

1936.
NEW ZEALAND.

DEPARTMENT OF LANDS AND SURVEY.

SURVEYS

(ANNUAL REPORT ON).

Presented to both Houses of the General Assembly by Command of His Excellency.

CONTENTS.

GENERAL REPORT—	PAGE	GENERAL REPORT— <i>continued.</i>	PAGE
Summary	1	General	4
Minor Triangulation	1	Staff	4
Topographical Survey	2		
Settlement Surveys	2	APPENDIX—	
Native Land Court Surveys	2	Head Office, Draughting Branch	4
Geodetic Triangulation	2	TABLES—	
Hawke's Bay Re-establishment Surveys	2	Table A.—Field-work executed	5
Standard Surveys	2	B.—Rural Surveys Area	5
Field Inspections	2	1.—Areas surveyed for Lands and Survey Department	6
Standard of Accuracy	2	2.—Areas surveyed for other Departments	7
Tidal Survey	3	3.—Work on hand	7
Land Development	3	4.—Office work	7
Proposed Operations	3		

The SURVEYOR-GENERAL to the Hon. the Minister of Lands.

SIR,—

Wellington, 22nd July, 1936.

I have the honour to present herewith the report on survey operations for the year ended 31st March, 1936.

I have, &c.,

H. E. WALSH,

Surveyor-General.

The Hon. Frank Langstone, Minister of Lands.

REPORT.

A SUMMARY of the operations carried out for the year ending 31st March, 1936, follows, grouped under appropriate headings. A concise summary of the field-work completed during the year is tabulated in Tables A, B, and 1 to 4 herewith.

Table A shows a slight increase in the average cost of rural and road surveys while the cost of the Native surveys is practically the same as for the previous year.

Table B shows a small decrease in the area under rural surveys, while the area under Native surveys is only 40 per cent. of that recorded for the previous year.

MINOR TRIANGULATION.

The work under this heading was principally in connection with the rural standard surveys in the Hawke's Bay District.

TOPOGRAPHICAL SURVEYS.

The whole of the work under this heading was confined to the Auckland District.

SETTLEMENT SURVEYS.

The returns show a decrease on the previous year of approximately 20 per cent. The areas are shown in Table 1 under their appropriate headings for each land district.

NATIVE SURVEYS.

This work is carried out partly by the staff and partly by contract surveyors and was principally in the Auckland and North Auckland Land Districts. Apart from the area shown in the return, other work was done by private surveyors, the cost of which was paid direct by the owners.

GEODETIC SURVEYS.

Work under this heading was resumed in the latter part of the year and ten stations were occupied and observations taken. Of the resulting twenty-seven triangles, twenty-two closed to within 1 sec. and five to between 1 sec. and 1.4 sec. All observations were taken on lamps with the Wild Primary Triangulation Theodolite No. 77.

HAWKE'S BAY RE-ESTABLISHMENT SURVEYS.

Further progress was made with the controlling rural standard work in the Hawke's Bay District, a distance of 172 miles being completed during the year by staff surveyors at an average cost of £26.84 per mile, which represents an increase of nearly 40 per cent. on the cost of the work for previous years. This increase is chiefly accounted for owing to a very wet season, more tortuous roads, and interruption of these surveys. Only one surveyor has been engaged for full time on this work, and with the work in hand and proposed work (approximately 77 miles) the work in this district, as far as rural standard surveys are concerned, should be completed during the coming year. With regard to borough standard surveys the field work and plans have now been completed, the work done comprises the standard survey of streets (in the boroughs of Napier, Hastings, and Wairoa) of a total length of approximately 120 miles at a cost of £50 per mile.

STANDARD SURVEYS.

With the exception of the standard survey work in the Hawke's Bay District and the maintenance of existing standards no work was carried out under this heading during the year.

FIELD INSPECTIONS.

During the year forty-eight investigational and inspection surveys were made and the results show that while the field work is generally very satisfactory, pegging in many cases does not come up to the standard required by the regulations.

STANDARD OF ACCURACY.

The general high standard of accuracy as indicated by traverse closures has been more than maintained, and the fact that the majority of the staff has been trained on the more precise work of rural standard surveys is reflected in the returns of traverse closures, comparatively few circuits exceeding 1 in 25,000 in closing error. The error allowed by regulation 1 in 4,000 (rural) and 1 in 8,000 (town) would appear to be too generous, especially where circuits contain modern work only.

