

FURTHER PAPERS

RELATIVE TO THE

PREPARATION

OF THE

P H O R M I U M F I B R E

*(In continuation of Papers presented in October, 1871.)*

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

---

WELLINGTON.

—  
1872.

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## GENERAL REPORT ON THE FLAX INDUSTRY, BY DR. HECTOR.

SIR,—

Colonial Museum, Wellington, N. Z.,  
16th July, 1872.

I have the honor to inform you, in continuation of the Report of the Flax Commissioners for 1870–1, of the action that has been taken during the past year for encouraging the development of the industry.

### *Distribution of Samples, etc., from the Exhibition of 1871.*

On the closing of the Exhibition, which was held in the Colonial Museum, after the articles which were lent by the various European and Native exhibitors had been returned, the remainder of the collection was distributed in the following manner.

Samples of the different kinds of machine and hand-dressed *Phormium* and the competing fibres were sent to the Museums at Auckland, Wellington, Christchurch, Dunedin, Nelson, Napier, and Taranaki.

Careful selections of the different varieties of the prepared fibre, together with rope, cordage, mats, and other articles manufactured from it, were also sent to the Agent-General, and to the Public Museums at Melbourne, San Francisco, and New York.

In accordance with a resolution of the House of Representatives, standard samples showing the various classes into which the fibre is divided by the brokers in London have been placed in charge of the Custom House officers at the following ports :—Wellington, Auckland, Christchurch, Dunedin, Nelson, and Invercargill.

Packets containing samples of the foreign fibres which compete with *Phormium* have been distributed among the manufacturers in the different provinces.

Live specimens of seventeen different varieties of the *Phormium* plant were transmitted to the Royal Gardens at Kew, and with a few exceptions reached there in good order.

The distribution of the foregoing collections of *Phormium*, which were in each case accompanied by full particulars respecting their production, value, and other matters of practical interest, will, it is hoped, tend greatly to attract attention to the merits of this fibre in markets where it is only known by name ; while the distribution of the foreign fibres throughout New Zealand will enable the producers to make themselves practically acquainted with the nature of those fibres with which they have to compete.

With reference to the standard samples issued to the Custom House officers, it may be stated that from specimens recently received from London of the fibre now in the market, the same qualities which these standards represent still maintain their relative value, and they may be safely taken as a guide in classifying exports.

### *Condition of the Industry.*

During the past year the demand for *Phormium* has steadily increased, but, owing to various circumstances a large number of mill-owners have unfortunately been compelled to suspend operations. One of the chief of these causes is the falling off in the supply of raw material within easy reach of the mills, owing to the destruction of the plants by the injudicious method of cutting the leaves, which was adopted before attention was sufficiently directed to this important subject. It is, however, established that five, six, or seven leaves will grow from each fan in the year, and that they reach maturity in from fourteen to fifteen months, so that if only mature leaves are cut, and the centre leaves are allowed to remain, an undiminished supply may be maintained for years ; and it is therefore hoped that the present dearth of raw material may be only temporary. It is very desirable, however, that the alleged deficiency should not depend on mere rumour, but that an official estimate should be obtained of the extent of flax land in the Colony, as erroneous statements on this point might create an unfounded distrust of the permanence of the industry.

The high rates of freight, and incidental and shipping expenses, amounting on large shipments to 29 per cent on the highest prices realised for the fibre in the London market, as shown by account sales received by last mail, have also seriously retarded the production of fibre, so that at the present time the quantity exported is considerably less than might be profitably disposed of. From the market reports, an abstract of which is given in Appendix IV., it appears that 52,727 bales of fibre, representing 8,788 tons, have been sold in London at public sales since 23rd April, 1870, up to 4th April, 1872, giving a monthly average of 366 tons for that period ; but that during the last three months the average has only been 154 tons. The price of the best qualities during the above period has shown a rise from £30 to £40, while 80 per cent is of first and second class quality during the first quarter of the present year, instead of only 36 per cent., as was the case in 1870 ; and the opinions expressed by the brokers leave no doubt that the fibre is getting into more general use, and that it has now a permanent hold on the market.

From the latest advices it appears that a supply of 300 to 400 tons a month can be readily disposed of, and that if still greater efforts be made to insure the careful cleaning, classing, and packing of the

fibre, there is no doubt of a continuance of a steady trade at prices that will prove remunerative. As long as it is applied to the manufacture of white rope, the price of *Phormium* may be expected to fluctuate with that of Manilla, the best samples averaging about £10 below the price of the latter article.

No improvement appears to have taken place in the quality of the best samples of fibre produced, and the recommendations as to the mode of packing the bales which were made last year, and have since been approved of by the brokers, are only adopted to a very limited extent.

The same brands still continue to command the highest prices in the home market, on account of approaching most nearly to Manilla in external appearance; but it is stated that the practice of mixing *Phormium* fibre with Manilla and other fibres by English rope manufacturers has been abandoned, and the fibre stands on its own merits.

#### *Manufactures.*

*Phormium* fibre is still used chiefly for the manufacture of white rope, of which a large quantity is now produced in the Colony, particularly at Auckland, where Messrs. Lloyd's mill, notwithstanding the introduction of improved machinery, with difficulty supplies the demands which there is for the Californian market.

The establishment of rope-walks, and the manufacture of the raw material in the Colony into a form in which it will better bear the high charges for export is one of the most desirable steps that can be taken towards establishing the industry. Mention was made in the last Report of the Commissioners of the superiority of *Phormium* rope made from fibre dressed with oil in resisting the action of water, and the result of renewed experiments undertaken by Mr. Kebbrell in order to test the relative durability of rope thus prepared, fully confirms the importance of this application, as it appears to increase the lasting power of the rope to a degree that is hardly credible, being equal to four times that of the best Manilla rope.

It will be seen from the report of the Home Agent, Mr. Buller (Appendix, p. 2), that experiments are now being conducted in England with a view of ascertaining the kind of oil that best acts as a preservative of the fibre, under the direction of Professor Church, who last year reported upon the chemical properties of the plant, and who is still employed pursuing his inquiries. If it can be established, which is not unlikely to be the case, that there is a peculiarity in the nature of *Phormium* fibre not shared by Manilla, which enables it to acquire a high degree of durability by so simple a process, there can be no doubt that New Zealand rope will before long rank as superior to all others in the market.

The sample bales of both Native and machine-dressed that were sent home to the Agent-General have been distributed to manufacturers for the purpose of being made into various articles for the International Exhibition now being held in London, and samples of the same articles may be expected shortly to reach the Colony.

The attempt to convert *Phormium* fibre into textile material is still engaging the attention of many gentlemen at home, and especially Mr. Thorne, who is extremely sanguine as to the results, and full reports which have been made on this subject will be found in Appendix II. Samples of yarns and cloth, made both from the pure fibre and from the fibre mixed with European flax, have been sent out to the Colony, the fibre in both cases having been prepared by Mr. Thorne's patent. These show that the manufacture of the coarser kinds of cloth is at least practicable, but whether profitable is not yet determined. On testing the fibre of the pure *Phormium* yarn it is found to have the defect which, as was pointed out in the previous Report, invariably attaches to the fibre when thoroughly cleaned with alkaline solutions—having considerable strength as long as it is kept dry, but on absorbing water, which it does with facility, it has no cohesive strength whatever, resembling, in this respect, bibulous paper.

The yarns and woven fabrics which have been forwarded conclusively prove, however, that the shortness of the ultimate fibres does not prevent the operation of spinning the thoroughly cleaned *Phormium* into fine yarns. Some of the mixed fabrics, such as strong canvas, in which only 25 per cent. of the *Phormium* has been used, have great strength and firmness of texture, and it is the opinion of practical manufacturers that when the fibre is thoroughly "cottonised" it can be successfully employed for manufactures of this class, and would be worth £80 to £90 per ton.

#### *Paper Making.*

The remarkable plasticity of thoroughly cleaned *Phormium*, after boiling with alkaline solutions, renders it well fitted for the manufacture of paper of a superior description; and the circumstance previously pointed out (Report 1871, p. 96) that its peculiar qualities in this respect might, perhaps, in skilful hands, lead to the introduction of a new kind of fabric, has attracted the attention of one manufacturing firm (Appendix, p. 2). If the waste fibre from the scraping mills and wet scutchers could be thoroughly treated with alkaline solutions at first, without ever being permitted to dry, a very small per centage of the solution would suffice to reduce it to the "half stuff" of the paper manufacturer.

#### *Cultivation.*

The reports on this subject confirm the correctness of the conclusions previously arrived at with respect to the growth, being at first very slow, both from seed and transplanted fans, and that not until at least two years have elapsed can any return be expected in either case, as the leaves on the plants have not until then sufficient length of blade nor quantity of valuable fibre to be useful. This is a question quite apart from the age of the individual leaves, which, for roping, are in best condition when fifteen months old, and for finer fibre when they are somewhat younger. For neither purpose, however, should the leaves be taken from plants that have not acquired a sufficient root mass for their nourishment, and this root mass takes several years to grow. The observations still require to be continued on the same plants, in order to ascertain this accurately, and also to find out the effect on the plant of permitting it to throw up a flower stalk.

*Machinery.*

Three machines for dressing the fibre require mention in this Report as having attracted attention during the past year on account of the improvements they afford on the stripping machines in ordinary use. The first of these is Mr. Pownall's machine, a description of which, abridged from his patent, dated 25th September, 1870, will be found in the Appendix, p. 23.

This machine, which scrapes only half a leaf at a time, but on both sides, was exhibited at work in Wellington, and performs the mechanical operation of scraping with less injury to the fibrous bundles than any other machine I have seen at work, and approaches most nearly of any to the Native method of preparation, the fibre differing only in the absence of the peculiar lustre which is retained by the fibrous bundles when torn out of the leaf by the Maoris. Mr. Pownall's machine is somewhat expensive in its construction, and the principle has not yet been sufficiently tested on a large scale to prove if it can be economically applied. At present its comparatively slow motion, and its only dressing half a leaf at a time, is against its adoption for the preparation of pure roping fibre, as the highest market price is obtained for such fibre when produced by more rapid, and, therefore, less expensive machines. At the same time the power required to work this machine is moderate, and there is no reason why the width of the scraping drums might not be increased, and the whole leaf fed through an aperture shaped so as to gradually flatten out as it approaches the scrapers, so that the preliminary expense of splitting the leaf would be avoided, and twice the quantity would be put through with the same time and labour as in the present form of the machine. I understand that Mr. Pownall is at present engaged in improving it in these respects.

The second machine to be noticed is also one in which the leaf is scraped on both sides by two ordinary strippers through which it is successively passed. It has been constructed, with other improvements, under the direction and at the expense of the Canterbury Flax Association; and the fibre prepared by this process is reported to have taken a very high price in the market, ranging from £42 to £45 per ton.

The only machine towards the perfection of which assistance has been sought from the Commissioners is that which was referred to in last year's Report as having been designed by Mr. T. Kelly. This machine, without involving any novelty in the principle of construction, adopts many improvements in detail that have been suggested by actual experience, as described by Mr. Kelly in the Appendix, page 3. The machine has not yet been tested by actual use, but the full-sized model and drawings have been sufficient to satisfy Mr. Kebbell and other competent judges that the improvements suggested will be of great advantage in raising the quality of the fibre and reducing the expense of production. The object which the Commissioners had in view in granting assistance was the construction of a machine—1st. That will clean at least 35cwt. per day on the average for a long period. 2nd. Capable of being adjusted and repaired without loss of time; and 3rd. So put together that duplicates of those parts most likely to give way should be supplied with the machine, and arranged so that they may be fixed in their places by an ordinary mechanic, so that the machine may be used in localities remote from workshops. These requirements appear to have been attained by Mr. Kelly's machine, but it would be more satisfactory to have it submitted to actual trial.

The subject of the improvement of the machinery now in use, and the more thorough investigation of certain points relative to the chemical character of the fibre in different stages of preparation, appear to me to be the only matters for which it is important that any further expenditure should be incurred by Government.

In conclusion, I venture to state that a perusal of the appended papers cannot fail to impress the conviction that the *Phormium* fibre is now not only fairly established as a marketable article, but that various other uses are being discovered for the short fibre, tow, and other *bye-products* of the process at present employed.\*

I have the honor to be,

Yours obediently,

JAMES HECTOR.

The Hon. the Colonial Secretary, Wellington.

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\* A compilation of the more important parts of the previous Reports of the Flax Commissioners has been prepared by direction of the Government to meet the frequent applications for information on this subject, the supply of extra copies of the Official Papers being exhausted.—“*Phormium tenax* as a Fibrous Plant,” edited by JAMES HECTOR, 140 p.p., 8vo. Wellington, 1872.



APPENDIX TO REPORT OF FLAX COMMISSIONERS, 1871-72.

I.—GENERAL CORRESPONDENCE.

(No. 181.k)—Dr. HECTOR to the COLONIAL SECRETARY.—28th, November, 1871.

I have the honor to call your attention to the fourth of a series of resolutions of the House of Representatives, passed on 10th September, 1870, which says :—"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 of *Phormium*, and place an official brand thereon, showing its quality as compared with standard samples issued to them by the Commissioners, such classification to be similar to the manner in which foreign grown hemp or flax is classified, viz. :—First, second, and third qualities ;" and to inform you that classified samples of *Phormium* fibre are now ready for distribution, and to request that you will inform me to whom they are to be issued.

(208.)—Dr. HECTOR to Messrs. STONYER and Co., Kaiapoi.—22nd February, 1872.

Mr. Kebbell informs me that the experiment with the last of the oiled lines (No. 247), which you forwarded to the Commissioners through Colonel Haultain, is still going on, and has already proved of great importance, as will be seen from the accompanying table with which he has favoured me, comparing it with other lines that have been experimented on.

The oiled rope, running dry, came down very unexpectedly after only forty-six days, and on examination the fibre appeared to have been injured in the manufacture. The label describes it as having been "boiled in oil," which, if the oil was heated to anywhere near the boiling point, would sufficiently account for the fibre having been injured. If tested with reference to breaking strain it is probable that it would not have borne more than half the weight that should be expected of it.

The oiled line, running wet, has not yet broken ;\* and, although the fibre has been injured, it has run nearly three times as long as any other, thus proving the economy of oiling the rope. Mr. Kebbell points out that another saving in the manufacture of fibre for oiled rope will be that thorough bleaching is unnecessary, and a less amount of scutching required, as the colour need not be so uniform. This will admit of a great reduction of labour in the drying process, and perhaps allow artificial means to be used ; and so prevent the weather limiting the production of fibre to the same extent as at present.

