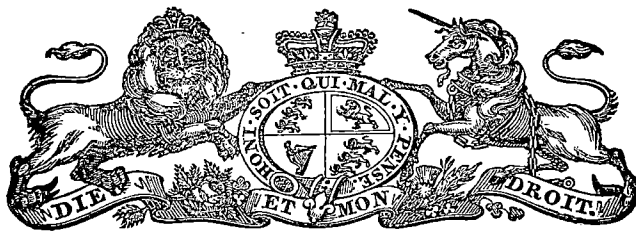


(No. 69.)



1879.

T A S M A N I A.

HOUSE OF ASSEMBLY.

I R R I G A T I O N :

MAJOR COTTON'S REPORTS AND ESTIMATES.

Laid upon the Table by the Colonial Secretary, and ordered by the House to be printed, October 9, 1879.



REPORTS, with Estimates, on IRRIGATION.

Longford, 13th July, 1844.

SIR,

IN compliance with the instructions conveyed to me in your letter of the 19th ultimo, I have the honour to forward the Plans, as far as they are yet completed, of the Irrigation project in which I am employed.

In explanation of the Plans, and of the progress of the survey, it may be desirable that I should here refer to my original instructions, and the measures I have taken to carry them out.

The extensive plains of the Macquarie, Elizabeth, and Lake Rivers, and the facilities supposed to exist for forming reservoirs of water in the upper parts of those rivers, offering a fine field for laying out a great combined project, I suggested that the three rivers should be explored and surveyed, and the lands examined, with the view of forming one great project for the Irrigation of the whole country commanded by the three rivers, on the principle that the more comprehensive the plan, the greater would be the effect produced from the same outlay of capital, or the same amount of labour employed,—the more sure the supply of water for the whole,—and the more uniform and general the benefit obtained. These suggestions were offered in my letter of the 31st July, 1843, supported by a copy of a Lecture on the subject of Irrigation generally, which I had given at the Mechanics' Institution a short time previous; and I then received orders to propose a plan for commencing Irrigation. The plan I proposed was approved by His Excellency; and instructions were given, under date 20th November, 1843, for the formation of a small establishment for the examination of the rivers and country referred to.

I commenced this examination in December; and on the 29th of that month I reported on the heads of the Elizabeth and Macquarie Rivers, giving a detailed account of the work undertaken by private enterprise and funds, with Government labour, for reserving water in the Long Marsh, and the dam formed by private hands under the authority of Government at Tooms' Lake.

In January I received more full instructions for the conduct of the survey, and from that time to the close of the season I have been employed in carrying it on; and the Plans now submitted exhibit the extent to which the operations have proceeded.

As far as I have yet gone in the planning of the reservoirs and channels, with all the masonry works, as dams, aqueducts, sluices, &c. for this portion, I have kept in view the formation of a great combined project for all the plain country commanded by the Macquarie, Elizabeth, and Lake Rivers, including Norfolk Plains,—a vast tract of the finest arable land in the Colony.

A first or partial undertaking might be carried on to the extent already surveyed and estimated, as explained in the Appendix to this report; but the capacity and the number of the reservoirs can be increased, and the main channels widened, according to the extent of land found available as the survey proceeds.

A. The "General Plan" is a map of the country between the Elizabeth and the Macquarie Rivers, and between the Macquarie and Blackman, in the County of Somerset, exhibiting the two reservoirs at the heads of the Macquarie; viz.—the Long Marsh and Tooms' Lake, and the proposed channels of distribution.

Tooms' Lake is an extensive shallow reservoir formed by a low embankment, retaining, when full, about fourteen million cubic yards of water. It is complete, having been formed with the assistance of Government by the efforts of a body of settlers possessing property on the banks of the river below. The Long Marsh is also an extensive flat, receiving the drainage of a far greater tract of country than Tooms' Lake; and may, by means of a short but high embankment, be made to retain fifty or sixty million cubic yards of water. This work was undertaken, and carried on to a certain extent, by Government labour, conjointly with private subscription, but has been discontinued.

The first work to be done is the completion of this embankment; and I give it in my plan a base sufficient for its being raised to the height of eighty feet, when I calculate that it will retain all the water flowing into the Marsh in one season: but the present Estimate allows only for the retention of thirty feet of water.

The water retained in these two reservoirs will be delivered into the natural bed of the river by means of sluices through their embankments; and, following its course while confined within precipitous banks, it will be arrested by a low dam six miles below the junction of the two heads. This dam forms the head of the two main channels north and south of the river, commencing in the Parishes of Peel on the north and Durham on the south side. These two main channels, coloured pink on the "General Plan," and their branches are allowed a fall of one and a half feet in a mile, and will, with the capacity given to them, carry water to twelve different properties, irrigating about 18,000 acres, besides the Townships of Tunbridge, Ross, and Campbell Town, in which about 2000 acres of crown land will be watered.

B & C. The plans of the Peel and Durham channels are drawn on a large scale to show more distinctly their course, and the lands to be watered by them, and the proposed sites for mills. The survey of the Peel channels is incomplete, having been interrupted by the winter weather: that of the Durham channels is complete as far as the Blackman River.

D. Plans of the masonry and other works in detail :—

No. 1. The dam at the Long Marsh in elevation and section, the sluices (showing the arrangement for opening them), and the gauge-chambers by means of which the quantity of water delivered will be regulated. The elevation of the dam shows its height when completed, as well as the height I have allowed for in the accompanying Estimate.

No. 2. Is the Peel and Durham dam across the river at the heads of the two main channels. Its object is not to retain any body of water, but to raise its level, and give an elevation of fifteen feet to the surface, in order that the channel heads may be raised above the river floods. The river, in its floods, will pass freely over the escape in this dam, and pursue its natural course; there being at the head of each main channel a regulating sluice, to limit the body of water admitted into each, or exclude it entirely when necessary.

Nos. 3, 4, & 5, are the details of cuttings and masonry works for the channels. The whole water will by means of these be under perfect control, to be dispensed or retained as required.

E. Is a scale showing the quantity of water required to flow in each main and branch channel, the capacity of channel due to the required supply, and data for estimating all the different works.

F. The Estimate, amounting to £40,000. It includes the completion of the Long Marsh Reservoir, the Peel and Durham Dam, the Durham Channels, and all the works connected with them, with a *rough* calculation of the expense of the Peel Channels; they being not yet fully planned.