The Propagation of Errors in the Rural Standard Traverses.—It has been customary in the Department and in the survey regulations to state the accuracy of a closed circuit as the ratio between the lengths of the closing line and that of the whole circuit, generally expressed in the form of links per mile. It is well known that a higher ratio may be obtained more often on larger circuits than on smaller, and therefore the accuracy of closure does not depend directly upon the circuit length.

When drawing up the specifications for the rural standard traverses in Hawke's Bay the limits allowed for the closing line in links in any circuit were based on the formula—

$$.5 \times d^{\frac{2}{3}} \text{ where } d \text{ is the length of the circuit in miles.}$$

The use of the function " $d^{\frac{1}{2}}$ " recommended in some text-books was discarded as requiring too large an initial constant for small circuits if due regard for large circuits of ten miles or more was to be made. The choice of the index $\frac{2}{3}$ was made for ease in computing as well as lying between the values $\frac{1}{2}$ and 1 (the direct length), but was not the subject of any special investigation.

It may be noted that the surveys were not necessarily precise, but were made for the purpose of throwing over the district as quickly as possible a reasonably accurate close control with permanently marked stations.

On the completion of the second and third order triangulations, the adjustment of this network of standard traverses was taken up and the question of weighting each section between junction points and triangulation points arose. At first the weights used were inversely as the square root of the lengths, thus reverting to the text-book index $\frac{1}{2}$. This, however, was found to place too great a correction upon the shorter lines, exceeding in some instances the errors which might reasonably be expected to occur in them. Further solutions were made with the weights of sections inversely as the length, and this method spread the adjustment corrections much more evenly, but was considered as going to the other extreme, and a more reasonable solution would lie between these two methods.

In order to arrive at a definite conclusion 115 consecutive closures were extracted from the computations comprising completely closed traverses, traverses between trig. points, and traverses between fixed points (by prior adjustments). These ranged in length from $1\frac{1}{2}$ miles to 15 miles, but on account of their small number (9) those over $11\frac{1}{4}$ miles have not been included in what follows. The remaining 106 closures were arranged in overlapping groups in order of length of circuit and the mean length and closing error in each group obtained.

These names were then placed in observation equations of the form

$$Ad^B - \Delta = 0$$

“d” being the length of circuit in hundreds of chains, and Δ the closing error, the co-efficient A and index B to be obtained by solution. The solution of these equations gave as the mean closing error in links—

$$\begin{aligned} & \cdot 24d^{.84} \text{ (d being in hundreds of chains), or} \\ & \cdot 20d \text{ (d being in miles)—} \end{aligned}$$

a closing error of 1 in 40,000 in a circuit of 1 mile and slightly higher in larger circuits.

From the size of the index $\cdot 84$ it may be inferred that it is more nearly correct to weight inversely as the length rather than inversely as the square root of the length for the purpose of adjustment.

For the purpose of determining the maximum permissible error in a circuit under similar conditions, the largest errors in each group of closures as arranged were taken and for each of them a similar observational equation was formed as for the mean error above. The solution of these gave as the maximum closing error—

$$\begin{aligned} & \cdot 42d^{.88} \text{ (d in hundreds of chains) or} \\ & \cdot 34d \text{ (d in miles).} \end{aligned}$$

On plotting the actual errors against those given by the formula it was found that only 5 per cent. were in excess and in those cases the excess was slight.

The similarity of the indices $\cdot 84$ and $\cdot 88$ is to be expected as in any one series of this nature the mean and maximum curves may be expected to be similar in slope.

It is intended as further traverse nets come up for adjustment to make a more complete analysis of a much larger number of closures and also to investigate the theoretical errors of traverses made under similar conditions.

TIDAL SURVEY.

Tide-tables for the year 1937 for the seven standard ports (Auckland, New Plymouth, Wellington, Lyttelton, Dunedin, Bluff, and Westport) for which predictions are published, were received from the Hydrographer to the Admiralty. The work of predicting the times and heights of high and low water was performed as usual by the Tidal Institute University of Liverpool from harmonic constants supplied by the Department.

LAND DEVELOPMENTAL WORK.

Included in the costs of unclassified work (shown as “Other work” in the attached tables) is that of land developmental work in various districts. This work comprises special topographical surveys, the measurement of areas for scrub-clearing, ploughing, &c.