On the other hand, Mr. Kebbell points out that the line has a dirty appearance, which might be prejudicial to its sale in a foreign market. In order to overcome this the rope should be manufactured here, and be disposed of in the New Zealand or Australian markets, where appearance is not so much looked to ; and, having once got a footing there, its cheapness and exceeding durability will soon force for it a way into the markets of the world.

In order to complete the experiments with oiled ropes, which Mr. Kebbell thinks of the greatest importance, before the end of the next session of Assembly. it will be necessary that the two pulleys which are at present standing vacant should be filled up immediately. He also thinks that the oil used should be heated to the least possible degree. I should, therefore, be obliged by your sending me sixty feet of rope, which allows for a spare line and re-splicing in case of accident happening to one of the two under experiment.

TABLE OF EXPERIMENTS.†

Description of Rope.	Run Wet and Dry with Salt-water.	Dry.	Greatest Shrinkage after Wetting.
	Days.	Days.	Inches.
<i>Phormium</i> .—Hand-dressed by Natives, and hand-made ... ..	22	57	7
„ Machine dressed and machine made... ..	22	63	6 $\frac{3}{4}$
„ Tarred ... ..	3	4	Fibre too much injured for experiment
<i>Manilla</i> .—Free from adulteration ... ..	30	39	8 $\frac{1}{4}$
<i>Phormium</i> .—Oiled ... ..	135	92	2 $\frac{1}{2}$

All the lines were sixteen feet long at commencement. The shrinkage was taken from the centre of the lower pully to the floor, consequently the amount of shrinkage for the whole line will be double that given.

The small amount of shrinkage of the oiled line is remarkable, showing the protection afforded by the oil, and the value of the rope for braces and running gear.

\* Broke in April.

† Brought up to date of Report.

APPENDIX TO REPORT OF

(237.)—Major J. A. GRAY to Dr. HECTOR.—12th March, 1872.

Mr. Stonyer requests me to thank you for the details of experiments with rope, and to state he has none of the rope by him, but is getting some made, and hopes to send it on Saturday. He is sending you two lengths—one No. 1 of double-dressed flax; No. 2 is best single stripped—both made and oiled alike. The oil is made hot, and the yarns passed through while it is simmering. They are not kept in, but merely passed through. If you can run the two together you will see which works best.

From our experiments we think the oil does not do much good to ordinary rough fibre, but our trials are not sufficiently numerous to say decidedly, as occasionally a good rope in other respects will go from some injury or defect in the manufacture at a certain part.

We tried an oiled pump rope made of the Ashley Gorge flax, which is considered the best single stripped here, and it only ran three days. One of the same, tarred, did not last a day, and one of plain white nearly two days. We then tried some double stripped, white, from young flax, that went twenty-nine days.

We then put in on 1st January a new one, two ropes of which were the same as that you have, and one of ordinary flax, oiled the same; but the ordinary flax shrunk so much more they would not work together, so we had to take it out, and put one of the other kind in. This is still going.

Our pump only runs ten hours a day, and the rope passes over each pulley about nine times per minute. This rope was made from fibre from old leaves that were gone brown at the tips, and, consequently, what we call seconds. The fibre was considerably cut in dressing, so much so the rope spinner complained greatly of its being over done; but my present opinion is that for ropes to run in blocks or over pulleys you must have the fibres well opened and very soft, and it is questionable if the old leaves, if they are not too far gone to clean well, are not better than the young ones.

If a rope is wanted simply to bear a straight strain without being bent, no doubt the long unbroken fibres will make the best.

I enclose copy of account sales of the bale that took the first prize at Christchurch in 1870, samples of which you have. We have sent home five tons of the same to a private order, and we have an order for twenty tons more at £45 delivered in London, besides an order for two tons to go to Melbourne at nearly as good a price.

We have been making some experiments with a machine the Flax Association here have had made, which adopts the first portion of the plan I wrote to you about before, which is successful as far as it goes, but still wants the finishing process to bring it to the highest class fibre. I have no doubt they will have forwarded you samples.

Enclosure.

(No 1491.)—ACCOUNT SALE.

Of one bale of flax, ex Cyrene, from Lyttelton, sold ex Public Sales in London, 26th September, 1871, by order of the New Zealand Loan and Mercantile Agency Company, Limited, for account of Messrs. Cobb and Lawtell, of Christchurch:—

Lot.	Mark.	No.	Package.	Gross Weight. cwt. qr. lb.	Tare. lb.	Nett. cwt. qr. lb.	Price per Ton.
59	W. S. & Co. } Pastoral }	30	1	3 0 13	21	2 3 20	£42

For the New Zealand Loan and Mercantile Agency Company, Limited,  
(Signed) W. J. STEELE, Secretary.

(No. 254.)—Messrs. BENNETT, BROTHERS, 8, St. Mary-at-Hill, London, to Mr. SKEY.—  
16th March, 1872.

Noticing your experiments with different kinds of fibres, and our business being in this article, we write you asking if you would kindly oblige us with a small quantity of the fibre (*Phormium*) after its treatment with the caustic potash, and also a little of the raw. We think it would be interesting to some of our manufacturers, and, therefore would be much obliged by your kindly assisting us in this matter.

(No. 218.)—Dr. HECTOR to Messrs. BENNETT, BROTHERS, 8, St. Mary-at-Hill, London.—  
8th June, 1872.

Your letter of 16th March, addressed to Mr. W. Skey, respecting the supply of a small quantity of *Phormium* after treatment with caustic potash, has been referred to me by that gentleman. Your request shall be attended to, and I will have the pleasure to forward a sample by the next English mail.

You will be able to procure samples of the raw fibre on application to Dr. Featherston, the Agent-General for this Colony, of 7, Westminster Chambers, Victoria Street, who will, no doubt, be able to furnish you with all the information you require on this subject.

(178a.)—Dr. HECTOR to T. KELLY, Esq., M.H.R.—16th November, 1871.

In reply to your letter of 9th September, offering to place at the disposal of Government certain improvements which you have designed on the flax-dressing machinery now in use, and naming certain conditions, I have the honor to inform you that, after considering the plans submitted by you, the Flax Commissioners have resolved to devote a sum not exceeding £70 for the purpose of testing your improvements by practical construction, and I have to request that you will be good enough to take the necessary steps to have the machine made, and to report to me when it is ready for inspection.



(196.)—T. KELLY, Esq., M.H.R., to Dr. HECTOR.—18th November, 1871.

I have the honor to acknowledge the receipt of your letter of the 16th instant, in which you state that the Flax Commissioners will devote a sum not exceeding £70 for the purpose of testing my improvements in flax machinery. I beg to state that I accept the offer of the Commissioners, and will, on my return to Taranaki, proceed with the construction of the machine.

(255.)—T. KELLY, Esq., M.H.R., to Dr. HECTOR.—4th June, 1872.

I beg to acknowledge the receipt of your letter respecting the machine, and I have concluded to forward the model to you, as I find that I will not have time to go to Auckland to get the machine made before the General Assembly meets, while, if it is made in Wellington, it will not much delay it, and I can look after its construction while there.

(271.)—T. KELLY, Esq., M.H.R., to Dr. HECTOR.—Wellington, 20th July, 1872.

I beg to furnish you with a description of the improved machine for dressing *Phormium*, a full sized model of which I have placed in the Museum, together with sectional drawings showing two modes of differential adjustment, also sectional drawing of machine, with my improvements applied to machines which beat on a bar, showing composition bar of improved construction.

I may state that this model is merely illustrative of the principle on which my improvements are based, so that I do not confine myself to the actual size of the stripping drum or other parts of the machine.

These improvements were suggested to me by observing the practical difficulties which I encountered in working Price's small machines. These difficulties were occasioned—first, by faults in construction; second, in faults of design; and third, in faults of material used in the construction of the machine.

The faults of construction I found to be want of length of the bearings of the feed roller, and difficulty of oiling, causing the journals to wear loose very rapidly, thus rendering it practically impossible to secure that control over the adjustment of the space between the surface of the rollers and the beating bars of the drum, so necessary to good dressing. The mode of securing the cast iron collar of the feed rollers to the wrought iron shaft or spindle was also very defective. This was effected, in the first instance, by drilling two holes through both collar and spindle at right angles to each other, and driving in an iron pin. The excessive vibration to which the rollers were subjected invariably loosened these pins, and they were a constant source of delay and loss. Subsequently the collars were keyed on in the ordinary way in which pulleys were keyed to shafting, but these also are constantly working loose. The mode in which I propose to key the collars will overcome those difficulties, and at the same time offer greater facilities for the removal of an old collar and the substitution of a new one.

The mode of fixing the scraping plate to the surface of the lower roller was another defect, being merely a piece of wood having a piece of hoop iron on its upper edge, and retained in its place by being wedged between the frame of the machine below the roller. This scraper was continually working loose, and necessitated the stoppage of the machine to replace it. I remedy this by having a transverse bar cast in the frame below the position of the roller, to which a steel plate with slots to receive bolts is secured, being easily adjusted to the surface of the roller, and retained there by tightening the nut.

Defects of the construction in the gearing of the feed motion I will not describe, as the defects have been, in a great measure, overcome in the large machines more recently constructed.

#### *Defects of Design.*

With regard to the defects of design, the first is the position in which the indiarubber springs are placed which press the bearings of the lower roller towards the beating bars of the drum. As these springs are placed in immediate contact with the bearings of the roller it is difficult to put in rubber of sufficient thickness, and it necessitates the removal of both rollers and all connecting gearing to replace worn-out springs. Being liable to be saturated with oil from the bearings, the rubber soon loses the indispensable property of firm elasticity, and thus entails unnecessary expense in keeping up the efficiency of the machine.

I remedy this by placing the springs outside the standards which hold the roller bearings in position, when they can be speedily and conveniently replaced without interfering with other parts of the machine. As regards adjustment, the design is faulty in consequence of the impossibility of easily and satisfactorily effecting it while the machine is running. If the rubber springs are in the proper state of compression, that is, just keeping the lower roller up to its work with sufficient firmness to insure the fibre being dressed without being unduly cut, yielding backward only when a greater abundance of fibre comes between the roller and the beating bars, the machine, if in good order, dresses well; but to insure good dressing under a variety of conditions it is found necessary in practice that the space between the face of the roller and the beating bars shall be capable of adjustment when the machine is running. This is effected in Price's by loosening the bearing of the stripping drum, so that it will admit of being moved by a set screw to or from the roller. This cannot be done satisfactorily or with accuracy.

I propose to remedy this by means of a pair of differential screws, working in the end of the machine communicating independently with the bearings of the lower roller. This adjustment includes the means of roughly adjusting before the action of the differential screw is brought into operation. The adjustment can be applied by means of a male screw,  $\frac{7}{16}$  in. diameter, working into a plate nut fixed by bolts to the end of the machine. Within this male screw a  $\frac{1}{2}$  in. screw works, to the end of which is attached a rod which communicates motion to the bearers by means of a lever, which has the effect of moving the roller from the beating bars, or by reversing the screw, allowing it to come closer; by this mode one turn

of the screw moves the bearer of the lower roller one-hundredth part of an inch. A simpler mode of differential adjustment can be effected by working a rod having a  $\frac{3}{4}$  in. screw at the end in a plate nut, as in the previous mode, and on the other end a  $\frac{5}{8}$  in. screw working in a nut at the end of a projecting tongue, which operates on the bearing of the roller direct. By this mode the adjustment is not so delicate—one turn of the screw moves the bearer one-sixtieth of an inch, which, I think, is sufficiently delicate for all practical purposes, especially as half a turn of the screw can be given if necessary.

I also propose to widen the drum, so that the dressing surface shall not be less than  $6\frac{1}{2}$  in., as I have found that narrower machines will not dress large leaves. The cover of the machine I have modified so as to make it stronger and simpler in fixing, and make provisions for the admission of water while the machine is dressing—the whole to be of wrought iron. The feed motion of my machine differs from others; it is driven by a belt running from a pulley on the main shaft on to a pulley whose shaft carries on its end a 4 in. pinion. This pinion gears into a pinion of a similar size, which is keyed on the spindle of the upper roller; both pinions are on the same level. The first pinion also drives a double carrier pinion below it, which, in its turn, reverses the motion and drives the lower roller in the proper angular direction, and at the same surface speed as the upper roller. The upper and lower rollers are, therefore, in a manner, independent of each other, as they are not directly geared together, and a freedom of movement is given to the upper roller without practically changing the depth of gear of the engaging pinions. To facilitate the replacing of a sound for a broken pinion, I propose that the ends of the shafts on which the pinions are fixed should be provided with a fixed key or feather, on to which the pinions would slide, and secured by a nut and leather washer.

#### *Material of Moving Parts.*

I think it is desirable that the journals of all the shafts should be of hardened steel. This especially applies to the lower roller and the stripping drum.

The collar of the lower roller should be of chilled iron, ground truly concentric to the journals, as it is impossible to dress well if the face of the lower roller is even slightly excentric to the journals.

The beating bars of the drum require to be made of homogenous metal, rather tough than hard. Soft steel or charcoal-hammered iron will probably be found to answer best.

The cast iron beater bars now in use are very unsatisfactory, as different degrees of hardness and brittleness are often found in the same bar. I propose to use soft steel bars secured to bars cast on the face of the drum, as shown in the model.

#### *Speed of Driving Parts.*

I propose to drive the surface of the feed rollers at from 120 to 125 feet per minute. This is about the rate at which a good feeder can deliver leaves of the ordinary length for the half day, and if carried on for eight working hours will pass through the machine from 35 to 40 cwt. of green flax. I propose to give from ten to twelve blows to the inch; less than ten is not sufficient, and more than twelve is unnecessary.

The surface velocity of the stripping drum I propose to increase from fifty feet per second, at which Price's small machines are driven, to 70 feet per second. The effect of this will be to necessitate the placing of the beater bars further apart on the face of the drum, and to secure the proper dressing of the fibre without the beating bars having to revolve too close to the face of the roller. I have observed that when the surface velocity of Price's drums were reduced below forty feet per second that it necessitated the surfaces of the roller and the beating bars to be set so close as to cut the fibre, as a lesser evil than to have a large portion of the leaf unoperated upon.

## II.—CORRESPONDENCE AND REPORTS OF HOME AGENTS.

(No. 177.)—Dr. HECTOR to Mr. MORRISON.—28th October, 1871.

I have the honor to request that you will kindly use your best endeavours to get the name of "New Zealand flax" altered to "*Phormium*," or "*Phormium* hemp," in the market reports, in the same way that the term Manilla or Manilla hemp is used.

As you are aware, much confusion has arisen from our fibre being called "flax," and it has unfairly had to compete with the real flax in consequence. This will, I hope, be avoided for the future by the proposed change in the market name of the fibre, which will then stand on a proper footing with other fibres as far as regards its having a distinct name that does not imply any comparison with Irish flax.