All my computations are for free labour; but it is palpable that in the present state of the Colony free labour cannot be obtained to the amount required to complete the work in one or two years: indeed, as my last instructions are to carry on the survey for the full project, my present Estimate has in it no object but to elucidate my plans, and give a view of what I expect to be the cost and effect of such projects in the Colony; and I append for the same purpose my estimation of the value of water, and a scheme for paying for it. (*Vide Appendix.*)

An extended project will be much less expensive in proportion to the benefit derived; and therefore the present computation of £2 per acre is above what will prove an average outlay for the whole country to be irrigated by the three rivers: particularly as the extensive plain which the Lake River commands will, from its extent and other advantages which it possesses, be done with far less labour.

At the rate of £2 per acre for the first outlay for the Government works, the water is brought within the reach of each proprietor for all his land fit for Irrigation.

I estimate the lowest *annual* value of water on the acre at £5; and I set the payment at a tithe of this, or 10s. per acre, after the fifth year, giving it three years gratis, the fourth year at 2s. 6d., and the fifth year at 5s.: under which scale I should expect the proprietor will obtain from the water itself ample means for preparing his land at first, and paying for the water after the fifth year at a price which will just remunerate the Government.

The sale of Crown Land in the townships will be a further return to the Government, and make up for the delay in receiving payment from the land proprietors. In the three townships of Ross, Campbell Town, and Tunbridge, 2000 acres of crown land will be watered; and would undoubtedly sell at an average price of at least £15 per acre, or £30,000, which amounts to three-fourths of the total amount.

I mention these particulars (and they are more fully detailed in the Appendix) to show that the project as at present planned would be a profitable outlay of money if paid for at the cost of free labour, though the return would be at a distant period; and therefore that the Government would be warranted in undertaking it for the benefit of the country, if it could bear the present outlay, and the delay of repayment.

The extended project would yield a greater proportionate direct return; and the advantages to the community, spreading over a wider space, would be more equable, and conduce more to general prosperity.

I may in conclusion therefore repeat, that the present partial project might be undertaken independently, and rest on its own recommendations, or it may be considered as a commencement of the full project, and be extended at a future period.

I would beg leave to add, that the North and South Esk Rivers offer great facilities for extending the Irrigation of the country to Launceston, and would afford water-power and canal communication to the town and its vicinity, as well as induce the sale of some highly valuable crown land.

In the south, although no very extensive fields for Irrigation exist, and the system to be pursued would be of a different character, yet I have no doubt that most important works might be carried on in that part of the country, combining all the advantages of water communication, water power, and Irrigation.

I have the honor to be,
Sir,

Your most obedient Servant,

H. C. COTTON.

J. E. BICHENO, *Esq.*, *Colonial Secretary*,
&c. *&c.* *&c.*

A P P E N D I X.

VALUE OF WATER AND SCHEME OF PAYMENT.

THE quantity of water to be allowed per acre is 2500 cubic yards per annum, to be drawn uniformly in the course of 5 months, or at any other rate to suit the crops, mills, &c. This quantity is sufficient for grass land, and is the maximum for any crop,—1000 cubic yards drawn in the course of 2 months is sufficient for grain; but cut green as a previous crop for hay, the grain would require water for a longer period, and pasture may be obtained after the crop is off by continuing the water, so that the full quantity of 2500 cubic yards would generally be used. Potatoes watered twice a month during the dry months will make a very great return, especially in this part of the country where frosts prevail; the expenditure of water being comparatively very small. Lucern irrigated is a highly productive crop: it requires the full supply of water. The grain crop is the least valuable. The increase of produce on any land will be at least 20 bushels per acre, which, at the low rate of 5s. per bushel, gives £5 as the value of the water per acre, when 1000 cubic yards only of water is used: and I set this as the lowest return for the use of water upon an acre of land. Green crops, potatoes, and all garden produce will yield up to £30 per acre; and Irrigation makes all crops sure as well as productive.

The total estimate of the first part of the Government project,—viz. the Peel and Durham Channels, with their supplying reservoirs,—amounts to £40,000, calculated at the cost of free labour. About 20,000 acres will be irrigated; so that the first expense is £2 per acre.

Tooms' Lake, one of the supplying reservoirs, has been completed by a body of subscribers, who have laid out on that, and the commencement of the Long Marsh, about £1200. I have therefore supposed that 600 acres belonging to the subscribers might be watered gratis for ever in consideration of their outlay; and, to mark the exertions of the founders of the Macquarie Irrigation, Crown Lands in the Townships of Tunbridge, Ross, and Campbell Town, to the amount of 2000 acres, may be sold at from £8 to £30 or £40, yielding at an average of £15, £30,000, or three-fourths of the amount of the first outlay.

Setting the value of the water at its lowest rate of £5 per acre, and fixing the water-rate at a tithe of this, or 10s. per acre per annum, the computation gives 25 per cent. on the total outlay when all the land is cultivated; and deducting 2½ per cent. for repairs and superintendence, the receipts will amount to 22½ per cent.—(£9000).

In addition to this annual return, and the receipts for Crown Land sold, water-power will be a further source of Revenue. There will be several mill-sites on the irrigating channels where water will be paid for, as it were, twice, where the water will not be withdrawn from the land by its being applied to drive mills; and there is also water to spare for some other mills, all of which will pay: but the number of them will depend on the population and wants of the neighbourhood—every principal proprietor will have water-power for threshing, winnowing, grinding, cutting turnips, &c. &c.

The whole of the works are so planned as that they may be enlarged for the purpose of extending the operations below; and the project, besides being complete in itself, is the foundation of a second project for the plains lower down the Macquarie, and will tend to diminish the expense of all the irrigation downwards to the sea.

With reference to what is stated above, I will suppose, 1st. That 600 acres belonging to the founders is watered gratis. 2nd. That the following rates shall be fixed for all other land; viz. :—

1st, 2nd, & 3rd year to allow for preparation of the land—Gratis.	s. d.
4th year, at per acre.....	2 6
5th year, ditto	5 0
6th and sequent years.....	10 0

Or at per 1000 cubic yards—

1st, 2nd, and 3rd year.....	Gratis.
4th year.....	1s.
5th year.....	2s.
6th year.....	4s.

3rd. That Mills shall pay for water at the full rate of 4s. per 1000 cubic yards.

STATEMENT of expected Returns from Lands for 20 Years.

