over that of the water retaining it in solution; hence, this gum does not differ from others in respect to its comportment with this re-agent.

The next series of Captain Hutton's chemical experiments was performed upon the contents of the cells, for the purpose of ascertaining the nature of the mucilaginous substance.

Under the heading "Bitter Principle and Mucilage," the results of these are detailed; from which Captain Hutton infers that the "mucilage is essentially different from the gum" occurring on the outside of the leaf.

In many respects, however, the reactions are precisely the same as those that are given for this gum; indeed, it is only in regard to its refusal to form precipitates with alcohol and nitrate of mercury, as stated by Captain Hutton, and also its behaviour with neutral acetate of lead, that it appears to manifest any difference to the gum.

But upon repeating these experiments, I find that decided precipitates do form when either alcohol or nitrate of mercury are added to this extract in quantity; while, in reference to the precipitate formed with neutral acetate of lead, this is no doubt caused by the presence of the bitter principle alluded to, and there certainly appears to be nothing left among these statements to establish or support any difference between the outer gum of the leaf and the gummy or mucilaginous substance in the cells.

But were these results stated correctly, they would still be of little use, from the circumstances under which they were obtained.

The whole case may shortly be stated as follows:—Two principles, not to mention others, are taken, the properties of neither of which we are perfectly acquainted with. Various re-agents are added to their aqueous solution, and from the reactions manifested is drawn the conclusion that one of these is "essentially differeut" from some member of its own group occurring, as it happens, in the same plant, and almost in absolute juxtaposition with it. But how do we know what reactions are due to the one and what to the other, or whether some may not be owing to the interaction of these principles themselves upon each other, in presence of the powerful re-agents used.

Clearly the results would be much more valuable and reliable if the several tests were applied to each principle, or at least to each predominating principle separately.

This separation might easily have been effected by means of alcohol, as the bitter principle is soluble in this menstruum (see page 8), while it is a distinguishing character of all gums or mucilages that they are insoluble therein.

In reference to the true character of the mucilaginous portion of this extract, I am inclined to think it is merely the ordinary flax gum in its normal state—that is, as originally produced by the plant; while the bitter principle associated with it in the cells is allied to the soluble resins.

I now arrive at a part which I experience some hesitation in discussing, as, to do this properly, requires an acquaintance on my part with the intricacies of vegetable structures which I do not possess.

Captain Hutton assumes the presence of a cementing substance in the flax by "which the ultimate fibres are bound togethor in bundles." To me, these ultimate fibres seem quite free and clear of each other upon their longitudinal surfaces, if only they are taken fresh from the plant and kept moist. However, the determination of this microscopically I leave for others, and I proceed to discuss the supposed chemical identification of this cement. Captain Hutton affirms that "the pure soaked fibre, when boiled for three hours in water, yields a pale yellow fluid, with an acid reaction, but no bitter taste, which on evaporation leaves a brownish gummy substance, insoluble in alcohol or acids, but readily soluble in alkalies and cold water." Now, I obtained an extract having the same chemical properties from Swedish filter paper (which is always held to be pure cellulose), by giving it full contact with boiling water for three hours, and this was after well washing the paper first in cold water, so that anything adherent to it accidentally, which could in any way affect the results, would be removed; all the water used had been freshly distilled.

Simultaneously with the colouring of the water, bubbles of carbonic acid gas were evolved from the filter paper; and the same results were observed in the case of the purest flax fibre when thus treated, while its surfaces acquired a distinct brown colour.

The fact then appears that the prolonged contact of boiling water with vegetable fibres effects chemical changes upon them, whereby they become more or less coloured, and yield portions of extractive matter to the water employed. It follows, therefore, that the substance extracted by Captain Hutton from the "pure soaked fibre" is not necessarily a cement at all, but might be, and no doubt is, in part or wholly, a product of the metamorphosis of the pure fibre itself. Granting, however, for the moment, that nothing but a cement has been removed in these experiments, I do not clearly see that the reactions, stated to have followed from the additions of the various chemical agents to the solution so obtained, establish anything at all in relation to the nature of such cement.

The effects of prolonged contact with hot water by Captain Hutton's own experiments, exercises such a radical change upon the supposed cement, that it no longer refuses to dissolve in cold water, and has acquired besides a deep brown colour. Clearly, therefore, the reactions cited as belonging to, and characteristic of the supposed cement, properly refer to some body or bodies chemically distinct.

Taking all this into due consideration, I am compelled to think that as yet Captain Hutton has neither demonstrated the presence of cement in the flax plant performing the duty he ascribes to it, nor yet, supposing such a cement to exist, that he has informed us anything more of its properties than that it is insoluble in cold water and acids.

In reference to the valuable information on the effects of retting the fibre, conveyed to us in this lecture, Captain Hutton's actual experience shows him that two obstacles exist to prevent the adoption of this process; 1st, the danger or absolute certainty of the ultimate fibres rotting before the retting has so far advanced as to produce any useful effect; 2nd, the tendency of the fibres to blacken, and their refusal to bleach afterwards without seriously weakening them.

As regards the first objection, we all know how important it is to stop the retting at the proper time, in the case of the common flax plant. Obviously, therefore, the hitting the proper time will be of equal or more importance in the case of Captain Hutton's flax, which was so thoroughly opened out before immersion.

Regarding the time which should be allowed for retting, this, too, must be obviously considerably less with a fibre already almost clean, than when mixed up largely with woody tissues, as in the case of the Irish flax. Three or four hours, however, to which Captain Hutton generally limits himself, is, for the soaking or retting, certainly a brief period.

Doubtless many changes have been wrought upon the more insoluble substances present even in this time, besides the removal of the more soluble ones; but I should prefer Captain Hutton's maximum time of twelve hours, but it would be very improper to fix any stated time for this operation, since much will depend upon the quality of the water employed, as also upon its temperature.

As to the next objection—the discolouration of the fibre—retting certainly has this tendency; but I can scarcely think this an insuperable obstacle. Very possibly some means may be found for averting this, or for bleaching it afterwards without incurring any serious loss of strength in the fibre. Experiments with this object in view seem very desirable.

I quite agree with Captain Hutton that the softest running water is the best for the steep, and that it is a *fatal* mistake on the part of flax producers to neglect the soaking of their flax in water after the machining.