PROPOSED OPERATIONS, 1936-37.

Hawke's Bay Re-establishment of Surveys.—Rural standard traverses having been extended in scope there remains a further 77 miles to be undertaken during the coming year. On completion of this very little more work of this nature will be necessary as, with one exception, only minor roads remain untraversed. Adjustment of the traverses is well in hand and will continue to occupy the computing staff for some considerable time yet.

Resurveys of Crown lands will be undertaken for title purposes, this work having been deferred wherever possible until all sources of existing survey data have been investigated. As very little further data will be brought to light it is now possible to decide on the amount of resurvey required.

Geodetic Triangulation.—It is anticipated that the main net of the North Island will be sufficiently well advanced to enable the final computations being put in hand. This will necessitate at least seven Laplace stations being occupied and observed for latitude, longitude, and azimuth.

Second Order Triangulation.—Work on this is being done concurrently with the geodetic triangulation so far as the central portion of the Mount Eden circuit is concerned and this will be continued during the coming year.

Standard Surveys.—Rural standard surveys in Auckland, Gisborne, Taranaki, Wellington, Canterbury, and Otago are being put in hand, and the existing work in the cities of Auckland, Christchurch, and Dunedin are being extended.

Precise Levelling.—Work of this nature based on the Lyttelton Tidal Station has been authorized. This work will link up several extensive levelling surveys already completed on assumed datums.

Topographical Survey.—In collaboration with the Defence Department an area of 1,000 square miles in Hawke's Bay is to be surveyed and mapped on a scale of 1 mile to an inch. The Air Services are to supply this Department with aerial photographs which will be worked up by the Arundel method of radial plotting to make the resulting map. Part of this survey should be available in manuscript maps this year.

Data is being compiled from Public Works surveys in Canterbury from which topographical maps will be enabled to be made.

Town and Suburban Surveys.—A total area of 321 acres chiefly in Otago and Southland is proposed to be subdivided for residential purposes.

Rural Settlement.—In this class there are areas amounting to approximately 30,000 acres to be subdivided during the coming year.

Native Land Surveys.—The area in hand is very small, requisitions for survey totalling 3,500 acres only having been issued.

Office Work.—With an increase in the number of surveys coming forward the office staff will be kept very busy during the year.

GENERAL.

Map Publications.—The Chief Draughtsman's report appended hereto gives details of maps published and of sales and issues during the year. It will be noticed that royalty fees collected for the year amounted to £233, equal to one-fifth of the cash sales to the public.

Warrants of Title.—One hundred and sixty-four warrants for the issue of certificates of title were examined and certified to under section 13 of the Land Transfer Act, 1915. Nine Proclamations of road-lines under the Native Land Act and one under section 106 of the Lands for Settlements Act, 1925, were dealt with during the year.

Earth Movements, Hawke's Bay.—Third order triangulation in the Wairoa District executed in 1934 disclosed serious differences between it and the second order work done in the early part of 1932. It was decided to revise the second order work as well as check portions of the third order, and nineteen second order stations from Mohaka eastwards were accordingly reoccupied. On adjustment it was found that movement had taken place at nine stations, while at several others movement was suspected, but could not be definitely proved. The movement comprises two distinct trends—first a movement due south of approximately 2 links along the coastal range running due east from Wairoa; and second, a movement to the north-east of approximately 1 link at the northwards of Wairoa.

The probable origin of this movement is no doubt the earthquake of 15th September, 1932, which caused considerable damage in the locality.

STAFF.

The technical branch has lost the services of Mr. H. A. Joyce, Chief Clerk and Accountant, Surveys and Drainage, Auckland, through death, and of Mr. S. B. Smith, Senior Draughtsman, Dunedin, retired after forty years' service, and Mr. C. W. Lind, retired on account of ill-health.

The staff has carried out its duties in a most praiseworthy manner, and its work is much appreciated by the various Chief Surveyors and myself.

H. E. WALSHE, Surveyor-General.

APPENDIX.

HEAD OFFICE, DRAUGHTING BRANCH.