<i>Year.</i>	<i>Acres under pre- paration. Gratis.</i>	<i>Acres paid for at 2s. 6d.</i>	<i>Acres paid for at 5s.</i>	<i>Acres paid for at 10s.</i>	<i>Founders' Acres Gratis.</i>	<i>Annual Receipts.</i>	<i>Amount to be expended on the Works.</i>
						£ s. d.	£ s. d.
1	500	—	—	—	600	—	15,000 0 0
2	1000	—	—	—	600	—	7000 0 0
3	1500	—	—	—	600	—	
4	1500	500	—	—	600	62 10 0	6000 0 0
5	1500	1000	500	—	600	250 10 0	
6	1500	1500	1000	500	600	687 10 0	
7	1500	1500	1500	1000	600	1062 10 0	
8	1500	1500	1500	1500	600	1312 10 0	6000 0 0
9	1500	1500	1500	3000	600	2062 10 0	
10	1500	1500	1500	4500	600	2812 10 0	
11	1500	1500	1500	6000	600	3562 10 0	
12	1500	1500	1500	7500	600	4312 10 0	6000 0 0
13	2000	1500	1500	9000	600	5062 10 0	
14	2000	1500	1500	10,500	600	5812 10 0	
15	1000	1500	1500	12,000	600	6562 0 0	
16	—	2000	1500	13,500	600	7375 0 0	
17	—	2000	2000	15,000	600	8000 0 0	
18	—	1000	2000	17,000	600	8500 0 0	
19	—	—	1000	19,000	600	9125 0 0	
20	—	—	—	20,000	600	10,000 0 0	

Total of Estimate at the cost of Free Labour £40,000 0 0

Amount of receipts when all the land is cultivated £10,000

Deduct for repairs and superintendence, at 2½ per cent. on £40,000 .. 1000

Remaining clear receipts, 22½ per cent. on £40,000 £9000

The interest on the Capital sunk is not taken into the account. If taken at 5 per cent. it will exceed the clear receipts for the first seven years, after which the receipts will increase from 5 to 22½ per cent.: this is on the irrigation of land only. The sale of Crown Lands, and the return derived from water for mills, will at once commence paying off the Capital.

H. C. COTTON.

ESTIMATES.

No. 1.

ESTIMATE FOR DAM, &c. AT LONG MARSH.

FREE LABOUR.

36,566 cubic yards of earth to be got, and shot, calculated at 5 yards per day.
 7870 cubic yards of puddle to be got, tempered, and placed, calculated at 2 yards per day.
 67,200 cubic feet of rough facing stone to be got, rough dressed, and built, calculated at 40 feet per day.
 10,450 cubic feet of rubble masonry in culverts, calculated at 15 feet per day.

	£	s.	d.
11,248 days for labour, at 2s.	1124	16	0
2093 ditto mechanic, at 4s.	418	12	0
418 bushels of lime, at 1s. 6d.	31	7	0
Centering, tools, repairs of ditto	50	0	0
2 framed stages, complete	42	0	0
2 gauges, iron work and valves	15	0	0
2 sluices, including cut masonry, in which they are to be set	40	0	0
2 crab winches, chains and fixing	36	0	0
Cottage for Dam-keeper	50	0	0

	£	s.	d.
<i>Supervision.</i>			
1 Superintendent, 1 year	150		
1 Overseer, ditto	60		
1 Messenger, ditto	35		
	—	245	0 0

TOTAL £2052 15 0

No. 2.

ESTIMATE FOR THE DAM ON THE MACQUARIE RIVER.

FREE LABOUR.

2710 cubic yards of earth to be got, and shot, calculated at 4 yards per day.
 995 cubic yards of puddle to be got, tempered, and placed, calculated at 1½ yards per day.
 7320 cubic feet of paving to top and slopes of escape, to be got, rough dressed, and laid, calculated at 20 feet per day.
 12,744 cubic feet of rough facing to top and slopes of dam, calculated at 30 feet per day.
 6899 cubic feet of rubble masonry in walls and culverts, to be got, dressed, and built, calculated at 12 feet per day.

	£	s.	d.
<i>Labour.</i>			
1340 days at 2s.	134	0	0
1365 ditto, mechanic, at 4s.	273	0	0
250 bushels of lime, at 10d.	10	8	4
Centering, tools, implements, repairs to ditto, wear and tear	10	0	0
6 freestone caps for pins, at 25s.	7	10	0
195 feet freestone coping, saddle back, tooled and throated, at 2s. 6d.	24	7	6
2 double sluices, fixed,	25	0	0
1 single ditto, ditto	15	0	0
Cottage for Dam-keeper	50	0	0

TOTAL £549 5 10

Supervision.

See No. 7, Estimate of Sundries.

No. 3.

ESTIMATE FOR EMBANKMENT AND AQUEDUCT ACROSS KITTY'S RIVULET,
DURHAM CHANNEL.

FREE LABOUR.

2790 cubic yards of earth to be got, and shot, calculated at 3 yards per day.
4327 cubic feet of masonry, calculated at 12 feet per day.

Labour.

	£	s.	d.
930 days, at 2s.....	93	0	0
360 ditto, mechanic, at 4s.	72	0	0
20 ditto, digging foundations, at 2s.....	2	0	0
180 bushels of lime, at 1s.	9	0	0
Scaffolding, centering, tools, repairs, &c.	10	0	0
132 feet run of freestone coping, saddle-back, tooled and throated, fixed with cramps, at 2s. 6d.	16	10	0
4 freestone caps, fixed at 25s.	5	0	0
TOTAL.....	£207	10	0

Supervision.

See No. 7, Estimate of Sundries.

No. 4.

ESTIMATE OF EMBANKMENT AND CULVERT ON THE DURHAM MAIN
CHANNEL, BETWEEN BRANCHES Nos. 5 & 6.

FREE LABOUR.

25,206 cubic yards of earth to be got, and shot, calculated at 3½ yards per day.
875 cubic feet masonry in culvert, calculated at 15 feet per day.

Labour.

	£	s.	d.
7201 days, at 2s.....	720	2	0
58 ditto, mechanic, at 4s.....	11	12	0
35 bushels of lime, at 1s.....	1	15	0
Water for ditto	0	17	6
Centering, tools, implements, and repairs of ditto	30	0	0
Tamping.....	20	0	0
TOTAL.....	£784	6	6

Supervision.

See No. 7, Estimate of Sundries.

No. 5.

