1876.

NEW ZEALAND.

PHOTO-LITHOGRAPHIC BRANCH OF GOVERNMENT PRINTING DEPARTMENT,

(PAPERS RELATING TO THE SAVING EFFECTED BY THE).

Presented to the House of Representatives, Session 1876, *and ordered to be printed.*

No. 1.

MEMORANDUM for the Hon. the MINISTER for PUBLIC WORKS

IT is very difficult to estimate the gain there has been to the department by using the photo-lithographic process in preparing plans, although it has been very great. The cost of the whole department is about £600 a year, of which about £300 is fairly chargeable against the Public Works.

This is equal to the salary of one good draftsman, or two junior draftsmen. It would have been impossible to get the absolutely necessary tracings made which are required for preparing contracts with less than twelve or fifteen draftsmen more than have been employed had we not had the Photo-Lithographic Department to help us.

With photo-lithography a cheap paper can be used, instead of the expensive tracing cloth which would otherwise be required, and the saving from this cause alone would nearly cover the cost of the Photo-Lithographic Department, which is chargeable against the Public Works. I believe the saving on the whole is under-stated at £2,000 per year, besides which a great saving of time has been effected, and much useful work done which would not and could not otherwise have been done at all.

Wellington, 17th July, 1876. JOHN CARRUTHERS.

No. 2.

The GOVERNMENT PRINTER to the Hon. the MINISTER for PUBLIC WORKS.

SIR,— Government Printing Office, Wellington, 18th July, 1876.

I have the honor to enclose a report by the Photo-Lithographer on his branch of the Printing Department, together with a statement showing its cost since the date of its establishment, and a return of work done during the same period.

I may add that it is a difficult if not an impossible undertaking to calculate the actual saving effected by the use of the photo-lithographic process, for the reason that there is no common basis afforded for making a comparison. To compare the multiplication of copies of drawings by draftsmen with those produced by means of photo-lithography would, as Mr. Deveril has pointed out, produce results which would appear absurdly great in favour of the latter. This much can, however, safely be said:—

1. It affords the means of producing in numbers, as required, maps, plans, and drawings, however elaborate, in a remarkably short space of time.
2. It affords the means of reducing those plans to any scale that may be desired.
3. It saves draftsmen's labour, by enabling maps and plans to be cut up and mounted for photographing.
4. It affords the means of procuring *fac-similes* of original documents, such for instance as the Treaty of Waitangi.
5. And, lastly, it is a great convenience when silver printing and other matters of a purely photographic nature are required.

I have, &c.,
GEO. DIDSBURY,
Government Printer.

The Hon. the Minister for Public Works.

Enclosure in No. 2.

The GOVERNMENT PHOTO-LITHOGRAPHER to the GOVERNMENT PRINTER.

SIR,— Government Photo-Lithographic Department, 17th July, 1876.

In accordance with instructions, I have the honor to forward statement showing amount of work done in this office for the various departments; also the cost of the establishment from its commencement to the 30th June, 1876, a period of three years and three months.

The number of sheets or sections of originals which has passed through the office is 1,527, and from these were produced no less than 1,723 transfers; independently of which a considerable number of photographs of various subjects has been taken and silver prints issued.

The number of photo-lithographs printed has been 488,193; the sizes varying from royal octavo to 4 feet by 3 feet.

The cost of the department has been £1,964 5s. 8d.; an average shows the annual cost about £605. Less than half the cost should be counted against the department of Public Works.

I can see no way of calculating the saving the department has been to the Government. If you calculate what would have been the cost of direct lithography, or of making hand transfers, the figures would amount to an absurd sum, and then be wrong; for I do a large amount of work that would not be done at all, although most useful, but for the fact of the transfers costing little or nothing. Then the saving of time is much, and the ease with which I can reduce subjects is something; and again, by reducing in size, I get several subjects on one stone, and so save in printing and paper. I think it impossible to calculate the saving.

The work done for other departments than the Public Works consists of plans attached to patent specifications, Native deeds and plans, geological plans, drawings, specimens, fossils, &c., maps and illustrations for reports, debentures, postal and railway tables, charts of soundings, plans for Provincial Governments, and a general assortment of miscellaneous things.

A modification of Osborne's process is used in working; and this method, discovered and worked out by me, has been of service in enabling the work which has crowded on the office to be done without increasing the staff.

I have, &c.,

The Government Printer, Wellington. HERBERT DEVERIL, in charge.

Sub-Enclosure 1 in No. 2.

TABLE showing AMOUNT of PHOTO-LITHOGRAPHIC WORK done for the various Departments from the end of May, 1873, to 30th June, 1876.

