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"The Mid-Victorian 'County Series' production process (an update)."

Fraser Donachie

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The Charles Close Society was founded in 1980 to bring together all those with an interest in the maps and history of the Ordnance Survey of Great Britain and its counterparts in the island of Ireland. The Society takes its name from Colonel Sir Charles Arden-Close, OS Director General from 1911 to 1922, and initiator of many of the maps now sought after by collectors.

The Society publishes a wide range of books and booklets on historic OS map series and its journal, *Sheetlines*, is recognised internationally for its specialist articles on Ordnance Survey-related topics.

The Mid-Victorian 'County Series' production process (an update)

Fraser Donachie

In my previous article on this subject [1] I presented a 'swim lane' diagram summarising the Ordnance Survey production process used for the 'County Series' large-scale maps and plans c.1870. The diagram was based on the descriptions found within the following references:

1. Lt. General Sir Henry James & Col. Duncan A Johnston. *Account of the Methods and Processes Adopted for the Production of the Maps of the Ordnance Survey of the United Kingdom; drawn up by officers of Royal Engineers, &c.* H.M. Stationary Office. First edition 1875. Second edition 1902.
2. Mumford, Ian. *The Maps of the Ordnance Survey: a mid-Victorian View*. London, The Charles Close Society: 1995. This reproduces a series of articles describing production methods and processes written by Captain H. Riall Sankey R.E. for the *Engineering* journal published in 1888. Whilst later than c.1870, the detailed descriptions complement the 'official' treatise above.[2]
3. Index sheets printed to track the progress of surveying, etc, of counties or groups of counties, including e.g. South Eastern Counties (*Sheetlines* 29), Argyllshire and Bute-shire, Shetland and Orkney Islands (*Sheetlines* 31) and Essex.[1]

This article introduces an updated 'swim lane' diagram that adds the one-inch map production process, as half-promised in the initial article. The revised diagram can be found across two pages at the conclusion of this paper.[3] Despite its complexity, I hope that the revised version continues to provide a useful *aide-memoire*.

The products of the one-inch workflow c.1870 consisted of three variants of the basic map; i) an outline edition that included contours, ii) a relief edition with hachures (but no contours) and iii) a hand-coloured geological map. The electrotyping process was crucial to these one-inch production activities, allowing the 'outline' content to be re-used across variants and avoiding the need to entirely re-engrave plates.[4]

Electrotyping had been adopted by the OS at Phoenix Park, Dublin, in 1840, just one year after its discovery. The process was perfected at Dublin

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1 *Sheetlines* 132. 'The Mid-Victorian 'County Series' production process'.

2 See also C Higley, *Old Series to Explorer, A Field Guide to the Ordnance Map*, 2011.

3 See also https://ccs-web.s3.eu-west-2/amazonaws.com/county-series-production-process.pdf

4 Electrotyping was also used between c.1849 and 1866 to produce the *Index to the Tithe Survey* variant of the one-inch 'Old Series' maps. See R Hellyer & R Oliver, *The First Ordnance Survey Map*, 2015.

by Mr William Dalgleish and used to make revisions of their six-inch maps. Electrotyping was introduced at OS Office, Southampton, in 1847 (an inexplicably long time after Dublin, given the benefits on offer) and rapidly became indispensible due to the high quality of the results and the variety of uses to which it could be put.

Figure 1 illustrates how an engraved copper plate could be revised, for example to show a new railway, using electrotyping. The original plate included engraved lines that hold the ink during intaglio printing. An electrotype would be made of the original plate, forming a copper 'matrix'. The engraved lines would now appear as raised lines on the 'matrix', enabling them to be easily removed using a scraping tool and clearing areas that needed to be re-engraved (as specified on an 'erasure sheet'). The cleared 'matrix' would then be electrotyped to form a new copper printing plate that could receive new engraving to depict the required revisions, whilst retaining the original areas not subject to revision.