ESTIMATE FOR EMBANKMENT AND BRIDGE AQUEDUCT ON THE MAIN
CHANNEL ACROSS YORK RIVULET.

FREE LABOUR.

705 cubic yards of earth to be got, and shot, calculated at 3½ yards per day.
2050 cubic feet of masonry in aqueduct, calculated at 12 feet per day.

Labour.

	£	s.	d.
171 days, mechanic, at 4s.....	34	4	0
201 ditto, labour, at 2s.....	20	2	0

	£	s.	d.
10 days, foundations, at 2s.	1	0	0
122 bushels of lime, at 1s.	6	2	0
Centering, scaffolding, tools, repairs	10	0	0
132 feet of coping, saddle-back of freestone, tooled and throated, and fixed with bead and cramps, at 2s. 6d.	16	10	0
4 freestone caps for pins, at 25s.	5	0	0
TOTAL.....	£92	18	0

Supervision.

See No. 7, Estimate of Sundries.

No. 6.

ESTIMATE FOR THE CHANNELS, BACK DRAINS, AND CUTTINGS CAUSED BY INEQUALITIES OF GROUND, &c.

FREE LABOUR.

For Quantities See Tabular Abstract.

	£	s.	d.
54,994 days labour at 2s.	5499	8	0
Tools, and repairs of ditto, for the above, estimating 300 days to the year, at 30s. per man	276	0	0
14,536 days, mechanic, at 4s.	2907	4	0
Tools, and repairs of ditto	72	0	0
Centering, moulds, running planks	50	0	0
1500 bushels of lime, at 1s.	75	0	0
Water for ditto	50	0	0
40 occupation bridges, at £5	200	0	0
12 sluices (6 head sluices to the branches, and 6 dispensing ditto), at £8	96	0	0
Fencing the various channels on both sides, when necessary, 36 miles, at £40	1440	0	0
TOTAL.....	£10,665	12	0

Supervision.

See No. 7, Estimate of Sundries.

No. 7.

ESTIMATE OF SUNDRIES.

	£	s.	d.
Purchase of 148 acres of land for channels, at £3 per acre	444	0	0
Ditto of 2 acres of land for cottage for dam and sluice keepers	10	0	0
Compensation for damage done to lands by works	100	0	0
Building 3 stations for the accommodation of men, at £150	450	0	0
Wood and water, 18 months, for stations :—			
Water 40 hhds. per week, 40 × 78, at 1s.	156	0	0
Wood 20 tons ditto, 20 × 78, at 2s.	156	0	0
Stores and implements for 3 stations, cooking utensils, &c. at £25.	75	0	0
Surveyor, men, and allowances	500	0	0
Superintendent	200	0	0
Six Overseers, at £50.	300	0	0
Three Messengers, at £30	90	0	0
	£1090	0	0
Ditto for 18 months	£1635	0	0
TOTAL.....	£3026	0	0

No. 8.

ABSTRACT ESTIMATES.

		£	s.	d.
Durham Channel.	No. 1. Dam at Long Marsh	2052	15	0
	2. Dam on Macquarie River	549	5	10
	3. Embankment and aqueduct across Kitty's Rivulet	207	10	0
	4. Embankment and culvert between Nos. 5 & 6	784	6	6
	5. Embankment and aqueduct across York Rivulet	92	18	0
	6. Channels, &c	10,665	12	0
	7. Estimate of Sundries	3,026	0	0
		17,378	7	4
	Contingencies 10 per cent	1,737	16	9
	TOTAL.....	£19,116	4	1

NOTE.—The estimate supposes that the labourers and mechanics will be hutted, and provided with wood and water, at the expense of the Government ; and that the Government will supply them. at contract prices with provisions.

	£	s.	d.
Total of Reservoirs and Durham Channels	19,116	4	1
Estimated expense of Peel Channels.....	20,883	15	11
TOTAL.....	£40,000	0	0

Longford, 2nd April, 1845.

SIR,

I HAVE the honor to forward plans and estimates of the two irrigation projects which I have recommended as the first to be undertaken by the Government.

In the month of July last I furnished plans of a considerable project on the Macquarie River, with an explanatory report, and estimates in detail for the works required. The survey was at the time incomplete, and the estimate comprised the main reservoirs on the Macquarie and a set of channels in the Parish of Durham, with all the requisite works planned and calculated; with a rough calculation of proposed works for the Parish of Peel, on the opposite side of the river, to depend on the same supplying reservoirs. With these plans and estimates I offered suggestions for the ultimate repayment of the outlay by rates charged on the water, founded upon calculations of the absolute value of water used in irrigation—the first expense of the undertaking, and the annual expenses of superintendence and repairs.

In this report, after explaining the two projects, one of which is the same as that before proposed in the Parish of Durham, I propose to recapitulate those calculations, and set them in comparison with the estimated cost of the two projects as performed by free labour.

The plan A is a map of a portion of the County of Somerset, showing the course of the Macquarie and Elizabeth Rivers from their sources to their junction. This map exhibits the sites of the proposed reservoirs and main and branch channels for the two projects; and I must here explain that the lands lying between Campbell Town and Ross, and up the east bank of the Macquarie to the proposed Peel and Durham Dam (the works for which were roughly estimated in my former report), were proposed to be irrigated by the Macquarie; but my survey of the Elizabeth River enables me to propose a better scheme for this tract, and it will be seen that I now propose supplying it by a channel from the latter river.

The first project, then, is for the irrigation of about 8000 acres, lying entirely between the Macquarie and Blackman, including the Township of Tunbridge. Tooms' Lake and the Long Marsh will, as being proposed, be the supplying reservoirs; and the dam of the latter is so planned as to retain a body of water sufficient, in conjunction with Tooms' Lake, to irrigate the tract and supply several mills with water-power.

In planning the works I have also arranged for the extension of the project, giving the Long Marsh Dam a form which will admit of its being raised to increase the capacity of the reservoir, and giving space for widening the main channel to carry an increased supply of water through to the land on the west banks of the Blackman and Macquarie.

The second project proposes to irrigate the lands between Ross and Campbell Town and down to the junction of the two rivers; those north of the Elizabeth as far as Wanstead, and both the Townships of Campbell Town and Ross. The supply of water will be retained in a reservoir formed for the purpose in Kearney's Bogs, near the head of the Elizabeth. The water discharged from the reservoir will flow in the bed of the river as far as the proposed Campbell Town Dam, from whence it will be conducted by the two main channels, north and south of the river, and several branches from each, to all the lands. The extent of land north of the river, included in this scheme, amounts to about 7000 acres, and south of the river 13,000 acres, and water-power will be provided for twenty mills.