Map Publication.—The number of editions of maps published during the year was 83, and the total cost of printing £1,040. The maps comprised survey districts ($\frac{1}{2}$ mile to 1 in.), 25; survey districts (1 mile to 1 in.), 34; counties (1 mile to 1 in.), 9; territorial (4 miles to 1 in.), 4; towns, 5; miscellaneous, 6. The number of maps printed being 18,891. In addition to the above a further publication of 1,200 road-maps of the North Island (in two sheets) for the Wellington Automobile Association was printed, making the total number printed under all headings 20,091. Cash sales of lithos from all districts amounted to £1,290, purchases by other Departments £804, and the value of maps issued free or used in the office totalled £1,530. Royalties obtained from maps based wholly or partly on the Department's records and published by private firms or companies amounted to £233 9s. 11d.

Town Schemes.—The number of town schemes approved during the year was approximately the same as for the previous year, although the total area subdivided was considerably less. A total of 154 scheme plans were approved, about 40 per cent. of which were in the Auckland and North Auckland Land Districts, and 20 per cent. in Canterbury, the balance being divided between the other land districts. Analysis of the schemes show that 412 acres outside the boundaries of boroughs and town districts were subdivided into residential lots, and of this area new roads accounted for 27 acres, recreation and other reserves 16 acres, leaving a balance of 369 acres subdivided into lots available for sale.

Draughtsmen's and Computers' Examination.—The annual examination was held in September, 1935, when 29 candidates presented themselves for examination. The results were as follows—Draughting: 16 candidates, of whom 2 obtained first-grade passes (Messrs. K. V. Kennedy and C. R. Lane), and 5 obtained second-grade passes (Messrs. G. H. Ennis, C. R. Lanning, E. Ngahuia, G. L. Redward, and A. M. Terry). Computing: 13 candidates, of whom 2 obtained second-grade passes (Messrs. F. N. Smith and C. T. T. Webb).

Standard of Length.—During the year 78 bands were compared with the standard, the total length being 374 chains. Of these 30 were steel bands of a length of 230 chains and 48 were invar bands of a length of 144 chains.

Maps, &c.—Good progress has been made in the preparation of the standard maps on the 1 mile to the inch scale. In view of the Census in April, 1936, all offices and particularly the Head Office were very busy preparing the necessary maps for this important function.

The topographical map of the Tararuas has now been completed, and will be published during the coming year. This map, which is well up to date, should be of great benefit to trampers in this region.

The motorists map of Wellington District is well under way and should also be published during the coming year.

Preparation of Flying Maps.—Preparation of flying maps of the Dominion has been under consideration for some time, and a commencement was made with these during the year in collaboration with the Aerodrome Branch of the Public Works Department. The Dominion has been divided into six strips and the first map, the main feature of which is the flying route from Auckland to Palmerston North, is practically completed, and publication of same in folder form will shortly be on issue; the other series will be published in due course.

The maps are on a scale of 8 miles to an inch, the size of each map being approximately 30 in. by 18 in., and when folded 9 in. by 5 in. Information is shown on the map in approximate colours, the main flying routes, aerodromes, landing-places, &c., being shown in red, water in blue, and roads in orange, while topographical information is shown in varying grades of colour up to 6,000 ft.; above that height no colour is shown. These maps should meet a long-felt want and will be of great benefit to flyers.

TABLE A.

Class of Work.	Area.	Average Cost.	Total Cost.		
			£	s.	d.
Minor triangulation	98,614 acres	0.40d. per acre	163	14	9
Topographical survey for settlement	6,293 acres	1.57d. per acre	41	2	2
Rural, by staff	39,201 acres	2.29s. per acre	4,490	8	3
Suburban, by staff	1,130 acres	16.41s. per acre	927	6	3
Town, by staff	181 acres	£1.82 per section	1,249	15	6
Native Land Court, by staff	5,182 acres	0.99s. per acre	254	14	2
Native Land Court, by private surveyor	5,680 acres	1.11s. per acre	313	19	2
Roads (city) by staff	119.3 miles	£50.4 per mile	6,016	14	2
Roads (rural), by staff	255.3 miles	£24.4 per mile	6,228	4	1
Other work by staff .. .. .	..	..	5,093	18	2
Total cost of completed work .. .. .	..	..	24,779	16	8

TABLE B.