NOTES on the presence in certain fibres of a substance susceptible of some striking colorific changes, when chemically treated, by WM. SKEY, Government Analyst.—Read before the Wellington Philosophical Society, on the 26th August, 1871.

IN attempting to bleach some samples of *Phormium tenax* with chlorine, I experienced such difficulty that I was led to investigate into the cause, when certain re-actions manifested themselves, which I think proper to communicate at once, as they show that there exists in certain fibres a substance which, as far as I can learn, has not yet been described in chemical works, and from the deportment of which with certain re-agents, we are able easily to discriminate those fibres which contain it from those in which it is not present.

The results arrived at up to the present time are as follows:—

1. That a number of fibres (that of *Phormium tenax* included), when allowed contact with chlorine, hypochlorous or chromic acid, acquire a pale yellow colour, which is changed to a beautiful rose red, when the fibres are afterwards treated with alkalies, alkaline carbonates, or earthy carbonates; while acids restore the yellow tint when applied to the reddened fibres.

2. That the alkaline manganates affect these fibres in the same manner as chlorine, etc., except that they are blackened by a deposit of oxide of manganese, which, when removed by the proper acids, leaves the fibre of a yellow colour, subject to the same colouration by contact with alkalies as in the above experiment (No. 1.).

3. That these fibres are coloured a pale yellow by alkalies and their carbonates, but, in the case of these last, the colour is paler than with the alkalies.

4. That by cold, strong nitric acid they are coloured red-brown, which changes to a yellow tint on contact with alkalies.

5. That slightly diluted cold sulphuric acid renders these fibres quite yellow; while the concentrated acid blackens them at common temperatures,

6. That when treated for a long period with chlorine, hot chromic, or nitric acids, these fibres are completely whitened, but deteriorated in strength. The addition of ammonia or sulphuric acid has then no colouring effect on them.

7. That *Phormium tenax* exhibits the same reactions with these several re-agents, and in as great a degree when previously digested for two hours in boiling ether, alcohol, or chloroform, or for eighteen hours in boiling water, or when soaked in cold water for eight days.

8. That *Phormium tenax* fibre cut up into lengths of one-eighth of an inch and digested for twelve hours in boiling water exhibits as well marked reactions to chlorine in conjunction with ammonia, or to sulphuric acid, as it did before such treatment.

In the annexed columns, the effects of ammonia on the oxidized fibres of certain plants in relation to these changes of colour are stated :—

Coloured Rose Pink.	Coloured Brown.	Unaltered.
Phormium tenax	Wood	Hemp.
Yucca	*Manilla*, impure ...	Sunn Hemp.
Sisal	„ pure (?) ...	*Rheea.*
Aloe		Raw Cotton.
		Linum.

A great number of samples of *Phormium tenax* have been experimented with, the results being always similar; among these have been :—

1. Those prepared by machinery only.
2. Those prepared by a short retting process and machined afterwards.
3. Those prepared by Maoris—the cleanest I could obtain.
4. Some prepared by myself and which had never been dry, and some of them which had been steeped in water five days.

In respect to the flax (*Linum*) used, it had no appearance of being bleached but only retted, and I am anxious to learn whether the fresh fibre of this plant would behave to these tests the same as that of the *Phormium tenax*.

This, together with a great many other points, will require time to enable me to determine. It would be desirable, for instance, to know if long continued retting would remove or change the principle on which the colouration of the fibre depends, and also the effect of sunlight ; also, whether the principle is as abundant in the fibre at one season of the year, as at another, and if it is equally dispersed through the several varieties and parts of the leaf.

It is premature as yet to enter fully upon the deductions which these results would lead to, but I think the following points are clearly established :—

1. That certain fibres among which is *Phormium tenax*, contain a substance quite distinct from the fibre, though such fibres have been prepared with the greatest care, and appear to be quite pure.
2. That this substance is insoluble in hot or cold water, also in alcohol, ether, and chloroform, and in aqueous solution of hydrochloric acid.
3. That a small portion of it is on the outside of the fibre, as shown by the carbonate of lime test.
4. That the whole of this substance is probably in chemical combination with the fibre.
5. That it cannot be removed chemically without injuring the fibre, as even pure fibre (*cellulose*), which does not contain this principle, is weakened considerably when passed through these processes.

In reference to the nature of this principle it is difficult to conjecture, as it clings so persistently to the fibre as to appear inseparable, except in an altered state.

From the blackening of the fibres containing it by sulphuric acid I infer that it is non-nitrogenous —probably it is allied to some of the colouring principles of madder.

When oxidized by chlorine, &c., it has the colour of fresh turmeric paper, which paper is, like this, reddened by contact with alkalies.

In conclusion, I may observe that this substance is not unlikely to be the basis of the yellow and red colour of the *Phormium tenax* and other plants, and that while it may not be necessary to remove it from these fibres for many purposes to which they may be applied, it is questionable whether we can have them of a pure unalterable white colour, without its removal.

Further Notes.

1. The fresh fibre digested for twenty-four hours in a weak solution of caustic potash, is whitened in those portions of it which have freest access to the liquid, that is the ends and outside portions, and such portions do not then give any reaction with ammonia after contact with oxydizing agents.

2. That prolonged contact with cold hypochlorous acid also renders such parts colourless, or nearly so, and that ammonia has then no effect upon such fibres.

3. That, by stopping the second process when the fibre is thus divested of the principle giving the reactions before described, such fibre does not appear to be greatly weakened, whether it is tested dry or wet.

4. That, in the case of the first experiment, the fibre is more weakened than in the second; but, still, not so much that the fibre appears very easily or readily detached into ultimate ones.

Deductions.

Taking all these results into consideration, I do not see that they tend as a whole to establish any theory which may be brought forward, that regards the principle thus indicated as a cement.

It is certainly a very definite principle, but the functions it may, or does perform in the growing plant we have yet to learn.

I may state that I have not found it with certainty away from the fibres, while it seems a constant associate of them in their natural, or, at least, in their green state.

XI.—RESEARCHES MADE IN THE LABORATORY FOR THE COMMISSIONERS.

Action of Fresh Water.