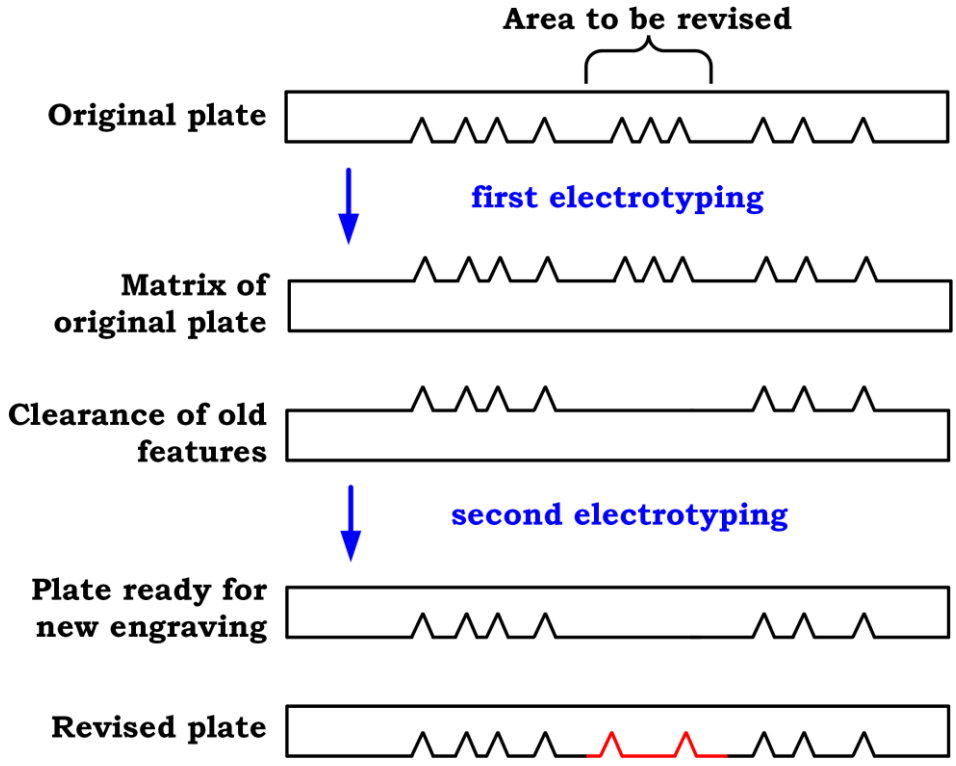

Figure 1. Copper Plate Revision Using Electrotyping

As well as revision, electrotyping was also exploited to create the three variants of the basic one-inch map mentioned above. The first Progress Report of the Ordnance Survey for the years 1855/56 (published 30 June 1857) was reviewed in the Proceedings of the Royal Geographical Society of London,[5] Vol. 2, No. 4. The reviewer states "When the [one-inch] plates have been engraved it is found expedient never to use them for printing, but to keep them as permanent references, and to prepare any required

[5] www.jstor.org/stable/1798952

number of electrotype duplicates from them. This art of electrotyping is here carried on, as Colonel James considers it, to perfection. There is no loss of sharpness in the duplicates, additions and alterations can be made without tampering with the original plate, and there is no fear of a gradual deterioration in future impression". The quality of the electrotyping process was so high that it could be used to create duplicates of the 'hills' plates that featured extremely fine detail.

As a further source of information about the production process, *Figure 2* shows the layout of the OS Office, London Road, Southampton, on the 1:500 town plan Hampshire LXV.7.21 surveyed 1868, engraved 1869 and published 30 September 1870.

Figure 2 – OS Office, Southampton c.1868

The buildings were clearly thought to be sufficiently important to warrant the depiction of their internal layouts. The plan illustrates how the various functions were assigned to the physical accommodation, at least at ground level. The following areas are identified:

- Electrotyping rooms and offices
- Copperplate printing room
- Drawing and printing offices

- Engraving rooms[6] (x 2)
- Manuscript store
- Map store
- Copperplate store
- Lithographic tracing room

The last four of these were located in the 'new' fire-proof building of c.1858. Just to the north, and not depicted on this plan, were the meteorological observatory, the astronomical observatory and the photographic office. The 1871 census shows that the London Road site included accommodation as well as offices and workspaces. Twenty children, under the age of twelve, are listed. It seems likely that these were the children of employees (rather than child labour).

Hand colouring of 1:500 and 1:2500 plans was undertaken at Southampton.[7] The Progress Report for the years 1855/56 states "All large maps are greatly improved by colours, to clearly distinguish the houses from the courts or gardens attached to them, and for clearly defining the extent of water, and the direction of the roads. I have therefore had a number of boys, from 13 to 14 years of age, taught to colour these large maps; they are paid from 6d. to 1s. a day, and we find that the average cost of colouring a sheet is 1¼d. We charge 6d. extra to the public for the coloured impressions".

Examining coloured plans reveals that the work was performed to a very high standard, albeit that errors were sometimes made.[8] It seems likely that a single sheet would be coloured by an experienced colourist, probably with access to the Fair Drawing, creating an *exemplar* or *model* that could then be studied by the junior colourists whenever needed. It also seems probable that the lads who survived this Dickensian monotony would have been offered employment in other functions, the job effectively being an apprenticeship that could also be used to sort the diligent from the lax.

A typical print run for a 1:2500 sheet would be 30 off, sent to the stores in their un-coloured state. These could all be coloured in one batch, ready for distribution to external map agents. However, if the print run was longer, say 50 off, then only a subset would be coloured to meet the immediate sales demand. The remainder could languish in storage for a considerable time before being coloured. Rob Wheeler and I discovered a 1:2500 sheet (Westmorland XXI.2) that has an Embossed Printing Date

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6 These were termed *pavilions*, so presumably had very large windows. The implication is that the hapless engravers would suffer extreme heat in the summer and extreme cold in the winter.

7 Richard Oliver advises that hand colouring of the 1-inch geological sheets was outsourced to an HMSO contractor.

8 See Rob Wheeler, 'The first edition of the 1:2500 in Glamorganishire and Monmouthshire' in *Sheetlines* 132 where Rob estimates an error rate of only 1 or 2 percent.

(EPD) of 1859 as well as an HM Office of Works ink stamp showing a colouring date of '1B' (January 1884); a difference of 25 years!

When writing the initial article I was unaware of a description of the production methods and processes published seventeen years before reference 1. It appears as *Appendix No. 9* to the Report of the Commission into the Ordnance Survey [9] published 20 May 1858. The full title of the Appendix is '*SKETCH of the Mode of making the National Survey, and of the different Processes adopted at the Ordnance Survey Office, Southampton, for the Publication of the Maps and Plans*'. Colonel Henry James, the then superintendent, would undoubtedly have supervised its compilation. Much of the material formed the basis for reference 1 of 1875, that updated and fleshed-out the 'Sketch' into a detailed description.