It has been directed that the name shall be changed in the official returns of the Colony, and if you could arrange that the same change should be made in the trade returns at home you will be conferring a great benefit on the Colony.

(241.)—The AGENT-GENERAL to Dr. HECTOR.—11th January, 1872.

With reference to your letter, No. 178, of the 28th October last, addressed to Mr. Morrison, respecting the desirability of having the designation of the *Phormium tenax* altered in the market reports by the disuse of the term "flax," I beg to inform you that the brokers have anticipated any action in the matter by placing the fibre in their reports under the term "hemp."

(No. 211a.)—Dr. HECTOR to the AGENT-GENERAL.—18th April, 1872.

I have the honor to inform you that a large parcel of very superior Maori-dressed *Phormium* was recently shipped by the 'Caduceus' at Auckland, to the address of Thomas Anderson, Esq., 27, Leadenhall Street, London, which is to be sold, I believe, at public sale. Should you require any more than the shipment the Commissioners sent home a few months ago for experiment, this will, no doubt, be open to you; and, from a sample which I have seen, it appears of fair quality.

I have to acknowledge receipt of your letter of the 11th January, in which you inform me that the name "hemp" has been applied to the *Phormium* in the English market reports. This is much to be regretted, as the term is equally as inappropriate as "flax," for while the latter gave the commercial world a fictitious idea of its value, and caused the home growers of *Linum* to discourage the use of *Phormium* for fear of its entering into competition with their trade, the former will tend to exclude it from being experimented with in the manufacture of stuffs, and will give the idea that it is only useful in the manufacture of rope and very coarse sacking.

I have, therefore, to request that you will endeavour to promote for this fibre a general use of the term "*Phormium*," which has already been adopted in these Colonies, and which, as it does not imply any resemblance to flax or hemp, will help to prevent its being brought into competition with any particular class of fibre.

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(193.)—Mr. MORRISON to Dr. HECTOR.—20th September, 1871.

I have the honor to acknowledge the receipt of your letter, No. 114, of 7th July last, and in reply I beg to inform you that I have received from Messrs. Levin and Co. bill of lading for the twenty-three bales of New Zealand flax shipped by the 'England.'

I note your instructions as to the object which the Commissioners have in view in sending this flax, and I beg to state that on the arrival of the 'England' the bales will be claimed, and distributed under the direction of the Agent-General.

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(No. 196.)—Dr. HECTOR to Mr. MORRISON.—21st December, 1871.

I have the honor to inform you that I have forwarded to your address by the 'Halcione,' which left here at the beginning of the month, a sample bale of *Phormium*, dressed by the Cape Egmont Flax Company at their mills at Opunake. It seems to have been carefully got up, is well scutched, and had the ends of the fibre hackled.

I shall be obliged by your reporting to me the opinion of fibre brokers on the quality of this bale, and the price which such fibre, if in bulk, would be worth in the market.

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(No. 252.)—Mr. BULLER to Dr. HECTOR.—28th March, 1872.

The Agent-General has referred to me your letter of the 21st December, 1871, addressed to Mr. John Morrison, on the subject of a sample bale of *Phormium*, dressed by the Cape Egmont Flax Company, at the Opunake Mills, and forwarded by you to England for the purpose of obtaining the "opinion of fibre brokers on the quality of the bale, and the price which such fibre, if in bulk, would be worth in the market."

The bale in question arrived safely by the 'Halcione' about three weeks ago, and was landed in good order.

Having obtained the approval of the Agent-General, I arranged with Mr. C. Thorne to get the fibre valued by some respectable brokers, and we have to-day received his report to the following effect:—

"I have shown the flax to-day to two of the leading fibre merchants—Messrs. Catling and Walker and Messrs. K. Hennelly and Co.—as well as to two of our principal New Zealand flax brokers—Messrs. Manning, Collier, and Co. and Messrs. Devitt and Hett. These respective gentlemen saw the flax at separate times, and without any knowledge of the value put upon it by each other. There was not any difference in their opinion, as they, one and all, estimated its value to-day (27th March) at £45 per ton.

"Probably had a parcel of ten tons equal in quality to your bale been submitted to public competition this day it might have realised over the value they put upon it, as there was a good demand in the sale-room for New Zealand flax, as Manilla hemp is high in price. Should the fall in the value of Manilla shortly take place, as is anticipated by the trade, then a reduction in the present prices of New Zealand flax may also be looked for, unless equally as superior as your bale. This estimate is only, of course, for roping purposes."

I also arranged with Mr. Thorne to send a small quantity of the *Phormium* to Mr. Forbes, of Dundee, for the purpose of ascertaining whether the fibre, as thus prepared, is adapted for textile fabrics, and this has accordingly been done. I trust that Mr. Forbes's report may arrive in time to permit of my forwarding it by the present mail.

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(No. 251.)—Mr. W. L. BULLER to Dr. HECTOR.—28th March, 1872.

I beg to send herewith for the information of the Commissioners a report of prices realised at the last hemp and flax sales (Devitt and Hett, 13th March). I beg to forward at the same time a sample (marked A) of the New Zealand hemp that brought the highest figure, viz., £38. It was given to me as a fair average sample of the <sup>O & G</sup><sub>D M</sub> of Messrs. Devitt and Hett's list; and, so far as my opportunities of

judging went, it certainly was a fair specimen. On showing it, however, to Mr. Larkworthy, Manager of the Bank of New Zealand, he expressed a decided opinion that this sample was far under the average quality of the hemp that fetched the highest price. At my request he then submitted this sample to two reliable fibre brokers in the city for valuation, and I have just now received a letter from him to the effect that they report it worth not less than £36 a ton in the present state of this market.

I mention this because it is important that you should know the exact value of the fibre in this condition of preparation.

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(No. 217.)—Dr. HECTOR to Mr. W. L. BULLER, London.—8th June, 1872.

I have the honor to acknowledge your letters of 28th March, reporting on the bale of *Phormium* prepared by the Cape Egmont Flax Company.

The opinions expressed by the brokers are very satisfactory and encouraging, and will, no doubt, stimulate manufacturers to produce a superior article.

Your letters of 7th March, respecting a new method of preparation of the fibre by Messrs. T. and C. Nichols, and of 28th March, enclosing sample of the *Phormium* that fetched the highest price in the London market, are also to hand. The latter is put on exhibition in the Colonial Museum, that exporters and manufacturers may have an opportunity of seeing the quality of fibre required. With regard to the former letter (7th March), I shall be glad to receive any further information on the subject of the invention of Messrs. Nichols. The samples forwarded appear very fair, but a little harsh. It is not possible however, to judge of the probable success of the process while I have so little information respecting it.

Messrs. Bennett, of 8, St. Mary-at-Hill, City, have requested samples of raw *Phormium*, which I will be obliged by your forwarding to them on application.

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(No. 190.)—Mr. MORRISON to Dr. HECTOR.—1st September, 1871.

Adverting to my letters (No. 230, 29th June, 1871, and 267, 27th July, 1871) having reference to the preparation of *Phormium tenax* by Mr. C. Thorne, of 16, Mark Lane, I have the honor, in continuation thereof, to transmit herewith a specimen of cloth which has been manufactured from a mixture of *Phormium tenax*, prepared by Mr. Thorne, and the best Riga flax, in the proportion of 25lbs. of the former to 75lbs. of the latter.

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(No. 228.)—The AGENT-GENERAL to Dr. HECTOR.—14th December, 1871.

I have the honor to transmit herewith copies of letters, dated as per margin,\* which have been received from Mr. C. Thorne, of Mark Lane, respecting the *Phormium tenax*, and I beg to inform you that the samples of yarn, cloth, &c., therein referred to are forwarded per sample post by this mail to your address.†

16, Mark Lane, E.C.,  
London, 30th September, 1871.

DEAR SIR,—

Agreeably to my promise, I now send you a few samples, which will probably prove interesting to your friends in New Zealand. On the 7th June last I handed you a sample of the fibre extracted from dry leaves of the *Phormium tenax* imported from New Zealand, and I then explained to you that, owing to the gum in the fibre being dry and very hard, I could not thoroughly redissolve it, yet I had succeeded in rendering the fibre sufficiently soft and fine to adapt it for spinning purposes. The samples herewith form part of the same batch of fibre from which the samples referred to were taken, so you will be enabled by this means to follow my progress.

No. 1 is a skein of bleached yarn made from pure New Zealand flax. You will observe the gummy matter remaining on the fibre has retained portions of the straw, hence the appearance of the yellow marks.

No. 2 is a skein of unbleached mixed yarn, made from 75 per cent. of Riga flax and 25 per cent. of New Zealand flax. This has been subjected, since spinning, to the process known as "twice boiled," to render it better adapted for weaving. This is thought especially well of by the manufacturer, as the New Zealand flax has increased the strength of the cloth without in any way altering its general appearance.

No. 3 is a skein of mixed yarn as above, only subjected to a "full bleach" instead of being "twice boiled."

No. 4 is a piece of cloth made from unbleached yarn of pure New Zealand flax. This was the first attempt made by my friends in using New Zealand flax. They told me I ought not to show this specimen, as, in making it, they were really only feeling their way, and finding out the treatment this fibre required. Nearly all fibres have some peculiarity, which makes it necessary to adapt machinery for their special treatment. This cloth was woven in a "jute" loom.

No. 5 is a piece of cloth made from bleached yarn of pure New Zealand flax. See sample No. 1. Although an improvement on No. 4, it is far from perfect.

No. 6 is a piece of cloth made from unbleached mixed yarn. See sample No. 2.

No. 7 is a piece of cloth made from bleached mixed yarn. See sample No. 3.

No. 8 is a sample of fibre extracted from leaves of the *Phormium tenax* grown in the gardens of the Earl of Shannon, at Castle Martyr, Ireland. These leaves were kindly forwarded to me in the

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\* 30th September, 1871; 17th October, 1871; 27th November, 1871; 11th December, 1871.

† The samples mentioned have been placed in the Colonial Museum.

green state on my application to his Lordship, as I was anxious to prove that, if the process I used was properly applied to the green leaf, the gum would be at once removed without injuring the fibre. His Lordship's gardener could only spare a few leaves, weighing  $12\frac{1}{2}$  lbs.; from these I extracted about  $16\frac{1}{2}$  per cent. of fibre, not sufficient for any practical purpose, but useful as collateral evidence of the efficiency of the process. This fibre is not fine enough for textile fabrics. I have just heard from my friend at Arbroath, that he hopes to have some canvas, fit for sail-making, (entirely from New Zealand flax yarn) ready for me in about a fortnight; but as it seems uncertain when it will come to hand, I think it advisable that you should have the accompanying samples at once, so that you may send them to your friends in New Zealand, and they may judge for themselves how far the various statements put forward "that New Zealand flax is not adapted for textile fabrics, and cannot be manufactured," are correct. When extracted from young leaves, so as to obtain a fine fibre, properly cleansed from the gummy matter, it can be adapted to the manufacture of articles in daily use; and when received in this country in large parcels, sufficient to attract the attention of manufacturers, there is no doubt it will go into regular consumption, and leave a large margin of profit to the producer, and thus tend to open up an important branch of trade for the New Zealand Colonies.

As you are aware, when I first tried to get this fibre worked, I was told it could not be done, and a large well-known firm in Arbroath, having proceeded so far as to put the fibre in a "rove," wrote stating that it could not be worked further without special machinery, and even then it would be doubtful whether it could be made into yarn fitted for cloth; yet this very same "rove" was worked into a yarn by my friend the spinner, who has taken so great a personal interest in my experiments; and a Dundee manufacturer and his chief clerk also rendered me very valuable assistance, and without their aid I should not have succeeded. Some day I hope to be allowed to make mention of their names, so that, should these first efforts in any way call attention to the usefulness of New Zealand flax, and thereby promote this branch of industry, they may receive that acknowledgment of their efforts to which they are so fully entitled.

The spinner personally superintended the whole work from fibre to complete yarn. This yarn was spun upon flax machinery without any alteration; but he tells me a very slight change would cause a great improvement in the manufacture; but unless there is a prospect of a large supply of the fibre coming forward, it would be useless expecting the manufacturers to change any portion of their machinery. It is satisfactory to find that it is the firm opinion of these practical gentlemen that this fibre can be utilized, and will benefit not only the colonists but also the flax spinners. It may be a work of time to introduce it, but they have seen sufficient, in carrying through my experiments, to prove to them that this fibre would soon make its position in the market.

Rope made from the fibre wears very well for some time, and bears a good strain, but when once it gives way, it seems to perish altogether, and does not leave any portion sufficiently strong to take a splice; but for many purposes it is much liked, and seems gradually working itself into favour. Whilst sound, it bears fair comparison with Manilla; unfortunately it does not seem to last so long.

Hoping my information may prove of some interest to you and your friends,

I am, &c.,

C. THORNE,

Assignee to Steart's Patent, Registered in New Zealand.

J. Morrison, Esq.,

New Zealand Government Agency, London.

Mark Lane, E.C.,

London, 17th October, 1871.

DEAR SIR,—

Begging reference to my letter to you of the 30th September, I now have pleasure to hand you the names of those gentlemen who so kindly assisted me in getting my New Zealand fibre turned into cloth.

The manufacturers were Messrs. E. Parker and Co., of Dundee; their chief assistant, Mr. Henry Roper, superintended the weaving of the cloth. Mr. A. K. Forbes, of Hatton Mill, near Arbroath, spun the yarn, and personally watched the process from the time the fibre entered the drawing-frame until it left the spinning-frames in yarns.

Mr. Dick, a gentleman well known in Dundee by the principal manufacturers, used exertion for me, in the first instance, to introduce the fibre to notice, and it was through his influence the attempt to spin the fibre was first made; but unfortunately, as I pointed out in the letter above referred to, the spinner did not succeed in getting it beyond the "rove."

I have, &c.,

C. THORNE.

J. Morrison, Esq.,

New Zealand Government Agency.

16, Mark Lane, E.C.

London, 23rd November, 1871.

MY DEAR SIR,—

I have this morning had a conversation with Dr. Featherston, the Agent-General to the Government of New Zealand. He does not seem to get on very fast with manufacturers in getting them to try experiments for him; in fact they nearly always write to him that they cannot work even the finer qualities of New Zealand flax. When he was last in England he showed Messrs. Marshall, of Leeds, some native-dressed fibre, and they told him they could spin it if they had a quantity. He has lately sent them about 20 lbs. weight, and now they write they can do nothing with it. He has given me a sample which accompanies this. I told him I believed you could spin it into a very fine yarn. He wants to get a correct report upon it from some one who will not simply say what they think can be done on looking at a sample, and then, when the bulk is sent, give an opposite and adverse report, but who will carry out the

report by working it up. I told him if he gave me the sample I would send it to a gentleman who might be relied upon for saying what he could do, and also would do what he said he could do.