The nature of the matters extracted from different kinds of fibre by boiling water has been made the subject of further experiment, and especially for the purpose of ascertaining their behaviour with the different re-agents, suggested by Captain Hutton (*ante*, page 84) for the purpose of distinguishing the "cement." The fibres examined were—

1. Fibre extracted from the green leaf of the *Phormium*, variety *Manunu*, in the Laboratory, by simple scraping and washing in cold water, care being taken never to allow it to become dry, until all tissue and juice of the plant was removed.
2. Maori-dressed fibre, from the young leaf.
3. Maori-dressed fibre from the old leaf. Both these were from the fine variety known as *Rataroa*.
4. Machine-dressed fibre, prepared from the young leaf by Messrs. Logan & Sinclair.
5. *Sisal* hemp.
6. Manilla.

In each case, the samples before being experimented on were washed continuously, till they ceased to impart any extractive matter to cold water. In making the extract, the same conditions were preserved in every case, as the amount of water, temperature, and degree of concentration of the solution obtained.

The results obtained have been placed in the appended table.

1. The specific gravity of the solution indicates the proportional quantity of matter extracted from each fibre by boiling. This, it appears, is least in the *Phormium* fibre which had been prepared without ever being allowed to become dry, and greatest in machine-dressed fibre. The fibre dressed by the Natives, the *Sisal* hemp, and the Manilla, all yield the same proportion, and considerably more than the well-cleaned *Phormium* fibre. The amount of extractive matter contained in the fibre that is not easily soluble in cold water, but is so in hot water, has therefore an evident relation to the care with which the fibre has been cleaned. At the same time, in the case of sample No. 1, which is a perfectly white, or rather, colourless fibre, the process of boiling effected the same change of colour as was observed when filter paper was operated on; which tends to show that the fibre, or some portion of it, undergoes a change.

2. The character of the extractive matter obtained from these fibres appears to be in each case the same; the different behaviour with re-agents employed being only such as are due to the different strength of the solutions. We thus find when proper precautions are taken to secure a pure solution of the supposed cement, that it proves to have properties identical with the solution obtained from fibre in which the juices of the plant have been allowed to dry. Also, that the extractive matter is to some extent at least due to an actual change of the fibre itself, probably oxydation; and lastly, that the description of the reactions by which it has been proposed to distinguish this supposed cement as a definite element in the structure of the plant, is in some fundamental points incorrect.

Experiments were also made in another form to determine the effect on the fibre of the removal of the extractive matter. A given weight of fibre was dried at 212° Fah., and was found to loose 14·88 per cent. of its weight. A similar sample was first boiled for four hours in water and then dried, and was found to have then lost 16.66 per cent., or about 2 per cent. of dry extractive matter had been removed by the boiling.

The strength of the samples was then carefully ascertained to be as follows:—

1. Broken in ordinary state 85
2. Dried at 212° 75
3. Boiled and broken wet 80
4. Boiled and dried at 212° 71

Comparison of the Reactions of the Extracts of various Fibres.

Name of Specimen.	Specific Gravity of Extract	Colour of Extract.	Reactions with undermentioned Re-agents.				
			Basic acetate of Lead.	Acetate of Lead.	Nitrate of Mercury.	Chloride of Tin.	Degree of Coloration of Fibre.
1. Flax prepared in Laboratory	1000·6	Very pale yellow	Very slight precipitate	Slight precipitate	Moderate precipitate, not so heavy as 1. 2. 3. 4	Very slight precipitate	Very slight.
2. Flax, Maori dressed, 1st pair of leaves	1001·6	Pale brown	Moderate do.	Moderate do.	Heavy precipitate	Slight do.	Slight.
3. Flax, Maori dressed, 3rd pair of leaves	1001·7	Deep brown	do. do.	Heavy do.	do. do.	do. do.	Greater than 2
4. Flax, machine dressed, Logan & Sinclair, young leaf	1003·0	Brownish yellow	do. do.	Heavy do.	do. do.	do. do.	A little darkened.
5. Flax, machine dressed, Logan & Sinclair, old leaf	1002·7	Brown	do. do.	Heavy do.	do. do.	do. do.	Notably darkened
6. Sisal	1001·8	Pale yellow	do. do. less than 2. 3. 4. 5	Slight do.	do. do. but not so much as in 2. 3. 4. 5	Very slight do.	Slight.
7. Manilla	1001·5	Pale brown	Moderate precipitate	Moderate do.	Heavy precipitate	do. do.	Much darkened.

Action of Fresh and Salt Water on Rope.

In a former report, 12th August, 1870, the result was given of experiments with ropes made of Manilla and *Phormium* fibres, relative to the alteration in length and weight which they underwent during successive wettings and dryings.

1. It was found in every case that both fresh and salt water extracted a quantity of greenish black matter from the New Zealand rope, but that nothing was extracted from the Manilla.
2. The New Zealand is much harder and stiffer when wet than the Manilla, and looser in texture when dry.
3. The Manilla shows less difference in length when wet and dry than the New Zealand, especially after treatment with sea water.

The difference between the two kinds of rope is, however, on the whole very slight, as disclosed by these tests, and only tends to prove that the New Zealand fibre rope is more prone to absorb moisture and undergo other changes, indicating that the fibres of the plant still retain more of the properties of fresh vegetable tissue than in the case of the Manilla.

Size of Rope.	Normal Length.	Normal Weight when dry.	Length after 12 hours' soaking in fresh water.	Length after drying at 212° F.	Weight after drying.	Length after 12 hours in sea water.	Length after drying at 212° F.	Weight after drying.	Strain required to gain the normal length.
									lb.
2½	12	100·30	11·50	11·55	96·76	11·22	11·55	94·80	60
2½	12	106·65	11·37	11·50	98·0	10·8	11·1	100·52	122*
2¼	12	99·20	11·50	11·67	95·15	11·2	11·6	94·47	100
2	12	84·70	11·47	11·75	83·1	11·52	11·6	81·33	60
1½	12	56·80	11·39	11·55	55·95	11·2	11·6	53·75	50
1½	12	42·83	11·62	12·1	39·1	11·45	11·55	39·00	12*
1¼	12	45·25	11·52	11·67	44·5	11·3	11·7	42·50	40
1	12	33 96	11·44	11·56	32·9	11·58	11·8	32·83	45
1	12	23·55	11·55	12·2	21·55	11·2	11·45	21·83	20*
½	12	19·57	11·23	11·35	17·45	11·26	11·77	17·06	20
½	12	9·50	11·00	11·9	8·55	11·3	11·85	8·75	20*

* Manilla. The rest New Zealand flax.