Land District.	Rural Survey.	Native Land Court.
	Acres.	Acres.
Auckland and North Auckland	22,817	9,967
Gisborne	5,000	..
Hawke's Bay	2,203	..
Taranaki	685	849
Wellington	306	46
Marlborough	268	..
Nelson	1,341	..
Westland	722	..
Canterbury	2,056	..
Otago	3,544	..
Southland	259	..
Total	39,201	10,862

Table 1.—RETURN OF FIELD-WORK EXECUTED BY THE STAFF AND CONTRACT SURVEYORS ON LANDS ADMINISTERED BY THE LANDS AND SURVEY DEPARTMENT FROM 1ST APRIL, 1935, TO 31ST MARCH, 1936.

District.	Minor Triangulation.			Topographical Survey for Settlement.			Rural.			Village and Suburban.			
	Acres.	Cost per Acre.	Total Cost.	Acres.	Cost per Acre.	Total Cost.	Acres.	Cost per Acre.	Total Cost.	Acres.	Number of Sections.	Cost per Acre.	Total Cost.
Auckland and North Auckland	£ ..	6,293	1.57	£ 41 2 2	22,817	2.53	£ 2,882 1 11	128	36	50.28	£ 193 14 1
Gisborne	5,000	0.30	75 4 6	..	..	..	..
Hawke's Bay	132 2 3	..	..	..	2,203	1.81	199 0 9	71	9	16.66	59 2 9
Taranaki	21 12 6	..	..	..	685	3.08	106 14 10	..	..	..	..
Wellington	306	2.94	44 19 9	65.9	23	51.54	169 16 1
Marlborough	268	1.21	16 4 7	..	..	..	..
Nelson	1,341	6.15	412 10 2	164.7	25	26.09	215 0 0
Westland	722	3.76	135 14 1	83.3	8	11.06	46 1 4
Canterbury	2,056	1.37	140 18 4	250.8	16	9.57	120 0 0
Otago	10 0 0	..	..	..	3,544	2.62	464 2 4	310.9	16	7.44	115 12 0
Southland	259	1.03	13 7 0	55.6	3	2.87	8 0 0
Totals	163 14 9	6,293	1.57	£ 41 2 2	39,201	2.29	£ 4,490 18 3	1,130.2	136	16.41	£ 927 6 3

District.	Town Section Survey.			Roads (City).			Roads (Rural).			Other Work (Cost).	Total Cost of Completed Work.
	Acres.	Number of Sections.	Cost per Section.	Miles.	Cost per Mile.	Total Cost.	Miles.	Cost per Mile.	Total Cost.		
Auckland and North Auckland	..	125	£ 0.86	..	..	£ 107 7 3	26.3	19.85	£ 521 1 1	1,154 16 6	£ 4,900 3 0
Gisborne	..	335	..	..	..	682 18 0	..	..	19 3 11	94	8 5
Hawke's Bay	..	37	2.04	119.34	50.42	£ 6,016 14 2	172.1	26.84	£ 4,620 2 10	420 8 9	£ 12,130 9 6
Taranaki	..	28	18.50	..	..	74 18 0	..	..	..	516 4 3	719 9 7
Wellington	..	28	5.40	..	..	72 1 7	..	..	..	370 9 4	805 16 3
Marlborough	2.2	69.06	148 9 6	311 1 3	327 5 10
Nelson	..	5	1.71	..	..	15 0 0	10.7	18.08	193 10 0	65 4 4	901 4 6
Westland	..	2	1.33	..	..	11 19 0	5.8	18.69	108 19 3	235 19 0	538 12 8
Canterbury	..	62	16.14	..	..	136 16 7	15.0	12.32	184 16 1	544 3 4	1,126 14 4
Otago	..	93	22.96	..	..	148 15 1	1.6	11.10	17 9 9	339 7 4	1,095 6 6
Southland	428 19 5	450 6 5
Totals	..	687	1.82	119.34	50.42	£ 1,249 15 6	233.7	24.87	£ 5,794 8 6	4,405 17 5	£ 23,089 17 0

Table 2.—RETURN OF FIELD-WORK EXECUTED BY THE STAFF AND CONTRACT SURVEYORS ON LANDS ADMINISTERED BY OTHER DEPARTMENTS FROM 1ST APRIL, 1935, TO 31ST MARCH, 1936.