Will you kindly examine this sample very carefully, and send me your verdict upon it. Dr. Featherston has only a small quantity, say 38lbs. or 40lbs. now on hand, but shortly expects nearly a ton. It is Native-dressed. He thinks it fine enough for cambric.

What he especially wants to know is—

- (1.) Is this fibre sufficiently fine to make a yarn capable of being woven into a delicate fabric?
- (2.) If imported in large quantities, would there be a ready sale for it, and what price might be looked for, at first start?
- (3.) With what class fibre would it come into competition?
- (4.) What is the smallest quantity you could work up and get woven, so as to show the fabric of the finest kind to which it is adapted?

After all his failures in getting an interest taken in the working of this fibre, I am sure he would greatly appreciate any trouble you might take. He is quite prepared to pay all expenses attending the experiments, and would, I have no doubt, consider you have rendered him a great service.

If possible, he would feel obliged by having the report not later than the 29th instant, as it would then be in time for him to forward a copy to the New Zealand Government by the next mail.

I anxiously await the arrival of my canvas. With kind regards, &c.,

I remain, &c.,

A. K. Forbes,  
30, West Keptil Street, Arbroath, N.B.

C. THORNE.

16, Mark Lane, E.C.,

London, 27th November, 1871.

MY DEAR SIR,—

This morning I received a letter from my friend Mr. A. K. Forbes, dated Arbroath, 24th November. He says he has received the sample of Native-dressed New Zealand flax.\*

"I have to-night taken the sample sent to a flax-dresser, who is to dress it over a fine hackle, and let me have it to-morrow. On Monday I shall put it into a fine yarn, and send it on to you same evening, along with a letter giving my answers to your queries, till which time I shall study the thing as closely as possible. These you will receive on Wednesday morning, the 29th. You must always bear in mind that my machinery is not capable of spinning a yarn fit for making into cambric, neither is there any of that fabric woven in this country. I am not acquainted with this department of the trade, and, in giving my opinion on the fibre, can only enter into it as far as my experience goes. This is always at your command."

The next part of his letter refers to work in experiments for me, and as they will probably interest you, I subjoin the extract:—

"By this post I send you a sample hank of flax yarn, 4lbs.; this, I think, you will say is good. I am getting on pretty fair with it; still the same drawback always obtains, namely, that it does not do alone. The flax I am now spinning would have answered beautifully for a mixture with Riga, and gone into a much lighter size; still, this yarn will make a towelling and sheeting cloth. I have been experimenting on the rough tow. It is far too strong and long, and, although beat in one way, I do not mean to be beaten, and will make it into a yarn; but what I can see is, that it is not in that state to be a ready and easy manufactured fibre, being too hard and long. You must not weary over the tows getting done, as really I am oppressed with orders for tow yarns, and do not know how to get my customers supplied fast enough.

"I shall do what I can to get them pushed through as fast as I possibly can. I shall send you full reports of all my experiments in working the several lots, on the completion of the several parcels into yarn; also the bleachers and weavers as well. You may assure Dr. Featherston that I shall be happy to do anything I can to advance his views in regard to spinning the New Zealand fibre at any time, and so far as I can."

The remarks regarding cambric were drawn forth by my stating you hoped the fibre would be found fitted for so delicate a fabric as cambric.

If I receive the yarn made from the Native-dressed sample on Wednesday, as promised, I will try and bring it up to you on that afternoon: failing that, I will call upon you on my way to town on Thursday.

Yours faithfully,

C. THORNE.

Dr. Featherston,  
New Zealand Government Agency.

MY DEAR SIR,—

Arbroath, 27th November, 1871.

I have now the pleasure of forwarding, by post, the New Zealand flax† spun into yarns. I had the line hand-dressed over a 12 hackle. This opened up the fibre very much, and made it beautifully soft, with the exception of the ends, which are originally hard and not nearly so well softened as the other parts. This is a great drawback to the full value of the flax, as that alone will prevent it going into a very fine yarn, which could easily be done with the other parts. I yet, however find it a very easy spun flax, and have put it into a 2lb. yarn. Even with my heavy machinery I could put it into a much smaller thread (but could not come down to a cambric size) if I had a quantity, say at least 40lbs. of line (hacked). The tow I find very good spinning fibre, and it has gone easily into a 2lb. thread. I should be quite willing to spin as much as could be sent of this quality, and I think if any of the linen-spinners in Leeds or Belfast were to try it, they could make it into a very fine Irish-linen yarn. I shall now answer your queries as well as I can:—

- (1.) After being well hand hacked, say over an 18 hackle, it would go into a linen yarn.

\* Meaning *Phormium*.

† Meaning *Phormium*.

- (2.) Yes. As imported for our fabrics, £60 per ton; if for Leeds and Irish fabrics, £80 to £90 per ton.
- (3.) With Irish and English flax, which is used for strengthening purposes.
- (4.) If I were to get it weaved, I should need at least 2cwt. of flax as imported. I could get it weaved into very fine towelling damasks and such like.

If your friend were to get the tow he expects, I should be glad to have it to spin for him, and would get it weaved in Dunfermline, where the best linen fabrics are made. I am getting on slowly with your own stuffs,—they are a more difficult matter. I hope, from what I have written, Dr. Featherston will be able to gain some information; and with kindest regards,

C. Thorne, Esq.,  
16, Mark Lane, London.

I am, &c.,

A. K. FORBES.

MY DEAR SIR,—

16, Mark Lane, E.C.,  
London, 11th December, 1871.

I have just received, by express train, two yards of my canvas made from New Zealand fibre. It is just as it left the loom, having neither been cropped nor calendered, which accounts for its rough appearance. I expect the 150 yards, of which this forms the sample, will be sent to me in a finished condition by Wednesday's steamer, but I send you a sample of one yard of this first lot, so as to enable you to send it to your friends by the mail on Wednesday. My friend wonders why you have not sent him the 40lbs. Native-dressed flax.

He promises me cloth fine enough for towelling and sheeting shortly. I will call on you to-morrow about 10.30 a.m.

I am, &c.,

Dr. Featherston,  
New Zealand Government Agency.

C. THORNE.

(No. 268.)—MR. BULLER to Dr. HECTOR.—9th May, 1872.

By the outgoing mail (via Southampton) I have forwarded to your address a parcel containing a roll of sheeting made of pure New Zealand *Phormium*.

It is a portion of the supply ordered by Dr. Featherston (through Mr. Thorne) some months ago, reference to which you will find in the correspondence already forwarded. One of the rolls supplied is of a finer quality and whiter in colour, but Dr. Featherston considered it better to retain this for exhibition here.

Mr. Thorne's Irish correspondent having agreed to attempt some finer fabrics, such as table damasks, &c., if I would supply not less than 2cwt. of Native-dressed fibre (gratis), I accordingly sent down that quantity, leaving three small bales still on hand, and I have to-day received Mr. Thorne's report, as follows:—"I handed the whole of the Native-dressed New Zealand flax to my Irish friend yesterday, and on examining some of the parcels we found a difference in quality, not only as regards colour, but also fineness. My friend says all will be carefully sorted, so as to leave an evenly-coloured or sized yarn. He expects to leave London the end of this or beginning of next week. When in Ireland he will see the matter carefully put in hand, and will spare no trouble to bring this to a successful result. I told him not to let expense be any obstacle; so I hope in about a month or two the report will be satisfactory."

I will do my utmost to hurry forward this interesting experiment, and will communicate the result to you as early as possible.

(No. 269.)—MR. BULLER to Dr. HECTOR.—15th May, 1872.

By direction of the Agent-General I have the honor to forward herewith, for the information of the Flax Commissioners, copies of letters from Mr. Thorne, relating to the conversion of New Zealand *Phormium* into textile fabrics.

I have, at the same time to report that, in accordance with your request, I have put myself into further communication with Professor Church, of Cirencester Agricultural College, with a view to getting a more complete and exhaustive report on the chemistry of *Phormium tenax*, and that I have this day received the following letter from him:—

"R. A. College, Cirencester,  
"14th May, 1872.

"DEAR SIR,

"I have been delayed by press of work from attending to your letter of 25th April earlier. During the last few days, however, I have gone over the New Zealand papers of the Flax Commission, and feel that I know pretty nearly what work is needed to complete the chemical study of the *Phormium tenax*. I have read the papers by Dr. Hector, Captain Hutton, and Mr Skey, and think I shall be able to unravel the remaining tangles of the subject. I will give you a list of the points to which my final and exhaustive inquiry should be directed, but I should be greatly aided in this work if I could have at hand a copy of the Reports by Dr. McNab and myself. I presume that there can be no objection to this, though I was not allowed to retain one of the duplicate lithographs of these preliminary reports which Dr. McNab and I sent in when they were first struck off.

"May I inquire the date of the mail by which you desire to transmit memos. of the progress of the arrangements?

"Yours faithfully,  
"A. H. CHURCH."

I need scarcely add that I have furnished a copy of the report as requested.

## Enclosures in 269.

MY DEAR SIR,—

16, Mark Lane, London, E.C.,  
1st April, 1872.

With regard to the sample I sent Mr. Forbes 'from your bale of New Zealand flax, ex 'Halcione,' he states:—"The sample of New Zealand fibre last sent is very good, but I would not value it at nearly so high a price for textile fabrics as will be received for it for rope, on account of its being still far from soft enough for spinning."

He also refers to the fabrics he is getting made as follows:—"Your cloths are pushing on, and I am promised all in good time for the Exhibition."

I have shown your flax (ex 'Halcione') to Mr. Frost, the well-known rope-maker, who thinks it is particularly good, and superior to any he has seen, with the exception of Native-dressed.

Dr. Featherston,  
Agent-General for New Zealand,  
7, Westminster Chambers.

(Signed) C. THORNE.

MY DEAR SIR,—

16, Mark Lane, London, E.C.,  
17th April, 1872.

I have heard from Mr. Forbes this morning. His letter is dated yesterday. The following extract will show you the progress made.

Dr. Featherston,  
7, Westminster Chambers.

Yours faithfully,  
(Signed) C. THORNE.

[Extract from Mr. A. K. FORBES's letter, dated Hatton Mill, 16th April.]

"I do not mind trying experiments myself, but it is the getting of the yarns weaved that worries me. I would require your head to go about pushing the manufacturers on. I must confess to being a bad hand at this sort of thing. I enclose a letter from one of the manufacturers, which will, no doubt, be satisfactory so far. The other manufacturer who promised to weave the cloth for the mail-bags is full of difficulties and obstacles—I believe none of them well founded. I regret all this more than I can tell you."

[Copy of a letter from EDWARD and Co. to Mr. A. K. FORBES.]

"DEAR SIR,—

"Friskheim, 15th April, 1872.

"We have got the bed-serge sheeting ready to come out of the loom. Seeing that we won't get all finished by the time, we purpose making a variety of different kinds. The next thing we will make will be the coarse serge; then a piece of sacking."

MY DEAR SIR,—

16, Mark Lane, E.C.,  
22nd April, 1872.

The following extract from Mr. Forbes's letter to me will, perhaps, prove interesting to you. His letter is dated Arbroath, 20th April:—

"I have got thirty-three yards of broad sheeting for Dr. Featherston. As it had to be starched before weaving, I have had it washed and laid on the grass at my cottage. I expect to have it ready for calendering on Monday, and hope to get it sent off to him\* about Wednesday or Thursday. It looks very well indeed, and I hope will give satisfaction. He has still to get towelling and linen. \* \* \* By this post I send you sample of your cloth made from your flax and finest tows—Nos. 1A and 1B. You will perceive this yarn has run very much to small hemp. This was a marked feature in the tows, and made it very difficult to spin. The cloth has not been cropped. I shall get the web about Tuesday, and will have it cropped before washing out the starch. This cloth would, I think, do well for coarse sacks and towels. A sample of the coal-bags (cloth) I am to get about the end of next week, and will forward to you as soon as I can."

This will show you that Mr. Forbes has not slackened his efforts to accomplish his promise to you.

Dr. Featherston,  
New Zealand Government Agency.

Yours very truly,  
(Signed) C. THORNE.

REPORT BY W. L. BULLER, Sc.D., F.L.S., ON THE NEW ZEALAND PHORMIUM, WITH SPECIAL REFERENCE TO THE ENGLISH MARKET.

Having written semi-officially to Dr. Hector by every mail since my arrival in England, seven months ago, and communicated full information on several matters relating to the preparation and use of the New Zealand *Phormium*, I do not consider it necessary to refer to these points again, except in a very formal way.

The object of the present report is rather to furnish, in a connected form, some account of what has been done and of what is being done here in the way of developing this article—both as to the preparation of the raw fibre and its conversion into textile fabrics, &c. My main purpose, therefore, is to exhibit, at one view, the progress that the trade in this fibre has lately made, its present estimation in the English market, and its future prospects as a staple article of commerce in the opinion of those most competent to form a judgment.

In preparing this paper I have endeavoured to bring together as much information as possible of that particular kind which, as Dr. Hector informs me, is most needed by persons in the Colony engaged

\* Sample roll sent by Suez, now in Colonial Museum.



in the business of flax-dressing, or otherwise interested in the development of this important branch of Native industry; and, in order to make this information more intelligible, I have obtained from the brokers carefully-selected samples of the various qualities of the New Zealand hemp to illustrate my report.

As it is important that producers in the Colony should not only know exactly what kind and quality of fibre is most wanted, and is likely to ensure a ready sale, but also what to avoid sending, I have thought it advisable to forward also samples of the worst class that was offered at the last sales, with the prices they realised affixed. It must be borne in mind that, but for the temporary scarcity of Manilla, and the very active demand for New Zealand hemp at that time, these inferior qualities brought a much higher price than they could reasonably be expected to fetch again.

It is of the first importance to the interests of the New Zealand trade to keep out this inferior stuff, and, for the next year or two, at any rate, to maintain a rather high standard of quality. As will be seen further on, the collapse last year was due almost entirely to the over-crowding of a new market with badly-prepared fibre.

Those who have studied the subject here are all agreed as to the high value of the *Phormium* fibre; but there are prejudices to be overcome in the minds of manufacturers and others, and till the fibre comes into pretty general use, its qualities will never be properly understood. Anything that operates as a check to its more extended use—such as a shipment of hard, bad-coloured, and half-cleaned stuff—excites suspicion at once, and throws back the trade. The present scarcity of Manilla, and its probable high price in the future, is very much in favour of the low-priced fibres. The New Zealand hemp is making a most favourable impression among the rope manufacturers, who for the last few months have been almost compelled to adopt its use as a substitute for Manilla; and I am informed by the Messrs. Noble that even Frost Brothers, whose former prejudice against it is well known, have lately been using it largely in their establishment.