Effect of Boiling Sea Water on the Fresh Leaf.

The effect of boiling the flax leaf in sea water was also made the subject of experiment, and it is found that when the leaf is first bruised and then immersed in boiling sea water for three hours, the fibres are set free, and a large quantity of extractive matter is removed without their strength being impaired. Fresh water in which flax is boiled becomes acid, but the sea water in these experiments remained neutral.

Effect of Sea Water on the Prepared Fibre.

In continuation of the foregoing experiments, and especially with the view of testing the nature of the matter which in machine dressed flax tends to bind the fibre into flexible woody bundles, the following experiments were made.

A small portion of the following fibres were thoroughly washed, cleaned, and finely divided, and then soaked in sea water for fourteen hours. The character of the extract was noted, and the change in the appearance and strength of the fibre when dried was also ascertained.

Samples of the same fibres were also boiled for two hours in sea water, and the same observations made.

1. Fibre extracted from the green leaf in the Laboratory, and thoroughly washed free from all extractive matter. This fibre was nearly pure white, and though it divided freely into its ultimate fibres, still possessed a degree of strength (93) in excess of ordinary samples. This fibre, having a mere trace of extractive matter, was unaltered in appearance after treatment with cold and hot sea water, and its strength was also unimpaired.
2. Fibre prepared by the Natives, soft, lustrous, and freely divided. This sample differed from the former in having been allowed to dry after the removal from the leaf before the extractive matters had been washed out. It coloured both hot and cold sea water pale brown, and was itself slightly changed in colour, whilst its strength was reduced 20 per cent.
3. Machine-dressed. This was a sample that had been steeped after passing through the stripper, and was clear, bright, and of a good colour. It was affected to the same degree by both the hot and cold sea water, but not so much as the Maori-dressed sample, and its strength was only reduced 10 per cent.
4. Manilla. This fibre imparted a pale brown colour to the cold sea water, and a dark brown to the hot; its strength being unaffected.
5. *Sisal* hemp gave the same results as Manilla.

These experiments prove that the action of sea water on all these fibres is in proportion to the amount of extractive matter which they contain, and that it has no specific action on the pure fibre.

ACTION OF ALKALIES ON THE FIBRE.

Portions of different kinds of *Phormium* fibre, and also of Manilla hemp, were submitted to the action of a strong solution of caustic potash, and kept at the boiling point for four hours.

The result was in every case the same, as has been described by Captain Hutton, the fibre being reduced to a soft pulp, like the "half stuff" of paper manufacturers, in which the ultimate fibres are perfectly non-coherent so long as the mass remains wet, but when dried possessing a considerable amount of tenacity. This is rendered very obvious by the behaviour of an untwisted thread of the fibre thus prepared, which will bear a strain of several pounds when dry, but immediately on touching any portion of it with a drop of water, will not bear as many grains.

This experiment was varied in several ways, care being taken to remove the last trace of the alkali from the fibre by treatment with dilute acid and subsequent washing, which had the effect of making the fibre extremely soft, silky, and white, but without in the least depriving it of the above singular property. Alcohol, ether, oil, and other non-hydrating fluids were substituted for the water, but were found not to reduce the cohesion of the ultimate fibres. When examined under the microscope in the dry state the prepared fibre is found to consist of shrivelled and collapsed ultimate fibres, twisted and matted together; but, on the addition of water, they are easily observed to become distended and separated from one another, acquiring, at the same time, a well-defined smooth outline. The form of the ultimate fibre itself is not much affected, nor does it appear to be in any degree weakened by the action of the potash, as broken cells are rarely seen, even when the dry fibre is parted with some violence; while in the wet state, the ultimate fibres can be separated for examination with great facility.

The action ef the alkali, therefore, appears to be that of altering, and probably thinning the cell wall, so as to render it capable of absorbing water with rapidity. The fact that the *Phormium* fibre can be reduced by a single process to the "half-stuff" of the paper-maker, but having the very unusual property of being composed of complete fibre cells, having an equal length of about half-an-inch, and at the same time possessing a pure colour and glossy lustre, may perhaps lead to the introduction of a totally new class of manufactures, by which a material will be obtained with even greater facility than ordinary paper of fine quality, and at the same time possessing an even texture, cohesive strength, and "body."

After the proper form is given to the fibre, by taking advantage of its gelatinous condition when wet, there would be no difficulty in drying it in contact with such a material as would prevent the fibres again absorbing water.

ACTION OF ACIDS.

When a mineral acid was substituted for the alkaline solutions, in experiments similar to the preceding, the fibre exhibited a totally different result, becoming feeble, harsh, and under the microscope showing that the fibre cells were weakened, as, whether broken wet or dry, the ultimate fibres themselves invariably snapped across and presented broken ends. The effect of the application of chlorine, as in the ordinary bleaching process, was the same as that of the acids, but to a less degree.

XII.—FURTHER REPORTS FROM HOME AGENTS.

Received, 10th September, 1871.—Continued from page 21.

(No. 170).—Mr. MORRISON to CHAIRMAN.—26th July, 1871.

I have the honor to acknowledge receipt of your letter No. 91, of 11th May last, enclosing bills of lading for one bale flax, and one flax stripping machine, per "Queen Bee," from Auckland.

In reply, I beg to inform you that the "Queen Bee" has arrived, and arrangements are being made for landing the flax and the machine, and for having the latter suitably located for the inspection of manufacturers and others interested in the *Phormium tenax*.

(No. 171).—Mr. MORRISON to CHAIRMAN.—27th July, 1871.

In continuation of my letter, No. 236, of the 29th ulto., I do myself the honor to transmit herewith copies of further letters received from Mr. C. Thorne relative to his experiments in manufacturing cloth from the fibre of the New Zealand flax. The samples alluded to in his letters are forwarded per sample post by this mail.