Using character recognition software I was able to capture the text of *Appendix No. 9* from a copy of the Commission's Report. The description is far more compact than those offered in either reference 1 or 2, and therefore it better lends itself to being reproduced within *Sheetlines*. Accordingly, it is reproduced below in its entirety. Note that it did not include any figures or diagrams.

It turns out that *Appendix No. 9* had an even earlier precursor. The David Rumsey Map Collection (DRMC) includes a bound copy of the first progress report published 30 June 1857. Unlike standard copies, this one includes an additional fourteen page *Notice*, on light blue paper-stock, bound into the same volume and presumably contemporaneous with the report itself.[10] The title is '*Notice of the different processes adopted at the Ordnance Map Office Southampton in the Publication of the Maps and Plans*'. The *Notice* and *Appendix No. 9* share the same wording, however the *Notice* omits the first four sub-sections of *Appendix No. 9*.

Whilst *Appendix No. 9* was compiled twelve years prior to my chosen 'datum' of c.1870, it forms a useful cross-check and supplements references 1, 2 and 3.

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9 The Commission's Report was primarily concerned with the question of the scales to be adopted on OS maps and plans, in an attempt to resolve the protracted debates and arguments known as the 'Battle of the Scales'. The Report was published in the wake of a vote in the Houses of Parliament on 18 June 1857 that stopped the drawing of 1:2500 scale plans, enormously frustrating Henry James and his staff. A Treasury Minute of 11 September 1858 formally enabled the production of 1:2500 plans to resume.

10 Although the DRMC website asserts that the Notice is in manuscript, this seems doubtful. Whilst it is rendered using neat handwriting, it seems likely that it was printed. It would be extremely unusual for Henry James to bypass an opportunity to promote the printing technology available at Southampton.

APPENDIX No. 9

SKETCH of the Mode of making the National Survey, and of the different Processes adopted at the Ordnance Survey Office, Southampton, for the Publication of the Maps and Plans.

CONTENTS.

1. TRIANGULATION.

The survey of the United Kingdom is based upon and connected with a triangulation which extends over the whole country.

The distances between the trigonometrical stations are derived from the measured base lines on Salisbury Plain and on the shore of Lough Foyle in the north of Ireland. This most important branch of the work has been executed with the greatest possible degree of accuracy, the difference between the measured lengths of the bases of verification and their computed lengths not exceeding 2½ inches in about seven miles.

The average length of the sides of the triangles in the principal triangulation is about 60 miles, but many of the sides exceed 100 miles in length. A full account of all the observations and calculations connected with this branch of the work has just been published, and I beg to lay a copy of the work before the Commission.

The primary triangulation is next broken up into smaller triangles, the sides of which are from five to ten miles long, and this secondary triangulation is again broken up into triangles, the sides of which are about one mile long, to form the tertiary or minor triangulation.

The men employed to make the detailed survey then actually measure the length of each side of the minor triangles on the ground, noting in their "Field-books" every fence, stream, or other object they may cross.

They then measure cross lines from one side of the triangle to the other, and by taking offsets from the measured lines to every object on the face of the country, they obtain in their field-books the data for plotting accurate plans of the country upon any scale which may be required.

The length of every measured side of a triangle is therefore checked by the computed trigonometrical distance, and the accuracy of the lines within each triangle is checked by the plotting, and thus no errors which may be made by the surveyor can escape detection.

By this method not only is perfect accuracy obtained in every part of the detail of the survey, but every object is in its exactly correct relative position to every other object however distant; thus, for example, any house on a plan of part of the centre of the kingdom is not only in its correct position in relation to any other house in its neighbourhood, but it is in its exact relative position to any and every house from Caithness to Cornwall.

2. LEVELS.

The levels which are engraved on the plans are all given in relation to one datum level, that for Great Britain being the level of mean tide at Liverpool; and in relation to this datum, principal lines

of levels have been carried all over the kingdom from Cape Wrath to the Land's End; and thus again the levels which are published on the plans are strictly correct in relation to each other, however widely separated the places may be.

3. SCALES FOR THE PLANS AND MAPS.

The scales which were adopted for the Ordnance survey of Great Britain are, for-

Towns, 1/500 of the actual linear measure ;

Parishes, 1/2500, or 25.344 inches to a mile in the cultivated districts ;

Counties, 6 inches to a mile;

The Kingdom, 1 inch to a mile.

The parish plans on the 25 inch scale, or the scale of one inch to one acre, are traced, and 30 copies taken by zincography.[11] Tables containing the area of each separate enclosure are published with these plans.

Each sheet is sold separately; they are one and a half miles long and one mile wide, and therefore contain 960 acres.

The plans of the towns, counties and the present map of the kingdom are engraved on copper.

LITHOGRAPHY, ZINCOGRAPHY, AND ANASTATIC PROCESS.

The plans of parishes on the 1/2500 scale have been published either by lithography, zincography, or by the anastatic process.

Zincography is now generally adopted on account of the facility of handling thin zinc plates rather than lithographic stones, which are necessarily very heavy, and are constantly liable to be broken.

The anastatic process will probably be valuable hereafter, as by its means as many copies of a zincograph as we please can be obtained from a single copy, and the stock of impressions of the plans can therefore be replenished *ad libitum*.

The copies of the plans produced by the three processes are scarcely distinguishable.

4. - LITHOGRAPHY.