Departments.	Number of Sheets or Sections of Originals.	Number of Negatives.	Square Inches of Glass covered by Photographs.	Number of Transfers.	Number of Photographs Printed.
Public Works	845	573	134,826	1,004	173,590
Geological and Museum	113	93	11,071	101	61,644
Patent Office...	281	136	21,624	140	100,500
Native Department	78	93	17,806	105	65,600
Premier's Office	17	15	2,800	20	13,100
Marine	39	43	9,746	56	22,455
Colonial Architect	36	125	31,824	134	1,530
Postal Department	11	7	930	39	4,800
Colonial Secretary	24	21	3,000	13	5,060
Crown Lands	19	24	5,054	29	11,590
Telegraph	10	13	2,918	13	11,500
Printing Office	1	2	308	2	150
Treasury	1	5	872	5	500
Defence Office	10	2	410	2	1,400
Inspector of Surveys	9	14	3,164	16	1,500
Registrar-General	1	1	256	1	100
Justice	2	2	168	2	1,000
Civil Service Examination Committee ...	1	1	256	1	100
Public Trust Office	2	2	168	10	500
Gold Fields	1	1	154	1	1,350
General Assembly	6	6	1,138	6	3,874
Immigration	1	1	154	1	250
Assembly Library	3	3	494	3	1,250
Provincial Government, Wellington ...	7	10	2,044	10	2,000
" " Taranaki ...	6	6	1,690	6	2,400
" " Hawke's Bay ...	3	3	462	3	450
Total	1,527	1,202	253,343	1,723	488,193

Sub-Enclosure 2 in No. 2.

TABLE showing COST of PHOTO-LITHOGRAPHIC DEPARTMENT to 30th June, 1876.

	£	s.	d.		£	s.	d.
To Cost of buildings and fittings	216	4	9	By Buildings and fittings	194	6	8
Rent of ground	31	0	0	Stock on hand	170	0	0
Stock account	211	19	8	Working material on hand	80	0	0
Working account	439	9	4	Cost of establishment from April 1, 1873, to June 30, 1876	1,964	5	8
Salaries	1,489	18	7				
Miscellaneous	20	0	0				
	£2,408	12	4		£2,408	12	4

The cost of the department has been at the rate of about £605 per annum.

No. 3.

PRINCIPLES and PRACTICE of PHOTO-LITHOGRAPHY as worked at the New Zealand Government Photo-Lithographic Department, Wellington.

THE object of photo-lithography is to reproduce in fac-simile, or on a reduced scale, maps, plans, manuscript, &c.; and before proceeding to describe the manner in which photography is used in the process, it would be as well, perhaps, to first refer to the method of ordinary lithographic printing from transfers.

Lithographic stones are limestone of a porous nature, and readily absorb water. They are cut to a suitable size, about two or three inches thick, and are ground flat, polished with pumice and snake-stone, and, being thoroughly dried at the fire, are laid upon the bed of the lithographic press ready for the transfer. As an instance of the method of producing copies of the transfers, we will take an ordinary departmental circular. This is written upon transfer paper with transfer ink. The transfer paper is paper coated with a certain composition, in which isinglass figures as the chief item. The peculiarity of the ink consists in the fact of it containing grease.

Now the stone being ready, as stated above, the back of the transfer is damped with a wet sponge; the damp being readily absorbed by the isinglass renders the face "tacky," and in this condition the transfer is laid face downward on the stone, backed with a few sheets of paper, and passed several times through the lithographic press. The immediate result of this is that the stone, from its peculiar nature, retains the grease from the ink with which the transfer is written. Water is next poured on the stone, which absorbs it freely, except in those parts or spots holding the grease from the transfer ink. The process of printing may now be easily understood, at least its theory, by considering the natural antipathy to each other existing between water and grease. A roller charged with ink, containing grease, is rolled over the wet stone, the ink taking readily to those portions which have previously received the greasy ink from the transfer, but being repelled by the water in the other portions of the stone. Sufficient ink being rolled on, a sheet of paper is placed over it, and the proof pulled.

Photo-lithographic transfers are treated in precisely the same manner, being, in effect, photographs in greasy ink upon a substance that will stick sufficiently to the stone in transferring.

The Production of the Photographic Negative.

The map or plan to be reproduced is pinned on the wall at one end of the operating room, and the camera, which, mounted on a heavy stand, runs on a tramway carefully adjusted at right angles to the plane of the wall, is brought to its position and focussed according to the size of the reproduction required. The lens generally used is Dallmeyer's "rapid rectilinear," but for certain classes of work his "triplet" is substituted. The glasses mostly used are 16 in. square, patent plate.