Mr. C. THORNE to Mr. MORRISON.

DEAR SIR,— British Hotel, Dundee, 11th July, 1871.

About three weeks since, I gave you a sample of New Zealand flax which I had prepared. I am now happy to inform you that the fibre was much liked by a spinner here, to whom I was introduced, and I have at last succeeded, through his kindness, in getting the fibre made into a yarn. The tow has also been manufactured. At first some difficulty was experienced in getting the flax machinery to work the fibre, but as the spinner took interest in it personally, he watched the causes of failure, and has overcome them; he is now sure New Zealand flax, if equally as well-dressed as mine, would become very useful to the spinners here, both for use by itself and for mixing; but, to make sure of this, he is making further experiments for me. I have been promised a piece of cloth made from the yarn in its "green state" (that is to say, as it came direct from the spinning frame) to-morrow, and if I get it in time, I will forward you a small piece; it will necessarily be very coarse, but when the yarn has been further dressed, the fabric will be finer. I have been here over a fortnight, and although

much wanted in London, I think it well *not* to leave until my experiments have been carried through, lest any failure should occur through the want of that contiuual "urging forward," which I find so necessary to get experiments fully carried out. The value set upon my fibre is £56 per ton; and on the tow from it, £28 to £30. This is said to be its lowest value, and if brought into regular consumption, higher prices may be looked for.

On my return to London I will give you further information, but thought you would like this in time for the mail. I shall not be able to write you to-morrow, as I have to go out to Arbroath to see my friend the spinner. In the meantime,

I remain,

J. Morrison, Esq.,
New Zealand Government Agency,
Adelaide Place, E.C.

Yours faithfully,
(Signed) C. THORNE,
of 16 Mark Lane, E.C.

Mr. C. THORNE to Mr. MORRISON,

MY DEAR SIR,— British Hotel, Dundee, 12th July, 1870.

Agreeably to my promise of yesterday, I now enclose you a small piece of canvas, made entirely from the tow of New Zealand flax; it is very rough, having been made from yarn taken direct from the loom, without any finishing or dressing of any kind. I am told my other specimens will be of a different, and much better character; but this is considered good for a *first* experiment—it is the "thin end of the wedge."

J. Morrison, Esq.,
New Zealand Government Agency,
Adelaide Place, E.C.

Yours faithfully (in haste),
(Signed) C. THORNE,
of 16 Mark Lane, E.C.

Mr. C. THORNE to Mr. MORRISON,

16 Mark Lane, London, E.C.,
25th July, 1871.

DEAR SIR,—

Begging reference to my letter to you of the 11th inst., and the enclosure of cloth on the 12th inst., I now have the pleasure of handing you a further sample of cloth, better dressed than the piece sent you on the 12th. I have in my possession yarns of various sorts, prepared for me whilst in Dundee. I have left some behind me to undergo the process of a "full bleach;" when this is completed, I expect to receive a very superior cloth to that now sent to you; it will be as well for you to forward all these samples, so as to show the progress made. My spinning and weaving friends tell me they have nearly overcome the difficulties they first experienced in working my fibre, which formed part of a parcel, of which I handed you a dressed sample on the 7th June last. In reply to the Commissioners' questions, in their letter of 15th May, the cost of dressing one ton of *actual fibre*, and delivering it free on board* averages £20 per ton for small parcels, but on a large scale, this would be reduced to £16 or £17 per ton. I pay Messrs. Frost Brothers £12 per ton for making fibre into rope.

John Morrison, Esq.,
New Zealand Government Agency,
Adelaide Place, E.C.

Yours faithfully,
(Signed) C. THORNE.

XIII.—SUPPLEMENT TO CATALOGUE.

ARTICLES made by SIMONS & MALCOLM, Richmond, Nelson, and exhibited by COMMISSIONERS.

1. 4-4 Matting, fine. Price, 2s. 6d. per yard
2. 4-4 Tarred matting, stout. Price, 2s. 6d. per yard
3. Rough reins. Price, 2s.
4. Web-headed halter. Price, 1s. 10d.
5. Rope of various sizes. Price, 56s. per cwt.
6. Sinnet mat. Price, 4s.
7. do. do. Price, 5s.
8. Coloured mat. Price, 5s. 3d.
9. do. do. Price, 6s. 6d.
10. Plain mat, Price, 5s. 9d.
11. Ball of stout twine. Price, 9d.
12. Ball of fine twine. Price, 6d.

ARTICLES made by W. COOK & Co., Nelson, and exhibited by COMMISSIONERS.

13. Hearthrug, dyed. Price, 30s.
14. Fancy mat. Price, 15s.
15. Fancy yarn mat. Price, 8s.
16. Do. do. Price, 6s. 6d.
17. Combination mat—cocoanut fibre and flax. Price, 7s.
18. do. do. Price, 5s. 6d.

* This is in the Colony.

19. Mat made of cocoanut fibre, with flax back. Price, 6s. 6d.
20. do. do. Price, 5s.
21. Plain mat. Price, 4s.
22. Matting. Price, 2s. 9d. per yard, made any size, from 12in. to 4ft. 6in.

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23. Twine. Price, 1s. 6d. per lb. Manufactured and exhibited by E. Moyle, Taranaki.
24. Mat of grass and flax. Made and exhibited by T. Bevan, jun., of Otaki.
25. Reid & Walker, Hokianga, machine-dressed.
26. Graham & Cook, Rangitikei. Hanks from bale of best quality. Swamp flax, not suited for age or length, withered leaves rejected. Wilson's machine used, wet-scutched, bleached on grass for 21 days, and dry-scutched; 7 tons of green flax to one of dressed.
27. Natives, Hokianga. Scraped with a shell.
28. Na Ihaia Porutu, Hutt. *Atiraukawa, Huhiroa, Rataroa, Oue, Atewheke, Ngutunui, Tarariki, Raumoa.*

Samples exhibited by C. R. E. Saunders, per Messrs. W. & G. Turnbull & Co. Prepared by a chemical process.

29. 1st quality. Cost of manufacture, £23 10s.
30. 2nd do. do. £20 10s.
31. 3rd do. do. £18 10s.
32. Cabbage tree fibre. do. £25.
33. A grass fibre.
34. Tow from the different samples.