The plan is first traced with lithographic ink on tracing paper, which is thinly coated with starch or paste, and for the sake of cheapness the outline is traced by boys, the woods and figures are stamped, and only the writing and a few details requiring some taste in drawing are traced by draftsmen; the drawing should not be too fine, and the lines should be firmly traced.

When completed, the tracing is laid between sheets of damp paper, and is afterwards ready to be transferred to stone or zinc.

The stone must be previously polished with pumice-stone, any former drawing having been first removed from its surface by rubbing it face to face with another lithographic stone, using silver sand and water between; a final polish is given to the stone by rubbing with a piece of "water of Ayr stone," or steatite.

The stone being prepared, the tracing is laid upon it, and is passed through the lithographic printing press about a dozen times, care being taken to damp it once or twice during the process, after which it is peeled off, and it will then be found that the ink from the tracing has adhered to the stone, to which, therefore, the drawing has been transferred.

As the stone has an affinity for grease of every kind, it is necessary to be careful to keep the tracing perfectly clean, and not to touch it with hot hands, &c., otherwise spots of grease will be transferred to the stone, and cause the prints from it to be dirty. These spots can, however, be removed with dilute nitric acid, or rubbed off with the water of Ayr stone.

[11] Orders to discontinue making these plans have been given in consequence of the decision of the House of Commons on the 18th June 1857.

The next process is to etch the stone with dilute nitric acid and afterwards to pour on it a solution of gum arabic; the acid effects a chemical change on the surface of the stone, diminishing its attraction for grease, it also removes any small particles of grease which may have adhered to the stone, and by opening its pores enables it better to imbibe wet, while the gum water fills up the pores, and prevents the blank parts of the stone from taking up the ink in printing.

The stone is now washed over with turpentine to remove all but the fatty portion of the transfer ink, after which the drawing is inked in by passing the printing roller over it, or which is probably better, by rubbing it over with a piece of flannel charged with printing ink.

When the lines have been thus sufficiently charged with ink, the printing may be commenced - the paper on which the impressions are taken being damped for some time before it is used, and after each impression the printing roller is passed over the stone, which is constantly kept damp by sponging.

5. - ZINCOGRAPHY.

The zinc plates are prepared by first rubbing off with "water of Ayr stone" any previous drawings which may be upon them, and afterwards graining them with fine sand and water, using for the purpose a zinc muller or rubber.

The drawing is made and transferred as in lithography; but, instead of using nitric acid, the zinc plate is etched with a solution of nutgalls.

If any alteration has to be made in the drawing, after scraping off the old work with "water of Ayr stone," the part scraped must be grained anew with fine sand before any new drawing is made upon it, or the first lines may be obliterated with a solution of fused potash, which forms at the same time a finely grained surface suitable to receive additions.

6. - ANASTATIC PROCESS.

This is a patent process, by means of which any drawing or print, however old, which has been made with a greasy ink, may be transferred to a zinc plate, and copies of it obtained by printing from the zinc.

It is first ascertained, by rubbing a piece of thin paper over some part of the drawing, whether the ink is so fixed that no trace of it will come off by pressure, if this is the case the drawing is immersed for a few minutes in a hot solution of strontia (1 oz. of strontia to a quart of water), which has the effect of loosening the ink; it is then partially dried, and afterwards is immersed in a solution of nitric acid (one to six of water). If the print be comparatively new, the strontia bath is not required, and it is only necessary to immerse it in the nitric acid. The drawing is then ready to be transferred to a zinc plate previously polished as finely as possible with powdered emery, and etched by placing a sheet of paper over it damped with nitric acid and passing it through the press. The transfer is effected by passing the plate through a copperplate printing press, after which the drawing is removed and the plate wiped over with gum water. It is then charged with printing ink, and subsequently etched with phosphoric acid, a few drops of which are mixed with gum water, after which it is ready to be printed in the usual manner.

7. - REDUCTION OF PLANS BY PHOTOGRAPHY.

The plans of towns on the 1/500 scale, and those of the cultivated districts on the 1/2500 scale, are reduced to the scale of 6 inches to a mile for engraving by photography.

The collodion process is employed for the purpose of taking the negative copy. The lens of the camera is a single achromatic meniscus, 3½ inches in diameter, with a principal focal length of 24 inches.

The plan to be reduced is attached to a board, which can be adjusted by a screw to any height above the ground which may be required, and turns upon a central pivot.

The camera is placed opposite to it on a table which runs upon wheels on a small tramway laid down on the floor of the photographic room.

The required scale of the reduction is obtained by tracing on the ground glass of the camera a rectangle corresponding on the reduced scale to the rectangle of the plan to be reduced. The curvature of the image and indistinctness of outline from spherical aberration, are both remedied by reducing the diaphragm in front of the lens to a small aperture.

The negative having been obtained upon glass is placed in the printing frame in contact with sensitive paper, and in this manner as many positive prints as may be required are taken in succession.

In reducing plans it has been found convenient to colour the houses yellow, by which means they print sharp and black on the paper, the yellow ray, as is well known, having no effect upon the sensitive coating of the glass plate on which the negatives are taken.

The introduction of this process has very much reduced the cost of reducing plans, and saves an immense quantity of time and labour.

8.—CONSTRUCTION OF THE MAPS ON COPPER AND TRACING FOR ENGRAVING.

Six-inch Map. - The six-inch map is engraved in sheets, 3 feet by 2 feet, the sheets of each county being made to fit together by the marginal lines so as to form, if required, a single plan.