The ordinary process of photography as practised now for portraits, views, &c., with the bromo-iodide of silver, is unsuitable for the production of negatives for photo-lithography, which should be absolutely clear and free from fog in the shadows or lines, and as intense and non-actinic in the lights as possible. Operators work differently to secure this *desideratum*. The following is the method practised in this office:—

The collodion is made as follows, and is never used until at least a week after iodizing:—

Rectified sulphuric æther (s.g. ·720)	6 pints.
Alcohol (s.g. ·806)	3 „
*Pyroxyline	1450 grains.

Iodized with the following:—

Alcohol (s.g. ·815)	3 pints.
Iodide of potassium	840 grains.
Iodide of ammonium	150 „
Iodide of cadmium	90 „

The nitrate bath is prepared with—

Distilled water	13 pints.
Nitrate of silver	20 ozs.

To this is added, before filtering, a few drops of iodizing solution.

After exposure in the camera the plate is developed with—

Water	80 ozs.
Proto-sulphate of iron	3 „
Glacial acetic acid	2½ „
Spirits of wine	Quant. suff.

The development must not be prolonged, nor must it be forced on under exposed plates. A rather stronger solution of cyanide of potassium than is generally used is employed to dissolve the unaltered iodide of silver, and the plate should now show as a fully exposed positive with perfectly clear shadows. A few drops of a strong aqueous solution of iodine in iodide of potassium is next diluted with water to the colour of brown sherry, and the plate flooded with it in presence of white light, after which is applied a dose of ordinary re-developing solution composed of pyrogallic and citric acids with a little dripping silver. This stage requires especial care that the intensifying be not carried too far, for if the silver be piled on to any great extent it will overlap and injure the sharpness of the fine lines, or may destroy them altogether. The negative is now, after careful washing, plunged into a saturated solution of bi-chloride of mercury, the first effect of which is to turn the film black, but after a short time it becomes quite white. It is immaterial what time the plate remains in the bath of corrosive sublimate, provided it is long enough to convert the whole of the metalic silver into

* Made according to Hardwich's formulæ. Sulphuric acid, s.g. 1·845, 2 fluid ounces; nitric acid, s.g. 1·45, 1 fluid ounce; water, ½ fluid ounce; cotton, 30 grains. Temperature, 170° Fahr. Time of immersion, five minutes.

the white salt of mercury and silver. When taken out it is well washed, and a weak solution of iodide of potassium in water poured on and off until the film is yellow right through to the glass.*

As a rule the negative is now flooded with a solution of gum arabic and stood on a rack to dry; but if considered advisable, a weak solution of chloride of gold is poured over, which increases the density. If there appears a tendency on the part of any of the fine lines to fill up, or fog, a weak solution of cyanide may be poured on and off after the treatment with the iodide of potassium. It is found in practice that the gum arabic affords sufficient protection in printing, and enables the glasses to be used over and over again without the difficulties in cleaning which would occur were the negatives varnished.

The Production of the Photographic Transfer.

Various ways are practised to obtain from the negative, produced as above, a positive in reverse upon the lithographic stone; but one of two methods is mostly used, the chemical theory of both being alike, while in their mechanical effect they are quite different. In one, the white parts of the subject are transferred to the stone, leaving the lines open to absorb the greasy ink poured on them; in the other, and more frequently used method, the lines in greasy ink are transferred direct to stone. The latter is the method practised in this office, and the theory of its working may be easily understood.

Gelatine, and many other organic substances readily soluble in water, if mixed when in solution with bi-chromate of potassium, acquire the property, when dry, of becoming insoluble after exposure for a short time to white light.†

If paper coated with gelatine and bi-chromate of potassium, and dried, is placed in contact with a negative and exposed to the sun's rays, the action of the light through the transparent portions of the negative, which represent the lines of the subject, renders those parts insoluble; whereas the remainder, which has been protected from the light by the opaque portions of the negative, is in no way altered. If now the whole surface of the print be coated with transfer ink, and afterwards the print itself placed in warm water, the gelatine in the parts unaffected by light readily dissolve, and carries with it the ink, leaving the lines only upon the clear paper. This method is that practised at the Ordnance Survey Office at Southampton, but is not adopted by me for two reasons. First, that from the fact of there being no gelatine left on the paper, except that covered by ink, it is impossible, in transferring, to pass the stone more than once through the press, for fear of the transfer shifting and the lines doubling; and secondly, in washing away the unaltered gelatine, that which is left on the lines is apt to be ragged and broken.