It may safely be averred that the New Zealand hemp has now taken a permanent hold on the market, and only requires a uniform steady supply of good quality to make it a highly remunerative branch of colonial industry.

I shall, first of all, give an account of a new mechanical invention for preparing the fibre (at present in charge of Messrs. T. and C. Nichols) which promises to prove of great ultimate benefit to New Zealand. The subject was first brought under the attention of the Agent-General by the Hon. H. W. Petre, who has since become a director of the company formed in London for giving effect to this new process on a very extensive scale. The inventors were anxious to obtain a promise of encouragement or assistance from the Government, and, at Dr. Featherston's suggestion, they allowed me to visit their provisional works at New Bradford to witness a series of experiments, which I accordingly did, in company with Mr. Petre and other gentlemen interested in the discovery.

It was arranged that I should communicate unreservedly to the Government the results of this visit, with the understanding, however, that no use should be made of the information till the rights of the inventors have been protected by a patent in the Colony—the necessary instructions for that purpose having already been forwarded to an agent in Wellington.

As the machine in use was only a model worked by hand, the experiments were necessarily on a very small scale, but the results, so far as the preparation of the fibre was concerned, were perfectly satisfactory. By a simple mechanical process, and without any subsequent scutching or hackling, a very clean fibre was produced—approaching more nearly in appearance and texture to Maori-dressed flax than anything I have hitherto seen.

Sample A (enclosed) was produced under my own supervision from the lower half of an immature leaf selected by myself.

Sample B (enclosed) was produced from the upper half of a leaf taken indiscriminately from the bundle.

The whole matter, of course, resolves itself into the question of the cost of production. The patentees are very confident on this head, and, as will be seen from the estimate given below, they believe that they can produce it in bulk, landed in London, at from £17 10s. to £20 per ton.

The principle of the process consists in the separation of the fibre by means of repeated blows or concussions delivered by a descending hammer on the edge of a rounded metal anvil, at such an angle as to free the fibre without breaking it. The anvil is so constructed that the leaf on receiving the blow from above has the refuse matter forced out on both sides of the line of impact, and precipitated into a trough below. I forward a sample of the latter marked A.A.

The rude character of the model marred the success of the experiment from a mechanical point of view, and the process appeared long and tedious. The leaf had to be passed through the machine six times in succession before the fibre was effectually cleansed; but it was explained to us that in the perfected machine this loss of time and labour is obviated by the passing of the leaf over six anvils in succession, after which it is carried by a travelling band or web under a brush and a jet of water, and is then delivered in the condition of the sample (marked C),\* the whole being effected by a single process.

The chief features in this mode of preparation is that no hackling or scutching is required, and there is, consequently, no loss of fibre in the shape of tow: but it appears to me that the machinery will require extremely fine adjustment to make it answer the required purpose.

Messrs. T. and C. Nichols, the managers of the company, have furnished me with the following estimate of the cost of production under their process, basing their calculations on the data afforded by the Report of the New Zealand Flax Commissioners (Sess. Pap. 1871. G.—No. 4.) It will be observed that in computing wages, fuel, &c., the maximum figures have generally been taken, while a very liberal allowance has been made for freight and other charges of transport:—

\* This and other samples, being too bulky for the post, will be sent by first vessel to Wellington.

APPENDIX TO REPORT OF

ESTIMATE by Messrs. T. and C. NICHOLS of the cost of producing two tons fibre (*Phormium tenax*) by their new process.

							£	s.	d.
Ten tons of leaves @ 20s.	...	...	...	...	...	...	10	0	0
Fuel ...	...	...	...	...	...	...	3	15	0
Labor—									
Six men @ 5s.	...	...	...	...	...	...	1	10	0
Ten boys @ 3s.	...	...	...	...	...	...	1	10	0
One Engineer	...	...	...	...	...	...	1	0	0
One Fireman	...	...	...	...	...	...	0	10	0
Superintendent	...	...	...	...	...	...	1	7	6
Packing ...	...	...	...	...	...	...	0	7	6
							<hr/>		
							£20	0	0

For two tons, or £10 per ton.

Freight and transport, inclusive of insurance and charges to London, £7 10s. to £10 per ton. Total cost per ton in London from £17 10s. to £20 per ton—the transport charges being regulated by circumstances.

As a proof of the confidence which exists in the permanence of the trade and in its profitable character, I may mention that in the course of a few weeks only Messrs. T. and C. Nichols have succeeded in floating their company (under the style of “The Colonial and Foreign Fibre Company, Limited),” with a capital of £100,000, the first issue of which, namely, £50,000, is already subscribed.

In order to show the scope of the company’s intended operations, I may be allowed to quote the following extracts from the prospectus just issued by the directors:—

“This company is formed for the purpose of extracting and importing, in a perfectly cleansed condition the fibre of the *Phormium tenax* (or New Zealand flax), the *Musa paradisiaca* (or plantain), the aloe, and other fibre-bearing plants which are found to be growing in various parts of the world, but more particularly indigenous to New Zealand, the East and West Indies, and the Cape Colonies. This fibre forms a most important article of commerce, for which there is an increasing demand. Hitherto no really efficient process has been introduced adapted for effectually and cheaply disintegrating the fresh leaves and stems; and, consequently, millions of tons of plants, from which fibre is obtainable, continue to be wasted for want of suitable means of extracting the fibre while the plants and leaves are in a green state, and the gummy matter or *Parenchyma* is soluble and removable, and before it has had time to harden and become to the manufacturer the obstacle and source of trouble and expense it has hitherto been.

“The company is prepared to achieve this desirable end by the adoption of new, efficient, and powerful machinery simple in principle, inexpensive in construction, requiring but little, and that inexpensive, manual labour, being specially designed for use in the Colonies and countries where the price of labour is high; and which has been invented and perfected after many years of experience and patient research. The machinery has been subjected to severe tests; repeated and careful experiments upon the leaves of the *Phormium tenax* and aloe, and stems of the plantain (specially imported for the purpose), have resulted in an entire success, producing by a single operation, and at a very small cost, most beautifully cleansed and white specimens of fibre, possessing all the characteristics required by the manufacturer as to strength, length of fibre, fineness, and whiteness, infinitely superior to any of the fibres hitherto introduced, which, owing to their imperfect cleansing, are unsuitable for many manufacturers without further costly preparation.

“The marked and highly important contrast between the method now pursued of preparing fibre and that proposed to be adopted by the company is this, that whereas the fibre, as at present imported, is extracted by several tedious, complicated, and expensive processes, involving waste of material, time, and money, and, after all, producing but an indifferent article, the company’s machinery will extract the pure fibre by one process, rapidly, economically, and in a perfectly clean state, uniform in quality, freed from all uncertainty as to result, with little or no waste, and entirely avoiding the injurious use of chemicals, steeping, retting, or other objectionable means, which all tend to damage the quality and character of the fibre.

“The demand for fibrous materials other than silk, wool, or cotton, has increased to a remarkable degree, and still continues to do so, while the supply does not keep pace with it. The importation in large quantities of the company’s perfectly clean fibres will, therefore, prove a great boon to the manufacturer, by affording him a continuous supply of an article thoroughly suited to his requirements, and thereby stimulate a steady demand for the product, add to its value, and give an immense impetus to trade.

“The *Phormium tenax* flourishes uncultivated over immense districts in New Zealand, and from the Report of the New Zealand Flax Commission and other sources it appears that an unlimited supply of leaves may always be relied on at an average of 20s. per ton, yielding in many cases as much as 25 per cent. of clean fibre to the ton of fresh gathered leaves. The successful development of the flax will be of paramount importance to the Colony, and its interests will be greatly advanced by the introduction of the company’s works.”

How far this new process above described may prove a success when applied on a large scale and to the production of fibre in bulk remains to be seen; and some months must necessarily elapse before the completion of the machinery required for the proposed operations.

But the promoters of the scheme are very sanguine, and have promised (should I still be in England) to communicate with me as soon as the full-sized experimental machine is in working order, so that I may have an opportunity of seeing it in action.

It is hardly necessary for me to refer to the fluctuations in the value of New Zealand hemp during the last two years, as they have been sufficiently felt in the Colony; but I am anxious to define the exact state of the market at the present time, and its prospects in the future. To do this satisfactorily I have, besides availing myself of every source of reliable information within my reach, personally seen and consulted the leading fibre brokers in this city, namely, Messrs. G. and J. A. Noble, Messrs. White, Binnie, and Co., Messrs. Barber, Simpson, and Co., and Messrs. Devitt and Hett, and the information thus obtained may be summarised as follows:—

1. It is pretty certain that the New Zealand hemp, having passed through the ordeal incident to the introduction of almost every new article of supply, is now fairly established in the market, and its qualities becoming every day better known and appreciated by manufacturers, the demand for it will increase so long as there is a steady supply.

2. Apart from the effect of rival interests, and the natural hostility of houses representing the Russian, Irish, Manilla, and other fibres, the reputation of the New Zealand *Phormium* suffered terribly from the stocking of the market with only half cleaned or badly prepared supplies. Indeed, I am informed that about November last the quantity of bad New Zealand hemp sent home was such that it had the effect of completely stopping the market. Large consignments were lying on hand, and there were no quotations whatever. The fibre had managed to get a bad name with the manufacturers, and for some time there were absolutely no buyers. By degrees, however, the market became free again. The Messrs. Noble inform me that the change of name (from “flax” to “hemp”) contributed as much as anything else to this improvement. Many of the manufacturers in the country who would on no account take “New Zealand flax” were willing to try “New Zealand hemp,” and allowed them to send a few tons for experimental purposes, and, after an unprejudiced trial of it, sent for more. The collapse operated beneficially in the Colony, by compelling producers to send home their fibre in better order. A few sales of really good quality brought our hemp into favourable notice again, and it has since continued to rise in public estimation and in price—the latter advantage, however, being partly in consequence of the temporary failure of other sources of supply.

3. Much care should be observed in the packing, and stowing as cargo. The slightest stain or taint of sea-damage, on being overhauled at the docks for classification, suffices to bring the bale into the category of “first class—sea-damaged,” and this very seriously affects its value in the market. The attempt to remedy this by employing men to tear out or remove the stained portions has proved a failure, for the bale is then returned by the dock functionaries as “made merchantable,” and the prejudice against it in the sale room is just as great as if marked “sea-damaged.” The brokers recommend small bales, not exceeding 3 cwt. and pressed-packed. Being more portable and manageable in this form than the unwieldy bales often sent, they are less liable to neglect and damage. They likewise condemn the practice of securing the bales with bands of iron hoops, as considerable damage is often done to the fibre through corrosion. A binding of hemp twist is recommended.

Messrs. Devitt and Hett are of opinion that covering the bales with canvas or coarse scrim is little or no protection, and involves unnecessary expense. Their experience is, that parcels having this semblance of “protection” suffer a proportionate share of neglect in the transport, and often arrive in worse condition, or more completely stained, than bales left uncovered. I call attention to this particularly, because of an opinion to the contrary (and adverse to Mr. Chilman’s) expressed by the Commissioners, at page XX of their Report (Sess. Pap. 1871. G.—No. 4). It would be very advisable, however, to try the experiment of converting into cheap bale covers the refuse leaves of the *Phormium* which are rejected in the process of manufacture, as already suggested by the Commission (l.c., p. 20).

4. Above all things else, the brokers urge the importance of keeping up the quality of the shipments to something like the present average standard. This will make the market perfectly safe, and a consumption which even now may safely be reckoned at from 300 to 400 tons per month will speedily increase to double that quantity.

I beg to forward enclosed the last Trade Reports of New Zealand hemp, as per margin,\* and, for the reasons stated above, I beg to furnish the following samples of fibre, with Messrs. Devitt and Hett’s remarks on each:—

SS with BB underneath. This is fine fibre, white colour, and good length. It is not perfectly clean, but the colour being so good accounts for the high price obtained for it—namely, £42 15s.

OCH. Good bold fibre, perfectly clean, and good length. The colour is good, but had it been whiter a higher price would have been obtained. It was sold at £42.

F. & W. NELSON. Good fibre, good colour, and well cleaned, but rather short. Sold at £40.

HFM. This is useful hemp, of good medium quality. It is fairly cleaned; good fibre, length and colour. We consider that for regular shipments of quality similar to this the price will be well maintained. It sold at £36 10s.

GA with W underneath, in heart. Fair length and fibre, but imperfectly dressed, and dull colour. Sold at £33.

X. Short, with heavy straw. Sold at £27 15s. This is a high price, and could only have been obtained in an exceptionally good market. We would strongly impress on shippers the necessity of refraining from sending home such quality as this, as the value is most uncertain.

I beg to forward, also, the following samples furnished by Messrs. White, Binnie, and Co., fibre brokers of this city:—

HF. Ex ‘Halcione,’ from Wellington. Sold 27th March, 1872, at £36.

“WAIKUKU.” Ex ‘Queen of the South,’ from Lyttelton. Sold 24th April, 1872, at £33.

\* G. and J. A. Noble, 3rd April, 1872; Devitt and Hett, 24th April, 1872.

M. Ex 'Halcione,' from Wellington. Sold 27th March, 1872, at £33 10s.

WS & G with D underneath. Ex 'Queen of the South,' from Lyttelton. Sold 24th April, at £33. Also, for comparison, samples of the following :—

Quilot hemp, from Manilla. Sold April, 1872, at £67.

Sisal hemp, from Mexico. Sold April, 1872, at £51.

As previously reported, the specimen bale from the Cape Egmont Company's works (wet scutched and the ends hackled), which was sent home by Dr. Hector for submission to the brokers, was valued at £45. I return a sample of this bale (marked CEC) for comparison with those on price list. With Dr. Featherston's approval, I have arranged to have this sample bale (ex 'Halcione') carefully repacked and exhibited at the ensuing International Exhibition.

From all the information I can gather, it will not, under any circumstances pay to send the tow home. Occasionally there is a brisk demand for small stocks, up to £16, but, as a rule, it is quite unsaleable at anything like a profitable figure.

Messrs. White, Binnie, and Co., who have taken much interest in the introduction of the New Zealand hemp into the English market, have given me a report on the subject, which I beg to forward herewith (Appendix I.)

I beg to furnish also (Appendix II) a letter from Messrs. Manning, Collyer, and Co., of 141, Fenchurch Street, and a memorandum by Messrs. Devitt and Hett, (Appendix III); the opinion of both these firms on the subject in question being entitled to the utmost weight.

I come now to the question of the adaptability of the New Zealand hemp for textile fabrics. Mr. C. Thorne, of 16 Mark Lane, has been for a long time past most persevering in his efforts to bring this article into use among the weavers and spinners of his acquaintance, and the results of some of the interesting experiments, which have been made through his influence, have already been communicated to the Colony. The great difficulty is to get any of the manufacturers to undertake the necessary trouble with small parcels. The extracts from Mr. Forbes's letters to Mr. Thorne, previously communicated through the Agent-General, will afford sufficient proof of this.

