The drawing strategies of James Nasmyth (1808-1890): Technological and artistic visual traditions in the early nineteenth century

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ABSTRACT

This dissertation explores the range of drawing practices open to James Nasmyth (1808-1890), the mechanical engineer. He has been used as the focus for the study of different conventions of drawing and mark-making in mid-19th-century Britain at a time when mechanization began to influence the production of images at many levels.

The context of his education and training in Edinburgh in the 1820s is described first; this covers not only the influence of his father, Alexander Nasmyth (1758-1840), the landscape painter, but also the curriculum and student bodies of the Trustees' Academy and the Edinburgh School of Arts. Nasmyth's working life coincided with the development and consolidation of technical and engineering drawing, and this dissertation examines the theoretical and material bases of this style as it appeared in technical illustrations; in teaching manuals; and in working and presentation drawings, using material from the Nasmyth & Gaskell donation at the Institute of Mechanical Engineers. In tandem with his working drawings, Nasmyth throughout his life continued the practice of observational sketching as a record of the people, places, and objects that interested him, and many of these drawings have been preserved in sketchbooks or in his *Autobiography*. In addition, James Nasmyth produced a book on the nature of the Moon landscape, *The Moon. considered as a Planet, a World, and a Satellite* in 1874 in collaboration with James Carpenter (1840-1899). This was illustrated with photographic images which exhibited several innovative features both in Nasmyth's idiosyncratic mixed-medium method of working, and in their method of production as print illustrations; this section drew on material from the John Murray Archive.

This whole range of drawing practices was considered in order to begin to address two questions: 1) were different drawing conventions kept rigidly apart at this period, and 2) did the development of mechanically reproduced images lead to a new synthesis between different mark-making conventions?

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Chapter I: Introduction: Technological and artistic visual traditions in the early nineteenth century

This dissertation is about the range of active drawing practices which were available in early- to mid-19th century Britain at a time when mechanical reproduction began to have an effect on visual culture. 'Mechanical reproduction' is often understood in the broadest terms to refer to the development of illustrated mass-circulation newspapers,[1] or the use of photography in illustration, and photography has sometimes been seen as the distinctive medium of mechanical reproduction.[2] On the other hand it has been argued that the propagation and circulation of images had reached such a level by 1840,[3] that it would be more accurate to view photography as just another mark-making and print medium (for example, in direct competition with lithography[4]). In general, the first part of the nineteenth century saw the acceleration of mass-produced images of all kinds,[5] in illustrated newspapers, journals, encyclopaedias and technical publications, which demonstrates the existence of a 'drawing industry' apart from fine art practices.[6] Several historians have shown the effect of this influx of images on subsequent fine art, for example Aaron Scharf in *Art and Photography*,[7] Francis D. Klingender in *Art and the Industrial Revolution*,[8] or T.J. Clark in *Image of the People*.[9] My dissertation has been pointed the other way; back towards the

[1] For example see the starting-dates of these newspapers: *L'Illustration* 1843; *The Illustrated London News* 1842; *Illustrirte Zeitung* 1843.

[2] For example in Walter Benjamin's influential essay 'Art in the Age of Mechanical Reproduction' in Benjamin 1973: 219-53.

[3] Crary 1990: 23; the first public announcements of the invention of photography were in 1839 by Daguerre in France (Gernsheim 1968) and W.H.F. Talbot in Britain (Schaaf 1992); in addition many others had been working on similar processes through the 1830s. A recent critical study by Geoffrey Batchen brings together a list of 24 possible inventors. (Batchen 1999: 35)

[4] Rosen 1988.

[5] As evidenced by the lurid title given to her exhibition catalogue by Farwell, B. (1977) *The Cult of Images: Baudelaire and the Nineteenth-Century Media Explosion* Santa Barbara: University of California.

[6] Fox 1980: 1-12; in Nadel and Schwarzbach 1980.

[7] Scharf 1974.

[8] Klingender 1968.

[9] Clark 1973.

world of the illustrators, draughtsmen, and engravers of the early nineteenth century.[10]

The work of many historians of photography, in exploring some of the 'pre-photographic' visual training of early photographers, has as a by-product opened up and exposed some wider aspects of the history of visual culture. That is because photography, often described as both an art and a science from its invention, was taken up by people from various backgrounds.[11] In that sense, the history of photography is a useful bridge from art history to the history of other visual traditions of science or technology. For example, Anne McAuley in her book *Industrial Madness* pointed to the role of Philip Delamotte's previous experience of engineering draughtsmanship in shaping his photographic compositions of the Crystal Palace in 1855.[12] Although my study is primarily concerned with drawing, not photography or print as such, it is largely due to the evidence of other drawing traditions provided by histories of photography and the print industry that have prompted the general questions behind this study. These include: what modes of drawing were available to one person? How

[10] Despite the manifest volume of drawing activity between 1800 and 1850, there is very little information available within the literature of art history. For example, Quentin Bell (1963) *The Schools of Design* and S. MacDonald (1970) *The History and Philosophy of Art Education* both define art and art education in Britain in a way which leaves out the volume of non-academic, non-fine art, activity almost completely. Two recent unpublished theses, listed in the Bibliography suggest a wider field to begin working in: 1) a critical survey of the historiography of art and design education in Britain after the Select Committee on Arts and Manufactures 1835-6, by Mervyn Romans 1998; 2) a survey of art and design education 1835-1902 which includes some material on Mechanics' Institutes from 1835 onwards, by Edward Bird 1992. However, Edward Bird discovered that very little documentation, for example on teaching or pupils has survived from these Institutes. Bird 1992.

[11] For example, John Hannavy's list of biographical notes on early Scottish photographers gives only 4 photographers with a training in art, as opposed to 28 other names from science, trade, or an amateur background. (Hannavy 1983) Both W.H.F. Talbot (in 'Some Account of the Art of Photogenic Drawing', Royal Society, 31 January 1839, reprinted in Newhall 1981: 23-31) and Arago on behalf of Daguerre to the French Academy of Science in 1839 (Newhall 1983: 92-4) gave examples of the artistic and scientific applications of photography.

[12] McAuley 1994:197-8; P.H. Delamotte (1820-89) whose 160 published photographs *The Progress of the Crystal Palace, Sydenham, 1855* have been admired by many for their anticipation of the 'modernist aesthetic' (Frizot 1998: 198) with their use of 'remarkably abstract composition' (McAuley 1994: 198). Delamotte was an illustrator, photographer and watercolour artist; son of the watercolour artist W. Delamotte (1775-1863) who was also drawing master at a military academy (*DNB* 8: 652).

useful was drawing as a general professional skill? What types of drawing education were available? What materials and methods were used? Who was involved, and how much 'overlap' and possible cross-fertilisation took place?

These questions could lead to several different research approaches. The phrase 'drawing industry' might suggest that a whole group of activities, for example the evolution of technical draughtsmanship, could be studied. However, because of the question of 'overlap' and cross-fertilisation, it was felt that a study of the totality of one person's drawing practice, in its widest sense, would be a very useful starting-point. This was because preliminary research had shown that, unlike the painstaking charting of influence given to artistic drawing practices, information has been scattered and broken up, simply because of the very diverse disciplines involved. For example, John Farey (1791-1851) was an important technical illustrator whose work will be discussed in Chapter II. However, because he was a technical illustrator his drawing work has not been widely studied by art historians; instead, a recent critical discussion of his drawings and working methods appeared in *Industrial Archaeology Review*.[13] Other relevant parts of his working life are further removed. For example, the historians Musson and Robinson, whose area of interest is science and technology, simply introduce John Farey as 'an eminent engineering consultant of London',[14] while quoting his evidence given to the Select Committee on Patent Laws of 1829. Another historian, Dutton, emphasises his work as a patent agent.[15] Similarly, James Nasmyth, the subject of my dissertation, featured in a massive scholarly survey by Mervyn Romans of the politics of early art and

[13] Woolrich 1998:49-67.
[14] Musson and Robinson 1969: 63.
[15] Dutton 1984:86-8. Chapter II, part 3 below will aim to suggest that the roles of technical illustrator and patent agent, far from being separate, were connected through the uses of drawing at this period.

design education, simply as 'the manufacturing engineer from Manchester',[16] despite other readily available material on Nasmyth's lifelong interest in art and art education.[17]

It was decided therefore to look for one person as the focus for a study of drawing practices, and to try to do this in the most inclusive way, using material from a range of disciplines. This was intended to be both a synchronic survey across one person's activities, but also to include the development through time of a working career. The desired subject would have various characteristics: an involvement with photography; and a working life that could be broadly seen as scientific or technological,[18] that is not primarily as a visual artist. The connection with photography was wanted because of the underlying groundwork already described, so that this research was imagined as just 'one step back' from areas of visual culture opened up by photographic historians. The second characteristic was wanted because it was hoped to assess a more general level of drawing use, analogous to Baxandall's 'social facts' and 'distinctive visual styles and habits'.[19] Although studying an individual may seem to go against the desire to study a wider social context, it was felt that the general

[16] Romans 1998: 69. In Romans' thesis, Nasmyth featured as a witness to the Parliamentary Select Committee on Arts and Manufactures of 1835-6 where, as in the quote above, he is noted as one of the few witnesses from outside London. Later on in the same thesis one of his statements to the committee was used by Romans to cast him in a Gradgrind-type mould in relation to the arts, as Nasmyth had stated that 'graceful forms of antique designs' in factories would be a good antidote to drunkenness amongst workers. (Romans 1998: 181) Nasmyth's inclusion as a witness is interesting so early in his life; this will be expanded in the discussion in Chapter IV below on Nasmyth's drawings and writings in Buchanan's 1841 *Essays on Millwork*.

[17] For example, although the *DNB* :116-8 also describes him firstly as an 'engineer' it also mentions his 'oil-painting'; his 'artistic perception' and his published photographic work *The Moon, considered as a Planet, a World and a Satellite*. In addition, Nasmyth's *Autobiography* contains many of Nasmyth's reasoned opinions on art and art education. Nasmyth's images also feature fairly frequently in modern general histories of photography, for example, *Wrinkled Hand and Withered Apple* illustrated in Chapter V below. (see for example Frizot 1998:375)

[18] This is with the proviso that current categories of 'art' and 'science' have to be treated with caution in this context. Firstly, because many words, and the categories of activity they refer to, such as 'science', 'geology', and 'photography' were neologisms of the period and were not part of the neutral, common usage of language as they are used today (see Yeo 1993; Batchen 1999; Schaaf 1992: 54) . In addition many people resisted the appellation 'scientist', for example Faraday and T.H. Huxley as late as 1894 (Ross 1962: 65-85).

[19] Baxandall 1972: His 'bottom-up' approach as exemplified in *Painting and Experience in 15th-century Italy* has had a formative effect on the work in this study, despite the differences of detail.

research questions could usefully be applied to one person. This was because: 1) studying a whole person would allow information, previously scattered in the way already described, to be brought together and evaluated. 2) It would allow some assessment of the different uses one person made of drawing; and whether any overlap or subsquent synthesis took place between different uses. 3) It would lead to more general research on wider drawing practices, through the establishment of connections to research in other disciplines. Having established a list of possible candidates, using information from a range of sources, each candidate was researched in relation to archive holdings, literature, etc. James Nasmyth (1808-1890) was chosen as the focus of this study for several reasons:

Firstly, even a preliminary search showed that in addition to his published *Autobiography*, there existed a wide range of relevant archive material.[20] Some material was in Scotland, and because Nasmyth was born and educated in Edinburgh, it was likely that there would be also be accessible background information available, for example in the National Archives of Scotland, or the Edinburgh University Special Collections. The fact that most of the James Nasmyth archive material had been harboured and built up by Nasmyth himself began to pose some questions during the research process, but nevertheless it was felt that this 'constellation' of clumps of material, held in different institutions with widely different narrative histories of their own disciplines, could offer up some unexpected comparisons and insights. Secondly, as is apparent even from his *Autobiography*, Nasmyth had a strong interest in drawing and felt that it was a fundamental mode of thought and communication, stating, for example: ' "the language of the pencil" is truly a universal one...yet it is in a great measure neglected in our

[20] For example the NRA list.

modern system of so-called education'.[21] Such verbal statements are backed up by the survival of many examples of work, such as sketches, drawings, models and photographs in addition to letters and other written comments. Finally, although he was not an artist, several of Nasmyth's visual projects were in the public domain; most notably in his book (in collaboration with James Carpenter) *The Moon; considered as a Planet, a World and a Satellite* of 1874 and his associated large Moon drawing which was awarded a prize medal at the Great Exhibition of 1851.

It was necessary to use a selective approach to the large amount of surviving Nasmyth material. This was partly because of the confines of the dissertation format, but also because the core topic was not Nasmyth's drawings *per se*; rather, they were to be used as a focus in the exploration of the range of active drawing practices which were available to one person. These more general concerns are apparent in Chapter II and Chapter IV. Chapter II is about the context of Nasmyth's own education in drawing between 1820-30; extending outwards from the drawing tradition of his own family, to the Edinburgh Trustees' Academy, the Edinburgh School of Arts, and the beginnings of technical drawing and illustration. The introduction to Chapter IV is concerned with some aspects of mechanical reproduction and the use of machines to produce forms and images without human hand work, with examples largely drawn from James Nasmyth's working life as the designer and producer of self-acting machine tools, remaining within this environment with an evaluation of some specific aspects of Nasmyth's scheme book and technical drawings from his Foundry, from the period 1839-60. In all these sections, there is an unfolding sense of the complex tension in Nasmyth's ideas of the value to be ascribed to hand work and machine work. Chapters

[21] Nasmyth 1883: 57.

III and V aim to explore that tension in the evolution of Nasmyth's most famous published images, the photographic illustrations for his book, *The Moon: considered as a Planet, a World, and a Satellite.* There are a couple of final points to be made in this introduction; both to do with assumptions made in this study about drawing *per se*. The first is that a study of drawing, however wide-ranging and interdisciplinary it may be, ought never to lose sight of the actual processes and materials used. The surface and its marks are seen as the proper level of attention in every sense. There is a mode of signification contained in the act of drawing and in the specific materials chosen, quite apart from the 'text' or the iconography contained within the image. Secondly, it will be seen that the term 'drawing' has been used in a very wide sense which includes aspects of print-making and photography. That is because mechanical reproduction at the period of this study was beginning to permeate visual culture at many levels. This study is about one person's engagement with that fact as developed through his range of drawing practices.

Chapter I: 2: Discussion of Sources

Material directly related to James Nasmyth has come from a variety of sources; both publications and archives. There is a full list of sources, as used, in the Bibliography; in addition, a short list of archive holdings is displayed by the NRA website.[22] During research on these archives, some other archives, not on that list, were found. This section is intended as a brief introduction to some of the main Nasmyth material used, with a discussion. This will include:

1. Nasmyth, J. (1883) *Autobiography*
2. National Library of Scotland: James Nasmyth sketchbooks MS 3241-3
3. Institute of Mechanical Engineers: James Nasmyth Scheme book and letters IMS 98-100; Nasmyth technical drawings
4. Nasmyth, J and J. Carpenter (1874) *The Moon: considered as a Planet, a World, and a Satellite*
5. John Murray, Publishers, Archive: James Nasmyth papers

<u>1. Nasmyth, J. (1883) *Autobiography*</u>

Nasmyth's *Autobiography* was edited by Samuel Smiles (1816-1904), author of *Lives of the Engineers* (1862) and *Self Help* (1859), amongst other titles. Smiles trained in medicine, but worked as a journalist and populariser of technology and industrial progress. He had a particular interest in bringing forward and celebrating the work of engineers, because he approved of the qualities of energy, native intelligence, thrift, and tenacity that he felt had contributed to the success of his chosen subjects despite their humble origins.[23] His collaboration with Nasmyth could therefore be expected to bring out some of these virtues.[24] In addition, the *Autobiography* was written and published when Nasmyth was in his late seventies. His distance from the events

[22] The National Register of Archives website is at www.hmc.gov.uk.
[23] *Who Was Who 1897-1915*:657.
[24] Problems with Smilesian literature have been tackled recently by Adrian Jarvis in a number of articles, but specifically in his (1997) *Samuel Smiles and the Construction of Victorian Values*.

could therefore have lent them a gloss of nostalgia and hindsight, in addition to the message of thrift and industry that Smiles might possibly have wished to add. The book was engagingly written, with homely or pungent details; for example at one point there was a description and picture of the home-made slow cooker that James Nasmyth designed and had made as part of his economy drive while training as a young man in London with Henry Maudslay in 1830. This description was rounded out with some recipes and shopping bills:

> a little multiplication will satisfy any one how I contrived to live economically and comfortably on my ten shillings a week. In the following year my wages were raised to fifteen shillings a week, and I then began to take butter to my bread.[25]

The book has been used as a source of information by many writers, most notably for the *Dictionary of National Biography* entry for James Nasmyth, histories of engineering,[26] and works of art history on the Nasmyth family.[27] As it has often been the only source available on Nasmyth and his family, some care is needed to corroborate statements made in the *Autobiography* independently. However, more detailed research has shown inaccuracies about dates and details in the *Autobiography*. For example, Nasmyth recalled the British Association meeting in Edinburgh of 1850 'presided over by the Duke of Argyll',[28] whereas the President listed by the BAAS for that year was Sir David Brewster.[29] There are some discrepancies of dating and names between the *Autobiography* and the Scheme Book which will be discussed in Chapter IV. These are very small problems, however, in comparison to the way in which Nasmyth expunged one of his siblings from his life story. This was discovered by J.A. Cantrell, the

[25] Nasmyth 1883:143-4.
[26] For example in Rolt (1986) *Tools for the Job*.
[27] For example in Irwin (1975) *Scottish Painters at Home and Abroad 1700-1900*.
[28] Nasmyth 1883:339; The Duke of Argyll was President at the Glasgow meeting of 1855. (Howarth 1922: 285) Nasmyth/Smiles use the device of introducing the Duke here in order to move the narrative on to a subsequent social visit to Inverary at the Duke's house.
[29] Howarth 1922:285.

economic historian: 'Nasmyth minimized and omitted the role of his partners and investors without whom the business could not have flourished...for example, his brother George Nasmyth (c.1806-c.1869)'.[30] Although George had worked with Nasmyth on early engineering projects in Edinburgh in 1826-7, and was an active partner in the two Manchester businesses set up by Nasmyth until 1843,[31] James removed him completely from the description of these triumphs given in the *Autobiography*.[32] Instead, Nasmyth allowed George to slip out of the narrative immediately after birth.[33] Therefore, although the *Autobiography* has been used as a constant and invaluable source of 'Nasmyth's voice' these examples have underlined the general rules of circumspection to be employed when using this kind of material.