These mills, as well as those provided for in the first project, are chiefly intended for farm purposes. Every principal proprietor will have a mill-site, where a fall of water can be allowed, affording sufficient power for threshing, cleaning, and grinding all the corn he can grow, and other farm work, and in most cases supplying fresh water to his dwelling-house and irrigating his garden. Three mill-sites are fixed upon for the use of the town at Campbell Town, one at Ross, and two at Tunbridge: these will be of greater power, and may be made to suit the wants of the towns as their population increases. They are situated on Crown land, which can be reserved, given on lease for a term of years, or sold with its prospective advantages, as the Government may think fit.

The plan B shows on an enlarged scale the course of the Durham Channels, the lands to be watered by them, the boundary lines of the various properties, and the Township of Tunbridge (the whole of which township, with the exception of 30 acres, belongs to the Crown). The proposed mill-sites are marked—eleven in number, including two on the Township of Tunbridge.

The total quantity of land proposed to be watered is 8000 acres, which will require 20,000,000 cubic yards of water; all the private mills will be driven by water merely passing to irrigated lands, and worked only during the irrigating season; and it is only the two mills at Tunbridge which will expend water passing to too low a level for irrigation within the

range of this project. There is but one house at present on the township, and there are 1100 acres of Crown land below the channels, which will shortly find purchasers, so that I have no doubt the population will increase quickly, and one mill would probably be established immediately. Each of these mills, worked through the year, would expend water from the reservoir to the amount of $1\frac{1}{2}$ million cubic yards; so that, when the project is in full operation, 23 millions of cubic yards of water will be required annually to be stored in the two reservoirs. They are planned to contain about 34 millions, giving a surplus for cases of accidental waste or unusual drought.

The plan C is an enlarged plan of the Elizabeth Channels, the lands to be irrigated by them, the Townships of Ross and Campbell Town, the boundaries of those properties through which the Channels pass, and the sites of the proposed mills—sixteen on located lands, three on Crown land in Campbell Town, and one on Crown land in Ross. The private mills, as in the first project, expend no water but what is used immediately below for irrigation, and will be worked only during five months while the irrigation proceeds. The sites of the four town mills may be reserved, given on lease, or sold, at the pleasure of the Government, as before suggested with respect to those at Tunbridge. The extent of land to be irrigated south of the river is about 13,000 acres, and north of the river 7000 acres—total 20,000, for which about 50 million cubic yards of water must be reserved, and for the town mills about 5 million cubic yards extra, making 55 millions to be retained in the reservoir at Kearney's Bogs when all the land is irrigated. I have planned the reservoir at present to contain this quantity, and the dam will admit of being raised whenever it shall become necessary.

The plan E is a survey of the marsh known by the name of Meredith's Marsh, one of the bogs; it is the best site on the river for a reservoir, being an extensive flat terminating in a narrow gorge. The only objection to this site is, that the marsh is for the most part private property, but the land is of little value; and I conceive that the proprietors would be glad to give it up for the purpose, in consideration of receiving from the Crown a double quantity of land elsewhere. Water might be reserved in the marshes higher up; but they would require extensive embankments, and would not receive so large a drainage. Looking forward to an extension of irrigation down the Macquarie River below the present scheme, the possession of this reservoir will be of the greatest importance as it receives the drainage of a great extent of country, and would at a small additional expense be made to retain the whole.

The eight sheets marked D contain detailed drawings of masonry and other works for both projects.

No. 1. The dam at the Long Marsh in elevation and section, the sluices and gauge chambers, by means of which the quantity of water delivered will be regulated. The elevation of the dam shows its height when completed, as well as the height I have allowed for in the accompanying estimate.

No. 2. Similar plan of the dam at Kearney's Bogs.

No. 3. Is the Peel and Durham Dam across the Macquarie at the head of the channel. Its object is, not to retain any body of water, but to raise its level and give an elevation of 15 feet to the surface, in order that the channel heads may be raised above the river floods. The river in its floods will pass freely over the escape in this dam, and pursue its natural course; there being at the head of the main channel a regulating sluice to limit the body of water admitted into it, or to exclude it entirely when necessary.

No. 4. Similar plan of the dam across the Elizabeth River at the head of the two main channels.

Nos. 5, 6, 7, and 8, are the details of cuttings and masonry works for the channels of the two projects. The whole water will, by means of these, be under perfect control, to be dispensed or retained as required.

The sheet F is a scale showing the quantity of water required to flow in the main and branch channels; the capacity of channel due to the required supply, and data for estimating all the different works.

The sheet G is a similar scale for the Elizabeth scheme.

H is the estimate of the Macquarie scheme, calculated for free labour, amounting to £20,517 2s. 10d. As free labour is not procurable, I submit this estimate to show the value of the works in comparison with my estimation of the value of the water preserved and distributed.

I is the estimate of the Elizabeth scheme, calculated for free labour, amounting to £35,007 7s. 6d.

I have not data upon which to estimate correctly what cash outlay would be required, with the aid of convict labour, for these works, but have made a rough computation, supposing every man actually at work to receive 6d. a day, and each man's work half that of a free man.

The Macquarie project would cost—

	£
In Convict labour	8000
In land in exchange for that occupied by works.....	500
And in cash.....	2000
TOTAL.....	<u>£10,500</u>

The Elizabeth project would cost—

	£
In Convict labour.....	11,000
In land in exchange for that occupied by the works.....	4000
And in cash.....	3500
TOTAL..	<u>£18,500</u>
Total of the two projects with the aid of Convict labour*.....	<u>£29,000</u>

The following table shows the cost per acre of the two projects as performed by free and convict labour severally; the former amounting on the whole to £1 18s., and the latter to £1 per acre.

	<i>Acres.</i>	<i>Free Labour Estimate.</i>	<i>Per Acre.</i>	<i>Convict Labour Estimate.</i>	<i>Per Acre.</i>
		£	£ s.	£	£ s.
Macquarie project.....	8,000	20,500	2 11	10,500	1 6
Elizabeth ditto	21,000	35,000	1 13	18,500	0 17
TOTAL.....	29,000	55,500	1 18	29,000	1 0

The value of water was computed in my former report at £5 per annum per acre on corn land, the least profitable of all watered crops. Setting this as the value of the water used on one acre, or for 2500 cubic yards, and fixing a tithe of this value, or 10s. per acre, water rate, the two projects will yield on 29,000 acres £14,500 per annum; or, deducting 600 acres watered gratis, 28,400 acres, £14,200; and, deducting for repairs and superintendence 2½ per cent. on £55,500 (£1387), gives an actual annual return of £12,813 when the whole tract is irrigated.