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35. Sample of rope made from inferior quality of Stonyer's flax. Used for hoisting sacks in the tackle in the mill for over four months; shows no signs of breaking. Exhibited by Major J. A. Gray, Kaiapoi.
36. Sample of rope made of inferior quality of Stonyer's flax. Used in Californian pump for 13 weeks and 4 days before it gave way. Exhibited by Major Gray, Kaiapoi.
37. Rough canvas, made of tow from *Phormium* fibre. Prepared by Mr. C. Thorne's process.
38. Canvas rolled, made of tow from *Phormium* fibre. Prepared by Mr. C. Thorne's process.

XIV.—STATISTICAL TABLES.

Table A.

SHOWING the NUMBER of BALES of FLAX and TOW brought to Public Sale in London, from 23rd April, 1870, to 4th May, 1871; showing the Classification adopted by the English Brokers, and the Quantity and Approximate Value of each class.

——	1ST QUALITY. Good to superior.	2ND QUALITY. Fairly Cleaned.	3RD QUALITY. Fully three-quarters dressed.	4TH QUALITY. Half to three-quarters dressed.	5TH QUALITY. Common to rough, half-dressed.	Total No. of Bales.	Sea Damaged.	Tow.	——
From 23rd April, 1870, to 20th May, 1870...	198	189	310	287	66	1,050	...	...	
„ 20th May, „ „ 17th June, „ ...	836	870	462	732	59	2,959	...	80	Total imports in bales into England, from May 17, 1870, to May 4, 1871 26,008
„ 17th June, „ „ 15th July, „ ...	36	619	400	999	430	2,484	...	252	
„ 15th July „ „ 12th Aug. „ ...	817	905	607	1,039	688	4,056	16	39	
„ 12th Aug. „ „ 9th Sept. „ ...	477	745	1,125	863	131	3,341	12	28	
„ 9th Sept. „ „ 20th Oct. „ ...	348	1,227	1,462	1,258	1,144	5,439	44	53	
„ 20th Oct. „ „ 22nd Nov. „ ...	1,031	1,070	2,390	655	493	5,639	...	401 & 9 tons.	On hand at commencement of above period ... 10,000
„ 22nd Nov. „ „ 22nd Dec. „ ...	539	623	247	275	156	1,840	...	23	
„ 22nd Dec. „ „ 24th Jan., 1871...	302	236	410	56	67	1,071	...	207	
„ 24th Jan., 1871, „ 21st Feb., „ ...	37	504	955	251	543	2,290	...	34	
„ 21st Feb., „ „ 16th March, „ ...	704	1,796	353	257	493	3,603	...	198	Total No. of bales 36,008
„ 16th March, „ „ 13th April, „ ...	147	97	96	173	157	670	7	18	
„ 13th April, „ „ 4th May, „ ...	314	368	670	175	39	1,566	8	69	
Total No. of Bales	5,786	9,249	9,487	7,020	4,466	36,008	87	1,546	
Per centage of total Bales	16·1	25·7	26·3	19·5	12·4	...	·0024	...	
„ „ in April and May, 1870 ...	18·8	18·0	29·5	27·3	6·3	...	...	...	
„ „ „ „ 1871 ...	20·0	23·5	42·9	11·1	2·5	...	...	...	
Variation of price during the period ...	£28 to £36 15s.	£23 to £30 10s.	£18 to £26	£14 to £22 10s.	£11 to £18 5s.	...	...	...	
Approximate average price	£32 10s.	£26 15s.	£22	£18 5s.	£14 10s.	£23 8s.	...	...	
Total value (reckoning 6 bales to 1 ton) ...	£31,341	£42,235	£34,785	£21,352	£10,793	£140,506	...	...	

The above Table has been compiled from Messrs. M'Landress, Hepburn, and Co.'s "New Zealand Flax Circulars," which are prepared in London and sent out by every mail.

Much of the flax that appears in this Schedule would have been placed in higher classes, and fetched many more pounds per ton, had a little extra trouble been taken in dressing it. For instance, some that was put down as "fairly cleaned," fetched only £22 5s., owing to its "greenish colour," and "having some red ends."

In the Circular of the 12th August, 1870, the English brokers remark:—"It is very important that attention be paid to colour; buyers look particularly to this, and will pay from £3 to £5 per ton more for even parcels of pale colour, than for flax as well dressed, but dark or green."

"Mixed in colour," "harsh," "wiry," "poor colour," "green and brown in colour, "red ends," "croppy," "coarse," "rough," "much straw," "red colour," and "heeled," are all terms of depreciation used in the market reports. The term "*croppy*" is applied when a portion of the skin is left on the fibre.

The three great requisites seem to be softness, fair cleaning, and good and even colour.

Table B.

SHOWING the VARIATIONS in PRICES of PHORMIUM FIBRE during 1870–71.

Report issued on	25th March, 1870.	20th May, 1870.	17th June, 1870.	15th July, 1870.	12th August, 1870.	9th September, 1870.	20th October, 1870.	22nd November, 1870.
I. Common to rough half-dressed	...	£12 5s. to £16	£15 to £17	£12 10s. to £16	£12 to £14	£11 to £13 10s.	£12 5s. to £15	£13 to £14 10s.
II. Half to three-quarters dressed	£19 5s.	£20 to £21 10s.	£18 to £21	£18 to £22 10s.	£15 to £17	£14 to £17 5s.	£16 to	£16 to £18 10s.
III. Fully three-quarters dressed...	...	£24 to £26	£22 to £24	£23	£23	£18 to £22 5s.	£22	£19 10s. to £23
IV. Fairly cleaned	...	£27 to £29 10s.	£25 to £28	to	£24 to	£23 to £26	£24 to £26	£25 to £28 15s.
V. Good to superior	£30 15s. to £37 5s.	£32.	£29 to £30 10s.	£31	£31	£31 5s. to £31 10s.	£28 to £31 10s.	£30 to £35