2. National Library of Scotland: James Nasmyth sketchbooks MS 3241-3242. MS 3243 is a group of larger, separate drawings and photographs.

These 'sketchbooks' MS 3241 and 3242 are two albums of sketches, photographs, and prints mostly by James Nasmyth, but also including examples by Alexander Nasmyth and Patrick Nasmyth. In addition there are examples of work from people outside Nasmyth's family, such as a print by J.W. Lowry,[34] a pencil sketch of Vesuvius by Clarkston Stanfield,[35] and some anonymous items. The provenance of these images was researched by Larry Schaaf in 1984: this collection was purchased by the Library in March 1945 at auction and there is no other information about their provenance before that date. When

[30] Cantrell 1984:13.
[31] Cantrell 1984:16-9.
[32] George was involved in some disgrace after leaving the Foundry which partly explains his disappearance, and the uncertainty about his dates (Cantrell 1984:16-9).
[33] Nasmyth 1883:54.
[34] MS3242 no.261 this print is after a drawing by Nasmyth of 1834 'cotton manufactory' MS3241 no.207.
[35] MS3242 no.294.

purchased, they had been laid down on 'brittle brown paper, in portfolio' and later reassembled by the Library into the two albums; 'no record of the original collation has been traced; most likely it set at least the general pattern for the present arrangement, which is strictly chronological'.[36] MS 3241 runs to August 1838 and MS 3242 runs from December 1838 to 1885. However, the first image in the set is dated 1796; before James Nasmyth's birth. This has a caption added in what appears to be Nasmyth's writing: 'Drawn by an automaton draughtsman or machine 1796'.[37] Many drawings have added captions in this manner, with apparently retrospective dating, except for the drawings that appear to have been dated during their execution. This, together with their assembly in chronological order, despite their varying origins, suggest that the collection may have been put together by Nasmyth much later in his life. Some echoes of the narrative in the early part of the *Autobiography*, for example, the 'walk from Liverpool to London' (discussed in Chapter II below);[38] views of London such as 'Maudslay's factory 1830'[39] and Westminster 1832,[40] suggest, indeed, that putting together these pictures may have been part of a process of recollection and reconstruction of his life's narrative connected with the writing of the *Autobiography*. Because of the diversity of the material and a sense of ordering and selection, the feel of these albums is more like a scrapbook than a sketchbook.

James Nasmyth certainly ordered and captioned one other scrapbook in the 1870s. This is in the National Gallery of Scotland Print and Drawing Collection, and is the scrapbook D. 3727 by Alexander Nasmyth (1758-1840), James' father, with added notes by James Nasmyth. The handwriting is very similar to that of the NLS captions,

[36] Schaaf 1990a: 15-6.
[37] MS 3241 no.1.
[38] Nasmyth 1883:159-71.
[39] MS 3241 no. 85; Nasmyth 1883:128-38.
[40] MS 3242 no. 98; Nasmyth 1883:127.

which suggests they were done at a similar period, and one of these notes has a date attached to it: 'James Nasmyth 1871'.[41] Two drawings by Patrick Nasmyth (1786-1831), James' brother, were in the same group, also with annotations, for example: 'An original sketch from nature by my brother, Patk. Nasmyth, 1820, James Nasmyth 1870'.[42]

The James Nasmyth images in the NLS are mainly atmospheric sketches of landscapes and antiquities. In addition there are a substantial number of fantastical images of fairies or alchemists in interiors furnished in a cluttered Gothic style.[43] There are also some experimental uses of mark-making such as photography, lithography, and other hybrids. The style of most of the images is linear; with the use of pencil or ink on thin paper, although there are also some chiaroscuro studies using ink washes in the earlier material.

3. Institute of Mechanical Engineers: James Nasmyth Scheme book and letters IMS 98-100; Nasmyth technical drawings

All this Nasmyth material was donated by Sir Holberry Mensforth (1871-1951), who was the last director of Nasmyth, Gaskell & Co, on Nov. 20 1940. The company had held the material until then, following Nasmyth's final withdrawal from work in 1857. The interest of this material is that it is a substantial body of sketches and drawings, from Nasmyth's working life, in contrast to the images in the NLS albums. In addition, because this material had been left with the company, it is probable that it has been unchanged since 1857. This material will be discussed in Chapter IV.

4. Nasmyth, J and J. Carpenter (1874) *The Moon: considered as a Planet, a World, and a Satellite*

[41] D. 3727.1.
[42] D.3727 (m).
[43] See Stevenson 1989:23-6.

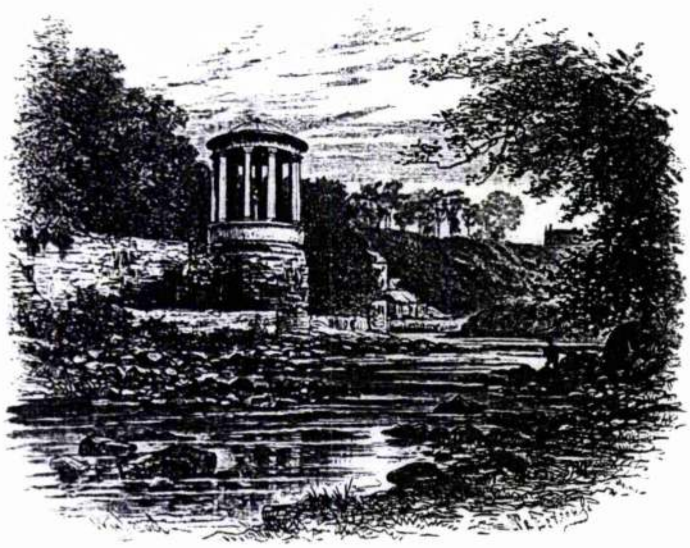
5. John Murray, Publishers, Archive: James Nasmyth papers

This book was published by John Murray and went through four editions in different formats until 1905. A research visit to the John Murray Archive was very fruitful, because the known holdings of letters, sketches, and other material had not been previously studied. This gave information about the response generated by complementary copies of the first edition and ledger information about the print and distribution details of all editions. In addition, there were some earlier letters to Nasmyth from fellow astronomers, for example from Warren de la Rue and Sir John Herschel. The Herschel letters were particularly interesting because they were the replies to letters from Nasmyth to Herschel at the Royal Society.[44] There was also some material to do with the later *Autobiography*; namely a school-type notebook filled with a handwritten narrative on which the first part of the Autobiography was based. There were also some drawings and etchings by Nasmyth, for example a drawing, *The auld Toll booth, Edinburgh*,[45] or an etching *Gathering Sticks*.[46] Also, th visit prompted the discovery of some extra material, namely a collection of letters negotiating the idea of the book on the Moon, and subsequent discussions about the image qualities and means of reproduction. This material will be included in Chapter V.

[44] Although these are connected with the book on the Moon, these letters were also used to prepare the *Autobiography*. Nasmyth 1883:382-8.

[45] This pencil sketch 9.5x11.5 cm. is a copy of the same scene which is reproduced as a wood-engraving in the *Autobiography* Chapter V. Nasmyth 1883: 85.

[46] This is a rustic vignette, undated, framed by trunks and branches and drawn with clean crisp lines; overall dimensions 13.2x17.8 cm.



ST. BERNARD'S WELL.

Figure 1: Alexander Nasmyth, detail from *Loch Katrine*, undated, oil on canvas 68.6 x 90.2 cm. Glasgow Museums and Art Galleries (Kemp 1970:97).

Figure 2: *St. Bernard's Well*, wood engraving (Nasmyth 1883:44).

Chapter II: 1: Nasmyth's drawing education in context: Family

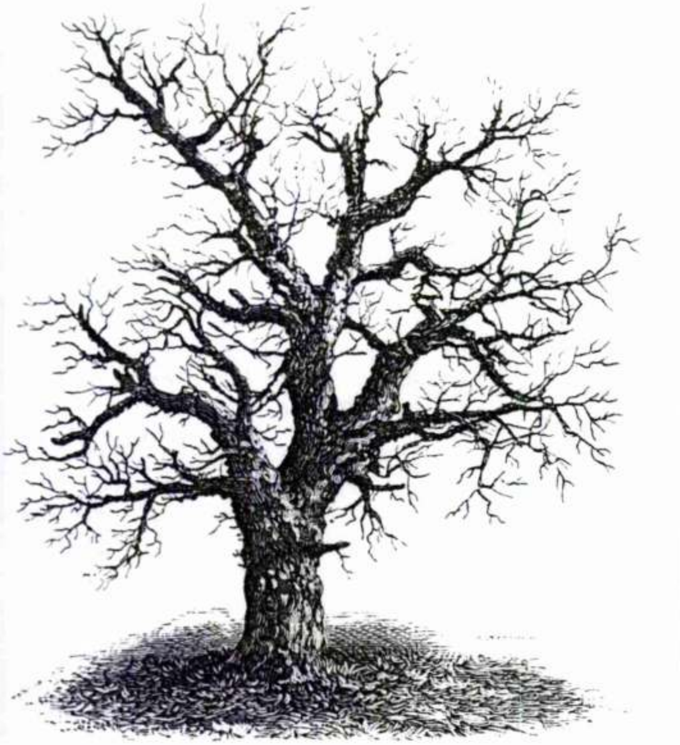
James Nasmyth was the youngest son of Alexander Nasmyth (1758-1840) of Edinburgh, the landscape painter.

Alexander Nasmyth has been described by David and Francina Irwin as a 'Janus figure' whose work extended between an 18th-century Claudian mode (in which the Scottish landscape was 'Italianized' on canvas) and the Romantic generation.[47] Martin Kemp has expanded on Alexander Nasmyth's 'Claudianisation' of landscape by considering his role within the picturesque movement, in which man's works were depicted as an enhancement of 'the inherent order which was considered to be present in nature herself'.[48] In enhancing the landscape in this way, Alexander Nasmyth did not simply confine himself to painting; as, for example, by inserting an imaginary classical temple onto the shores of Loch Katrine[49] (Fig 1). In addition, he remodelled the existing landscape as in his design for St. Bernard's Well (Fig.2) which was constructed on the Water of Leith in Edinburgh in 1789[50] as well as designing other picturesque structures for patrons such as the Duke of Argyll and Sir James Hall of Dunglass.[51] Kemp's examples showed that there was a circularity between the actual remodelled and the imaginary depicted landscapes of Alexander Nasmyth. A further twist to this circular process is given in a study of the Tongland Bridge near Kirkudbright,[52] in which, as the author Ted Ruddock points out, the word 'picturesque', did not just refer to the rustic style of the bridge, but to the entire design process. The bridge was designed in a collaboration between Alexander

[47] Irwin 1975: 138.
[48] Kemp 1970: 93-100.
[49] Detail of the painting *Loch Katrine* oil on canvas 68.6 x 90.2 cm. undated, Glasgow City Council Museums and Art Galleries.
[50] For Lord Gardenstone, see Kemp 1970:94.
[51] Irwin 1975: 138-9.
[52] Ruddock 2000: 134-44.

38 THE FAMILY TREE. [CHAP. II.

My father modelled old castles, old trees, and suchlike objects as he wished to introduce into his landscapes. I append an illustration, which may perhaps give a slight idea of his artistic skill as a modeller. The one I specially refer



THE FAMILY TREE.

to, he called "The Family Tree," as he required each of his family to assist in its production. We each made a twig or small branch, which he cleverly fixed into its place as a part of the whole.

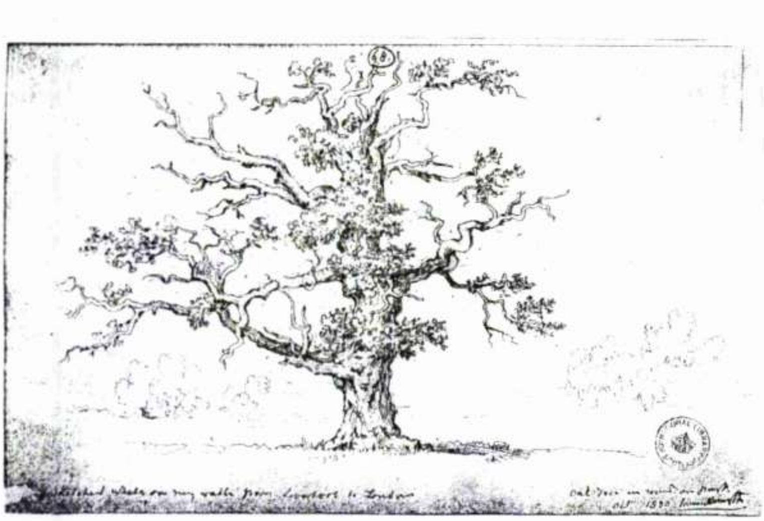


Figure 3: ***The Family Tree,*** **wood engraving (Nasmyth 1883:38).**

Figure 4: James Nasmyth, ***Oak Tree,*** **1830 pencil 13.2 x 20.6 cm. (NLS MS3241 no.68).**

Nasmyth and Thomas Telford in 1803-5. Nasmyth made sketch pictures of various proposed bridges, modifying Telford's original designs in order to give different effects within the illustrated landscape, before approval was given for the final construction by Thomas Telford. Nasmyth continued to work in this way in his own later independent bridge projects such as the Nasmyth Bridge at Almondell, West Lothian of 1811.[53]

There was another kind of circularity at work in Alexander Nasmyth's depiction of landscape which is recalled nostalgically by his son James in his *Autobiography*:

> My father modelled old castles, old trees, and suchlike objects as he wished to introduce into his landscapes...The one I specially refer to, he called 'The Family Tree', as he required each of his family to assist in its production. We each made a twig or small branch, which he cleverly fixed into its place as a part of the whole. The model tree in question was constructed of wire slightly twisted together, so as to form the main body of a branch. It was then subdivided into branchlets, and finally into individual twigs. All these, combined together by his dexterous hand, resulted in the model of an old leafless tree, so true and correct, that any one would have thought it had been modelled direct from nature.[54]

Figure 3 shows James' illustration of this from his *Autobiography*. In relation to drawing practices of the period this is an interesting passage. Firstly, making maquettes or other three-dimensional studio setups for paintings was one studio practice available to painters.[55] Secondly, this method of sketching with materials was one which James Nasmyth would develop in his own way; and finally; in this account the tree was constructed as a collaborative family effort. In

[53] Ruddock 2000:142.
[54] Nasmyth 1883: 38-9.
[55] Another example could be Gainsborough's constructions of landscapes made from 'dried herbs.. mirrors... sprigs of broccoli... coal', etc. (Turner 1996 11: 912), although this does not have quite the same quality that Nasmyth was at pains to stress of hand modelling. Later examples include the careful assembly and commissioning of objects for the pre-Raphaelites. Holman Hunt, for example, had the lantern for *The Light of the World* 1851-3 made to order. (Maas 1984:18-23)

this way, it could be argued, Alexander Nasmyth presided over the evolution of a joint 'schema'[56] -in this case, for trees, which could demonstrate one example of the way that the Nasmyth family style was developed in working practice. This idea is backed up by examples in James Nasmyth's sketchbooks in the National Library of Scotland, and particularly by one sequence from 1830.[57] At that date, while his master,[58] Henry Maudslay (1771-1831),[59] was away in Berlin, the trainee engineer James went on leave to Liverpool to see the new trial railway engine, Stevenson's *Rocket*. As he had a month's leave, he decided to walk back to London to enjoy 'the most interesting and picturesque places'; to visit industrial enterprises; and to reflect generally on his future work.[60] The drawings from this tour which were chosen for this sketchbook, however, were nearly all of trees as in Fig. 4.[61] The predominance of this motif is striking, prompting the question; was there nothing else between Liverpool and London except old, gnarled trees?[62] It seems likely that the 'Family Tree' influenced at least one of the participants in this three-dimensional process and re-emerged in these numerous sketches.

Alexander Nasmyth also relied on family collaboration for the production of paintings and for gathering on-the-spot sketches of views he was unable to visit himself,[63] which may have led him, as

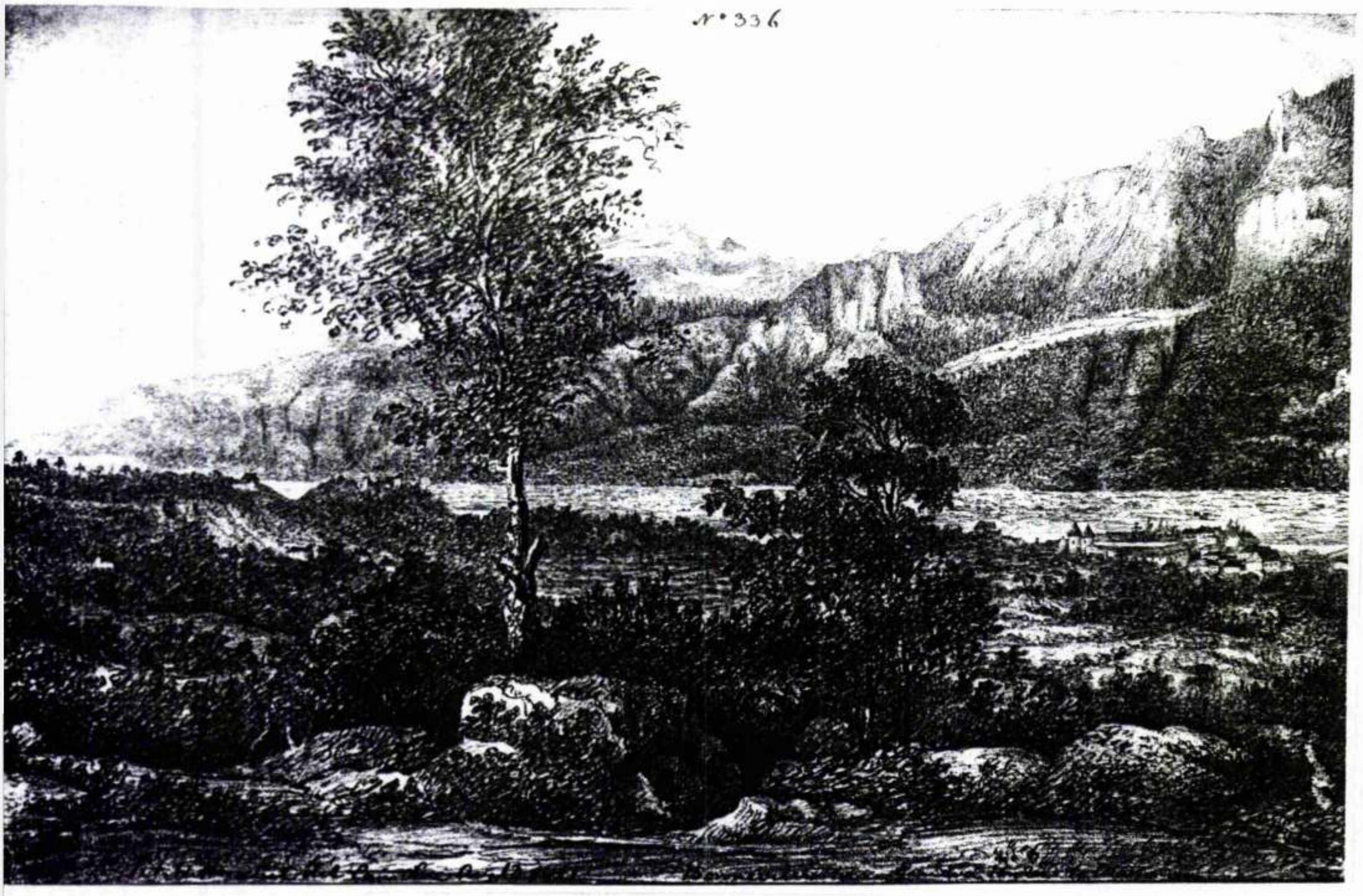
[56] Gombrich's term from *Art and Illusion*.
[57] See the Discussion of sources, Chapter I part2 on the backgound to the sketchbook.
[58] This was James Nasmyth's affectionate title for Maudsley; Maudsley had in fact stopped taking on apprentices and Nasmyth was taken on in 1829 officially as his 'assistant workman'. (Nasmyth 1883:141)
[59] Nasmyth's book spells this surname 'Maudsley', whereas elsewhere (DNB) this is spelt as 'Maudslay'; if there are any discrepancies of spelling in this study, that is the source of them.
[60] Nasmyth 1883:155-71.
[61] NLS MS3241 no. 68.
[62] In NLS MS 3241 this 'walk from Liverpool to London' sequence runs mainly from nos. 60-72 of which nine are of similar trees; this contrasts with the striking word-pictures of, for example, the Black Country given in the *Autobiography*. (Nasmyth 1883: 163-4)
[63] There are many examples of sharing sketches and collaborating on paintings in Johnson and Money (1977) *The Nasmyth Family of Painters*; in addition James Nasmyth describes being deputized by his father to go and sketch Castle Grant and Elgin Cathedral for two commissioned paintings of places that his father 'was now too old to visit'. The patrons were involved in this process and approved 'warmly' of this collaboration.(Nasmyth 1883:193-5).