As explained in my former report, a certain remuneration is due to the founders of the Macquarie irrigation, by whose exertions and funds the Tooms' Lake Reservoir, now to be connected with these works, was formed; and I would suggest that 600 acres belonging to the subscribers should be watered gratis, both to mark the exertions and to repay the expense of the founders,—and deducting on this account £300 from the annual receipts, the net return becomes £12,800 per annum.

The sale of Crown land in the townships will amount within a few years to £30,000—viz., 2000 acres in the Townships of Tunbridge, Campbell Town, and Ross at an average price of £15 per acre.

* Convict labour.....	£19,000
Land.....	4500
Cash.....	5500
TOTAL..	<u>£29,000</u>

With respect to the return to be expected from mills, I think it would be desirable to fix a light rate upon each mill supplied with water power,—not as a source of revenue, but as a mark of right retained by Government over the distribution of the water. Those which will be erected on Crown land in the three towns will be mills of great power, if a sufficient quantity of water is reserved for them; and when the irrigation is extended to tracts lower down the river, the water passing through them will not be lost. It follows, therefore, that the mill power set apart for the towns may be made to keep pace with the increase of population and the wants of the towns: they may be made to yield funds for public improvements, or, as I have mentioned above, they may be given on a lease for a term of years; or the sites, with all their prospective advantages, sold at once, or placed in the hands of trustees for the benefit of the towns. I will, therefore, make no estimate of the return on mill power in the following table of prospective returns for the two projects, but confine myself to the amount of assessment on water used for irrigation, and the amount received from the sale of land in the towns:—

STATEMENT of expected Returns from Lands for 20 Years.

Year.	Acres under Preparation Gratis.	Acres paid for at 2s. 6d.	Acres paid for at 5s.	Acres paid for at 10s.	Founders' Acres Gratis.	Irrigation Receipts.	Crown Lands sold.			Total Receipts.	Deduct Expenses and Repairs.	Net Annual Receipts.
							Acres.	At per Acre.	Annual Amount.			
						£ s.		£	£	£ s.	£	£ s.
1	500	—	—	—	600	—	50	15	750	750 0	—	750 0
2	1000	—	—	—	600	—	100	—	1500	1,500 0	—	1,500 0
3	1500	—	—	—	600	—	200	—	3000	3,000 0	1400	1,600 0
4	1500	500	—	—	600	62 10	300	—	4500	4,562 10	1400	3,162 10
5	1500	1000	500	—	600	250 0	450	—	6750	6,800 0	1400	5,400 0
6	1500	1500	1000	500	600	687 10	450	—	6750	7,437 10	1400	6,037 10
7	1500	1500	1500	1,000	600	1,062 10	450	—	6750	7,812 10	1400	6,412 10
8	1500	1500	1500	1,500	600	1,312 10	—	—	—	1,312 10	1400	
9	1500	1500	1500	3,000	600	2,062 10	—	—	—	2,062 10	1400	662 10
10	1500	1500	1500	4,500	600	2,812 10	—	—	—	2,812 10	1400	1,412 10
11	2000	1500	1500	6,000	600	3,562 10	—	—	—	3,562 10	1400	2,762 10
12	3000	2000	1500	7,500	600	4,375 0	—	—	—	4,375 0	1400	2,975 0
13	3000	3000	2000	9,000	600	5,375 0	—	—	—	5,375 0	1400	3,975 0
14	3000	3000	3000	11,000	600	6,625 0	—	—	—	6,625 0	1400	5,225 0
15	3000	3000	3000	14,000	600	8,125 0	—	—	—	8,125 0	1400	6,725 0
16	3000	3000	3000	17,000	600	9,625 0	—	—	—	9,625 0	1400	8,225 0
17	2400	3000	3000	20,000	600	11,125 0	—	—	—	11,125 0	1400	9,725 0
18	—	2400	3000	23,000	600	12,625 0	—	—	—	12,625 0	1400	11,225 0
19	—	—	2400	26,000	600	13,750 0	—	—	—	13,750 0	1400	12,350 0
20	—	—	—	28,400	600	14,200 0	—	—	—	14,200 0	1400	12,800 0

NOTE.—If the works performed by Convict labour cost in all £29,000, the sale of 2000 acres at £15 per acre, £30,000, will pay the whole amount of the first outlay in the course of 8 years.

I suppose, in the above calculation, that the whole of the land will be laid down for irrigation in the course of twenty years, at the end of which period the annual receipts from so low a rate as 10s. per acre would yield a clear revenue of £12,800 per annum. In the first eight years the outlay, if the work be performed by Convict labour, will be paid for by the sale of Crown lands; and in the next eight years the Land Fund would be reimbursed, and the rate may be taken off, except a fraction for repairs and superintendence, unless, as in other countries, the water be made a source of revenue for Government purposes.

I have not the smallest doubt that the use of irrigation will extend as quickly as the above table assumes. An agricultural population will rapidly pour in upon these irrigated plains, finding a maintenance and paying rent to the great proprietors of these at present unproductive, or indeed all but barren, tracts.

Tunbridge is an exceedingly fine site for a central town; Campbell Town, already a considerable town, would immediately extend itself; and Ross, supplying its beautiful freestone, would aid in the establishment of the other two, and increase its own importance.

There is a portion of the land included in the general project laid before the Council last year which is not provided for in these plans. It lies north of the Macquarie, on the borders of Johnson's Rivulet, and can be watered by means of that stream, which I am now surveying for the purpose.

I am also carrying on a line of levels from the extremity of the Macquarie main at Tunbridge, with a view of extending it across the Blackman, and down the west banks of that river and the Macquarie.

I then propose to examine the lakes at the head of the Lake River, and the sources of the South Esk, for the formation of reservoirs, and to carry on the survey for the irrigation of the extensive plains which depend on those rivers.

I have the honor to be,
Sir,

Your most obedient Servant,

H. C. COTTON.

The COLONIAL SECRETARY.

I. ESTIMATE OF THE MACQUARIE RIVER SCHEME.

No 1.