For this purpose the co-ordinates of all the trigonometrical points, and of the corners of the sheets of the map, are computed with reference to the meridian of a central trigonometrical point in each county. The sheet lines are then drawn and the trigonometrical points laid down on the copperplates by their co-ordinates, which is done with a machine, the principal parts of which are two scales at right angles to each other, and a tracing point which traverses in directions parallel to the scales.

The photographed plans being traced on tracing paper with lamp black, the tracings are fitted down by the trigonometrical points and sheet lines to the copperplates, which are previously covered with a thin coating of wax; they are then rubbed with a burnisher, by which means the lamp-black is transferred to the wax, and when the tracing is peeled off; there remains on the wax an outline drawing sufficient for the guidance of the engraver, who cuts the work into the copper through the wax ground.

Each six-inch engraving contains 24 square miles; and embraces the same district of country which is contained in 16 plans on the 1/2500 scale, the marginal lines of which are equivalent to l½ miles and one mile respectively.

The latitudes and longitudes have been of late engraved on the marginal lines of the six-inch map.

The meridional point in each county being always a point in the grand triangulation of the kingdom, its latitude and longitude are known with the greatest accuracy, and from these are easily computed the latitudes and longitudes of the sheet corners of the map.

One-inch Map. - The one-inch maps of Scotland and Ireland are being laid down on Flamsteed's projection modified, and the sheets of each kingdom will therefore join together to form one map; this is not the case with the one-inch map of England, which has not been laid down on any projection, but by the method of parallels and perpendiculars to different meridional lines in different parts.

The plans are reduced for the engraver by the pentagraph or by photography from the engraved impressions of the six-inch map, and are then traced, and

the tracings fitted down to the copperplates by means of points previously scored on the copper in the same manner as the tracings of the six-inch map, the distortion caused by the projection being quite insensible in a small area. The hill features are first sketched on six-inch engravings, and are subsequently drawn on the reduced scale by a skilful draftsman for the engravers to copy.[12]

The contours on the six-inch map are of great assistance to the hill draftsman in regulating his scale of shades and fixing the proper relative importance of the different features, as well as for giving the exact form of the map of the hill.

Plans of Towns. - These are engraved on copper, and the scale on which they are engraved being five times that of the plans on the 1/2500 scale, it is arranged that 25 sheets shall be included in one 1/500 sheet.

9. ENGRAVING.

The engraving consists of two processes, viz., direct cutting with the "graver" or "the dry point," and of etching.

The instruments called gravers are of various shapes and sizes, according to the kind of lines required to be produced. Square gravers are used to cut broad lines, and lozenge-shaped gravers for the finer ones; they are pushed forward in the direction required to form the lines.

The "dry points" and etching points resemble large sewing needles fixed in handles about five or six inches long. The graver cuts the copper out, forming a clean line; the "dry point" used for the more delicate lines raises a "burr," which has to be removed by an instrument called a "scraper," otherwise the work would print very thick and unequal.

Etching consists in covering the surface of the copper plate with a substance called "etching ground," composed of asphaltum, Burgundy pitch, and virgin wax. The subject is traced on the ground, and with the "etching point" marked through to remove the ground wherever it passes, and expose the surface of the copper to the action of aquafortis, technically called "biting-in." This process is continued until the fainter tints are sufficiently deep, the acid is then poured off, the plate washed with pure water and dried.

The parts that are bitten-in enough are now painted over with "stopping-out" varnish, when dry the acid is again poured on the plate and process of “stopping-out” and biting-in must be repeated in this way until the darkest tints are sufficiently corroded.

The work has to be completed with the "dry point," to give the more delicate tints and finish. The hills on the one-inch map of England are thus etched, and afterwards completed with the dry point.

A considerable saving in the cost of engraving the Ordnance maps is effected by using steel punches to cut the woods, figures, rocks, &c. on the copperplates.

The work is thus done much more quickly than by hand, and boys are employed at it in the place of skilled engravers.

A portion of the writing also on the copperplates is engraved by machine (Becker's patent), and the parks and sands are ruled by machine with a steel dotting wheel, the pressure of the wheel and the interval between the lines of dots being regulated according to the tint required to be produced.

10. COPPERPLATE PRINTING.

The ink is dabbed on the copperplate with a dabber made of old blanket, and is first wiped off with a cloth dipped in an alkali solution, and then finally cleaned off with a cloth wetted with water only.

In such large surfaces as those of the copperplates of the six-inch map this method is much easier to the printer

[12] It is contemplated to reduce the hill sketches for the engraver by photography.

than the usual mode of wiping with the hand.

The paper for printing is wetted and brushed over to make its surface smooth for the better reception of the ink, and being laid on the copperplate is passed through the press, the upper roller of which is wrapped round with three turns of blanket and one turn of a cloth called "fronting," which is placed next to the paper. After printing the impressions are first dried between mill-boards and are then placed between glazed-boards and pressed in an hydraulic press, after which they are ready for issue.

The ink used in copperplate printing consists of Frankfort black with a mixture of Prussian blue; it is ground with burnt oil in a small mill constructed at the Ordnance Map Office for the purpose.

11. ELECTROTYPE.

The process of electrotype is applied at the Ordnance Survey Office to the purpose of obtaining duplicates of the copperplates of the Ordnance maps, and has been found to be eminently useful, not only as a means of always preserving unworn copies of the plates, but also as enabling copies of them to be taken in their different stages of progress, so that different classes of information can be engraved upon a map the same in all other respects; as, for instance, we may have one copy of a map with contours, boundaries, &c., another with the hill features engraved, a third with geological lines, &c.