Irwin suggested, 'to systematise his art to a degree which in his old age was having a deleterious effect on his personal style'.[64] On the other hand, the family business of painting and running a private drawing school has been seen by Mungo Campbell as a high level of career management: 'the influence exerted on the taste of the picture-buying public by drawing instructors such as the Nasmyth family was at its strongest in the market for landscape painting and watercolours' who also adds that Nasmyth's dominance over Scottish tastes in landscape painting mystified outsiders.[65] As Kemp noted ironically,the collaborative nature of the family business and the fact that seven of the children were professional artists meant that Alexander Nasmyth was not therefore idly called 'the father of Scottish landscape painting'.[66].

James Nasmyth was part of a family involved in the production and promotion of landscape art. As suggested, this did not simply mean the production of paintings for sale, because the family also ran a private drawing school at their house in York Place, Edinburgh. Alexander Nasmyth 'set on foot drawing classes, which were managed by his six daughters, superintended by himself'.[67] These classes were largely patronized by 'young ladies' of 'county families' who, in addition to drawing and painting in the studio, went on many excursions all around Edinburgh and the surrounding countryside, sketching from nature.[68] James Nasmyth in his *Autobiography* is quite clear that this kind of sketching was not necessarily intended as the first stage of a painting, but was valued as an end in itself:

> Thus, looking at an old sketch-book brings back to you the recollection of a tour, however varied, and you virtually make the journey over again with its picturesque and beautiful

[64] Irwin 1975: 145.
[65] Campbell 1993: 32.
[66] Kemp 1970:93.
[67] Nasmyth 1883: 55.
[68] Nasmyth 1883:55-8.



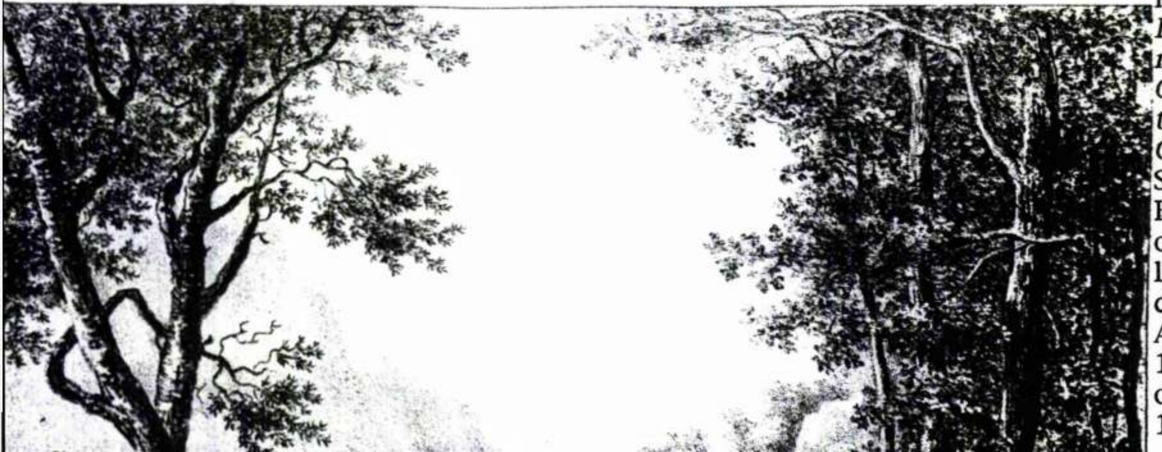


Figure 5: *Bonneville near Geneva, on the road to Chamonix* Sir John Herschel camera lucida pencil drawing 13 August 1821. 19.2 x 27.9 cm. (Schaaf 1992:7)

Figure 6: Georgiana Spencer *Passage du Mont saint-Gothard* drawn on lithographic stone by A.Regnault after an original by Lady Elizabeth Foster 1817. 15 x 19.9 cm. (Twyman 1990:170)

> associations...Written words may be forgotten, but these slight pencil recollections imprint themselves on the mind with a force that can never be effaced. Everything that occurred at the time rises up as fresh in the memory as if hours and not years had passed since then.[69]

The Nasmyth family of James' upbringing, therefore, was not only involved in landscape painting at a period when that genre was being re-valued by patrons, but was also producing 'active' patrons; an audience who not only bought and looked at paintings of landscape, but also travelled, observed, sketched and painted for themselves.[70]

A similar change in the depiction of landscape can be seen in the growing production of illustrated travel books at this period, aided by the cheap new printing technology of lithography.[71] It is possible to see a 'landscape sketching' convention becoming rapidly and firmly established by a feedback process between the soft marks of graphite pencil sketches on paper and their lithographic equivalent.[72] The lithographic process, indeed, allowed sketches to be multiplied through printing so that what had hitherto been a private act (sketching) with a distinctive style of mark-making became validated for public distribution. Two images, juxtaposed here, exemplify this feedback between pencil sketching and lithography. (Figures 5 and 6) Figure 5 is a pencil sketch by the scientist Sir John Herschel (made with the aid of a *camera lucida*) on a Continental tour in 1821, from a private sketchbook.[73] Figure 6 is from an early lithographed book

[69] Nasmyth 1883: 57-8.
[70] Some of the class and gender issues of drawing at this period touched on in this section and the one following are dealt with in Ann Bermingham (2000) *Learning to Draw: Studies in the Cultural History of a Polite and Useful Art* New Haven: Yale University Press.
[71] Most famously in the series: C. Nodier, J. Taylor and A. de Cailleux (1820-78) *Voyages pittoresques et romantiques dans l'ancienne France* Paris: Didot l'aine.
[72] The use of pencil and paper as first choice for sketching was also developing at the same period as lithography due to technological changes in paper manufacture and synthetic graphite production (Turner 1996 9:225) so the feedbackcan be seen as running in parallel from the beginning.
[73] Schaaf 1992:7. Sir John Herschel (1792-1871); mathematician and scientist; as a Cambridge undergraduate 1811-13 one of a group of friends which also included Charles Babbage and William Whewell. After 1816 Herschel was involved in important astronomical projects *DNB* 26:263-8.

Passage du Mont saint-Gothard by Georgiana Spencer of 1817. This was a privately-printed work designed expressly as a *souvenir* of a journey by a wealthy Englishwoman and her friend Lady Elizabeth Foster.[74] The image in this picture was redrawn on stone by a lithographic artist after the original pencil sketch. These examples illustrate some of the drawing skills educated people aimed at as a means of communication and of keeping a record, and once again there is an active relationship between images professionally produced (in this case, for publication) and similar private sketchbook images. This seems to resemble the descriptions of Alexander Nasmyth's classes, where the practice of constructing a visual record of personal experiences through pencil sketches throughout one's lifetime was valued in addition to an interest in landscape painting *per se*.

At this same period, landscape was being recorded, observed and evaluated through its appearance as a speaking document; both for its own sake and for industrial and military use. Engineers and surveyors, both civil and military, were recording the contours and features of the landscape in greater detail. For example, in Scotland following the 1745 rebellion, the Military Survey of 1747-55 employed Paul Sandby (c. 1731-1809) as the chief draughtsman.[75] Both Paul and his brother Thomas Sandby (1723-98) built on their experiences of surveying in order to further their careers as professional artists, in a way that defies rigid categorization into 'mapping' and fine art.[76] In addition, the emerging science of geology was founded on the questioning of the appearance of the structures of the Earth; structures that were often in plain view but previously

[74] Twyman 1990:170.
[75] Christian 1990: 18-22.
[76] See Christian 1990: 21-2 and also Charlesworth 1996: 247-66. His account suggests that 'the brothers' careers clearly demonstrate a complicity between the Hanoverian state and the promotion of a particular type of panoramic landscape representation'; in short, that in this case military mapping and artistic landscape depiction cannot be disentangled.

unremarked; most famously in Hutton's Unconformity, viewed by James Hutton,[77] Playfair and Sir James Hall of Dunglass at Siccar Point in 1788.[78] Sir James Hall (1761-1832), Alexander Nasmyth's patron and friend,[79] was an active amateur geologist and President of the Edinburgh Royal Society. James Nasmyth remembers frequent geological walks in Edinburgh with his father and his friends in which the features of Castle Hill and Arthur's Seat were discussed and evaluated as evidence for the geological history of the current landscape.[80] Alexander Nasmyth therefore was interested in geological theories of landscape formation;[81] an interest, as we shall see, that was passed on to his son, James.

James Nasmyth did not go to any drawing classes away from home, although he could have attended the Drawing School of the Board of Trustees (called the Trustees' Academy) which his father had attended.[82] James' formal education was a short period at the Edinburgh High School from 1817-20 during which he endured Latin and Greek under 'a mere schoolmaster in the narrowest sense of the term'.[83] At the same period, the Drawing Academy changed its classes from the afternoon to evening[84] (see below) so that it would have been possible for James to attend; certainly friends and acquaintances of the Nasmyth family such as David Roberts and D.O.Hill were pupils

[77] James Hutton (1726-97) agricultural 'improver', entrepreneur, worked as an overseer and engineer on the Forth Clyde Canal construction. *DNB* 27: 68 Hutton's *Theory of the Earth* was published in 1795 (Hutton (1795) *Theory of the Earth* Edinburgh: Messer Cadell, Junior and Davies).

[78] McIntyre and McKirdy 1997. Geology, mapmaking, and industrial enterprise were closely conected in the geological maps first published by William Smith. (Smith 1815)

[79] James Nasmyth was named after him. (Nasmyth 1883:64)

[80] Nasmyth 1883: 45-50.

[81] Charlotte Klonk in *Science and the Perception of Nature* has pointed to later Nasmyth paintings, such as *Tantallon Castle* (1816) National Gallery of Scotland with its storm and weathered rocks as 'showing awareness of natural forces shaping rocks'. (Klonk 1996: 96-7)

[82] The Trustees' Academy was established in1760 by the Board of the Trustees for Improving Fisheries and Manufactures in Scotland. It was financed by the assets seized from Jacobites after the 1745 rebellion. (Irwin 1975:90) Alexander Nasmyth's entry to the Academy is also given in Irwin. (Irwin 1975:140)

[83] Nasmyth 1883: 82.

[84] NG1/1/34: 15.

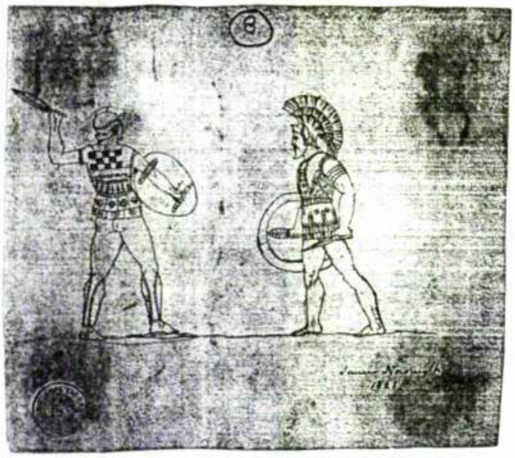


Figure 7: James Nasmyth,1821, pencil drawing 12.2 x 13.7 cm. (NLS MS3241 no.8).

Figure 8: James Nasmyth, 25 August 1822, pencil drawing 19 x 14 cm. (NLS MS3241 no.14).

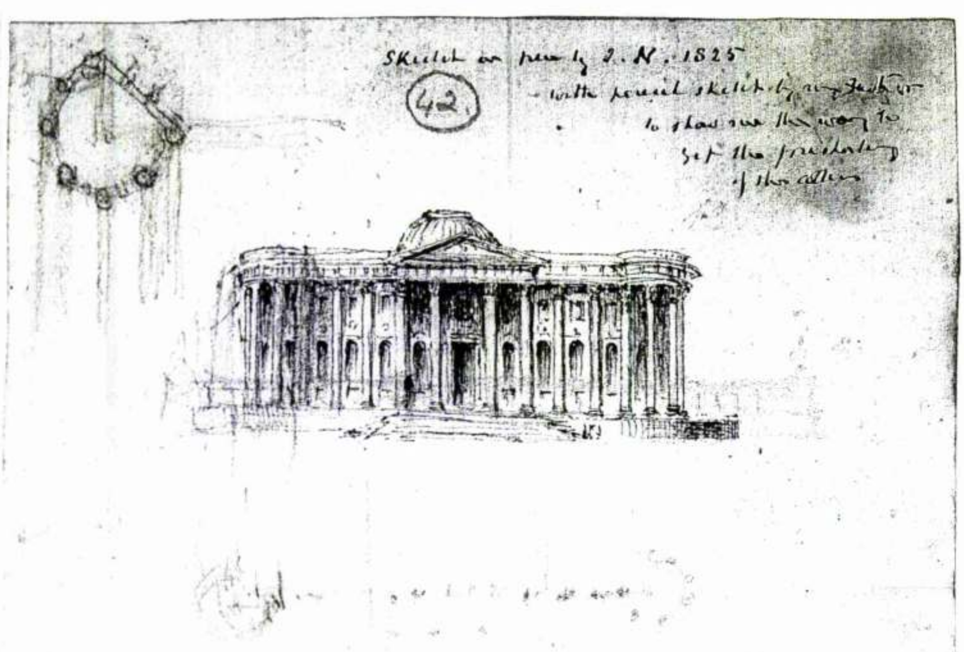


Figure 9: James Nasmyth, pen drawing with pencil additions by Alexander Nasmyth 1825 9 x 13 cm. (NLS MS3241 no. 42).

there at that time.[85] After leaving the High School, James Nasmyth studied from home; taking classes in Arithmetic and Geometry, as well as gaining practical experience in an iron foundry, participating in chemical experiments, and receiving drawing instruction from his father:

> my father gave me every opportunity for practising the art of drawing. He taught me to sketch with exactness every object, whether natural or artificial, so as to enable the hand to accurately reproduce what the eye had seen. In order to acquire this almost invaluable art, which can serve so many valuable purposes in life, he was careful to educate my eye, so that I might perceive the relative proportions of the objects placed before me. He would throw down at random a number of bricks, or pieces of wood representing them, and set me to copy their forms, their proportions, their lights and shadows respectively. I have often heard him say that anyone who could make a correct drawing in regard to outline, and also indicate by a few effective touches the variation of lights and shadows of such a group of model objects, might not despair of making a good and correct sketch of the exterior of York Minster.
> My father was an enthusiast in praise of the *graphic language*, and I have followed his example. In fact, it formed a principal part of my own education. It gave me the power of recording observations with a few graphic strokes of the pencil; and far surpassed in expression any number of mere words. This graphic eloquence is one of the highest gifts in conveying clear and correct ideas as to the form of objects -whether they be those of a simple or familiar kind, or of some form of mechanical construction, or of the details of a fine building, or the characteristic features of a wide-stretching landscape. This accomplishment of accurate drawing, which I achieved for the most part in my father's workroom, served me many a good turn in future years with reference to the engineering work which became the business of my life.[86]

Some early drawings of James Nasmyth have survived in the

[85] NG1/1/34: 105 amd 62 respectively; see also Nasmyth 1883:50 (Roberts) and 350(Hill) where strangely enough Nasmyth does not mention Hill's photography although he does take the chance to dismiss his painting skills. Nasmyth certainly knew of and corresponded with Hill on the subject of photography in the most cordial terms as shown by Sara Stevenson's article 'Brief Encounter'. (Stevenson 1989:23-6)
[86] Nasmyth 1883: 98-9.

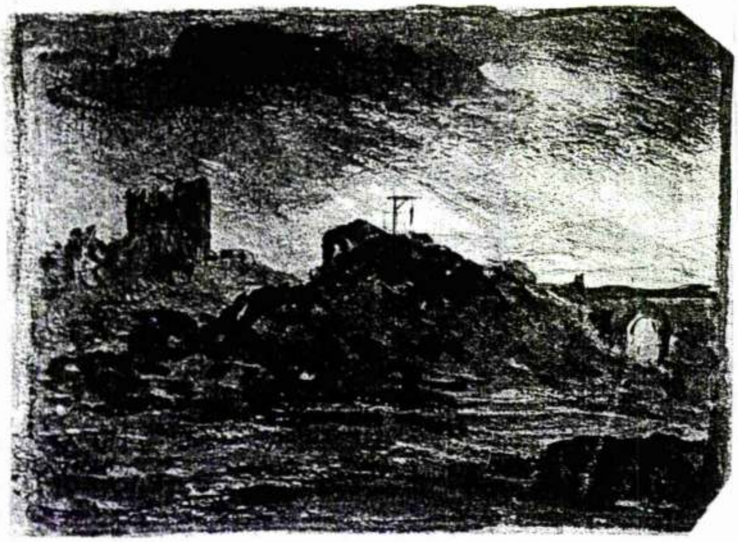


Figure 10: James Nasmyth, pencil and brush drawing with ink washes (no date) 7.5 x 9.8 cm. (NLS MS 3241 no. 48).