Dr. Featherston has, however, after considerable delay, and much personal urging, induced some houses to give it a trial on a small scale, the fibre being supplied gratis from this office; and it is only by continued individual effort of this kind that we can hope to have any thing done, till the fibre has sufficiently made its way to command attention on its own account.

The best qualities of *Phormium* fibre, as imported, are fit only for fine roping purposes, and they require to undergo a certain amount of skilful preparation before they are available for the cloth mills. The chief objection, at present, to Steart's Patent (for which Mr. Thorne is assignee), as applied to the hemp obtained in the market, is the expense of thus preparing it for manufacturing purposes; but Mr. Thorne assures me that the process can be applied to the green leaf with equal or even greater success, and without any additional expense, thus saving on the ultimate cost of the required article the whole of the preliminary labour of dressing the hemp; and in support of the statement as to the quality of his production direct from the green leaf, he has sent me a sample, which I have marked CT, and now forward with the rest.

Mr. Thorne has addressed to me a letter (copy of which I furnish, Appendix IV), expressive of his full confidence that with perseverance on the part of importers and a regular supply of fine soft fibre, the New Zealand *Phormium* will eventually be as freely taken by weavers and spinners as those fibres now in general use.

Mr. A. K. Forbes, of Hatton Mills, Arbroath, Spinner, writes under date of April 28th :—

"I think I can add little to what I have already said about New Zealand fibre—in fact, nothing has transpired to alter my opinion of its adaptability for textile fabrics. Worked alone it is too expensive, both in spinning and weaving, but for mixing purposes, if it can be brought in at a fair price, it would be a great boon."

He also forwards a small piece of cloth, respecting which he writes to Mr. Thorne as follows :—

"By this post I send you sample of cloth made from your flax and finest tows. The cloth has not been cropped. I shall get the web about Tuesday and will have it cropped before washing out the starch. This cloth I think would do well for corn sacks and towels. A sample of the coal bags (cloth) I am to get about the end of next week, and will forward to you as soon as I can."

I am forwarding this sample of cloth by post with this report, because, as Mr. Thorne justly remarks in the note covering it, "It is different to any yet sent to the Colony, and makes further progress, proving still more strongly the adaptability of *Phormium* fibre for textile fabrics."

In addition to the various samples of hemp enumerated above (to be forwarded to the Colony by first opportunity) I send also some excellent specimens in bulk, of string and small cordage made of pure New Zealand *Phormium*.

I may here state that the practice of mixing New Zealand hemp with Manilla in rope-making is now universally condemned, and, so far as the legitimate trade is concerned, has been discontinued; for it has been ascertained by experience that the difference in the elastic properties of the two fibres has a most injurious effect on the wearing qualities of the rope.

In compliance with Dr. Hector's request, I have arranged to have a quantity of machine-dressed *Phormium* made up into rope, with paraffine oil, in the manner suggested by Drs. Church and McNab in their Report on the Chemistry of *Phormium tenax*.

Professor Church has recommended me to try a mixture of one part of oil to two of tar, and another of two of oil to one of tar, and also to try the experiment with oil alone. He states in one of his letters to me :—

"I found that wood tar, owing to its proneness to oxidation, set up an injurious change in the fibres of *Phormium*. This change was much reduced when that kind of paraffine oil, called lubricating or machinery oil, was used, mixed with Stockholm or other wood tar, and it appeared to be *nil* when the oil was used alone. The oil I prefer has a specific gravity of not less than .890, and in cold weather has much crystallized paraffine in it."

## Appendix I.

DEAR SIR,—

6, Mincing Lane, E.C., London,  
27th April, 1872.

As promised, we append some memoranda respecting New Zealand hemp, which may be useful to you.

The consumption of New Zealand hemp in all last year in this country and the quantity exported to Europe and the United States, Canada, &c., amounted together to 3,213 tons. There are no statistics to show separately the quantity consumed and the quantity exported. We received during the same period from New Zealand 2,950 tons. This year we have received during the three months, January to March, 486 tons, and the consumption and export was 830 tons. Previous to 1st January, 1871, no statistics were taken. Notwithstanding the progressive rise in value from an average price of about £23 to an average price of £36, the consumption has not only not fallen off, but has slightly increased. The trade now are well acquainted with and accustomed to the use of New Zealand hemp, and as the cleaning of it has greatly improved, and is improving, the objections to its use which were frequent when it was imported in a very strawn and unclean state have almost disappeared; and we think the New Zealand shippers may rely upon a consumption of 3,000 to 4,000 tons per annum without any material variation or depreciation in value.

The demand for hemp and fibres of all descriptions has of late years been greatly on the increase, and it is well worthy of notice that notwithstanding the introduction and large consumption of New Zealand, Sisal, Bombay, and other fibres, the consumption of Manilla, &c., does not fall off, and that their value has been greatly enhanced, as the supply does not materially increase.

The price of New Zealand hemp must always depend greatly on the price of Manilla hemp; and now that the value of New Zealand hemp has risen to its proper level, we may expect it to be affected from time to time by the variation which may occur in the price of Manilla hemp. The value of good roping Manilla is to-day £51 per ton; of Quilot Manilla, £66; of Sisal, £51 per ton. So far as we can judge, the increasing consumptive power will effectually prevent any material fall in the price of Manilla.

Many years ago, when an attempt was made to introduce New Zealand hemp into the market, the value of Manilla good roping was about £23 per ton, but of late years it has varied between £46 to £56 per ton, and the old price is now out of the question.

We do not wish to be over sanguine as to the prospects of New Zealand hemp, but if the shippers will clean it carefully, and send it to us in good condition, we do not anticipate any difficulty in obtaining £35 per ton for a supply of 300 tons per month.

W. L. Buller, Esq.,  
7, Westminster Chambers.

We are, &c.,  
WHITE, BINNIE, & Co.

## Appendix II.

SIR,—

141, Fenchurch Street, E.C., London,  
29th April, 1872.

In reference to your inquiry as to the prospects of New Zealand hemp in this market, we have a very confident opinion that the consumption of this material will continue to increase for cordage purposes. The prejudice so long existing against it has all but disappeared, while by some consumers it is preferred to Manilla hemp, when properly prepared, the durability of the rope being very great.

For textile purposes, there is also strong reason to expect a large demand, and should the result of recent experiments be confirmed by working on a large scale—of which we have no doubt—it is scarcely possible to estimate the quantity that may ultimately be required.

It is of the first importance, both for cordage and textile purposes, that the fibre should be suitably prepared, and the lower the price at which this can be done the greater will be the ultimate consumption.

Prices have now risen to a rather high point, but they are still about £10 per ton lower than the corresponding qualities of Manilla hemp. We can hardly expect present prices to be maintained should any important supplies arrive, but we think a minimum price of say £30 to £35 per ton for well-cleaned hemp may be depended upon for cordage purposes.

W. Buller, Esq.,  
7, Westminster Chambers.

We are, &c.,  
MANNING, COLLYER, & Co.

## Appendix III.

37, Mincing Lane, London.  
27th April, 1872.

*New Zealand Hemp.*—At present the market is very strong, as there is a short supply and good trade demand. We have little fear as to its future prospects should shippers be careful in sending home regular supplies of good quality. For such we have little doubt of present prices being maintained; and 400 tons per month we think might be easily moved off. We should like to call attention to the packing of the bales. These should be pressed—weighing from 3cwt. to 4cwt., and the hemp done up in heads. Care on this point sometimes considerably enhances the value.

Hoping these remarks may be found useful,

W. L. Buller, Esq.,  
7, Westminster Chambers.

We are, &c.,  
DEVITT & HETT.

## Appendix IV.

16, Mark Lane, London, E.C.,  
26th April, 1872.

MY DEAR SIR,—

Yours of this date relative to New Zealand *Phormium* I have duly received.

I am satisfied that the fibre can be adapted to textile fabrics, notwithstanding that the various analytical reports on the formation of the fibre are calculated to suggest a contrary result. The first difficulty is to *prepare the fibre*, and render it fit for spinning, and the next difficulty is to find an enterprising manufacturer willing to operate upon it. Both these I have overcome; for, after preparing the fibre in England from the dry leaf as imported, I succeeded in obtaining the assistance of Messrs. E. Parker and Co., of Dundee, and Mr. Alexander K. Forbes, of Arbroath; and by their valuable aid, the fibre prepared by me was spun into yarn and manufactured into cloth, samples of which, as you are aware, have been duly forwarded to New Zealand.

Since then Mr. Forbes has spun up for me a further quantity of fibre into various sized yarns, from which sacking, coarse sheeting, and canvas have been manufactured. These articles are usually made from Italian hemp, Russian flax, and similar fibres. Still there are many *prejudices* to be overcome before the advantages of using *Phormium* fibre will be believed in. With perseverance on the part of importers, and a regular supply of fine, soft fibre, the desired result may be obtained, and the *Phormium* fibre will eventually be as freely taken as those fibres now in general use. It will necessarily be a work of time, for many manufacturers are unwilling to believe that the fibre can be adapted to their uses, and are too bigoted to give it a trial. Even practical proofs fail to convince them, for when articles *manufactured from this fibre* are shown to them they express their doubts as to the correctness of the statement, and offer their own opinion that the fabric is composed of Italian hemp, and *not* of New Zealand flax. Fortunately there are happy exceptions to these "disbelievers in any thing they do not understand," as may be seen from the success which attended the exertions of the friends before named.

I have now some fibre in the hands of an eminent firm of spinners, at Belfast, but until success has crowned their efforts, I do not think it right to mention their names. My fibre, having been entirely prepared from the *dry* imported leaf, it is not so soft or freed so effectually from the gum, as if it had been taken direct from the growing plant, and my friends write me that it is too coarse to make a fine yarn, but they do *not* express any doubt as to their being able to spin it, or to its adaptability for textile fabrics. From their report I am led to hope they will be able to give me their attention shortly, and that I shall receive the cloth within a month or so. Before this mail leaves I expect Dr. Featherson will be in possession of the sheeting which Mr. Forbes has had made for him from the Native-dressed flax. If Dr. Featherson had been in possession of a further quantity of from 3cwt. to 4cwt. of Native-dressed flax, I think I could have persuaded my Belfast friends to give it a trial.

My *practical* spinning and weaving friends express themselves as fully satisfied from the uses to which they have been able to apply the fibre worked up for me, that the New Zealand *Phormium*, if better, or equally as well prepared, would prove very useful to them for mixing with other fibres, and would give strength to the fabrics, my experiments having been on a sufficiently large scale to enable them to form a decided opinion. I am especially indebted to Mr. Forbes for the very great interest and trouble he has taken in giving the fibre a practical and careful trial. I write to him by to-night's post to ask him if he has time to write his views on the fibre. Should he do so I will send them to you.

Yours very truly,

C. THORNE.

W. Buller, Esq.,  
7, Westminster Chambers.

## Appendix V.

6, Mincing Lane, London, E.C.,  
30th April, 1872.

DEAR SIR,—

We send you to-day, as requested, sample of flax in a condition which it ought *not* to be shipped. It is worth £28 per ton, as there is rather a scarcity of unclean hemp at present, and the price sells it; but we could not guarantee even to find a market in normal times for such hemp.

We are, &amp;c.,

WHITE, BINNIE, &amp; Co.

W. L. Buller, Esq.,  
7, Westminster Chambers.

(No. 707).—MR. W. L. BULLER to DR. HECTOR.—30th May, 1872.

I do myself the honor to forward by sample post to-day to your address—1. A sample of sacking, manufactured from the tow of the New Zealand *Phormium*. 2. A sample of Scotch sheeting made from pure New Zealand hemp, machine-dressed.

By next P. and O. mail steamer from Southampton (on the 6th June) I purpose sending you two bolts of sacking or rough canvas (both single and double warp), for the purpose of showing to what practical purposes the coarse fibre and refuse tow might be applied in the Colony.

The proposal to establish a manufactory for this sort of material in New Zealand has already been mooted among capitalists here interested in the Colony. It is believed that this kind of sacking would be found very suitable for woolpacks, and for other colonial purposes.

I have also to inform you that I have arranged to have a portion of the bale of Cape Egmont Company's flax (ex 'Halcione') made up into cordage of various kinds for the International Exhibition. Samples of the sheeting and other textile fabrics manufactured from pure New Zealand *Phormium* will also be exhibited.

(No. 708.)—MR. W. L. BULLER to DR. HECTOR.—30th May, 1872.

In pursuance of your instructions, I have arranged with Professor Church, of Cirencester Agricultural College, to furnish a further and more exhaustive Report on the Chemistry of the New Zealand *Phormium tenax*. I beg to furnish herewith a copy of our correspondence on the subject.

7, Westminster Chambers,

Victoria Street, Westminster, S.W.,

DEAR SIR,—

29th May, 1872.

On behalf of the New Zealand Flax Commission, I have much pleasure in accepting your offer to prepare a further report on the chemistry of *Phormium tenax*, of the kind and on the terms mentioned in your note of 25th instant.

I need hardly say that I shall be ready to assist you in every possible way—by forwarding classified samples of the fibre for comparative examinations, or by furnishing any information in my power as to the growth and development of the Native plant.

I shall take an early opportunity of seeing Dr. Hooker, who, I am sure, will assist us to the utmost of his ability.

If, however, a sufficient supply of green leaves cannot be obtained from Kew Gardens, I shall have no difficulty in getting a supply from Ireland.

Professor Church, M.A.,  
Cirencester College.

Believe me, dear Sir,

Faithfully yours,

WALTER BULLER.

MY DEAR SIR,—

Royal Agricultural College,

Cirencester, 25th May, 1872.

I give on the next leaf a list of the subjects which I propose to include in the Second Report on New Zealand Flax. If it be thought that the investigation should extend to other particulars, will you let me know?

I cannot promise the Report before 31st October in the present year, as the analytical work required will be very tedious and troublesome.

I am willing to undertake the investigation of the four subjects named on the annexed leaf for the sum of £40.

W. Buller, Esq.,  
7, Westminster Chambers.

I remain, dear Sir,

Yours faithfully,

(Signed)

A. H. CHURCH.

P.S.—I take it for granted that Dr. Hooker will, as heretofore, place specimens of the fresh plant at my disposal. I feel sure that he will kindly provide this important help.

*Phormium tenax*.—Subjects for a further Chemical Report.

- (1.) A more complete analysis of the fresh plant, including a further study of its proximate constituents.
- (2.) Determination of the chemical differences of the fibres from the several parts of the leaf, and from leaves of various ages.
- (3.) Experiments as to the best ways of treating the fibre, so as to prepare it for its several uses.
- (4.) Further examination of these fibres, so far as may be necessary for comparison.