It has also been usefully employed in joining two or more engraved plates together so as to form a single copperplate for printing from. In order to do this, electrotype matrices of the plates are first taken, and having been cut to the edges to be joined, are fitted together as closely as possible, after which a thin piece of metal is laid along the line of junction at the back of the plates, and is rivetted and soldered to each of them, the ends of the rivets being cut off flush with the upper surface, which is scraped and burnished to an even plane along the junction. The joined matrices are then placed in the decomposing trough and a copper duplicate is obtained, on which the portion of the engraving which has been destroyed in scraping the edges (to the extent of about one quarter of an inch along the line of union) is made good by the engraver.

In this way county maps of several counties in Scotland have been formed (to serve as indexes to the six-inch maps of those counties) out of the copperplates of the one-inch map, in one instance no less than seven plates have thus been joined together.

Another great advantage is the facility which the process affords for altering engravings, it being much easier to scrape off obsolete details, &c., from the electrotype cast or "matrix" of an engraved plate in which they are in relief, than to cut them out from the original copperplate, this application has been especially valuable in the insertion of the railways on the one-inch map of England, which could hardly have been effected by the ordinary mode without destroying the plates.

The galvanic battery employed is that invented by Mr. Smee, in which the metals are zinc amalgamated with mercury and copper silvered and platinized, the exciting liquid being dilute sulphuric acid.

The zinc plate, 2 feet by 2 feet 4 inches, and weighing 85 Lbs., is suspended between two platinized silvered plates of the same size as itself in a bath of dilute sulphuric acid (about twenty gallons of water to one gallon of acid), to each of the silvered plates is attached a bundle of six copper wires (16 inch in diameter), which are united together by means of a screw-plate, from which there proceeds a bundle of twelve copper wires, the extrémities of which are soldered to a sheet of crude copper of the same dimensions as the plate to be copied.

From the zinc plate also proceeds a bundle of twelve copper wires which are attached to the engraved plate, which has been previously washed over with cyanide of silver, and then with a solution of iodine, which is afterwards evaporated in the sun, by which means all chance of adhesion of the new to the old copper is obviated.

A composition of wax and tallow is also laid round the edges of the plate to prevent the deposit of electrotype copper around them.

The engraved and the plain copper sheets are then laid horizontally one above the other, with a space of about an inch between them, in a wooden trough lined with lead or gutta percha, and containing a saturated solution of sulphate of copper and sulphuric acid. As soon as this is done the galvanic action begins, copper is deposited on the engraved copper-plate, and the zinc plate in the battery tank commences to be dissolved, the sheet of crude copper in the trough also dissolving and supplying the waste in the sulphate solution caused by the deposit of copper on the engraved plate; during the process a rocking motion is given to the troughs by means of a simple machinery of which the motive power is a descending weight, which is wound up about every seven hours, the total descent being forty feet.

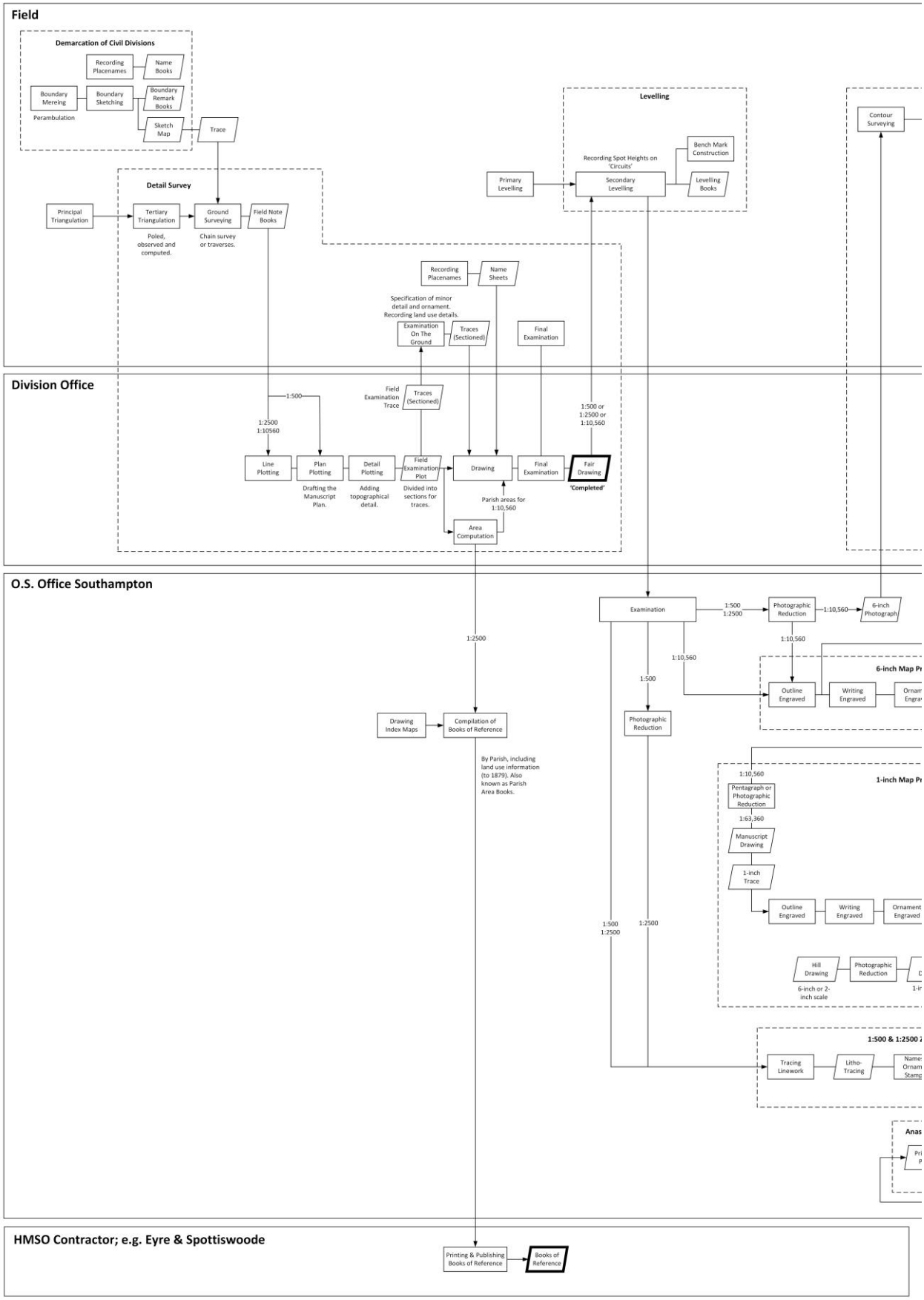
As soon as a sufficient time has elapsed the plate is taken out of the trough, and the sheet of copper which has been deposited is removed from the engraved plate, of which it will be found to be an exact cast, the sunk lines on the engraving being represented by lines in relief on the electrotype "matrix."