Figure 11: Hamble from a drawing by Gilpin, *Gilpin's Day* Plate 18; monochrome aquatint (Bicknell and Munro 1988:22).

sketchbooks in the National Library of Scotland;[87] many of these are of copies from the antique (see Figures 7 and 8) which is very much in accord with the programme of work at the Trustees' Academy.[88] A slightly later drawing of 1825 (Figure 9) is interesting as it has been corrected by his father: 'to show the way to get the foreshortening of the pillars'.[89] This demonstrates that Alexander Nasmyth supplemented straightforward observation (as in the drawing exercise with random bricks described above) with a systematic conceptual three-dimensional geometry); this underlying structural approach to landscape can be linked to earlier traditions.[90] Other early drawings of James Nasmyth show the influence of William Gilpin's picturesque images,[91] (Figures 10 and 11) although the choice of this gloomy gibbet-dominated landscape was probably a product of Nasmyth's own evolving aesthetic enthusiasms, which would come to include the darkly Gothic, cluttered, alchemists' dens which will be described more fully in Chapter III.

[87] NLS MS3241;3242;3243.
[88] See part 2 below.
[89] NLS MS3241 no. 42.
[90] Kemp 1970:92.
[91] The Rev. William Gilpin (1724-1804) ran a school in Cheam for around 30 years from 1748 onwards, and also began to develop his ideas on landscape appreciation into his series of essays 'Observations on picturesque beauty' which began to appear from 1770 onwards. *DNB* 21: 383-5.

Chapter II: 2: Nasmyth's drawing education in context: Masters, manuals, and the Trustees' Academy

The previous section described Alexander Nasmyth's private drawing school, which was an example of one important mode of drawing instruction carried over from the eighteenth century, that is, through private masters. The instruction of private drawing masters was supplemented from around 1800 by a huge increase in the production of drawing manuals,[92] which at the same time were undergoing a complete change in character.[93] This was the subject of a 1988 exhibition *Gilpin to Ruskin,*[94] and this exhibition, with its accompanying book by Peter Bicknell and Jane Munro, gave valuable access to private collections of drawing manuals. The exhibition charted the growth of observational landscape sketching, as 'an agreable pastime for ladies and gentlemen of leisure' between 1800 and 1860.[95] By contrast, earlier eighteenth-century manuals had followed established European practice modelled on the French academic system and had consisted of little more than series of examples to copy; for example, the publication in 1777 of Richard Earlom's *Liber veritatis* (200 sepia mezzotints after Claude Lorraine).[96] There had also been a stress on study of the human figure as in, for example, Cipriani's *Rudiments of Drawing* of 1786.[97] Over the next thirty years this changed completely, with the majority of manuals offering instruction in landscape sketching through the mediums of

[92] 1800-1830: 150 books for the amateur artist were published compared with 41 in the previous thirty, and 67 in the following thirty years. The first specifically landscape manual was James Roberts' *Introductory Lessons* of 1800. (Bicknell and Munro 1988:8)
[93] Bicknell and Munro 1988:8.
[94] *Gilpin to Ruskin: Drawing Masters and their Manuals 1800-1860* Fitzwilliam Museum Cambridge.
[95] Bicknell and Munro 1988: 14. This is from a passage that begins: 'at the beginning of the nineteenth century drawing had ceased to be essentially a matter for professional artists only and a useful practical accomplishment for soldiers, survyors, architects, antiquaries, etc. and had become an agreable pastime...etc.' (Bicknell and Munro 1988:13-4)
[96] Richard Earlom (1777) *Liber Veritatis* London: John Boydell.
[97] Cipriani, G. B. (1786) *Rudiments of Drawing* London: G. Bartolezzi. (Bicknell and Munro 1988:15-6)

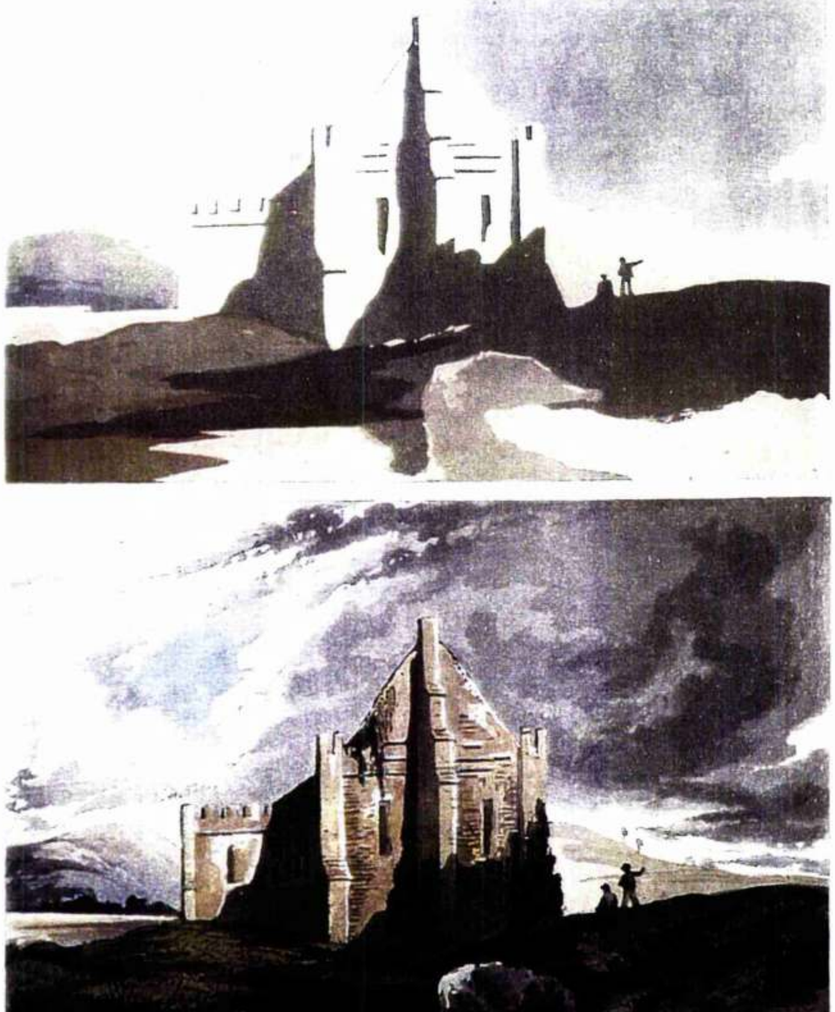


Figure 12: George Harley *First Principles of Landscape Drawing -Plate 27* aquatint 1829 (Bicknell and Munro 1988:49)

pencil and watercolour. The manuals themselves were illustrated with facsimiles of those kind of marks using soft ground etching, lithography, and aquatint to reproduce chromatic watercolour effects, as in the 'progressive method' illustrated in Figure 12, from George Harley's *The First Principles of Landscape-Drawings* (1829), published by Ackermann.[98] Nasmyth's popularity as a landscape painter in Scotland, and the success of his drawing school, was therefore part of a wider movement in Britain, from the beginnings of interest in the picturesque put forward by the Rev. William Gilpin (around 1790) and the surge in printed manuals from 1800-1830.[99]

However, as the previous section has already indicated, there was a tradition of landscape drawing and instruction already in place, for example, for artists and for military officers. Nicholas Alfrey has suggested in *Mapping the Landscape* that categories of drawing were fairly rigidly separated:

> Military draftsmen operated within a self-contained world; we still know too little about the contacts there may have been between them and other artists, but direct exchanges between the two different kinds of landscape practice do not seem likely on the face of it.[100]

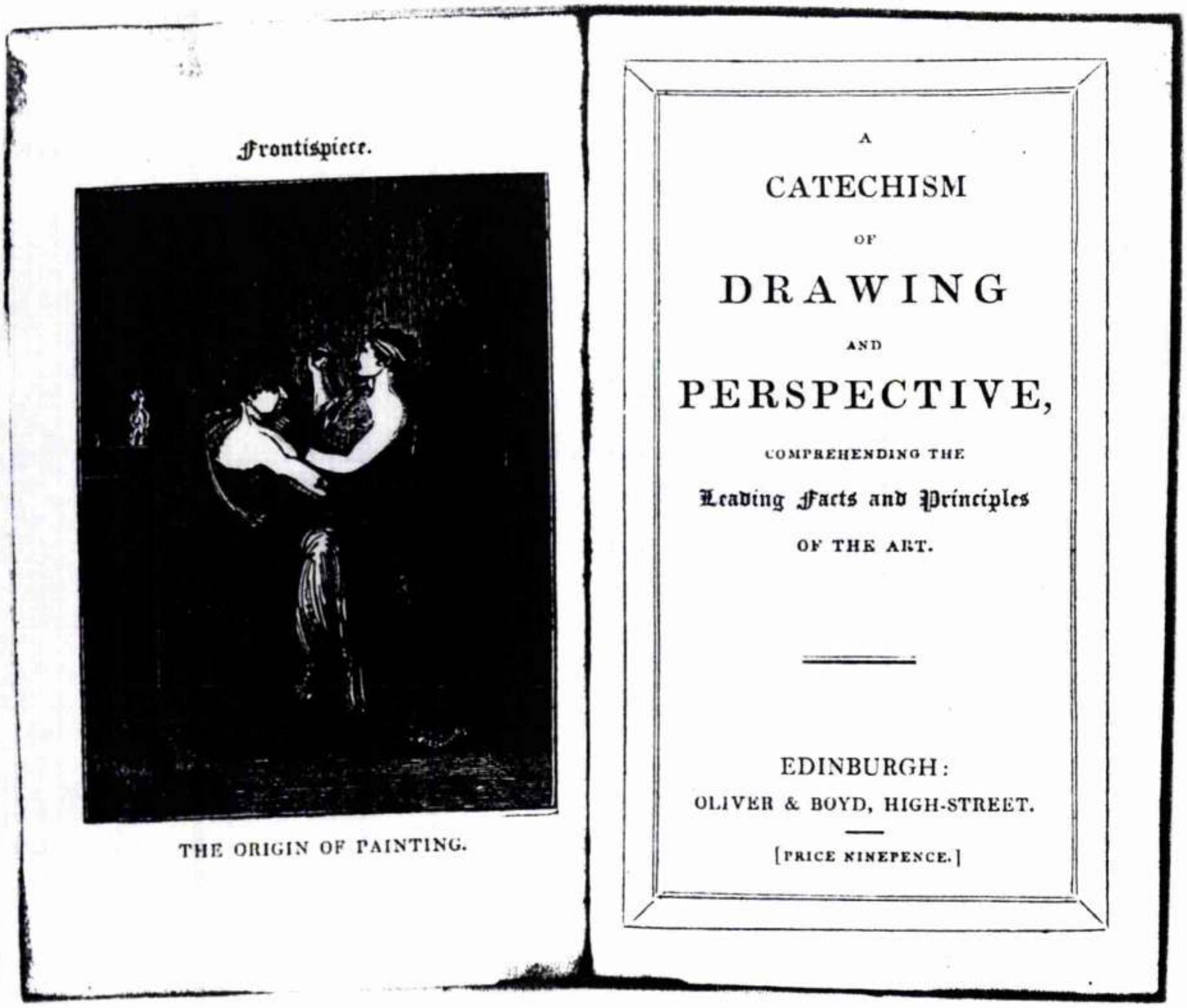
The example of the Sandby brothers, however, seems to indicate that the situation was more complex, particularly as approaches to landscape depiction were themselves undergoing fairly rapid change. In addition, if one returns to another example, Figures 5 and 6 in the previous section, it is possible to see some difficulties with the idea of rigid separation between the categories of drawing available to one person. Figure 6 was chosen as a straightforward example of landscape sketching as the product of 'an agreable pastime for ladies

[98] Ackermann was the most notable publisher of coloured aquatint books; there was also a drawing school at their premises in the Strand until 1805 with masters in figures, landscape, and architecture. (Bicknell and Munro 1988:55)
[99] Irwin 1975: 124-45.
[100] Alfrey 1990: 22-7.

and gentlemen of leisure', but it was juxtaposed with Figure 5, a drawing by Sir John Herschel which, although visually very similar, has a more complex status. Firstly, the phrase 'gentleman of leisure' seems somehow to miss the point of Herschel's exceptionally busy and productive career.[101] Secondly, the series of camera lucida drawings of which Figure 5 is one, were produced during tours of the Continent devoted to both artistic and scientific study. Herschel's trip of 1821 with Charles Babbage required a formidable 'philosophical travelling kit' with instruments and equipment for geological researches, and included: 'a Camera Lucida, Drawing board & other apparatus for drawing...'[102] The mingling of work and leisure; artistic and scientific interests here were drawn together in the study of geology. Geology at this period was an activity that was very hard to classify, either in terms of the social status of those taking part, or whether it was a 'pure' or 'applied' study. Many people studied landscape geology in the process of doing other things, because as a discipline, it was very new and still in the process of formation. The Geological Society, founded in 1807, was initially dedicated to the accumulation of observations of landscape features, gathered by members from a variety of backgrounds: artists, chemists, quarriers, surveyors, for example.[103]

If drawing could be used by one person for a variety of uses, for example either atmospheric sketches or careful observational records, then perhaps it is possible to find examples of drawing instruction where range and overlap exist, rather than for 'self-contained worlds'. One example of the kind of overlap to be looked for is given in the programmes of study that James Watt and Matthew Boulton organised for their sons in the late eighteenth century. Watt and Boulton

[101] See for example *Out of the Shadows.* (Schaaf 1992).
[102] Schaaf 1990b:17. In passing, it is worth noting that the camera lucida was itself invented by Wollaston in around 1800 in order to facilitate geological observations. (Schaaf 1990b: 10)
[103] Klonk 1996: 77-99.



Frontispiece.

THE ORIGIN OF PAINTING.

A
CATECHISM
OF
DRAWING
AND
PERSPECTIVE,
COMPREHENDING THE
Leading Facts and Principles
OF THE ART.

EDINBURGH:
OLIVER & BOYD, HIGH-STREET.

[PRICE NINEPENCE.]

Figure 13: Anonymous Frontispiece and title page *A Catechism of Drawing,* 1822 Edinburgh: Oliver & Boyd.

themselves were 'self-made men' in the sense that they had made their own fortunes and had supplemented some elements of a formal education with additional self-motivated study;[104] but not in any sense 'arising from nowhere'.[105] However, in their ambitions for their sons, 'they had very distinct views about the sort of education required by boys who were to become gentlemen, manufacturers, and philosophers'.[106] This involved, in later adolescence, travel and study on the continent with a continous programme of work with private tutors. For example, to James Watt junior in Geneva during 1785, his father wrote that, although science was important, it ought not to interfere with 'your more important studies, which are mathematicks, natural philosophy, and drawing', and later that summer in Eisenach he was requested to continue with 'drawing and dancing'.[107] Matthew Boulton's correspondence is fuller, and reveals more details of his conception of the 'embelishments (sic) to the Character of a Gentleman',[108] which included, at Versailles in 1786, lessons in 'Drawing: Fancy, Architecture, Perspective'.[109] In these programmes of study, there were conscious overlaps of the uses of drawing. It was not simply either an 'agreable pastime' or purely for use in the engineering workshop. Matthew Boulton's conception of a gentleman did not rule out working for one's living, in fact, quite the reverse, as he warned his son against having anything to do with aristocratic Englishmen in Paris.[110]

An Edinburgh drawing manual of 1821, *A Catechism of Drawing*,[111] provided a precis of the skills, materials, and methods that seemed

[104] See 'Training Captains of Industry' in Musson and Robinson (1969), which was largely based on excerpts from the correspondence of James Watt and Matthew Boulton.
[105] See the discussion in Macleod 1996: 22.
[106] Musson and Robinson 1969: 201.
[107] Musson and Robinson 1969:205-7.
[108] Musson and Robinson 1969:214.
[109] Musson and Robinson 1969:209.
[110] Musson and Robinson 1969:211.
[111] Published anonymously by Oliver & Boyd, High-Street, Edinburgh.

aimed at the kind of 'overlap' student of drawing mentioned above; that is, someone using drawing sometimes for personal enjoyment, sometimes for work:[112]

> Besides the elevated enjoyment derived from painting (of which drawing is a mode) as a fine art, holding the same rank as poetry and music, it is useful in many of the arts, and affords a great help to language, in describing and explaining machines, buildings, and other objects.[113]

The practical application of drawing was also underlined by the brisk list of drawing kit given:

> Q. What materials are necessary for drawing outlines?
> A. Black-lead pencils, chalk, or charcoal, Indian rubber (caoutchouc), drawing paper, a case of mathematical instruments, a drawing board, a gunter's scale, and a T square.[114]

The advice was sometimes contradictory, being torn between an older, academic progression of work and more modern recourse to nature. For example, in Chapter VI 'Of the Method of Proceeding' this advice was given:

> Q. What should the student do next?
> A. After he can draw lines and circles readily and accurately, he may proceed to copy objects; first from drawn or engraved outlines, next from shaded copies, then from statues or casts in plaster, and, lastly, from nature.[115]

With landscape, particularly 'the most useful division', the drawing of 'views, or representations of real scenes', more modern advice was given, in accordance with its more modern status:

> Q. What are the best means of learning to draw views?
> A. To copy from nature as soon as one has acquired as much command of the pencil as to be able to draw lines.

[112] The copy in Glasgow University library is inscribed with the name of an owner, 'Capt.P.Maughan', although there is no date with the name.
[113] *Catechism of Drawing*: 9.
[114] *Catechism of Drawing*: 35; these instruments suggest surveying work. (See the *Edinburgh Encyclopaedia* 1830 (Mensuration) and Crone 1978: 101-3)
[115] Catechism of Drawing: 38.