District.	Native Land Survey.				Roads, Railways, and Water-races.			Other Work (Cost).	Total Cost of Completed Work.
	Acres.	Number of Sections.	Cost per Acre.	Total Cost.	Miles.	Cost per Mile.	Total Cost.		
Auckland and North Auckland	9,967	69	s. 0·87	£ 433 4 8	..	..	£ ..	£ 439 11 0	£ 872 15 8
Gisborne	..	..	..	..	..	..	..	..	..
Hawke's Bay	..	..	..	..	..	..	..	..	..
Taranaki	849	19	2·85	121 4 8	2·5	33·76	84 8 0	6 12 0	212 4 8
Wellington	46	3	6·02	14 4 0	..	..	..	..	14 4 0
Marlborough	..	..	..	..	0·5	34·5	17 4 11	..	17 4 11
Nelson	..	..	..	..	..	..	..	..	..
Westland	..	..	..	..	..	..	..	..	..
Canterbury	..	..	..	..	12·2	19·88	243 5 8	72 16 7	316 2 3
Otago	..	..	..	..	6·4	13·80	88 17 0	166 16 2	255 13 2
Southland	..	..	..	..	..	..	..	1 15 0	1 15 0
Totals	10,862	91	1·05	568 13 4	21·6	20·09	433 15 7	687 10 9	1,689 19 8

Table 3.—RETURN SHOWING SURVEYORS EMPLOYED AND WORK ON HAND AT 1ST APRIL, 1936.

Chief Surveyors.	Surveyors employed.		District.	Work on Hand.					Standard Traverse.	
	Staff.	Contract.		Topographical.	Settlement.	Native.	Roads, &c.	Towns.	City.	Rural.
R. G. Macmorran	12	..	Auckland and North Auckland	Sq. Miles. 4	Acres. 12,716	Acres. 1,731	Miles. 108	Acres. ..	Miles. ..	Miles. 90
H. L. Primrose	1	..	Gisborne	..	55	..	..	..	..	30
P. W. G. Barlow	2	..	Hawke's Bay	60	14,606	..	3	..	..	37
F. H. Waters	2	2	Taranaki	..	3,883	303	39	..	..	..
J. D. Clapperton	1	2	Wellington	..	..	1,396	9	..	..	..
P. R. Wilkinson	1	..	Marlborough	..	500	..	..	2	..	..
A. F. Waters	1	..	Nelson	..	160	..	2	10	..	..
C. H. Morison	1	..	Westland	..	1,240	..	..	5	..	..
L. J. Poff	3	..	Canterbury	128	5,055	43	45	58	10	..
N. C. Kensington	2	..	Otago	..	400	..	10	246	20	..
H. R. Mottram	2	..	Southland	..	383	..	..	..	..	..
Totals	28	4	..	192	38,998	3,473	216	321	30	157

Table 4.—PRINCIPAL CLASSES OF OFFICE-WORK DONE FROM 1ST APRIL, 1935, TO 31ST MARCH, 1936.

Land District.	Plans placed on Instruments of Title.				Deeds and other Instruments passed.	Plans examined and passed.				Maps drawn for Lithography.		Lithographs sold.
	Crown.		Native Land.	Land Transfer.		Crown.	Native.	Land Transfer.	Other Departments.	Standard Publications.	Sale Plans, &c.	
	Leases and Licenses.	Freehold.										
Auckland and North Auckland	623	366	541	9,610	5,680	228	57	638	197	16	9	£ 390 2 6
Gisborne	85	..	163	480	..	10	8	19	15	..	2	52 4 10
Hawke's Bay	65	24	18	694	882	79	71	223	24	..	..	76 12 0
Taranaki	195	..	21	710	476	15	16	79	30	4	..	58 19 3
Wellington	203	228	46	3,243	1,932	5	6	197	104	5	3	146 11 0
Marlborough	65	8	8	168	..	9	4	17	15	1	1	24 10 7
Nelson	280	22	..	856	1,165	33	..	93	11	..	..	57 15 3
Westland	135	..	..	480	25	23	..	26	20	..	..	65 6 6
Canterbury	460	66	..	2,398	1,279	31	..	233	27	5	..	171 17 7
Otago	311	..	..	2,951	1,744	34	..	148	33	5	23	168 3 9
Southland	174	48	..	906	1,305	7	..	71	15	5	..	95 10 6
Head Office	..	..	..	..	..	..	..	..	..	4	..	785 9 3
Totals	2,596	762	797	22,496	14,488	474	162	1,744	491	45	38	2,093 3 0

Approximate Cost of Paper.—Preparation, not given; printing (934 copies), £10.

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