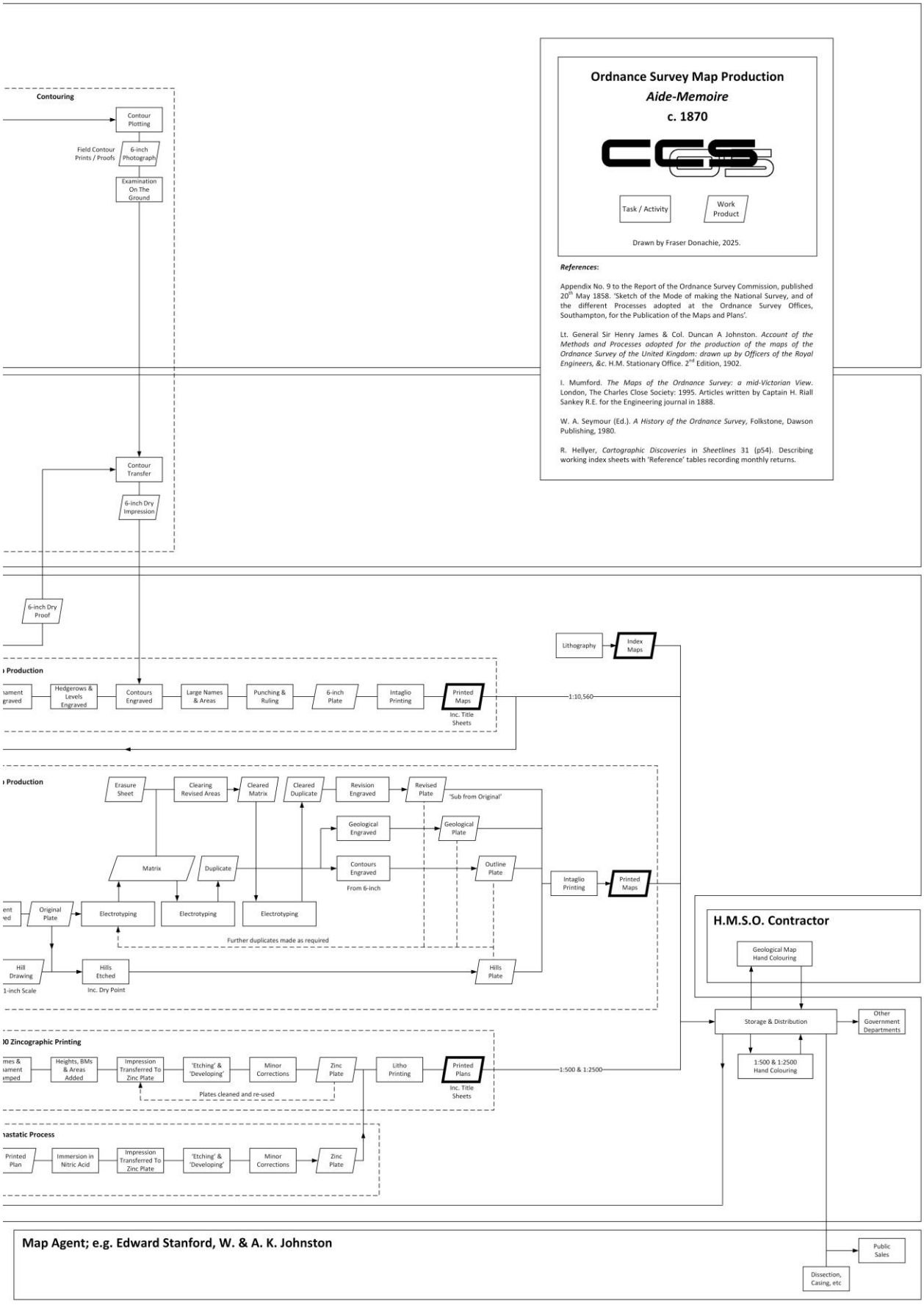
The same process being repeated with the substitution of the newly made "matrix" for the engraved plate, an electrotype "duplicate," an exact facsimile of the original engraving in every respect, is obtained.