> Q. Is there any disadvantage in continuing long to draw from copies?
> A. By doing so one is very apt to get into a servile imitation of the style of the copies, and also to have recourse to mechanical means of transferring the outline; both of which are injurious when one comes to draw from nature.[116]

Included in this drawing manual were chapters not only on landscape, but on watercolour painting, which were mainly about the colours available and their mode of application. However, the two examples of watercolour use in painting referred to landscape; to the colours for distance and for foliage.[117] It is interesting to read, in the chapter on landscape, the list of suitable details that the 'young person' should master before fitting them in to a 'whole landscape', for these are homely objects such as 'rustic implements, gates, cottages, mill-wheels with the water falling in them, little bridges, especially such as are formed of unhewn sticks, or otherwise very rustic, and single bushes and trees'.[118] These were the kind of contemporary art subjects appreciated also by James Nasmyth's brother Patrick: 'decayed pollard trees and old moss-grown orchards, combined with cottages and farm-houses in the most paintable state of decay, with tangled hedges and neglected fences, overrun with vegetation clinging to them',[119] in contrast to the more elevated picturesque subjects popular in Alexander Nasmyth's generation.[120]

This relatively humble publication, unillustrated apart from its crude frontispiece (Figure 13), and put together from various unattributed sources,[121] combined older approaches to drawing with more recent ones, and furthermore demarcated different practices according to

[116] *Catechism of Drawing*: 65-6; from Chapter XIV 'Of Landscape'.
[117] *Catechism of Drawing*:53-9; from Chapter XI 'Of Water Colours'.
[118] *Catechism of Drawing*:66.
[119] Nasmyth 1883:60.
[120] Examples illustrated in Irwin 1975 include: *The Falls of Tummel* and *View of Loch Ness and Dochfour House* (Plate 9) *Tantallon Castle* (Plate 108).
[121] Including the pirated version of Joseph Wright's *The Corinthian Maid* 1782-5 in the frontispiece.

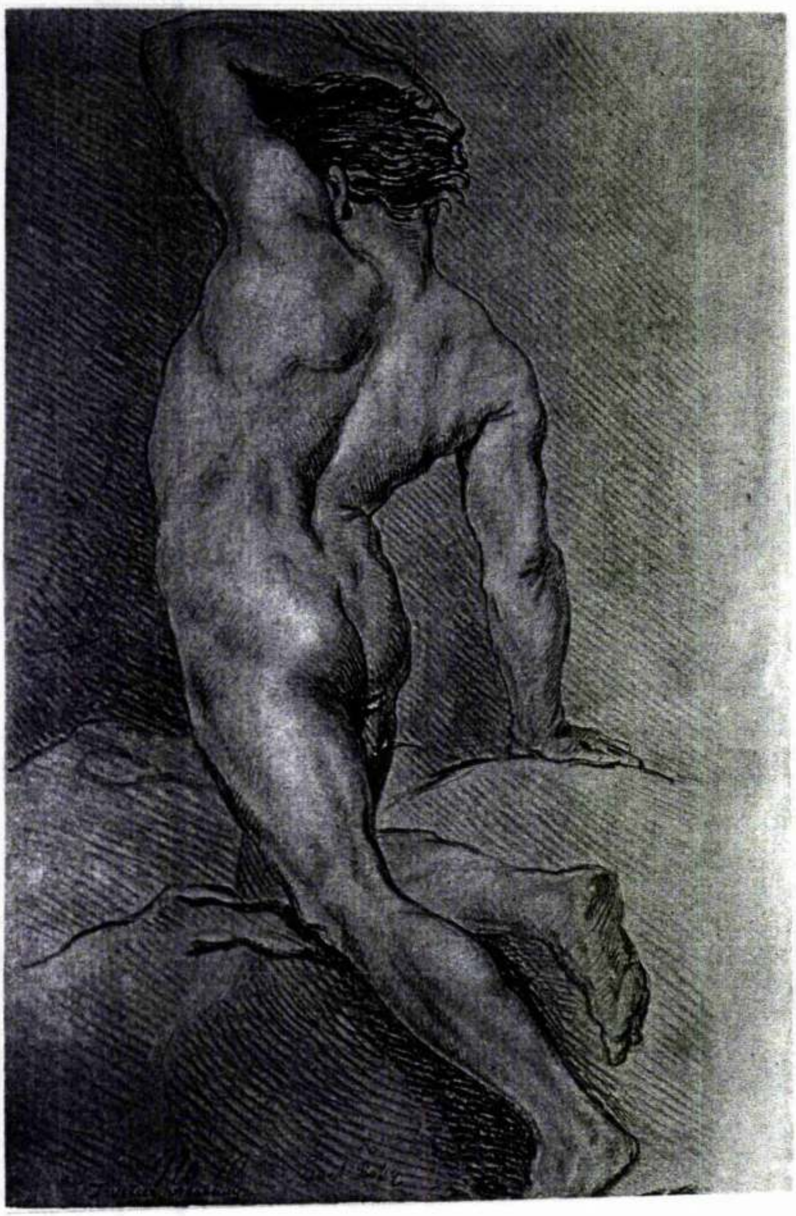


Figure 14: William Bell Scott, *Study of a Nude Young Man,* undated, annotated 'Trustees Academy No. 10 Exact Copy' pencil (National Galleries of Scotland Print and Drawing Collection D4712.15).

different uses or subject matter. It is interesting to compare these approaches with the teaching of drawing at the Trustees' Academy in Edinburgh.

The minutes of the Trustees' Board provide one source for discovering attitudes and approaches to drawing, particularly at moments of change, when policy was discussed. For example, the minutes of 12 December 1798 gave a clear summary of some of the aims of the 'New drawing Academy under Mr. Graham'[122] John Graham (1754-1817) was the head of the Trustees' Academy from 1798 until his death in 1817. He himself was a former pupil of the Academy, having started out as a coachpainter. His main interest was in history painting and this would be reflected during his tenure by the setting of historical compositions for the Premium competitions.[123] In order to improve the teaching resources, the Trustees agreed in December 1798 that to teach the 'higher Branches of design, and drawing from the human figure', it would be necessary to 'purchase a collection of Plaister figures and Busts from the Antique'.[124] There were no life classes at this date, so drawing from the human figure meant that the students either drew from casts, or copied engravings, drawings, or paintings. Figure 14 is an example of a student drawing from around 1827 by William Bell Scott with the legend 'Exact Copy',[125] which suggests this method of instruction continued after Graham's period as master, and Figure 15 overleaf is a plate from the *Edinburgh Encyclopaedia* of 1830 which shows two styles of engraving applied to antique

[122] NG1/1/29:458.
[123] See Irwin 1975:90-7, for a discussion of Graham's teaching.
[124] NG1/1/29:458. By 1839 the collection of casts, by then housed in the Royal Scottish Academy building, included 46 catalogued items. (Wilson 1839) See also Helen Smailes' article (1991) 'A History of the Statue Gallery at the Trustees' Academy in Edinburgh and the Acquisition of the Albacini Casts in 1838' *Journal of the History of Collections* 3 (1991): 125-43.
[125] National Galleries of Scotland Print and Drawing Collection D.4712.15; this drawing is accompanied by another nude study dated 1827 with the legend 'after J. Graham 1827' (D.4712.16) The curator of this collection, Valerie Hunter suggested that in view of the upper-left origin of the directional shading, and because of the quality of the outline, that this is copied from an engraving. (from a conversation with the curator during 2002)

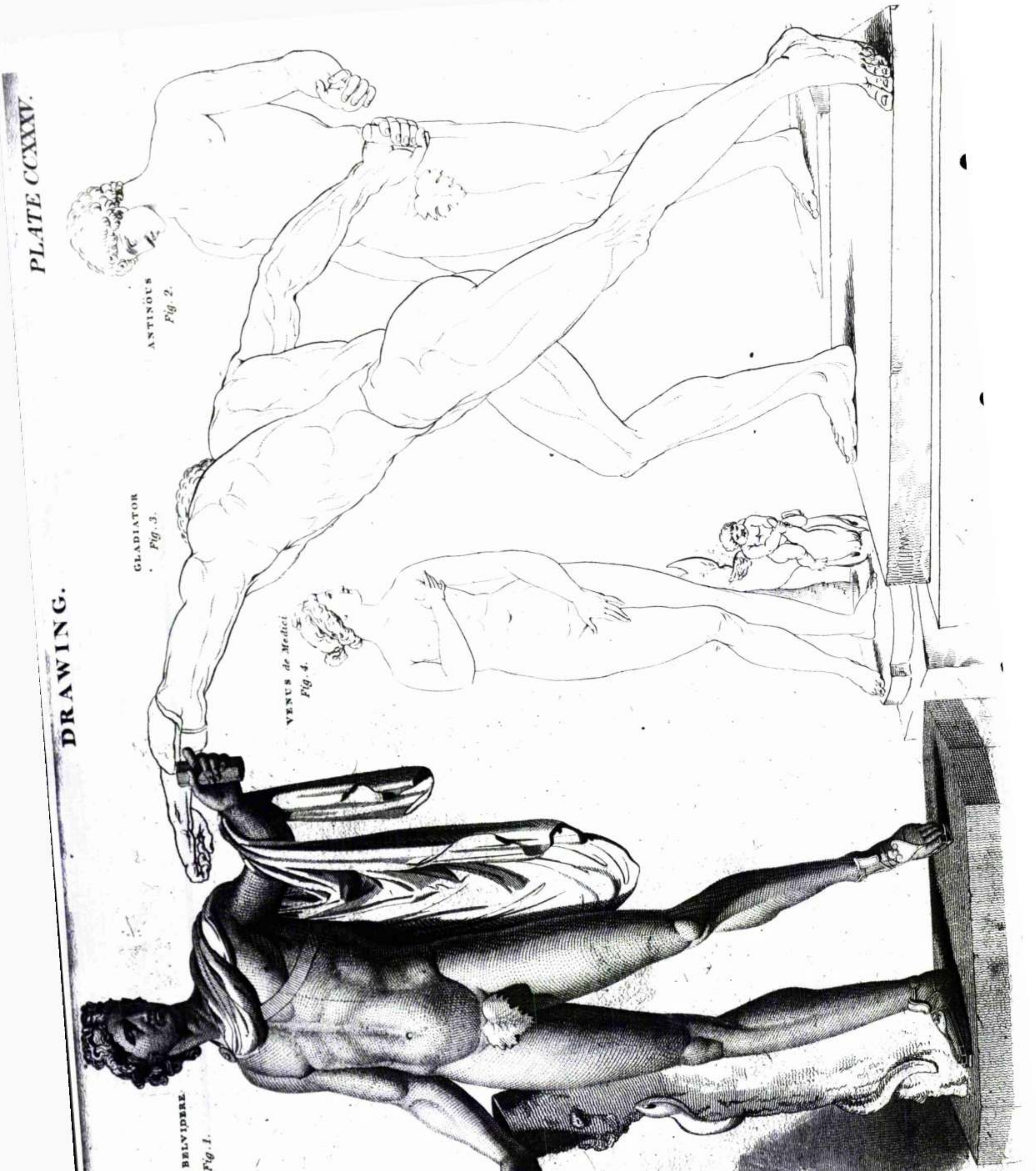


Figure 15: Figures from the Antique designed and etched by P. Gibson, *Edinburgh Encyclopaedia* Plate CCXXV 1830 Vol. 8: 235.

figures.[126] The classes were to be housed in a room '30-40 feet long, 12-15 feet high, in a decent location'. There were to be twenty students per class, one male, one female, each class to be taught three times a week, two hours at a time, eight-nine months of the year, for two years in total.[127] There was an interesting discussion on the conditions of entry: should the student produce a drawing of a 'round figure or a statue', or, should the student be admitted on recommendation for a trial period of six weeks? The Trustees and the new master agreed that:

> copying from drawings and paintings is generally adopted by drawing Masters and it satisfies those who are superficially acquainted with Art; but the fact is notorious, that those young Persons who can copy tolerably, when left to themselves to copy from Nature, can scarcely do any thing![128]

Another similar discussion took place during in the period of James Nasmyth's early education in Edinburgh; on 16 December 1817 the Trustees considered who should take over as Master after the death of John Graham. One of the candidates was James' father, Alexander Nasmyth. All the candidates had to submit paintings of 'Figure Subjects' and some trouble was taken to chase up a painting from another candidate, Andrew Wilson, whose references obviously indicated in the most flattering terms his 'qualifications to guide the students of the human figure...in the attainment of those essential requisites of Art as well as to instruct those who aim only at its

[126] This plate illustrates the article 'Drawing' from the *Edinburgh Encyclopaedia* 8:105-12. These plates were designed and etched by Peter Gibson, who seems also to have written the article (signed P.G.), and is part of a larger section which includes the article 'Drawing Instruments' by John Farey which will be discussed in part 3 below. Although the final published date of the Edinburgh Encyclopaedia was 1830, it was in fact compiled over many years, and volume 8 dates from 1812. See C. Davies Sherborn *Journal of the Society for the Bibliography of Natural History* Vol. 1 (1936-43) : 112.

[127] NG1/1/29:459-60; despite this resolution to run a female class, subsequent references to girls are hard to find in these minutes. Patricia Brookes has alluded to the 'mysterious disappearance of the issue of women students around 1800' (Brookes 1989: 204), however there do seem to be later references to a 'Miss Bain' and a 'Miss White' who were awarded premiums on 1 March 1820. (NG/1/1/34: 163)

[128] NG1/1/29:460-1.

subordinate branches'.[129] Andrew Wilson (1780-1848) had been a student at the Trustees' Academy under David Allan[130] and became a landscape painter, initially influenced by the style of Alexander Nasmyth, and had lived and worked in Italy as an artist and dealer.[131] Before his appointment to the Trustees' Academy, Wilson had been teaching at the Royal Military College at Sandhurst,[132] and it seems from the Trustees' Board minutes that it was the teaching references from there that made the Board choose him as the new Master, as they obviously wished to teach drawing as a discipline with diverse applications.[133] The decision to take this drawing master (who was a landscape painter) from a military institution seems to offer an example of 'direct exchanges between the two different kinds of landscape practice' and is furthermore a specific example of the desire to provide drawing instruction for a wide range of pupils, rather than for 'self-contained worlds'.[134] This diversity was continued in the makeup of the students after this date as the list of students' trades given below will show. Andrew Wilson showed himself to be interested in teaching drawing as a subject with the widest possible application in another way, for he suggested on his appointment (20 January 1818), that the classes should be moved to the evenings between six and eight, as 'masters in general grudge extremely giving their Apprentices two hours in the forenoon'.[135] A further meeting on 3 February agreed to place newpaper advertisements for student applicants and to stress that 'the Academy is not intended for those who study drawing as an amusement'.[136] A sample of applicants listed on 17 February 1818 included: seven engravers' apprentices, ten house and ornament painting apprentices, two carvers and gilders,

[129] NG1/1/34:7.
[130] Irwin 1975:93.
[131] Irwin 1975: 240-2.
[132] Irwin 1975: 240-2.
[133] NG1/1/34:7.
[134] See the discussion above on *Mapping the Landscape*. (Alfrey 1990: 22-7)
[135] NG1/1/34:15.
[136] NG1/1/34:21.

three silversmiths, three brassfounders, three cabinetmakers and upholsterers and eight students of painting and sculpture.[137] It was during this period that D.O.Hill and David Roberts entered as students; Canova offered casts of his work through an ex-student in Rome, and the building of the new premises of the Mound was put in hand.[138] The Academy, therefore was intended for a wide range of students who wished to use their drawing to earn their living.

Does this mean that 'gentlemen' were not students? That is implied by a discussion on 22 November 1825 in relation to the extra room that would be available in the new building on the Mound. One of the Board members asked; will it now be possible to open a 'Drawing Academy for the children of Gentlemen?'[139] In the light of this section this question seems surprising, given the examples of more fluid drawing practices. These suggest that it could not be stated with certainty either that landscape sketching in pencil and watercolour was suitable only for 'ladies and gentlemen of leisure' or that drawing from the human figure was the only acceptable training for professional painters (including landscape artists), sculptors, soldiers, engravers and house decorators in 'self-contained worlds'.

To close this section; it seems worthwhile to question the use of the word 'gentleman' which seems often to pre-empt any detailed analysis.[140] One example of the 'closed' use of the term is given by R.A. Buchanan who opened an essay in the journal *Victorian Studies* entitled 'Gentleman Engineers: The Making of a Profession' with these words:

[137] NG1/1/34:62.

[138] NG1/1/34:62-297.

[139] NG1/1/35:125.

[140] The OED gives such a wide range of uses of the word 'gentleman', from the legalistic to the jocular, to suggest that this is a contested, or open, term. Roy Porter's description of the English social order in the preceding, and more stratified, 18th century confirms this suggestion: 'unlike in certain parts of Europe, no iron curtain of law or blood permanently divided bondman and freeman, trade and land, commoner and noble'. (Porter 1990:49).

> 18th-century British engineers were a motley crew. At the outset of their careers few of them could have been considered a gentleman by any stretch of the imagination[141]

Here the term 'gentleman' has been used as a self-evident and rigid category. There are several problems with this. Firstly it assumes that social status at this period was cut and dried.[142] Secondly, the uncritical use of this term could lead to the treatment of everyone below the level of 'gentleman' as part of an undifferentiated mass. However, a more recent collection of essays edited by A.W. Skempton, *Civil Engineers and Engineering in Britain 1600-1830* paints a far more nuanced picture of the education, and background of this group.[143] They included: military or civil land surveyors, masons, architects, mathematicians, and millwrights. For example, some early members of the Smeatonian Society[144] included Jesse Ramsden (1735-1800) the instrument maker, William Faden (1749-1836) the engraver and cartographer, and James Cooper (d. 1801) the millwright.[145] Although these three people were not men of leisure, neither does it seem accurate to call them a 'motley crew'; instead they were part of a very long social gradient which included lesser figures such as Robert Shout (1734-97) harbour engineer of Sunderland Harbour and former mason.[146] These examples of people and their backgrounds have been given in order to make a point about the use of the word 'gentleman'. In addition to the other examples from this whole section such as Herschel, Hutton, Boulton and Watt, to James and Alexander Nasmyth themselves, they suggest that the relationship of class to work and education at this time was complex.

[141] Buchanan 1983: 407-29.
[142] In contrast, historians such as Asa Briggs 1974:170 or F.M.L. Thompson 1988:16-9; 104-5 have stressed the much more subtle and complex nature of social class at this period.
[143] Skempton 1996.
[144] 'The profession of civil engineering...may be said to have been formally recognised for the first time by the foundation of the Society in 1771'. (Skempton 1996: 23)
[145] Skempton 1996: 34-8.
[146] Skempton 1996: 115-8.