(No. 272.)—MR. W. L. BULLER to DR. HECTOR.—8th June, 1872.

I regret to have to report that, owing to a general strike on the part of the workmen, all the North Ireland mills are at present closed, and, as a necessary consequence, the further experiments with New Zealand *Phormium* are at a standstill.

By last mail I sent you samples of sacking, manufactured by Mr. Forbes out of pure New Zealand fibre. Referring to these samples, Mr. Forbes says, in a letter to Mr. Thorne, "I can give the best certificate to the quality of the fibre out of which the sacking has been made, as these have required no extra work, and this, I think, is important, as being the article of cloth which the Colony is most anxious to introduce. I hold that the colonists can make all their own packs, &c., from the New Zealand fibre.

Mr. Forbes writes that the towels (New Zealand *Phormium*) ordered by Dr. Featherston will be dispatched to London this week. I hope to be able to report by next San Francisco mail that the Irish flax trade "strikes" are over, and that our experiments are again in progress.

(No. 273.)—MR. W. L. BULLER to DR. HECTOR.—12th June, 1872.

I do myself the honor to forward herewith bill of lading for one case (containing samples of sacking), shipped to your address by the present mail *via* Suez—freight and charges paid here.

I beg to forward at the same time copy of a letter from Mr. C. Thorne, whose most valuable assistance I have again to bring under your notice.

I hope by next mail to be able to report what steps have been taken in order to get this industry properly represented in the International Exhibition.

Enclosure.

16, Mark Lane, London, E.C.,  
10th June, 1872.

MY DEAR SIR,—

Yours of the 8th I received this morning. I *did* get the bolts of cloth away by the P. & O. steamer, which left on the 8th instant, as I promised you I would, and herewith hand you the receipt for the box for you to send to Dr. Hector, to whom it is addressed.\* The package contains—

*1 bolt, 38½ yards canvas	} All pure New Zealand hemp.
1 " 36 " single warp sacking	
1 " 27 " double " "	

The canvas is made from fibre prepared by me, yarn spun by Mr. A. K. Forbes, and the cloth made by Messrs. John Walker and Co., Stanley Works, Arbroath. The cloth called sacking is made partly from fibre prepared by me here, and partly from fibre prepared in New Zealand. Only the tow has been used in the manufacture of this sacking, and it is considered quite fit for woolpacks, coal sacks, and corn sacks. Finding a place in the box which required filling, I put in a hank of the line fibre and some tow, from which the canvas was made; also a hank of the fibre from which the tow was taken to make the sacking, but this latter has been lying about for some time, and does not look well; it, however, shows how soft the fibre is.

I have long upheld that New Zealand hemp can be softened and rendered fit for textile fabrics, and Mr. Forbes has put the matter beyond a doubt by his very practical experiments and proofs. His latest production of cloth, viz., "fine towelling," entirely of New Zealand hemp, I hand you herewith. It is needless for me to enter into detail regarding these positive evidences of what the fibre can be utilised for; but I am sure Mr. Forbes's letters to me, when handing the particulars of the fabrics, will prove of interest to all concerned, and I therefore annex extracts from his letters bearing upon the matter. With regard to the canvas, some people have expressed a doubt as to whether it would stand the effect of water. Mr. Forbes maintained it would. I laid the three bolts on the grass, and had them well watered; heavy rain fell before they were removed from the grass. The result was as follows:—

	Length when received.		Length when wet.		Length when redried and calendered.
*1 bolt	38½ yards	...	36 yards 1 foot 6 inches	...	38½ yards
1 "	41 "	...	39 " 0 " 3 "	...	41¼ "
1 "	40 "	...	38 " 0 " 9 "	...	40 "

I will see you in a day or two. In the mean time I remain,  
Very faithfully yours,

W. Buller, Esq.,  
7, Westminster Chambers, S.W. C. THORNE.

[Extracts from various letters from A. K. FORBES, Hatton Mills, Arboath, to C. THORNE, 16, Mark Lane, E.C., London.]

"12th December, 1871.

"I have just been to the factory, and found your canvas all ready, so had it baled and sent off. \* \* There are three bolts, 40, 41, and 38½ yards. They are good weight, and the manager says they will stand a great deal of wear. He would have liked the weft of the line instead of the tow, which would, he said, have made a cloth that would never wear out."

"21st May, 1872.

"I have this morning been to the factory where your cloths have been finished, and have given orders for their despatch by rail to you to-day.

- "3 bolts tow sacking, made from GGG with T in diamond, 1, 2, 3 tows. Single warp, marked 1, 2, 3.
- "4 bolts tow sacking, do., do., do. double warp, marked 4, 5, 6, 7.
- "1 bolt bleached sheeting, made from flax line and wefted with tow, No. 1A.
- "1 bolt do., do., No. 1B, marked 8.

"I think these are all good cloths, and you will find the bleached sheeting nice and soft; a little lumpy, caused by the nap in the tow. The manufacturer is now making a bolt of light sacking from No. 1A, No. 1B, and Nos. 1, 2, and 3 tows. \* \* \* The sacking is all quite easy to weave, and requires no more work than ordinary yarns; but the sheeting is more difficult. I hardly like to say as yet that the fibre can be profitably employed. \* \* \* I think what you say puts it in a right light—that a loss will have to be submitted to before it is decidedly introduced into this country for textile fabrics. As to its adaptability for such, I have no hesitation in saying that I have proved its usefulness for that purpose. I can give the best certificate to the quality out of which the sacking has been made, as these have required no extra work, and this, I think, is important, as being the article of cloth which the Colony is most anxious to introduce. I therefore hold that the colonists can make all their own packs from the New Zealand fibre."

"3rd June, 1872.

"I have given the questions you ask a good deal of consideration, as careful replies to these are of great importance. For woolpacks the fibre would come into competition with jute; and, if it were put into the market here, would have to compete with jute selling for these purposes at from £15 to £20 per ton. For coal bags, which I believe it is quite fit for, it would compete with common Russian

\* Now in the Colonial Museum.



hemp, at a price of from £20 to £25 per ton. For corn sacks it would compete with common flax tow, at a price from £23 to £28 per ton. I have no doubt there will be a great difficulty to get the fibre introduced here; but I put most value on it from the fact of its easy and large production in the Colony, and the ease with which it can be put into packing fabrics. It is of the utmost importance to a Colony, which requires so large supplies of packing, that the colonists should have now been shown that they have a fibre growing in their Colony quite adapted for these packs—wanting only enterprise to put up a mill and factory for the purpose of making them. \* \* \* I should imagine that once the colonists have a first-rate process they can send their lines here to sell at a high figure for roping, and retain the tows to make into woolpacks and sackings, which will be a means of realising a handsome profit to the growers.”

“8th June, 1872.

“By this post I send you two samples of towels for Dr. Featherston, \* \* \* also towelling, and made from warp of Dr. Featherston's Native-dressed and your own 5lb. flax line. I almost think yours looks the prettier of the two, although the full-bleached looks very nice. The pattern comes out very well. These samples have not been cropped. When the web is sent it will look cleaner, and have a better finish. I hope you will be pleased with them. I shall despatch some more webs and samples to you next week, about Wednesday or Thursday, and, if possible, a web or two to Dr. Featherston. \* \* \* I am most anxious your Irish friend should be successful in his experiments; the Irish have more “gush” than the Scotchmen, and if the spinning and weaving succeeds there they will be more ready to take it up than Scotchmen; and I have no doubt, were your process adopted in New Zealand, a line could be sent there fit for anything.”

### III.—REPORTS RESPECTING PHORMIUM CULTIVATIONS.

#### I. WELLINGTON.

REPORT on the Growth of ROOTED PLANTS and SEEDLINGS of *Phormium tenax* in the Botanical Gardens, Wellington, by Dr. HECTOR.

The experiments to which this report refers were undertaken for the purpose of ascertaining by practical experience the rate of growth of *Phormium* plants, and whether the different varieties can be propagated with certainty from seed.

Fourteen varieties were selected, with the assistance of the Natives at Taranaki, by Mr. Hulke, and seeds of each carefully collected and forwarded to the Commissioners, the Native names being verified by reference to the list furnished by Mr. T. Kelly, who has devoted much attention to this subject. Six of these varieties were subjected to experiment.

1. *Raumoa*.—Light green leaf, reddish brown keel and edge, narrower underneath.
2. *Parekoritawa*.—Leaf very bright green, longitudinal stripe, of sulphur colour; fibre very good; edge and keel orange colour.
3. *Huhirua*.—Good fibre; easily separated from gum; leaf bluish green, narrow edge, black or very dark brown; keel reddish chocolate; leaf gradually narrows to a point.
4. *Takaitapu*.—Fibre very strong; leaf erect, brown edge.
5. *Korako*.—Dark green leaf; edge, a narrow line of dark brown; keel, a pale yellow.
6. *Atiraukawa*.—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.

The seeds were sown in boxes on 10th December, 1870, and came up freely in from eighteen to twenty-one days.

They were allowed to remain in the boxes till the month of June following, when they had attained a height of five to six inches. They were then planted out in rows in rich well trenched land in the bottom of a gully, the land having been carefully drained, and arrangements made for thorough irrigation when necessary.

At the same time some of the seedlings were placed on hill slopes, but also in well tilled ground.

The rooted plants of the same varieties, each consisting of a single fan root, rootlets, and three or five leaves, were planted out in rows in a sloping gully where there is deep rich moist soil. The leaves, except the central shoot, died down in nearly every case, and three months, from March to June, elapsed before they began to show any signs of growth.

The period to which the following notes of growth refer, both as regards the seedlings and the rooted plants, is from June, 1871, to July, 1872.

#### *Seedlings.*

The determination of the varieties which the seedlings most resembled was made by Mr. Kelly, who originally named the plants from which the seeds were collected.

1. *Raumoa*.—On the slope this variety had made hardly any progress during the year, having only five or seven narrow lax leaves, eight to twelve inches in length. On the rich land they had about doubled their size; but very few plants resembled the original variety of this name, most of them being like *Oue*.

2. *Parekoritawa*.—Variegated flax. On the slope this variety had made no progress; but in the bottom land it showed greater vigour than any of the others, having made in some cases fifteen fans, with leaves thirty inches in length. The seedlings were not true to the plant, none of them showing variegation, but most reverting to the character of *Oue*, with one or two having the characteristic black edge of *Taihora*.

*Huhiroa*.—The seedlings of this variety were very thin and lax, none having made more than eight fans, with leaves twelve to twenty inches in length. The characters of the variety could not be distinguished in any case, all of the plants resembling either *Oue* or *Takaiapu*.

4. *Takaiapu*.—Only a few plants of this have come up true, most of the others being like *Oue* and a few like *Huhiroa*. The growth is pretty fair, most plants having made from ten to twelve fans, with leaves two feet in length.

5. *Korako*.—Nearly all the plants of this variety came up like *Oue*, only a few having a bronze tinge like *Atiraukawa*, none being true. The growth was fair, showing ten fans, the largest leaf being thirty inches.

6. *Atiraukawa*.—Also like *Oue*, and with the same growth as last.

From this it appears that at the age of six months as reported last year, the seedlings show no difference of character, but after being planted out for twelve months longer they begin to show irregular variation, in which a few of the best known varieties are represented, but that these occur indiscriminately among the seedlings from every variety, none of the seedlings coming up true.

As every care has been taken throughout the experiment to secure accuracy, this sporting must be due to the inoculation of the flowers of the different varieties by insects and birds before the setting of the seed.

As a rule all the varieties have shown a marked tendency to revert to one form, which is nearest to that of *Oue*, which has a narrow olive green leaf with orange coloured keel and edge. This variety, according to the best authorities, is the typical *Tihore*, or cultivated fibre plant of the Natives.

#### Routed Plants.

1. *Panekoritawa*, or variegated flax.—The year's growth from a single fan root of this variety is six fans, the longest leaf being two feet and a half.

2. *Atewhiki*.—Bronzed flax with red keel, had made two to three fans, with leaves three feet six inches.

3. *Tutaiwiki*.—Bronzed flax with black keel. No fresh fans have been formed in any of the plants of this variety, but the growth of the leaves is very vigorous, the longest being five feet, and there being seven to nine to each plant.

4. *Ngutunui*.—Has made very little height, but has thrown out many small fans, so that there is good promise for next year.

6. *Atiraukawa*.—Nine to ten fans, with leaves four feet long. This variety has made most progress of any.

A plant of *Ngutunui* was lifted and examined. The original stock had entirely rotted away, leaving only the decayed leaves and a hard fibrous root mass. From this there had been four distinct root sprouts, two of which had four fans, one three, and one only one fan, giving a total of fifty-six leaves, the last formed fan having five leaves, the second pair being two feet in length, and the largest of any on the plant. From these root-masses long orange coloured rootlets were given off for two feet, maintaining a thickness of one-third of an inch in diameter, and from these towards the base short root fibres ramify. The weight of leaves on this plant after removing the butts was thirty-six ounces, which yielded on boiling with soap 15½ per cent of pure fibre, which therefore represents the produce in the first year after transplanting, but only one-third of which would be available as outside leaves fit for cutting.

#### II. NEW PLYMOUTH.—Mr. HULKE to Dr. HECTOR.

I have the honor to make the following Report, being the first Annual Report of the present state of the Experimental Nursery for the Cultivation of *Phormium tenax*, established by the order of the General Government in this Province.

The number of different varieties of *Phormium* now in cultivation has been increased by the addition of three hitherto unprocured—*Korako*, from near Hawera; *Ngutu parara*, from Oeo; *Te puna*, from near Waitara. Of these *Te puna* is by far the largest variety of *Phormium* I have yet seen, the leaves being from seven to eight inches broad, and nine feet long; it requires rich soil and a sheltered position. *Korako* is highly spoken of by the Natives as producing a good fibre fit for many purposes. I am unable to speak as to its growth from the short time I have had the plants.

Among the other varieties in cultivation, I have no hesitation in confirming the high opinion formed by all Natives of the general value of *Atiraukawa* this in the Nursery has outgrown the rest, and will, I have little doubt be largely planted, should the cultivation of *Phormium tenax* ever be proceeded with. *Huhiroa* is second only to *Atiraukawa*, in quality and growth, and is one of the few varieties worth planting. I would also include among the quick growing varieties *Ngutunui*, *Taiore*, *Tito-o-moe-wai*, *Raumoa*, *Tutaiwheke*, *Manunui*. All these thrive most luxuriantly in the common soil of the Nursery, and offer many fans fit for cutting at the present time. From their growth and general appearance I conclude that *Oue* and *Tihore* are the same. *Paretorihawa*, although throwing out a large number of fans, is slow growing, and never will be cultivated for other than ornamental purposes. *Tarariki* is very dwarf, and not profitable for manufacture. *Atewheke* I include among the ornamental varieties. *Rataroa* is at present very dwarf, with strong growth, and promises to be valuable for fibre.