The platinized plates are dipped every day in to a solution of perchloride of iron to remove impurities, and the zinc plates are scrubbed at the same time.

When the battery is in good working order, and the engraved plate is laid under the sheet of rough copper, about 1Lb. of copper to the square foot is deposited *per diem*. With the engraved plate upper-most, only half that quantity is deposited, but the copper is of better quality and more free from impurities.

Experiments have been tried to ascertain the increase of the amount of deposit to be obtained by heating the metallic solution; this was found to be very considerable, about 1 lb. of copper per square foot having been obtained in the twenty-four hours ; the process, however, is a more expensive one, and the fumes arising from the troughs most pernicious, so that it is not desirable to use hot solutions, except in an emergency when a plate is required to be copied in the least possible time.


Field
Demarcation of Civil Divisions
Recording Placenames
Name Books
Boundary Mereing
Boundary Sketching
Boundary Remark Books
Perambulation
Sketch Map
Trace
Detail Survey
Principal Triangulation
Tertiary Triangulation
Poled, observed and computed.
Ground Surveying
Chain survey or traverses.
Field Note Books
Levelling
Primary Levelling
Recording Spot Heights on 'Circuits'
Secondary Levelling
Bench Mark Construction
Levelling Books
Contour Surveying
Recording Placenames
Name Sheets
Specification of minor detail and ornament. Recording land use details.
Examination On The Ground
Traces (Sectioned)
Final Examination
Division Office
1:500
1:2500
1:10560
Field Examination Trace
Traces (Sectioned)
1:500 or 1:2500 or 1:10,560
Line Plotting
Plan Plotting
Drafting the Manuscript Plan.
Detail Plotting
Adding topographical detail.
Field Examination Plot
Divided into sections for traces.
Drawing
Final Examination
Fair Drawing
'Completed'
Parish areas for 1:10,560
Area Computation
O.S. Office Southampton
Examination
1:500
1:2500
Photographic Reduction
1:10,560
6-inch Photograph
1:10,560
1:10,560
1:500
6-inch Map Pr
Outline Engraved
Writing Engraved
Ornam Engrav
1:2500
Drawing Index Maps
Compilation of Books of Reference
Photographic Reduction
By Parish, including land use information (to 1879). Also known as Parish Area Books.
1:10,560
1-inch Map Pr
Pentagraph or Photographic Reduction
1:63,360
Manuscript Drawing
1-inch Trace
Outline Engraved
Writing Engraved
Ornament Engraved
1:500
1:2500
1:2500
Hill Drawing
Photographic Reduction
6-inch or 2-inch scale
1:500 & 1:2500
Tracing Linework
Litho-Tracing
Name Ornam Stamp
Anas
HMSO Contractor; e.g. Eyre & Spottiswoode
Printing & Publishing Books of Reference
Books of Reference


Ordnance Survey Map Production
Aide-Memoire
c. 1870
Task / Activity
Work Product
Drawn by Fraser Donachie, 2025.
References:
Appendix No. 9 to the Report of the Ordnance Survey Commission, published 20th May 1858. 'Sketch of the Mode of making the National Survey, and of the different Processes adopted at the Ordnance Survey Offices, Southampton, for the Publication of the Maps and Plans'.
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W. A. Seymour (Ed.). A History of the Ordnance Survey, Folkstone, Dawson Publishing, 1980.
R. Hellyer, Cartographic Discoveries in Sheetlines 31 (p54). Describing working index sheets with 'Reference' tables recording monthly returns.
Contouring
Contour Plotting
Field Contour Prints / Proofs
6-inch Photograph
Examination On The Ground
Contour Transfer
6-inch Dry Impression
6-inch Dry Proof
Lithography
Index Maps
Production
Hedgerows & Levels Engraved
Contours Engraved
Large Names & Areas
Punching & Ruling
6-inch Plate
Intaglio Printing
Printed Maps
Inc. Title Sheets
1:10,560
Production
Erasure Sheet
Clearing Revised Areas
Cleared Matrix
Cleared Duplicate
Revision Engraved
Revised Plate
'Sub from Original'
Geological Engraved
Geological Plate
Matrix
Duplicate
Contours Engraved
From 6-inch
Outline Plate
Intaglio Printing
Printed Maps
Original Plate
Electrotyping
Electrotyping
Electrotyping
Further duplicates made as required
Hill Drawing
1-inch Scale
Hills Etched
Inc. Dry Point
Hills Plate
H.M.S.O. Contractor
Geological Map Hand Colouring
Storage & Distribution
Other Government Departments
1:500 & 1:2500 Hand Colouring
Zincographic Printing
Heights, BMs & Areas Added
Impression Transferred To Zinc Plate
'Etching' & 'Developing'
Minor Corrections
Zinc Plate
Litho Printing
Printed Plans
Inc. Title Sheets
1:500 & 1:2500
Plates cleaned and re-used
Lithographic Process
Printed Plan
Immersion in Nitric Acid
Impression Transferred To Zinc Plate
'Etching' & 'Developing'
Minor Corrections
Zinc Plate
Map Agent; e.g. Edward Stanford, W. & A. K. Johnston
Public Sales
Dissection, Casing, etc