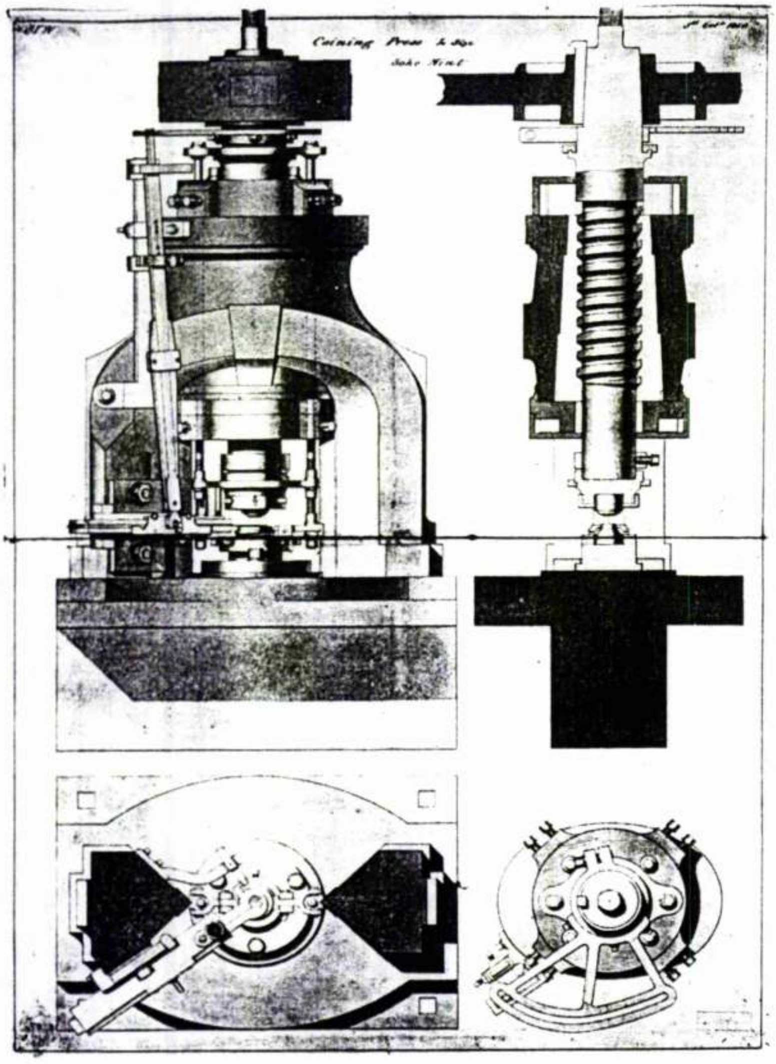
Equally, many professions and trades would have required some education in drawing. This section has shown that there is evidence from many sources that that education would have been not only diverse, but would have assumed that drawing, like other modes of communication, would have been practiced in many 'registers' by one person, from the playful to the professional, at this period.

Chapter II: 3: Nasmyth's drawing education in context: Technical drawing

As outlined in the two previous sections, education in drawing was demanded in several modes (such as landscape sketching and academy figure drawing) by a wide range of students who were not fine artists. These students and apprentices came from many lines of work requiring accuracy both in observation and for visual communication. These included technologists, scientists, military and civilian surveyors, architects and skilled tradesmen. General drawing skills were developed either through landscape or figure drawing, and through copying existing examples, usually through engravings. These general skills included: hand-eye coordination, improved observation, and the development of a range of conventions suitable for representing three dimensional subjects on a flat surface. These skills, and the associated teaching, were similar for both artists and general students. For example, the student engravers, cabinetmakers and brassfounders at the Trustees' Academy were in the same classes as aspiring painters and sculptors. However, separate conventions were evolving for specialist uses. This section will discuss to what extent 'technical drawing' existed in the early part of the nineteenth century (that is, around the period of Nasmyth's youth in the 1820s), and aim to indicate the uses and qualities of such drawing. Firstly a general review will be given, followed by more detailed analysis of theoretical/ conceptual drawing, and the rise of technical illustration.

A Catechism of Drawing in 1821 suggested that drawing was useful for 'describing and explaining machines, buildings, and other objects'.[147] In association with its list of recommended instruments,[148]

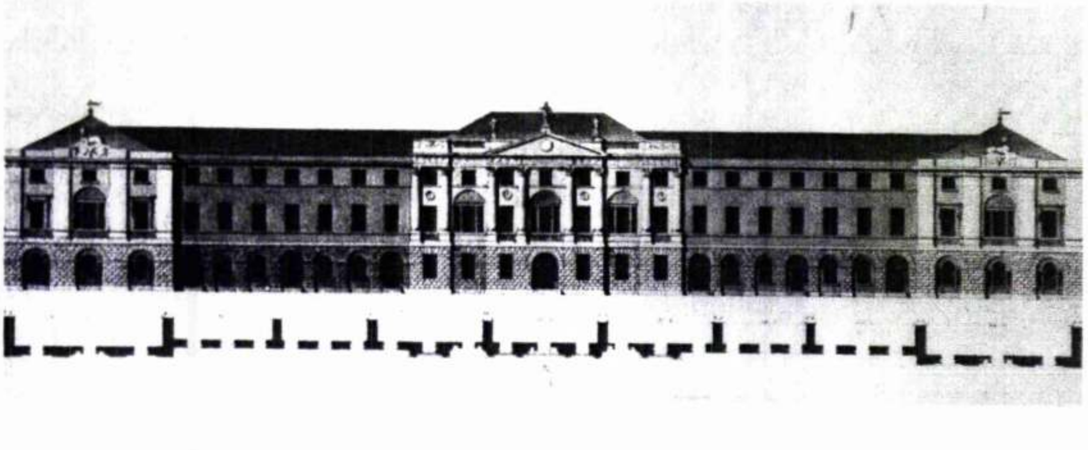
[147] *A Catechism of Drawing* 1821: 9.
[148] 'Black-lead pencils, chalk, or charcoal, Indian rubber (caoutchouc), drawing paper, a case of mathematical instruments, a drawing board, a gunter's scale, and a T square' *A Catechism of Drawing* 1821: 35.



A drawing of a Coining Press for the Soho Mint, dated October 3, 1850. A good example of architectural drawing practice carried over into engineering drawing. The parts are tinted with water colour and shadows are used to give the three-dimensional effect. The draughtsman himself has had some difficulty in interpreting the bare outlines – notice in the sectioned side view that an error was made when colouring the T-section base, and subsequently rectified.

Figure 16: *Coining Press for the Soho Mint* 3 October 1850 (Booker 1979: Plate 6).

Figure 17: *Robert Adam's Charlotte Square* (Markus 1982:128).



this seems to imply that the style and conventions of engineering drawings in Britain in the late eighteenth and early nineteenth century were related both to those of surveyors and architects. This was confirmed by a specialist study of the history of engineering drawing in Britain by Peter Booker (1979) who suggested that these parallel conventions continued up to and beyond the 1850s in examples such as that given in Figure 16. However, it is important here to note that a drawing such as this, or an architectural drawing in a similar style showing front or side views with added shadows and colour (see Figure 17), was often produced after the fact and must be separated from working drawings made as part of the process of production.[149] Moreover, even here a distinction must be made between a drawing made to indicate the final appearance of a structure, and a working drawing made in order to work out the precise dimensions of details and components, and how they fitted together. A drawing made to indicate the final appearance of a structure, as for example Alexander Nasmyth's drawing of the Tongland Bridge near Kirkudbright, would at this date function more to convey aesthetic information, rather than information about process and detailing, which would then be worked out *in situ* by the tradesmen concerned.[150] A similar approach to the assembly of machinery is implied in James Nasmyth's *Autobiography* when he describes the 'revolution in mechanical engineering' of Henry Maudslay who produced his first screw lathes in 1797:[151]

> Before his time no system had been followed in proportioning the number of threads of screws to their diameter. Every bolt and nut was thus a speciality in itself, and neither possessed nor admitted of any community with its neighbours. To such an extent had this practice been carried that all bolts and their

[149] Booker 1979: 37-9.

[150] In a discussion of architectural drawing in France Katie Scott noted: 'It was not until the 19th century that Jean Rondelet, with the application of Gaspard Monge's geometry could transform architectural drawings from mimetic representation into instructions capable of compelling exact compliance from a labour force'. (Scott 1995: 69)

[151] Rolt 1986: 94.

> corresponding nuts had to be specially marked as belonging to each other.[152]

It was only at this period, around James Nasmyth's youth, that these *ad hoc* methods began to change, and with this, different approaches to working drawings began to evolve. These supplanted the previous uses of constructional drawings made by earlier skilled tradesmen during their work on site. Carpenters could draw out a geometric projection to work out how to cut and put together, for example, a set of spiral stairs;[153] similarly masons would draw out on their materials the necessary constructions, for example to cut a series of voussoirs.[154] Few drawings of this type have survived, partly because of trade secrecy, but also because any necessary drawing would have been done directly onto the material,[155] however, each new structure would be tackled as a separate operation, and the forms and dimensions would be generated as required using a mixture of empirical rules-of-thumb, and standard geometrical formulae.

In contrast to these craft practices, around the end of the eighteenth century, there was a move to apply systematic, theoretical thinking to manufacturing. In the field of drawing, this involved the development of a range of new methods of representation, through drawings or models. What is interesting is the range of these experimental methods of visualization and representation which displayed striking contrasts between an empirical, even intuitive, approach, and the more obviously theoretical. This will be discussed first by contrasting the work of James Finley and Gaspard Monge in America and France; then a further approach to technical drawing, that of William Farish, will be described.

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152 Nasmyth 1883: 131-2.
153 Booker 1979: 65-7.
154 Booker 1979: 61-4.
155 Booker 1979: 67.

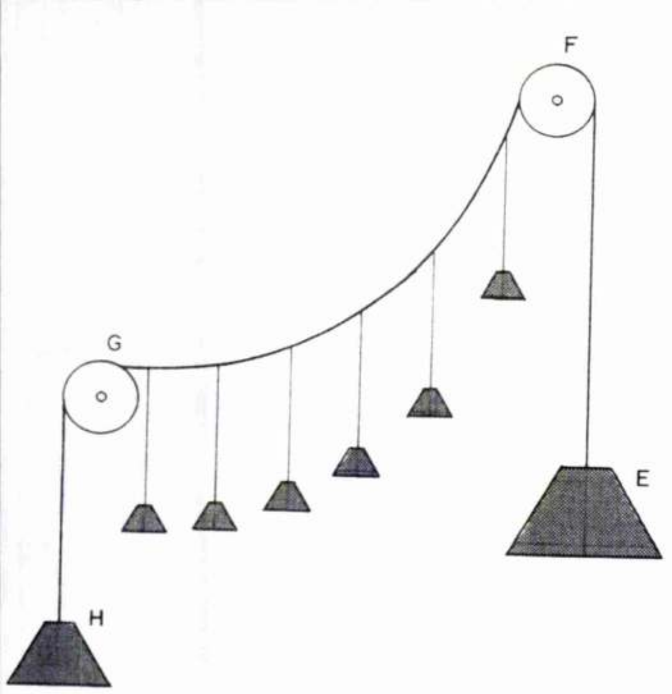

Figure 2.3
Finley's method for determining the variance in cable tension between middle of span and supports.

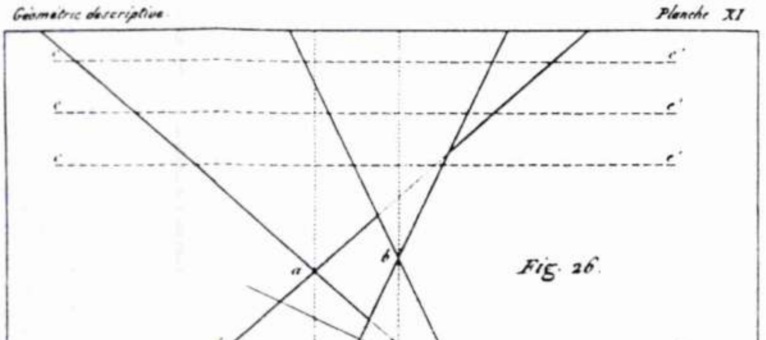

Fig. 43. Plate XI from Monge's *Géométrie descriptive*, 1795. In the main this shows the method used today for determining the curve of intersection of two cones. The drawing appears more complicated as Monge also used it to demonstrate how to draw the projections of a line tangent to this curve at a given point.

Figure 18: Modern diagram showing one of Finley's experiments (Kranakis 1997:46).

Figure 19: Gaspard Monge, *Geometrie descriptive* Plate XI, 1795 (Booker 1979:99).

One empirical modelling approach was exemplified by the American James Finley (1762-1828) in his study of the relationships between load and tension using weights, string and pulleys (See Figure 18) during his development of the level-roadway suspension bridge patented in 1808.[156] The information generated by these three-dimensional models was then transferred to bridge patent drawings in the form of written specifications. The drawing was a generic formula applicable to many different particular circumstances, and was intended to be disseminated as widely as possible using the patent system.[157] In Finley's case, his design generated income through royalties of $1 per linear foot of bridge constructed.[158] Finley's mode of representing structural forces to himself was through models, and his mode of advertising and selling his subsequent designs was through printed images and plans. The value of these images was therefore dependent both on their multiplication and on Finley's control of them through the patent system.[159]

Finley's work and his structural modelling methods were known in Britain from 1811 onwards, and leading engineers in this country in the 1820s such as Samuel Brown and Thomas Telford both used empirical and experimental techniques to design bridges.[160] This kind of modelling can be contrasted with the theoretical mathematical system developed over twenty years by Gaspard Monge (1746-1818)

[156] This material on Finley is taken from Eda Kranakis' *Building a Bridge*, (Kranakis 1997) in which Finley's unprecendented generic methods were contrasted with the more formalized French design process at the same period by which a similar suspension bridge was carefully planned for one specific site by the engineer Navier in collaboration with a whole series of mathematical and aesthetic committees.

[157] The first United States patent statute had only come into existence in 1790; there had been patents in Britain before that time but until the end of the 18th century they had been perceived as unjust, aristocratic purchases of monopolies. (Dutton 1984: 22) It was only under the impact of thinkers such as Adam Smith, Jeremy Bentham, and J.S. Mill that patents began to be seen as the lawful reward for the kind of systematic, theoretical development of manufacturing under discussion here.

[158] Kranakis 1997:40; Kranakis describes this here as 'an entrepreneurial undertaking within the context of the patent system'.

[159] This is an example of one of the new methods of generating value from images at this period that can only be touched on briefly within this dissertation.

[160] Kranakis 1997: 124.

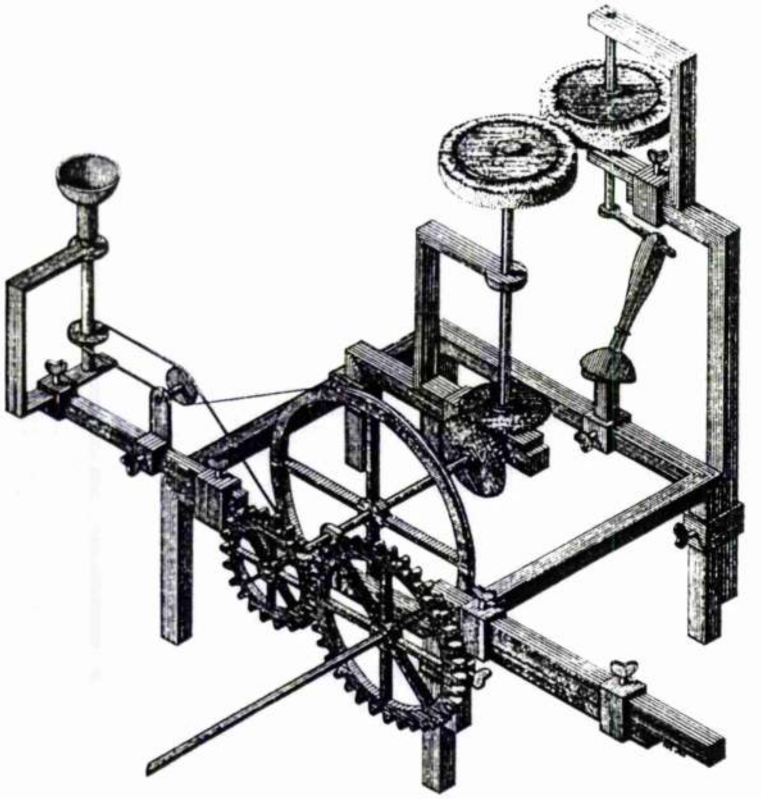

Fig. 48. Plate 2 from Farish's *Isometrical Perspective* 1820. It shows in isometric projection some of the demonstration apparatus assembled to illustrate power transmission principles.

Figure 20: Drawing by Rev. William Farish engraving by Wilson Lowry, *Example of Isometric perspective* 1821 (Farish 1821: Figure 9).

at the Military School of Mezieres (Metz), and later published as *Geometrie descriptive* in 1795.[161] Monge's system was incorporated as a key element of teaching at the Ecole Normale of the Revolutionary period in 1794, and its successor, the Ecole Polytechnique.[162] Descriptive geometry was not only taught at these schools as an academic form of geometry, but also incorporated into classes with practical application for carpentry, stone-cutting and machine design. Monge's system of visual representation harnessed a general theoretical approach to the solution of specific manufacturing problems; and because of his involvement with the influential Ecole Polytechnique, and its powerful patron, Napoleon,[163] his work helped to shape not only a method of drawing, but also engineering as a discipline.[164] According to Peter Booker, this system did not extend into the 'English-speaking world',[165] where technical drawing practices were evolving in a different way. However, there is some evidence that efforts were made to introduce descriptive geometry to the Schools of Arts in Britain in the 1820s, including the School in Edinburgh where James Nasmyth was a pupil, and this will be discussed later in this section. Monge's descriptive geometry allowed complex three-dimensional forms and relationships to be generated and evaluated through drawing. (See Figure 19) Unlike Finley, Monge's 'modelling' was theoretical; the two-dimensional operations on paper were intended to be directly translatable into three-dimensional structures.