D A M A T L O N G M A R S H.

FREE LABOUR.

	DAYS.	
	Mechanic.	Labour.
33,780 cubic yards of earth to be got and shot, 5 yards per day	—	6756
3,164 cubic yards of puddle to be got, tempered, and placed, 2 yards per day	—	1582
42,636 cubic feet of stone facing, to be got, rough dressed, and built, 20 feet per day	2131	—
2,820 cubic feet of stone facing in counterfort, 12 feet per day	235	—
9,792 cubic feet of masonry in culverts and gauge chambers, 12 feet per day	816	—
<i>Total Days</i> ..	<u>3182</u>	<u>8338</u>

	£	s.	d.
3,182 days, mechanic, at 4s.	636	8	0
8,338 days, labour, at 2s.	938	16	0
500 bushels of lime, at 1s. 6d.	37	10	0
Centering and tools, and repairing ditto	50	0	0
2 gauges, iron work and valves	7	10	0
2 sluices, valves, racks, levers, &c., complete	25	0	0
Cottage for Dam-keeper	50	0	0

Supervision.

1 Superintendent, 1 year	£150		
1 Overseer, ditto	60		
1 Messenger, ditto	35		
	<u>245</u>	0	0
TOTAL	<u>£2090</u>	<u>4</u>	<u>0</u>

No. 2.

DAM ON THE MACQUARIE.

FREE LABOUR.

	DAYS.	
	Mechanic.	Labour.
2094 cubic yards of earth to be got and shot, at 4 yards per day....	—	523
555 cubic yards of puddle to be got, tempered, and placed, 2 yards per day	—	277
15,015 cubic feet rough masonry, for face of dam, to be got, rough dressed, and built, 20 feet per day	750	—
10,010 cubic feet of rough paving, for top and inner slope, 30 feet per day	333	—
7825 cubic feet of masonry in escape, 12 feet per day	652	—
2799 cubic feet in retaining walls, chambers, &c., 12 feet per day ..	233	—
<i>Total Days</i>	<u>1968</u>	<u>800</u>
	£	s. d.
1968 days, mechanic, at 4s.....	393	12 0
800 days, labour, at 2s.....	80	0 0
600 bushels of lime, at 1s.....	30	0 0
Centering tools, implements, &c.....	10	0 0
2 freestone cap for pins, at 25s.	2	10 0
4 ditto for chamber, at 15s.	3	0 0
105 feet of coping, fixed, at 2s. 6d.	13	2 6
2 double sluices, fixed	20	0 0
1 single ditto	7	0 0
Cottage for Dam-keeper	50	0 0
<i>TOTAL</i>	<u>£609</u>	<u>4 6</u>

No. 3.

EMBANKMENT AND BRIDGE AQUEDUCT ACROSS THE KITTY'S RIVULET.

FREE LABOUR.

	DAYS.	
	Mechanic.	Labour.
2790 cubic yards of earth to be got and shot, 3 yards per day.....	—	930
Digging foundations	—	20
4327 cubic feet of masonry, at 12 feet per day	360	—
<i>Total Days</i>	<u>360</u>	<u>950</u>
	£	s. d.
360 days, mechanic, at 4s.....	72	0 0
950 days, labour, at 2s.	95	0 0
180 bushels of lime, at 1s.....	9	0 0
Scaffolding, centering tools, &c.	10	0 0
132 feet run of coping, at 2s. 6d.	16	10 0
4 caps, fixed, at 25s.....	5	0 0
<i>TOTAL</i>	<u>£207</u>	<u>10 0</u>

No. 4.

EMBANKMENT ON MAIN CHANNEL BETWEEN NOS. 5 AND 6 BRANCHES

	DAYS.	
	Mechanic.	Labour.
25,206 cubic yards of earth to be got and shot on the entire line of embankment, 1454 feet, and the channel formed therein, $3\frac{1}{2}$ cubic yards per day	—	7201
875 cubic feet of masonry in culvert, 15 feet per day	58	—
<i>Total Days</i>	58	7201
	<u>58</u>	<u>7201</u>
	£	s. d.
7201 days, labour, at 2s.	720	2 7
58 days, mechanic, at 4s.	11	12 0
35 bushels of lime, at 1s.	1	15 0
Water for ditto	0	17 6
Centering tools, and turning planks, and repairing ditto	30	0 0
Tamping	20	0 0
<i>TOTAL</i>	£784	7 1
	<u>£784</u>	<u>7 1</u>

No. 5.

EMBANKMENT AND BRIDGE AQUEDUCT ACROSS THE YORK RIVULET.

	DAYS.	
	Mechanic.	Labour.
705 cubic yards of earth to be got and shot, and channel formed therein, $3\frac{1}{2}$ yards per day	—	201
Digging for foundations	—	10
2050 cubic feet of masonry, 12 feet per day	171	—
<i>Total Days</i>	171	211
	<u>171</u>	<u>211</u>
	£	s. d.
171 days, mechanic, at 4s.	34	4 0
211 ditto, labour, at 2s.	21	2 0
122 bushels of lime, at 1s.	6	2 0
Centering, scaffolding, tools, &c.	10	0 0
132 feet run of freestone coping, saddle back, at 2s. 6d.	16	10 0
4 caps, at 25s.	5	0 0
<i>TOTAL</i>	£92	18 0
	<u>£92</u>	<u>18 0</u>

No. 6.

CHANNELS.

	DAYS.	
	Mechanic.	Labour.
16,368 cubic yards of rock to be excavated and shot, 20 cubic feet per day	—	22,096
68,485 cubic yards of loam to be got and shot, at 4 yards per day	—	17,121
41,146 cubic yards of loam and stones to be got and shot, 3 yards per day	—	13,715
11,514 cubic yards of sandy loam to be got and shot, 5 yards per day	—	2,303
193,875 cubic feet of masonry in culverts, at 12 feet per day	16,156	—
19,387 cubic feet of masonry in occupation bridges, special culverts, &c., 12 feet per day	1,615	—
<i>Total Days</i>	17,771	55,235
	<u>17,771</u>	<u>55,235</u>

	£	s.	d.
17,771 days, mechanic, at 4s.	3554	4	0
55,235 ditto, labour, at 2s.	5523	10	0
Tools and repairs for the above	72	0	0
Centering, moulds, running planks, &c.	50	0	0
8522 bushels of lime at 1s.	426	2	0
Water for ditto.	50	0	0
25,000 perches of fencing, being about three-fifths of double the length of the channels, taken at 1s. 6d. at an average	1870	0	0
40 occupation bridges, at £5.	200	0	0
12 sluices, at £8	96	0	0
TOTAL	£11,841	16	0

No. 7.