Osbourne's process, as practised in Melbourne, obviates these difficulties in an ingenious manner. There the gelatine is mixed with albumen, and after the print is coated with transfer ink, it is floated for a few minutes on boiling water, which coagulates the albumen, and holds it and the gelatine, or the greater portion of it, fast to the paper, the ink washing away with the aid of a sponge. This method was practised here at the commencement of work, but is now discarded. It was found that the ink, softened by the action of the boiling water, gathered to a considerable extent upon the lines, rendering them liable to "smash" in transferring, especially when used fresh; and also that soluble gelatine was present in the transfers, and required more boiling water to dissolve and clear it away than could be conveniently used, considering the amount of work to be performed. After a number of experiments I succeeded in working out a modification of the process, which works satisfactorily, and the following is the method in detail:—

Gelatine is soaked, and afterwards dissolved in water over a gas stove, and heated to a temperature 110° Fahr., when a solution of chrome alum‡ is added, well stirred, and the whole strained. Paper is coated with this at a temperature of about 90° and is hung up to dry, when it becomes insoluble although still capable of absorbing water. This operation is conducted in daylight, and any quantity of paper may be prepared at a time, as it appears to keep for any length of time. Paper prepared thus has been sent by me to England, and there yielded excellent transfers. It is sensitized by floating for a few minutes on a saturated solution of bi-chromate of potash, and hung up to dry in a dark room. When dry, I claim that this sensitized paper will keep for a greater length of time without deterioration than that prepared by any other process with which I am acquainted. Tannin may be used in lieu of chrome alum, but the paper, when the latter is employed, seems to keep longer after sensitizing. A sun print is taken on this paper in the ordinary manner from the negative, and is afterwards laid face downwards on a lithographic stone coated with greasy transfer ink, and passed through the press. The surface becomes by this treatment coated with a thin coating of ink. It is next floated for a minute or two, face upwards, on a dish of cold water, and then laid upon a sheet of zinc. The water having been absorbed through the back of the paper by those portions of the gelatine not acted upon by light, the ink is readily removed with a wet sponge and a little friction. A few minutes soaking in a dish of clean cold water removes the now useless bi-chromate, and the transfer, being of a clear white, enables any remaining ink to be seen and easily removed. It is now hung up to dry, and is ready for the stone.

It will be seen that the white portions of the transfer, being still covered with the original coating of insoluble gelatine, are yet capable of absorbing a sufficient quantity of water to render them "tacky," when wetted at the back or placed for a few minutes between sheets of damp blotting-paper, to adhere firmly to the stone in transferring; and this is of great advantage to the printer, as he is not

* Instead of the iodide of potassium, a weak solution of hydrosulphate of ammonia may be used, which converts the deposits into sulphide of silver, but the continual stench of sulphuretted hydrogen in the place is trying to health and temper, and is therefore discarded in favour of the less offensive iodide of potassium.

† "Bi-chromate of potash contains chromic acid, which is a high oxide of the metal chromium. Light alone produces no effect upon chromic acid, but if organic substances are also present the chromic acid is reduced to the condition of a lower oxide of chromium, and the liberated oxygen unites with the organic body. Some kinds of organic matter act more decidedly than others, and especially gelatine, which reduces the bi-chromate rapidly in presence of sunlight, the gelatine itself being oxidised into a resinous substance which remains in union with oxide of chromium."—*Hardwich.*

‡ The proportion varies according to the quality of the gelatine, and I have found different samples of chrome alum affect the gelatine differently.

required to deviate from his ordinary method of working; nor is there the slightest difficulty in detaching the paper when the transfer process is complete. The lines of the transfer are less liable to be ragged and broken than if the gelatine were removed from the paper; and further, the discarding of boiling or even hot water (on account of the gelatine being in the first place rendered insoluble), necessary for the removal of ink or soluble gelatine, does away with the attendant atmosphere of steam and heat from the fires. Finally, the ink, not being softened by boiling water, is retained on the lines of the transfer only, according to the amount originally put on, and does not gather and afterwards "smash," and distribute or thicken on the stone.

In case of an accident to the stone, or should a fresh transfer of a subject which has been once put down be needed, the once-used transfer can be again inked and washed off, and is then ready to be transferred again.

In cases where copies of subjects are likely to be wanted at some future day, two or more prints are taken and the bi-chromate at once washed out, when they are hung up to dry and laid aside. These can at any time be inked and rubbed off, and the resulting transfer be ready in a few minutes.

HERBERT DEVERIL,
Government Photo-Lithographer.

Wellington, New Zealand, 17th July, 1876.

By Authority: GEORGE DIDSBURY, Government Printer, Wellington.—1876.

Price 6d.]