A third development of technical drawing considered here is that of the Rev. William Farish (1759-1837) of Cambridge University. This

[161] Booker 1979: 86-106.
[162] Booker 1979: 103-6. The Ecole Polytechnique was founded in September 1795 as a state-funded general training for civil engineers, artillery officers, etc. (Crosland 1967: 190)
[163] For example, Monge was a member of the Institute of Egypt between 1797-9, Napoleon's initiative of 'colonization, conquest, and enlightenment'. (Crosland 1967: 14-7)
[164] Booker 1979: 114.
[165] Booker 1979: 114.

was contained in his *Plan of a Course of Lectures on Arts and Manufactures, more particularly such as relate to Chemistry*, and has been described by Booker as the most influential mode of technical drawing in Britain.[166] Farish developed his mode of isometrical projection in order to enable the assembly of his demonstration equipment, which would be built up as required from a collection of generalised parts. This was published in the *Cambridge Philosophical Society Transactions* as 'On Isometrical Perspective' in 1822. (See Figure 20) This image was engraved by Wilson Lowry (1762-1824) whose work was arguably as influential as that of Farish on the style of British technical drawing, particularly through his production of the plates for Abraham Rees' *Cyclopaedia* which will be discussed below. This drawing looks far more like the object than the representations of Finley or Monge and could be seen as inhabiting the borderline between a picture drawing, and a conceptual diagram. Unlike the 'face-on' architectural style of Figures 16 and 17 it presents an oblique view. However, unlike a 'pictorial view', an isometrical drawing displays the dimensions of all the parts as a linear measurement on the paper to scale.[167] For example, the 'farthest away' leg of Figure 20 is the same length on paper as those at the front and has not been modified by any foreshortening, however geometrically accurate. In that sense, isometric drawing can be seen as a development of the kind of clear, explanatory technical illustration described in publications such as Charles Blunt's *An Essay on Mechanical Drawing* of1811. In this the author described how to construct accurate perspective drawings and then, in a series of over fifty lithographed plates, demonstrated how to tackle subjects such as bleaching apparatus by paying careful attention not only to the function of the machine, but also to the best way of framing that function:

[166] Booker 1979: 114-5.

[167] That is, for example, at a scale of 1:24 a line 1" long would stand for a linear dimension of 2'.

> The principal matters to be attended to, in determining the height of the eye, and the position of the artist in respect to the machine, are, in this example, that the upper ends of all the cylinders may be distinctly seen...the depth of the apparatus may be clearly made out...and the second row of cylinders well understood.[168]

As a useful reference point for construction, isometrical drawing as in Figure 20 was a rapid and efficient convention as the dimensions of all the parts could be read off the drawing (just as in the 'face-on' architectural-style view) while at the same time some sense of the three-dimensional assembly was given.

In relation to these general remarks on technical drawing, we should consider the situation in Edinburgh, and more specifically, at the School of Arts, which was opened in 1821 when it included James Nasmyth amongst its new students.[169] Although model-making was an important documented activity in the drawing processes of both James Nasmyth and his father,[170] less is known about the influence of some of the newer approaches described above.[171]

The Edinburgh School of Arts was founded in 1821 and began teaching with a total of 420 students in that year.[172] The backgrounds of the students suggest that this was a complementary institution to the Trustees' Academy, with some overlap of the trades represented: cabinetmakers, joiners, smiths, brassfounders, millwrights, masons,

168 Blunt 1811:85-6.

169 Nasmyth 1883:112; Nasmyth's father was also listed amongst the subscribers to the School in P56/14, that is, the pamphlet: *First Report of the Directors of the School of Arts, Edinburgh* 1821 which is held in Edinburgh University Library Dept. of Special Collections. Their bound pamphlets all begin with the code 'P' and that is the source of all the similar referencesbelow.

170 See Nasmyth 1883:99 and 110-23.

171 Peter Booker seems to suggest that none of these newer approaches to technical drawing had much influence in Britain, citing the writer of a technical pamphlet as late as 1868, A.W. Cunningham *Notes on the History, Methods, and Technological Importance of Descriptive Geometry* that the 'Solid... Constructive... Model-making' approach to shaping matter was the closest approach to Practical Geometry in Great Britain where 'much ignorance prevails, even amongst teachers, respecting what in France and Germany is considered the very ground-work of Technical Education.' (Booker 1979 :130-131)

172 420 students enrolled before the School had to 'close the books because of an overcrowded lecture theatre'. P56/14:15.

watch and clockmakers, and opticians.[173] Four lecture courses were offered, in chemistry, mechanics, architecture and farriery.[174] On reading the syllabuses of the lectures offered, it is possible to infer that drawing and visual communication would have been important for at least three of these courses, namely, mechanics, architecture, and farriery.[175] For example, there were mechanics lectures on millwork, architecture and optics which gave specific illustrations of the 'sound theory' introduced in earlier lectures. The architecture series was divided between a history of architecture with illustrations, and practical exercises in geometrical constructions, perspective drawing and structural mechanics. The range of these architectural classes suggests the encouragement of several modes of drawing: from the 'picturesque' suggestion of a whole structure in context to geometrical and technical constructions. The lending library list of this date contained over 40 titles devoted to art, design, architecture and drawing.[176] In addition, due to demand, an additional course in drawing was set up; these classes in 'Mechanical and Architectural drawing' began in May 1822.[177] In relation to the development of specialized technical drawing, a published textbook, *Elements of Arithmetric, Algebra, and Geometry, for the use of Students in the Edinburgh School of Arts* was produced by George Lees in 1826. This included Books I-IV of Euclid's *Elements* which used ruler-and-compass methods of geometrical construction, and we will see in Chapter V how James Nasmyth, in his 1841 essay, 'Nasmyth on Tools and Machines' linked this form of two-dimensional drawing with the

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[173] P56/14:16.

[174] If the School of Arts could be seen as a proto-technical college, the inclusion of farriery reminds us that at this period the horse was, amongst other things, the main source of motive power. The 24 lectures on farriery given by Dick were an exhaustive survey of the anatomy and physiology of every part of the horse with a description of their attendant diseases and cures.

[175] The syllabuses for the mechanics and architecture courses, plus the lending library catalogue of the School of Arts for 1821 are contained in the pamphlet P56/14.

[176] As Above, the lending library catalogue is contained in pamphlet P56/14.

[177] P56/14:26.

production of three-dimensional working machines.[178] It seems likely that Lees' textbook was also circulated outwith Edinburgh, because a publication of the following year, which was concerned with disseminating Monge's very new system of descriptive geometry, referred rather slightlingly to it in the introduction.[179] This book was George Birkbeck's 1827 translation of Baron Dupin's treatises on descriptive geometry *Mathematics Practically Applied to the Useful and Fine Arts* and it was expressly aimed at the new Schools of Arts in Britain. Furthermore, the Preface to Birkbeck's translation seems to imply that Mongean descriptive geometry was in use at the Schools of Art, including Edinburgh. In it he states that Dupin's course of instruction is based on:

> scientific information (and) practical knowledge collected...in the workshops and manufacturing establishments...of Europe. The value of this new species of instruction was felt by him on his first visit to Glasgow where it then alone prevailed... (this led to) the School of Arts in Edinburgh with its course of lectures on the application of Geometry to Arts and Manufactures.[180]

George Birkbeck (1776-1841) could be seen as one of the driving forces behind the Schools of Arts and mechanics' institutions in Britain. After graduating from Edinburgh University in 1799, Birkbeck began teaching at the Andersonian University in Glasgow, and in 1800 began courses of lectures to which working men were admitted for a low fee. In 1823 the Glasgow Mechanics' Institution was founded, and in 1824 Birkbeck helped found the London Mechanics' Institution.[181]

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[178] Lees was the teacher of mathematics at another school in Edinburgh, the Scottish Military and Naval Academy, which also had a strong and varied drawing element in its curriculum. This is discussed later in this section. (Lees 1826: title page)

[179] .the Geometry of Lees is little more than a judicious abridgement of...the elements of Euclid'. (Birkbeck 1827:xv)

[180] Birkbeck 1827: i-iii.

[181] *DNB* 5:80-1. Edinburgh, Glasgow and London therefore seem to be among the first centres of technical education for tradesmen. One other notable example was Liverpool Mechanics' School of Arts (1825) which became Liverpool Mechanics' Institution in 1832, when it had 1010 members and offered classes in 'landscape and mechanical drawing, architectural drawing and Drawing the human figure, ornamental design, and modelling'. (Willett 1967:30)

Although Birkbeck's preface suggested that descriptive geometry was taught at Edinburgh, this was not listed on the syllabus printed in 1821, nor were there any books on this subject in the library. However, the catalogue of an Edinburgh bookseller, Wm. and David Laing from 1826, contained both Monge's *Geometrie descriptive* of 1811 and Du Pin's *Developpements de Geometrie* of 1813.[182] Furthermore, by 1825 and1826, the students from the mechanical philosophy class at the School of Arts were competing for the Directors' Prizes by providing the most elegant solutions to geometrical problems, with prizewinners' drawings being reproduced in the Annual Reports.[183] For example in 1826 Directors' Prizes were awarded to Francis Tudhope; joiner, William Bain; mason, and William Sheddon; iron turner. Their prizes were respectively: *Davidson's Practical Mathematics, Playfair's Euclid* and *Legendre's Geometry, Brewster's Edition.*[184] This seems to support Birkbeck's statement to some extent; it also suggests that tradesmen who had studied at similar institutions in Britain did have access to some specialized technical drawing at this period.[185] It also seems that at the Edinburgh School of Arts, at least, more general visual skills were seen as an irreplaceable method of communication. A speech to the Directors in 1826 praised:[186]

> Drawing, which some may regard as a mere embellishment. This is a great mistake. Drawing -such, at least, as is taught in the Institution, is immediately subservient to the other studies of the Pupils. Without some facility and correctness in the

[182] Laing 1826. Other recent French developments available in print from Laing's included Legendre's *Exercises de Calcul Integral* of 1816, and *Memoires de la Classe des Sciences, Mathematiques et Physiques de l'Institut Imperial de France depuis 1812.* (Laing 1826)
[183] P69/11 and 12.
[184] P69/12:39.
[185] Although the emphasis on geometry may be a Scottish one, reflecting the influence of Robert Simson (1687-1771) the champion of geometry as a method of reasoning as opposed to Cartesian algebraic methods (Davie 1961:109). The more general point from George Davie's work is that mathematics (with geometry as a central element) was taught in the early ninteenth century in Scotland as a fundamental humanities subject with time spent on the philosophical questions raised. (Davie 1961:109-11)
[186] Rev. Dr. Brunton, Professor of Oriental Languages at Edinburgh University, speaking to the June 1826 meeting of the Directors of the School of Arts. P69/12:5

> construction of diagrams and delineation of models, the business of the Natural Philosophy Class, I am afraid, would go but poorly on. In Chemistry, a sketch of the apparatus by which an experiment is conducted, forms often a pleasant and effectual record of the experiment itself. But farther- Drawing leads directly to professional usefulness. All must have had to regret the inability of an otherwise intelligent tradesman to give his employer a sketch of what words only imperfectly and obscurely describe. No one but such a tradesman can tell how much both of time and materials may be wasted in blundering experiments, without the aid of this art to embody his conceptions on paper. I should not regret it if even those parts of Drawing which are more strictly called an embellishment, were cultivated in the Institution; for they teach the Pupil to look with a more observant and intelligent eye on the objects of both nature and of art.[187]

In Edinburgh, in addition to the Trustees' Academy and the School of Arts, classes in 'landscape and perspective drawing' were available daily at the Scottish Military and Naval Academy on George Street, which was the institution at which George Lees was based.[188] There were therefore at least three institutions teaching drawing to a wide range of students who intended to use drawing in their working lives, although not necessarily as artists.[189] The modes of drawing ranged from landscape and figure drawing, to architectural and anatomical drawing. The students could also learn a range of perspectival and geometrical methods of representing three-dimensional forms on paper. The possible influence of these different uses of technical drawing on James Nasmyth will be discussed in later sections, but now we will turn to a slightly different but no less important aspect of technical drawing at this period, which is, broadly, the impact of materials and processes on the style of technical drawing around the

[187] P69/12:5.

[188] There were two separate classes a day taught by Major Charles Downes, Superintendent: Military Drawing, Surveying and Levelling 10-12; Landscape, etc. 12-1 daily. Report of the Directors of the Scottish Military and Naval Academy 21 Nov. 1826 P69/10.

[189] Although there are no numbers of students available for the third school, the total in a year such as 1826 seems to have been well over 400: 40 at the Trustees' Academy; 420 at the School of Arts; plus the George St. school numbers.

1820s. This discussion will include a description of technical drawing equipment, the expansion of drafting offices and the rise of technical publications.

At the beginning of the nineteenth century many engineering drawings for all stages of the work were produced by the engineers or craftsmen directly involved; however, by the middle of this century there had grown up 'a considerable population of draftsmen'.[190] This grew out of the division of labour and the need to control and co-ordinate work at a distance in large industrial organizations.[191] This change can be seen in the career of James Nasmyth, who began producing small working machines and models from 1825.[192] At first these were designed and made by himself but larger jobs such as 'the road steam carriage' of 1827 were produced in part at an outside foundry[193] which would have required readable technical drawings. By 1841 Nasmyth's business at the Bridgewater Foundry in Manchester had a separate drawing office whose work will be discussed in Chapter IV. In the development of the style of technical drawings at this period, the division of labour, the dissemination of technical illustrations, and the materials used to produce the drawings were all interconnected elements.

In the early nineteenth century, technical drawings were produced on stretched paper using pencil to lay out the drawing accurately. At this date, both paper and pencil were the products of recent technical changes. Graphite pencils were available in various grades from HH

[190] Booker 1979:133.
[191] Baynes and Pugh 1981: 63.
[192] Nasmyth 1883:110-2. For example, he produced a 'sectional model of a complete condensing steam-engine' for the School of Arts at this time.
[193] Nasmyth 1883:120-1.

(very hard) to BB (extra black for deep shadowing).[194] It was reccommended that they be 'of very pure lead, without any mixture of hard particles. The hardness of its substance should be adapted to the purpose for which they are to be used: for mathematical drawing, the lead should be hard so that it will cut to a fine point... at the same time it should mark with so little pressure, that it will not penetrate or indent the paper'.[195] This was then overlaid when correct with pen,[196] and the pencil removed with india rubber or breadcrumb.[197] Industrially-produced paper, first introduced following Louis Robert's invention of the continuous-web paper machine in 1798,[198] had by 1850 become almost universal.[199] The surface of machine-made drawing paper was smooth due to hot pressing, sizing and filling with substances such as chalk;[200] available in a range of sizes above demy (19.5 x 15.25 inches).[201] The principal drawing instruments in the service of neatness and accuracy included rulers and compasses, supplemented by a growing battery of other, more specialized tools by the 1830s; these will be discussed below. Copies, before blueprints became available after mid-century,[202] were produced by hand, using tools for accurate transfer of measurements such as compasses. The adoption of mechanically-produced tools (such as steel pen nibs)[203]

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194 Farey 1830:121; Although pure drawing graphite from Cumbria had been available since the 16th century, modern 'lead pencils', with a core of crushed graphite blended with a binding medium such as clay offered a reliable range of qualities. These had been available, for example from Faber in Germany since 1760, or in Conte's process since 1795. (Turner 1996 24:353)

195 Farey 1830:121.

196 Pens with steel nibs were first produced in the late 18th century, and were first industrially produced in the 1820s, with the most important manufacturer Joseph Gillot patenting his process in 1831. (Turner 1996 24:348-50) Further developments saw the price of steel pens fall from 6/- to 6D. per gross between 1830 and 1851. 'The Manufacture of Steel Pens in Birmingham' *The Illustrated London News* 22 February 1851: 148-9.

197 *Catechism of Drawing* 1821:63; Farey 1830:121.

198 Andre 1996:16.

199 Bower 1999: 17-30;Tomlinson 1854 Vol. II: 357-74; Payen 1859 Vol II:458-84.

200 Andre 1999:302.

201 Tomlinson 1854 Vol II:369.

202 Cyanotype printing (blueprint) was invented by Sir John Herschel in 1842, although it was not taken up by drawing offices until the late nineteenth century. (Verbal communication from Gavin Stamp)

203 Hambly 1988:11-14;57.

and supports (machine-made paper),[204] produced in drawing 'thin, hard and strong neoclassical contours'.[205] It has been argued that the steel pen was the vehicle at this period for injecting mechanical and industrial values into fine art through neo-classicism, which used the clear, unvarying line equally valued for industrial diagrams and designs.[206] The evolving style of nineteenth-century technical drawing, already being formed by new materials such as steel pens (and the machine-made hot-pressed sized paper able to withstand these pens)[207] was further reinforced by the translation of drawings into steel plate engravings for the growing number of technical publications. One notable example was Abraham Rees' *Cyclopaedia; or, universal dictionary of art, sciences and literature* published in 45 volumes from 1805 onwards.[208] One major illustrator for this was John Farey (1791-1851), a prolific and influential author, illustrator and engineering consultant whose own work demonstrates clearly some of the coalescing conventions of technical drawing at this period. His work as an illustrator and populariser of scientific and mechanical instruments began in 1805 with Rees' *Cyclopaedia*,[209] when he was just fourteen. His younger brothers and sisters also took part in his business, for example, his sisters Sophia, Marianne and Ann helped to produce technical drawings whilst also selling their own drawings to fashion magazines.[210] His illustrations were reproduced as steel-engraved plates, many from the workshop of Wilson Lowry (1762-1824), the engraver who produced the plates for William Farish's article on isometric drawing discussed above. As an engraver, Lowry specialised in technical subjects, and made several inventions of his own to facilitate this. Two examples are the ruling machine and the

[204] Bower 1999: 26.
[205] Howard 1985: 789.
[206] Howard 1985: 785-98.
[207] Hambly 1988:49.
[208] The complete 1819-20 edition listed in the Bibliography had 45 volumes.
[209] Woolrich 1998:50.
[210] Woolrich 1998:57.