Table B.—*continued.*

Report issued on	22nd December, 1870.	24th January, 1871.	21st February, 1871.	16th March, 1871.	13th April, 1871.	4th May, 1871.	8th June, 1871.	20th July, 1871.
I. Common to rough half-dressed	£14 to £15 10s.	£16 to £18 5s.	£14 to £16 10s.	£14 to £16	£13 to £15	£14 to £15	...	...
II. Half to three-quarters dressed	£18 to £20 10s.	...	£17 15s.	£16 10s. to £18 5s.	£16 to £19 10s.	£16 to £18 5s.	£15 to £20	£15 to £20
III. Fully three-quarters dressed...	£22 to	£22 5s. to	£19 15s. to £22 10s.	£19 5s. to £23 10s.	£22	£21 to £24	£21 to £25	£21 to £25
IV. Fairly cleaned	£28 10s.	£30 10s.	£23 to £24 5s.	£23 15s. to £28 5s.	...	£24 15s. to £27 5s.	£26 to £30	£26 to £30
V. Good to superior	£30 to £36 10s.	£31 5s. to £36 15s.	...	£34	£29 to £34	£29 to £33	£32 to £34	£32 to £34

Table C.

SHOWING QUANTITY and VALUE of ROPING and other HEMPS, JUTE, &c., IMPORTED into ENGLAND during the Years 1868, 1869, and 1870, compiled chiefly from the "Trade and Navigation Account" presented to the Imperial Parliament in February, 1871.

—	Total Quantity imported.			Value (Total).			Average value per Ton.		
	1868.	1869.	1870.	1868.	1869.	1870.	1868.	1869.	1870.
	Tons.	Tons.	Tons.	£	£	£	£ s.	£ s.	£ s.
Roping Hemp	52,810	52,788	55,442	2,080,611	1,940,275	2,063,377	37 0	36 15	37 4
Jute and vegetable substances of the nature of hemp*	110,253	124,803	120,177	1,949,864	2,181,717	2,356,990	17 3	17 9	19 10
Manilla hemp ... ... (included in first line)	8,756	4,632	6,467	415,116	245,348	354,589	47 8	52 19	54 16
Per centage of roping hemp ...	16·2	8·7	11·6	...	...	...	...	...	...
New Zealand	...	...	4,033	...	...	95,372	...	...	23·8
Per centage of roping hemp ...	...	...	7·3	...	...	...	...	...	...

*Jute is produced in India at about £5 per ton.

Table D,

SHOWING QUANTITY and VALUE of ROPING and other HEMP, CORDAGE, and JUTE, &c., IMPORTED into the UNITED STATES during the Year ending 30th June, 1867.

—	Quantity.	Value.	Average Price per Ton.
	Tons.	£	£ s. d.
Roping hemps	19,853	601,766	30 16 0
Manufactured cordage	864	40,686	43 12 0
Total	20,717	642,454	31 0 0
Manilla hemp } included	15,273	445,847	29 3 0
do. cordage } in above	119	5,395	45 7 0
Total	15,392	451,242	...
Per centage of Manilla hemp, and cordage	73·7	...	...
Jute, gunny cloth, &c.	31,992	538,499	16 16 0

Table E.

Showing the VALUE of FLAX EXPORTED from NEW ZEALAND up to the end of the Year 1864, and the QUANTITY and VALUE for each subsequent year to 31st December, 1870, taken from the COLONIAL STATISTICS.

Year.	Quantity.		Estimated Value.	
	Tons cwt.	Estimated No. of Bales.	Per Ton.	Total.
			£ s. d.	£
1865	2 14	15	27 10 0	75
1866	11 3	67	89 0 0	996
1867	126 15	760	33 5 0	4,256
1868	534 0	3,204	15 5 0	8,137
1869	2,027 0	12,162	22 6 0	45,245
1870	5,470 0	32,820	24 2 0	132,578
	8,171 13	49,028	...	191,287
Exported prior to 1865	...	...	...	17,909
Total value	...	...	...	209,196

Table F.

EXTRACT from the CENSUS RETURNS showing NUMBER of FLAX MILLS, &c., in New Zealand during 1870.

—	No. of Mills	No. of Machines used and Power employed.	Amount of Horse-power.	Hands employed.		Quantity in Tons manufactured in 1870.
				Male.	Female.	
Auckland	54	94—23 steam, 71 water	489	463	29	1,138
Napier	2	5—steam	17	39	2	43
Taranaki	4	11—water	48	63	...	42
Wellington	14	38	108	177	11	508
Marlborough	4	21—8 steam, 13 water and steam	62	127	...	324
Nelson	2	3—2 steam, 1 water ...	13	14	...	18
Canterbury	24	50—9 steam, 15 water ...	237	414	...	1,531
Otago	40	66—26 steam, 38 water, 2 horse	294	305	18	581
Southland	17	34—7 steam, 10 water	182	104	2	272½
Totals	161	342	1,450	1,706	62	4,457½

Table G.

RESULT of EXPERIMENTS made to ascertain the relative DURABILITY and WEAR of NEW ZEALAND and MANILLA ROPE.—Wellington, March and April, 1871.

	Description of Rope.	Circumference.				Length.					Weight.				No. of days run.	No. of feet run, at 4,575 per hour.	No. of miles run.	Durability, per cent.
		Before Experiment.	After Experiment.	Loss, per cent.	Loss at chafe opposite splice, per cent.	Before Experiment.	Maximum Stretch.	Per centage of Stretch.	Maximum Shrink.	Per centage of Shrink.	Before Experiment.	After Experiment.	Loss or gain.	Per centage of loss or gain.				
		inches.	inches.			ft. in.	ft. in.		ft. in.		oz. drs.	oz. drs.	oz. drs.					
Dry	Manilla	1·43	1·25	13	22	17 8	0 5·5	2·6	0 1	·47	Not accurately noted.				20	915,000	173·3	100
Dry	New Zealand (white) ...	1·56	1·25	20	28	18 3	0 7·75	3·5	0 3·25	1·5	13 10·8	10 14·2	-2 12·6	-20·3	28	1,281,000	242.6	134
Dry	„ (tarred) ...	1·56	1·34	14	22	18 4	1 4·75	7·6	0 0·75	·34	16 2·4	15 8 9	-0 9·5	- ·3	15	686,250	129·9	74
Wet	Manilla	1·43	1·12	22	22	18 2	0 4	1·9	1 11	11·0	Not accurately noted.				22	1,006,500	190·6	110
Wet	New Zealand (white)	1·56	1·18	24	28	18 2	1 0·75	6·1	1 0·5	6·0	13 9·9	12 3·8	-1 6·1	-10	20	915,000	173·3	100
Wet	„ (tarred) ...	1·56	1·34	14	22	18 1	1 4·5	7·9	0 8	3·8	16 14·8	17 0.4	+0 1·6	+ 0·6	19	869,250	164·6	95

The ropes were run over pulleys fixed on a horizontal shaft at Messrs. Kebbell's mill, and through a block below, to which a 56lb. weight was attached. Circumference of pulleys, 15¼ inches; grooved out to a diametre of 2½ inches.