All the above mentioned varieties of *Phormium* have now arrived at a stage of growth sufficiently matured to enable them to be classified under their respective names; many of them have greatly altered in their markings since first planted, shewing quite a different habit.

Among the many thousand seedlings raised in the Nursery in 1870 I have selected three varieties, showing distinct forms of variegated foliage to any I have yet seen, one promising to be a very fine variety. The difference in the growth of the seedlings is also very remarkable, the seed being sown the same day, some on the surface of an old hotbed, and some in the ordinary soil of the garden, the former being quite a twelve month's growth in advance of the latter.

An application having been forwarded by you from the Secretary of the Canterbury Flax Association for a collection of plants of the best varieties of *Phormium*, three hundred strong plants were forwarded in September, 1871, and at the present time some thousands of both seedlings and matured fans of the best varieties are ready for distribution.

During the past year the Nursery has been visited by many persons interested in the manufacture and growth of *Phormium tenax*, all of whom have expressed their surprise at the luxuriance of its growth and the utility of the nursery.

I am happy to state that the expense for the year has been considerably within the estimate, and does not exceed the sum of £6 12s. 6d. Even this, if we take the value of the donation to the Canterbury Flax Association into account, will present a much smaller figure. Details of the expenditure I enclose herewith.

### III. CANTERBURY.

INTERIM REPORT ON *Phormium tenax* cultivated in the GOVERNMENT DOMAIN, Christchurch.—By JOHN F. ARMSTRONG, Government Gardener.—31st July, 1872.

In July, 1869, I received from the Government 852 plants of *Phormium* from Hawke's Bay, and twenty-four from Taranaki, which comprised the following ten varieties, viz:—*Oue*, *Tihore*, *Tapoto*, *Huhiroa*, *Atiraukawa*, *Akewiki*, *Korako*, *Rauhangara*, and *Hatuwa*.

These were planted on a piece of ground dug two feet deep, in rows six feet apart each way, and grew remarkably well the first season, but unfortunately they proved to be too tender for the open ground in the Domain. The leaves made in summer were invariably destroyed by the hard frosts of our southern winter, and they will probably die out in a year or two. Of course, under these circumstances, they are not worth importing into Canterbury,

About the same time, 100 plants of the common dark-edged variety growing about Christchurch were planted near the others, under precisely similar conditions, which in two years gave a yield averaging thirty tons of green leaves per acre.

Experience has shown me that the seed of *Phormium tenax* should be sown as soon as ripe, say in March, in the richest soil available, in drills six inches apart, and not more than half an inch deep, and the ground kept perfectly free from weeds. When the seedlings are six inches high they should be finally transplanted. I have raised thousands of seedlings without any difficulty whatever, and in no case do I ever soak the seeds.

### IV.—REPORT BY A SUB-COMMITTEE ON THE PHORMIUM PLANTATIONS OF THE CANTERBURY FLAX ASSOCIATION.—31st July, 1872.

*The Association's Plantation in Antigua Street.*—The extent of ground under cultivation comprises about one acre, the subsoil being clay, with a rich peaty soil on top; although only planted during the months of September and October last year, the whole of the plants exhibit signs of vigorous growth. Over 3,000 plants were put out, and were planted in clumps of three. The leaves, as measured now, vary in growth from two feet six inches to four feet six inches. That portion of the ground which has been kept clean from weeds is found to be more favourable to the plants stooling out than that which has not been similarly treated. Several of the plants which were put out as late as November last exhibit a more stunted appearance, but still show signs of having taken a good hold of the soil. The plants forwarded by the General Government from Mr. Hulke's Nursery at New Plymouth, have not grown in the same proportion as the Canterbury plants; this, however, may partly be accounted for from the length of time they had been lifted, and the state in which most of them were received; and they had, moreover, to contend against an unusually dry summer.

*The Plantation in the Government Domain.*—The plantation in the Domain is under the charge of Mr. Armstrong, the Government Gardener. The plants here, indigenous to the Province, are growing in a most luxurious condition. Upon measuring some of the leaves, they were found to have reached a height of from six to seven feet, and are remarkably clean and smooth from tip to stem, which is something astonishing, considering that the plants have not been in the ground quite two years; and so dense are some of them, that a man of average height is quite lost to view. The plants from the North Island appear to be less rapid in their growth, although showing signs of great vigor; but the *Tihore* and *Tapeto* varieties show the most marked improvement in this respect.

Some of the Canterbury plants have been cut, the bushes yielding half a hundredweight of sound leaves to each plant. The Sub-Committee strongly recommend the growing of the Canterbury flax, as it is found in two years time a first crop could be cut, yielding on an average twenty-five tons or more to the acre, which would be worth, say at 5s. per ton, £6 5s. per acre, the only expense attending which would be the first planting of the stools, and subsequent occasional cleaning of the ground, until such time as the plants appeared to be fairly established.

The soil in the Domain is of a sandy nature, on a shingly bottom.

In the course of another year, a correct record can be made of the further growth of those plants which have been but recently cut down.

IV.—STATISTICS OF PHORMIUM TRADE.

TABLE A.—SHOWING the NUMBER and VALUE of BALES PHORMIUM FIBRE and Tow brought to Public Sale in London, from 23rd April, 1870, to 4th April, 1872 ; 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.	Tow.
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
17th June, " " 15th July, "	36	619	400	999	430	2,484	252
15th July, " " 12th Aug., "	817	905	607	1,039	688	4,056	39
12th Aug., " " 9th Sept., "	477	745	1,125	863	131	3,341	28
9th Sept., " " 20th Oct., "	348	1,227	1,462	1,258	1,144	5,439	53
20th Oct., " " 22nd Nov., "	1,031	1,070	2,390	655	493	5,639	455
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
16th March, " " 13th April, "	147	97	96	173	157	670	18
13th April, " " 4th May, "	314	368	670	175	39	1,566	69
4th May, " " 1st June, "	425	927	634	185	36	2,207	31
1st June, " " 29th June, "	305	507	677	199	85	1,773	94
29th June, " " 27th July, "	313	530	210	20	16	1,089	299
27th July, " " 24th Aug., "	41	471	619	143	...	1,274	128
24th Aug., " " 21st Sept., "	117	88	1,021	68	17	1,311	215
21st Sept., " " 14th Oct., "	179	458	1,482	297	36	2,452	581
14th Oct., " " 16th Nov., "	...	299	658	358	...	1,315	221
16th Nov., " " 14th Dec., "	124	497	399	30	...	1,050	190
14th Dec., " " 11th Jan., 1872	...	711	683	77	...	1,471	233
11th Jan., 1872, " 8th Feb., "	30	556	183	122	...	888	21
8th Feb., " " 7th March, "	8	553	264	7	...	832	...
7th March, " " 4th April, "	342	509	206	...	...	1,057	20
Total number of Bales ... ..	7,670	15,355	16,520	8,526	4,656	52,727	3,489
Total value, reckoning 6 bales to 1 ton	£43,463	£76,775	£71,587	£35,520	£11,252	£238,597	...
Per centage of total Bales ... ..	14.6	29.1	31.3	16.2	8.8	...	...
" " 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	...	...
" " in March and April, 1872	32.4	48.1	19.5	...	...	...	...

The above Table has been compiled from Messrs. M'Landress, Hepburn & Co.'s "New Zealand Flax Circulars," which are prepared in London and sent out by every mail.

TABLE B.—SHOWING the VARIATIONS in the PRICE of PHORMIUM in the LONDON MARKET during 1870-72.

	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.
	£	£	£	£	£
23rd April, 1870, to 20th May, 1870	32	29 10s. to 27	26 to 24	21 10s. to 20	16 to 12 5s.
20th May, " " 17th June, "	29 to 30 10s.	28 to 25	24 to 22	21 to 18	17 to 15
17th June, " " 15th July, "	31	to	23	22 10s. to 18	16 to 12 10s.
15th July, " " 12th Aug., "	31	to 24	23	17 to 15	14 to 12
12th Aug., " " 9th Sept., "	31 10s. to 31 5s.	26 to 23	22 5s. to 18	17 5s. to 14	13 10s. to 11
9th Sept., " " 20th Oct., "	31 10s. to 28	26 to 24	22	to 16	15 to 12 5s.
20th Oct., " " 22nd Nov., "	35 to 30	28 15s. to 25	23 to 19 10s.	18 10s. to 16	14 10s. to 13
22nd Nov., " " 22nd Dec., "	36 10s. to 30	28 10s.	to 22	20 10s. to 18	15 10s. to 14
22nd Dec., " " 24th Jan., 1871	36 15s to 31 5s.	30 10s.	to 22 5s.	...	18 5s. to 16
24th Jan., 1871, " 21st Feb., "	...	24 5s. to 23	22 10s. to 19 15s.	17 15s.	16 10s. to 14
21st Feb., " " 16th March, "	34	28 5s. to 23 15s.	23 10s. to 19 5s.	18 5s. to 16 10s.	16 to 14
16th March, " " 13th April, "	34 to 29	...	23	19 10s. to 16	15 to 13
13th April, " " 4th May, "	33 to 29	27 5s. to 24 15s.	24 to 21	18 5s. to 16	15 to 14
4th May, " " 1st June, "	33 to 28 5s.	26 15s. to 24	23	to 18	14 10s.
1st June, " " 29th June, "	30	27 15s. to 25 15s.	...	...	16 to 15 5s.
29th June, " " 27th July, "	34 5s to 30 10s.	29 5s. to 25 5s.	25 to 18	17 10s.	...
27th July, " " 24th Aug., "	...	32	to 24	21 10s. to 21	...
24th Aug., " " 21st Sept., "	33 10s. to 32	29 10s. to 29	26 to 24	...	...
21st Sept., " " 14th Oct., "	31	29 10s. to 27 15s.	27 to 23 15s.	23 to 19 5s.	...
14th Oct., " " 16th Nov., "	...	30 10s. to 30 5s.	29 10s. to 24 10s.	24 to 22 5s.	...
16th Nov., " " 14th Dec., "	35 5s. to 33	32 5s. to 28 5s.	27 15s. to 24 15s.	24 to 22 10s.	...
14th Dec., " " 11th Jan., 1872	36	34 15s. to 20 5s.	30 to 26	25 15s. to 24	...
11th Jan., 1872, " 8th Feb., "	36	33 5s. to 31 10s.	30 15s. to 27	26	...
8th Feb., " " 7th March, "	38	36	to 28 10s.	27 to 25 5s.	...
7th March, " " 4th April, "	40 to 37 15s.	36 15s. to 35	34 5s. to 31 5s.	...	...
Variation of price during above period	40 to 28	36 15s. to 23	34 5s. to 18	27 to 14	18 5s. to 11
Approximate average price ... ..	£34	£30	£26	£20 10s.	£14 10s.

## V.—DESCRIPTION OF NEW MACHINE.

THE following is a DESCRIPTION of the MACHINE invented by C. J. POWNALL, Esq., and patented 23rd Sept., 1870, in Continuation of Abstracts of Patents given in Commissioners Reports, 1870. (See Part. Pap., D. 14, p. 50.)

In this machine the inventor purposes, in place of allowing the knives fixed upon the cylinder of a machine to come into contact with the leaf of the *Phormium tenax* in its transit through it upon a block or roller, as now used, to substitute a "yielding medium." For this purpose, a piece of tempered sheet steel, about three inches wide, and one thirty-second of an inch thick, one side of which is securely fastened down by screws or rivets upon the block or roller, and upon which the leaf is brought into contact with the knives upon the cylinder, taking care that thus fixed it is so adjusted that the reverse side of this spring shall set up or project from the block or roller about one-quarter of an inch. The knives upon the cylinder are then brought into direct contact with, and made to bear upon the surface of this raised spring, at about half an inch from its raised outer edge; and as they will then, in revolving, continue to press upon this remaining half inch of the projecting spring after the contact has been made, a double action ensues, viz., bruising, and afterwards scraping the leaf for that distance.

This spring will be found sufficiently strong to support the leaf during the blow of the knife upon it, as it may be adjusted to any required tension, and at the same time yielding enough to allow the thick butt of the leaf to be properly cleaned without injury or waste of the fibre, and equally effecting that object upon all parts of it.

A second part of the invention consists of a mechanical arrangement whereby, with one cylinder only, both sides of the leaf are alternately scraped and cleaned. The cylinder or drum is made of metal, wood, or other suitable material, about fifteen inches in diameter, and five inches wide. In the centre of the outer surface of this drum is a groove, three and a half inches deep by one and a half inches wide. Into, or upon the two outer sides of this groove, metal knives or scrapers are fastened at suitable intervals, projecting about half an inch into the inner portion of the groove. A piece of tempered sheet steel, about three and a half inches square, is then fixed into a bracket (similar to a carpenter's square), and is securely attached, with the addition of adjusting springs or screws, into or upon the suitable part of the frame in which the cylinder revolves, so that the spring when thus fixed will project perpendicularly into and between the knives fastened as before mentioned upon the outer rims of the circular groove, giving this spring, however, a sufficient angle to cause the knife upon one side only to come into close contact and bear upon it about one half an inch from the extreme end. Leaving a clear space of about one inch, another spring, exactly similar to the last, is fixed upon the frame, but giving it the angle in the opposite direction, so that the knives upon the other side of the groove are brought into contact, and bear upon it in the same manner. The split leaf being then inserted through small rollers, fluted or otherwise, and secured by levers or springs in the usual way, is first scraped on one side between the first adjusted spring and the knives fixed upon that side of the groove to which the angle inclines. These knives then continue in their rotation, and pass so close to the edge and side of the bracket holding the second spring that no room is left for the flax leaf to pass in that direction; but it is forced by them into the intervening space of about one inch, as before directed, to be left between the springs, and then being caught and carried between the second spring and the knives fixed upon the opposite side of the groove, is secondly scraped upon the other side, and in this manner the action continues alternately, until the leaf is fully cleaned on both sides.

Experience shows that upon this principle one knife upon a cylinder of the above-named dimensions, making 200 revolutions per minute, with the small holding three inch rollers making one-third that number, will scrape one side of the split leaf perfectly clean for a space of one half inch, being the distance left between the point of contact and departure of this knife in its rotation on the face of the spring, and which space may be extended if found desirable. The number of knives upon a cylinder must therefore depend upon the velocity with which it is driven. The cylinder may be made to take in more than one half leaf by increasing the number of small holding rollers. The processes of washing, rolling, drying under cover, and scutching, are then proceeded with.

The patentee claims the invention of the use of "raised springs" to machinery for cleaning, bruising, or stripping *Phormium*.