GENERAL ESTIMATE.

FREE LABOUR.

	£
Purchase of 148 acres of land occupied by channels, at £3.	444
Ditto of 1 acre for dam cottages	10
Compensation for damage to lands	100
Building three stations for the accommodation of men, at £150	450
Wood and water for stations for 18 months	312
Stores and implements for three stations	75

Supervision.

Surveyor, men, and expenses	£500
Superintendent	200
Six overseers, at £50.	300
Three messengers, at £30.	90

£1090

For 18 months..... 1635

TOTAL.....£3026

ABSTRACT.

FREE LABOUR.

	£	s.	d.
No. 1. Dam at Long Marsh.	2090	4	0
2. Dam on Macquarie River	609	4	6
3. Embankment and bridge across Kitty's Rivulet ..	207	10	0
4. Embankment on main line, between Nos. 5 & 6 branches.	784	6	6
5. Embankment and bridge aqueduct on main channel York Rivulet .	92	18	0
6. Channels.....	11,841	16	0
7. General	3026	0	0
	£18,651	19	0
Contingencies 10 per cent	1865	3	10
	£20,517	2	10

II. ESTIMATE OF THE ELIZABETH RIVER SCHEME.

No. 1.

DAM AT KEARNEY'S BOGS.

FREE LABOUR.

	DAYS.	
	Mechanic.	Labour.
30,983 cubic yards of earth to be got and shot, 4 yards per day.....	—	7745
6208 cubic yards of puddle to be got, tempered, and placed, 2 yards per day	—	3104
134,100 cubic feet of rough facing stone to be got, rough dressed, and built, 20 feet per day.....	6705	—
2376 cubic feet of rough masonry for counterfort, 12 feet per day..	198	—
3920 cubic feet of masonry in culverts, sluice gauge chamber, 12 feet per day.....	326	—
<i>Total Days</i>	7229	10,849
	£	s. d.
7229 days, mechanic, at 4s.	1445	16 0
10,849 days, labour, at 2s.	1084	18 0
250 bushels of lime, at 1s. 6d.	18	15 0
Centering and tools, and repairing ditto	50	0 0
2 gauges, iron work, and valves	7	10 0
2 sluices, valves, racks, levers, chains, &c., including cut masonry....	25	0 0
Cottage for Dam-keeper	50	0 0
<i>Supervision.</i>		
1 Superintendent, at per annum	£120	
1 Overseer, ditto	60	
1 Messenger, ditto	30	
	210	0 0
<i>TOTAL</i>	£2891	19 0

No. 2.

DAM ON THE ELIZABETH.

FREE LABOUR.

	DAYS.	
	Mechanic.	Labour.
2720 cubic yards of earth to be got and shot, at 4 yards per day	—	680
809 cubic yards of puddle to be got, tempered, and placed, 2 yards per day	—	404
12,238 cubic feet of rough masonry for facing of dam, to be got, rough dressed, and built, 20 feet per day	611	
5167 cubic feet of paving for top and inner slope of dam, 30 feet per day.....	172	
3280 cubic feet of masonry in escape, 12 feet per day	273	
5391 cubic feet of masonry in retaining walls, chamber, &c., 12 feet per day	449	
<i>Total Days</i>	1505	1084
	£	s. d.
1505 days, mechanic, at 4s.	301	0 0
1084 days, labour, at 2s.	108	8 0
300 bushels of lime, at 1s.	15	0 0
Centering tools, implements, &c.	10	0 0
4 freestone caps for pins, £1 5s. each .	5	0 0
90 feet run of freestone coping at 2s. 6d.	11	5 0
4 double sluices, fixed.....	40	0 0
2 single ditto	15	0 0
Cottage for Dam-keeper	50	0 0
<i>TOTAL</i>	£555	13 0

No 3.

CHANNELS.

FREE LABOUR.

	DAYS.	
	Mechanic.	Labour.
30,295 cubic yards of rock to be excavated and shot, 20 feet per day	—	40,898
191,614 cubic yards of loam to be got and shot, 4 yards per day	—	47,903
18,428 cubic yards of loam and stones to be got and shot, 3 yards per day	—	6142
17,376 cubic yards of sandy loam to be got and shot, 5 yards per day	—	3475
325,751 cubic feet of masonry in culverts, at 12 feet per day	27,146	
32,575 cubic feet in occupation bridges, special culverts, &c., 12 feet per day	2714	
Total Days	29,860	98,418

	£	s.	d.
29,860 days, mechanic, at 4s.	5972	0	0
98,418 days, labour, at 2s.	9841	16	0
Tools, and repairs for ditto, 30s. per man per annum, 300 days per annum	641	5	0
Centering moulds, running planks, &c.	100	0	0
14,000 bushels of lime, at 1s.	700	0	0
Water for ditto	70	0	0
149 occupation bridges at £5	745	0	0
25 sluices, at £8	200	0	0
30,000 perches of fencing, being about three-fifths of twice the length of channels, taken at 1s. 6d. as an average	2250	0	0
TOTAL	£20,520	1	0

No. 4.

GENERAL ESTIMATE.

FREE LABOUR.

	£	s.	d.
Purchase of 294a. 1r. 26p. of land for channels at £3 per acre	883	4	9
Ditto for Dam Cottage, 1 acre	10	0	0
Compensation for damage to lands	250	0	0
Purchase of 1535 acres at Kearney's Bogs for reservoir, at £2 per acre	3070	0	0
Building three stations for men, at £150.	450	0	0
Wood and water for 5 stations for two years	494	0	0

	£		
Supervision.			
Surveyor, men, and expenses	500		
Two Superintendents at £200	400		
Nine Overseers at £50.	450		
	1350		
For two years	2700	0	0
	£7857	4	9

No. 5.

A B S T R A C T.

FREE LABOUR.

	£	s.	d.
No. 1. Dam at Kearney's Bogs	2891	19	0
2. Dam on Elizabeth	555	13	0
3. Channels	20,520	1	0
4. General	7857	4	9
	<hr/>		
	£31,824	17	9
Contingencies 10 per cent.	3183	9	9
	<hr/>		
	£35,007	7	6
	<hr/>		

H. C. COTTON.