The ropes were wetted with salt water poured on them till they would absorb no more, and the wetting was repeated every fourth day, after the ropes had apparently dried.

The New Zealand ropes were machine made, from Lloyd's Steam Rope Works, near Auckland, and are valued at £45 per ton. The Manilla was purchased in Wellington, and was the best of the size that could be procured. The results show that the New Zealand white rope, when kept dry will last 60 per cent. longer than tarred rope of the same make, and 34 per cent. longer than the Manilla, but chafes more by 10 per cent, and is more susceptible to change of weather. When wetted with salt water the Manilla lasted better than New Zealand by 10 per cent., but had 5 per cent. excess of shrinkage.

THE following information has been received since the printing of that part of the Report in which it should appear.

30th September, 1871. J. HECTOR.

HON. COMMISSIONER OF CUSTOMS.

The reports that were brought a few months ago by almost every mail of the large quantities of New Zealand flax that were landed in England in a damaged condition, and the heavy loss sustained by the Colony from this cause, led me to think that it would be very desirable if this matter could be looked into by some trustworthy person on the spot.

As Mr Chilman, the Collector of Customs at New Plymouth, about the time I refer to was on the point of leaving for England, on leave of absence, I wrote to him and asked him to endeavour to be present when any of the New Zealand laden vessels might be discharged in London, and afterwards, if possible, to trace the flax through the various warehouses and brokers' hands until it reached the manufacturer. Mr. Chilman readily assented to my request. By the last mail I received a letter from him, of which a copy is annexed, containing some interesting and valuable information on this subject, which I suggest should be communicated to the Flax Commissioners, with a view to being made public in such manner as they may consider best.

30th September, 1871. W. SEED.

RICHARD CHILMAN, Esq., to W. SEED, Esq., Secretary of Customs.—London, 27th July, 1871.

I have investigated the question of sea-damaged flax, and had a good opportunity of doing so, inasmuch as some shipped in the "Melita" by the Company I am interested in, was classed as sea damaged. I went to the warehouse and saw the wharfinger to whom it appears the classification rests, and he pointed out to me the bales so classed. It appears that if a bale were discoloured, say a foot square, or even less, it is put down as sea damaged. I had a bale opened, and drew the wharfinger's attention to the fact that even in the slight portion that was stained the strength of the fibre was not injured. He admitted this, but said that change of colour was a proof of damage more or less; so that if a single hank is discoloured, or even a few strands in a single hank, as I pointed out in one instance, a bale of 3 cwt. is to be branded. The wharfinger said that if the damage was only slight, the purchaser would take this into account; but I am satisfied this is not so, at all events I shall attend the public sale on Wednesday next, and shall then be better able to judge; but I am afraid it is a case of giving a dog a bad name, and that the produce suffers by this arbitrary action. There is no doubt that the damage, more or less, occurs on board the ship from sea water.

Another most important point in packing the bales of an uniform size, and the wharfinger recommends the following dimensions—that of an ordinary bale of jute, 3.2 x 2.2 x 1.6; this package should weigh from 300 to 350 lbs. One difficulty that might occur was pointed out to me. The supply of jute in London just now is very limited, but if there were large arrivals of jute and of flax, the flax would be rejected; because from being so loosely packed, and the bales of different sizes, it would be more profitable for the warehouseman to take in the jute. This question of packing so materially affects the cost of freight that mill owners cannot be too particular about it. Another point is that the flax should be done up into hanks—we have packed some full length, but it is a mistake. The twist in the hank in no way injures the fibre. The largest rope-maker in Liverpool called his working foreman into his office when I was there and asked him about it. Covering with Hessian, as we have done, is also an useless expense; it does not prevent the sea water from getting to the flax, and from its being so open I am not sure but what it spreads the stain over a larger surface. I hope this information may be of service. I shall see any parties in London interested in flax, and get them to co-operate with me in a strong representation to the brokers respecting the sea damaged flax, as there is no doubt that it would be better to take out all hanks that are discoloured, than to let this bugbear affect the price of the whole bale.

* * * * * *

Extract from Messrs. M'LANDESSS, HEPBURN, and Co.'s monthly Flax Circular, dated London, July 27th, 1871.

We have had a quiet but very firm market for New Zealand flax during the past month, and prices, particularly of the better qualities, have ruled in favor of sellers. The import since the 29th ult. has been 1,200 bales, but the "Queen Bee," bringing over 700 bales, which are said to consist of superior quality, has not yet discharged; consequently the supplies on the market have only been moderate. The transactions reported by private contract total up about 1,300 bales, and 1,253 bales have been offered at auction, of which 670 bales found buyers, the following prices being those obtained at the most recent sales, viz.:—For barely three-fourths cleaned, £17 10s; for three-fourths cleaned, of inferior to good quality, £18 to £25 10s; fairly dressed of middling to good color and quality, £24 to £20 5s; and well-dressed flax £30 10s to £34 5s per ton. Of 86 bales tow, only 25 bales of coarse common quality sold at £11 per ton. There is no doubt that this fibre is now looked upon with greater favour by rope makers, and so long as a wide margin exists between its value and that of Manilla hemp, its consumption will steadily increase; the latter fibre has been in improved demand this month, and prices have advanced £1 per ton, £46 to £46 10s being the present value of fair roping. Some improved specimens of New Zealand flax have recently come to hand, and we trust that the exertions being made in the colony to discover a method of preparing the fibre before shipment that will soften and divide it sufficiently fine to make it suitable for the manufacture of textile fabrics, will ultimately be crowned with complete success.