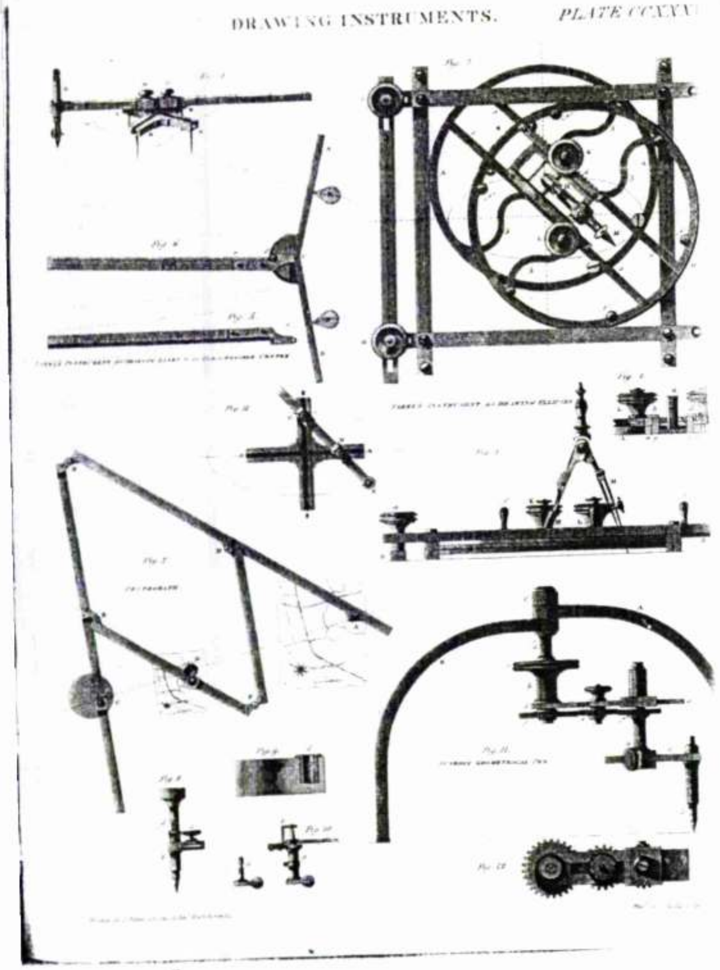
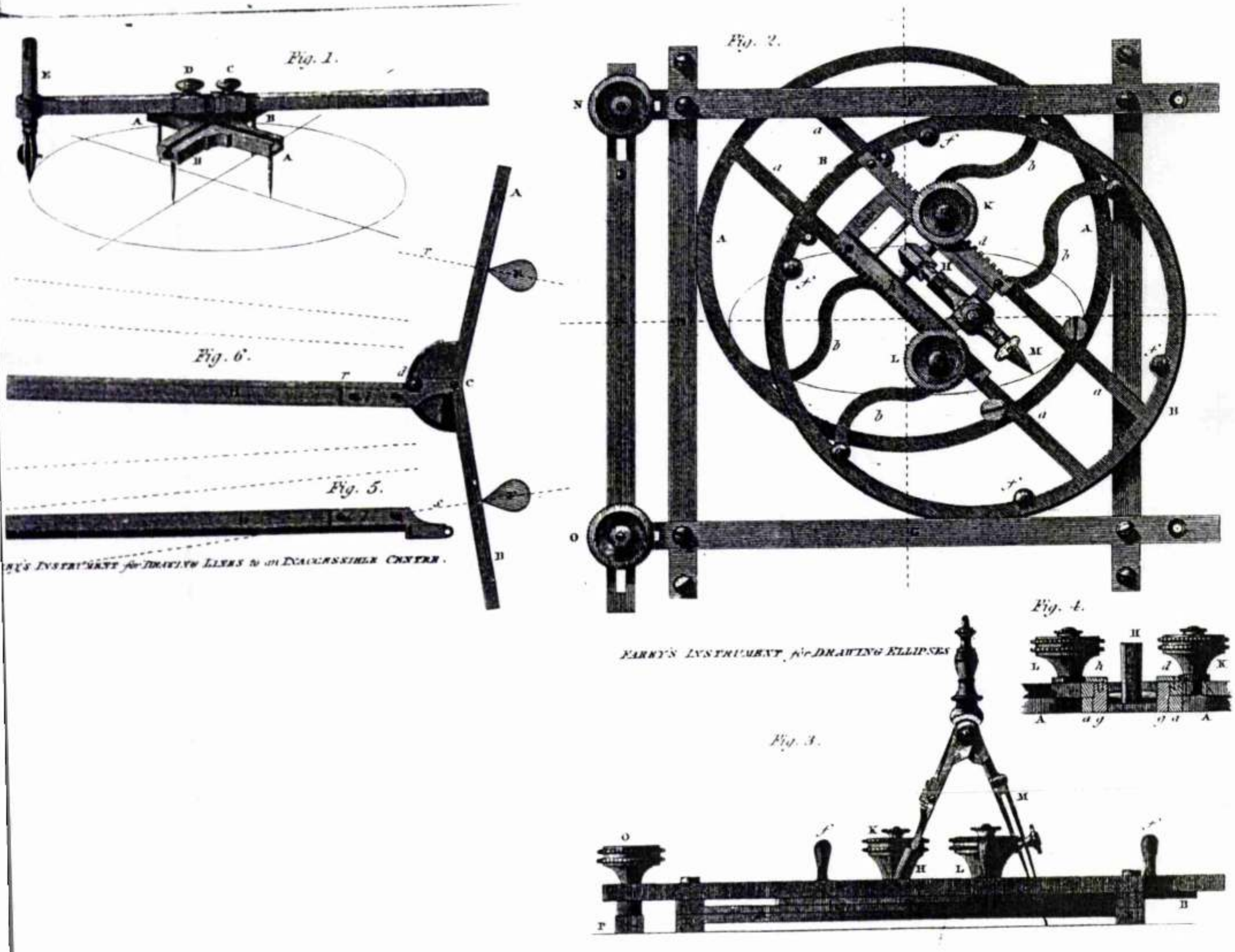


Figure 21: John Farey, *Drawing Instruments*, *Edinburgh Encyclopaedia* Plate XXCCCV 1830 Vol. 8.

Figure 22: Detail of Figure 21.



use of a diamond point to achieve very fine lines.[211] His major source of work from 1800 was Rees' *Cyclopaedia*, and as this had a planned print run of 6000, his daughters, who were also engravers, produced duplicate plates to achieve this.[212] Lowry was also a founder member of the Geological Society; yet another example of the diverse fellowship of geologists at this date.[213] In printed works like Rees' *Cyclopaedia*, the collaboration of the engraver and the illustrator produced a composite style. As already described, Lowry the engraver had made some technical innovations which generated unmodulated fine lines laid down with an undeviating, machined rectilinearity. John Farey's methods were described by himself in an article on drawing instruments in the *Edinburgh Encyclopaedia* of 1830, illustrated in the style uniquely generated by such instruments.[214] (See Figure 21) Many of the specialist drawing instruments that he popularized in both the *Cyclopaedia* and the *Edinburgh Encyclopaedia* were also invented by himself, such as the elliptograph and the centrolinead shown in Figure 22.[215] (These were for drawing accurate ellipses and for fixing a vanishing point outside the paper or drawing board, respectively) Another important instrument shown in Figure 21 is the pantograph (also called, as here, the pentagraph, and the eidograph). This is a mechanism for allowing drawings to be copied and also reduced or enlarged at will. It was very useful indeed for copying irregular contours, as in maps or observational drawings, and was therefore important in the context of Edinburgh publishing at this

[211] Hunnisett 1980:88. The ruling machine was invented to produce unmodulated, even rules. These could be laid down at graded distances apart to give the effect of recession in space, in a seascape for example. The effect was to suggest tone and recession whilst attempting to efface the marks used to achieve this. The diamond point was intended to give the effect of an ideal or axiomatic line; that is, extension without breadth. Once again this seems like the attempt to convey an idea visually whilst at the same time effacing the marks which are doing this work.

[212] Hunnisett 1980:88.

[213] *DNB* 34:212-9; this entry also describes the later career of his daughter, Delvalle Lowry, who published two books on engineering and geology in the 1840s.

[214] As already noted in the previous section, Volume 8 of the Edinburgh Encyclopaedia (which contained the articles on Drawing) was actually compiled by 1812. This makes much more sense in terms of John Farey's career and in terms of style, as can be seen by comparing Figures 21 and 22 with Figure 23 overleaf of 1819. See C. Davies Sherborn (1936-43) *J. Soc. Bibl. Nat. Hist.* 1:112.

[215] Farey 1830:131; Woolrich 1998:50.

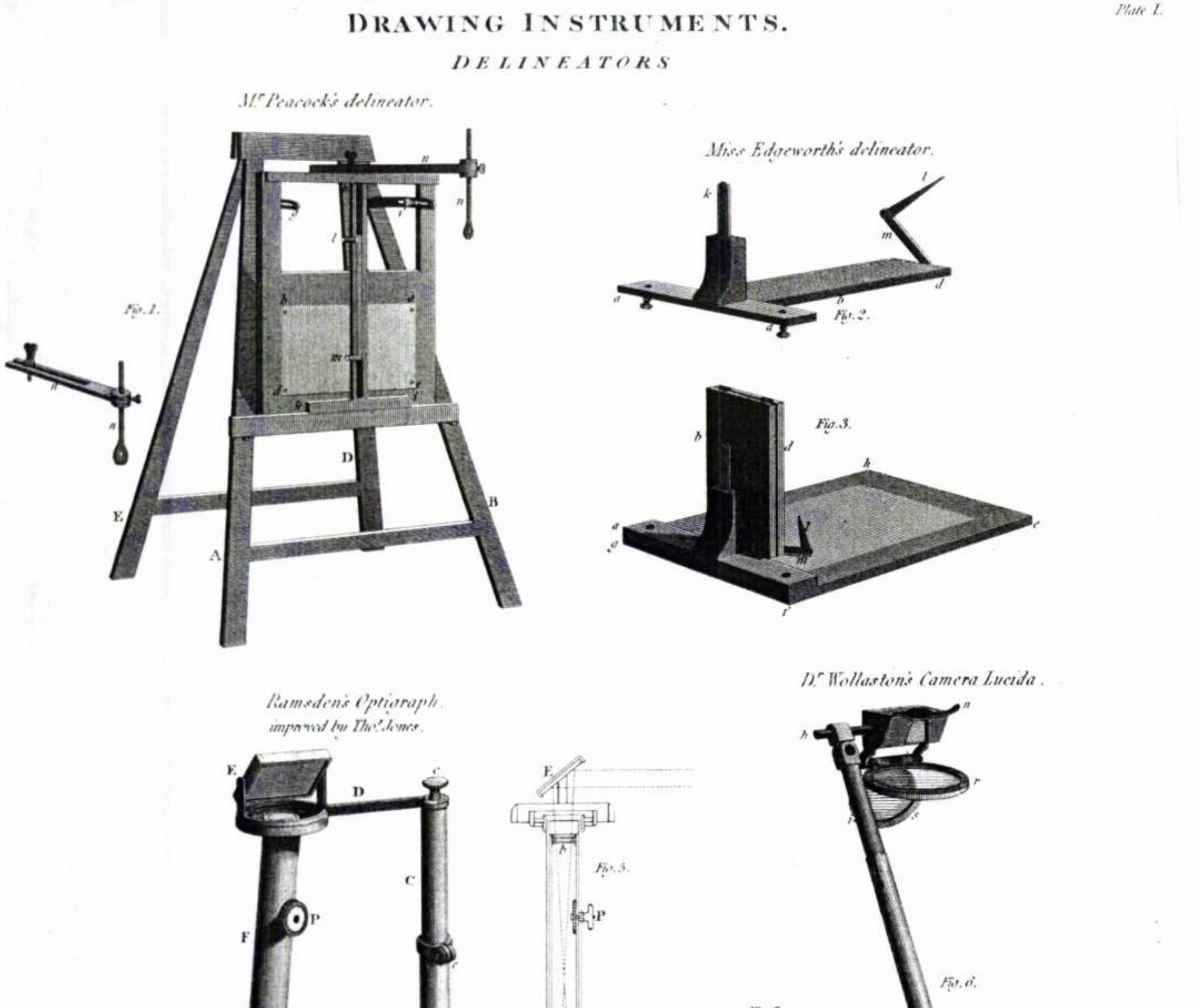
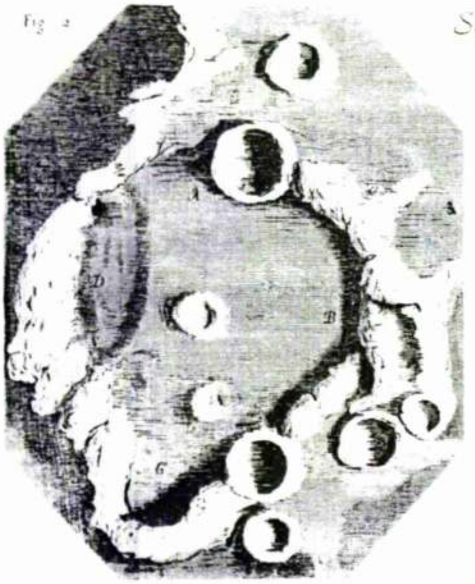


Figure 23: Drawing by John Farey, engraving by Wilson Lowry, *Delineators* (Rees 1819 Vol. XI: Plate I).

period with its strong tradition of engraving for cartographic and encyclopaedic publications.[216] Farey's mode of drawing was to make an accurate drawing of a machine with the help of a Wollaston-type camera lucida and to establish perpective vanishing points (this would be at the stage of a pencil drawing with 'little pressure'). After this, the drawing was worked up in ink, using ruler and compass, and using also the elliptograph and centrolinead to draw the various lines.[217] In passing, the engraving by Lowry of the camera lucida (Figure 23) amongst other 'delineators' shows clearly the conventions of technical illustration, with its ruled lines and accurate ellipses. The illusion of cylindrical forms turning from light into darkness was conveyed by graded spacing of lines, whereas plane breaks were marked by uniform application of tones on each surface. The illusion of three-dimensional objects was further aided by judicious use of cast shadows. The drawing, both by the illustrator and the engraver, has been completed with the help of drawing machines to a level of neatness and perfection unattainable by hand. (The quality of the lines and shading can be compared with a non-technical plate from the *Edinburgh Encyclopaedia*, shown at Figure 15 in the previous section[218]) The aim of these mechanical drawing instruments, just as surely as the compass and straight edge of geometry, was to indicate that the object depicted is in some way generic.[219] Nevertheless, because they are illustrations of pre-existing objects the first stage of this process was an individual observation, mediated through the 'delineator', and setting up some tension in the status of the drawing. The rhetorical function of this style is underlined by the fact that

[216] See T.N. Clark *et al.* (1989) *Brass and Glass* for information on Scottish instrument making workshops, in particular Chapters 4 and 5 for the eidograph controversy: 25-95; also Kemp (1990) *The Science of Art*: 167-220; and Yeo (2001) *Encyclopaedic Visions* chapter 7, for the Edinburgh background to the enterprise of communicating knowledge.
[217] Woolrich 1998:50.
[218] Figures 15 and 21 were both published together as Plates for the articles on drawing in the *Edinburgh Encyclopaedia* of 1830.
[219] This discussion will be expanded further in the section on Nasmyth's 1841 essay 'Nasmyth on Tools and Machines' in Chapter IV.



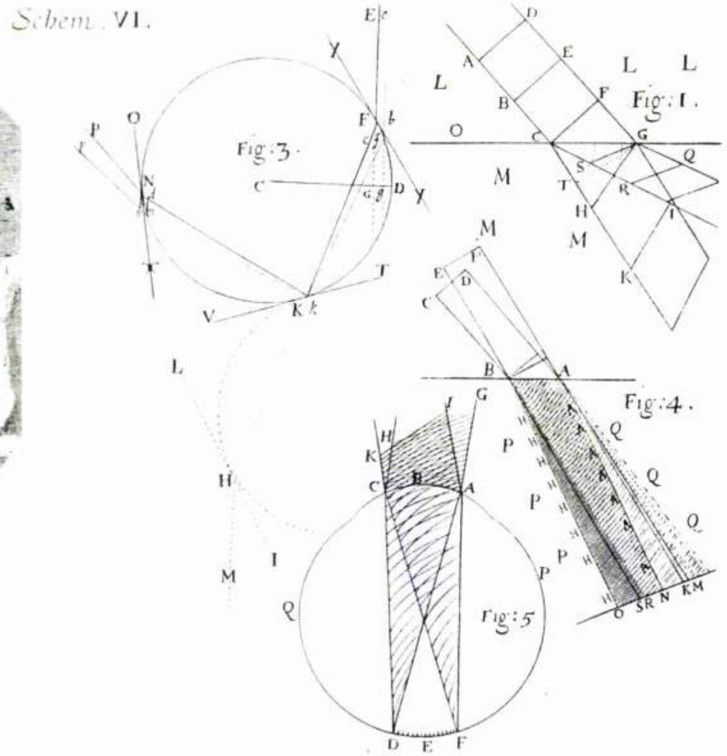


Figure 24: Two contrasting styles of drawing from *Micrographia* (Hooke 1665); these details are taken from part of Scheme xxxviii facing page 244; and part of Scheme vi facing page 60 (actual size).

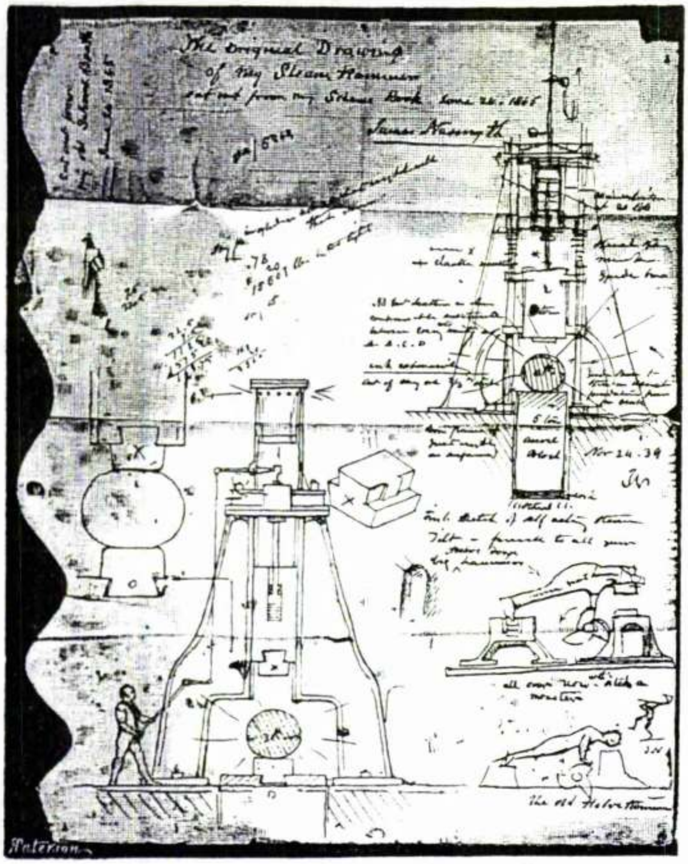
Farey's drawings are not always reliable records. The historian of John Farey's work has put this clearly: 'historians...must beware of thinking that if the drawing looks high-quality and well-engraved the information on it must be accurate; this is not always so'.[220]

Although for the purposes of this argument the roles of characteristic methods and tools in technical drawing of the time have been stressed, it is worth noting in passing that a clean, linear style had already been established for abstract, as opposed to purely observational, scientific drawings. This can be seen in comparing the two styles side-by-side in examples drawn from Robert Hooke's *Micrographia* of 1665. In Figure 24 two separate images are juxtaposed: on the left is a drawing of part of the Moon, the crater Hipparchus, which Hooke produced from a telescope observation. By contrast, the right-hand image illustrated an abstract, theoretical discussion of the 'proprieties of the motion of Light'.[221] This helps to demonstrate that a strong, established, but separate drawing tradition existed for scientific and technical purposes with different conventions and uses. At the same time, as discussed in the previous two sections, learning to draw, and using drawing, was not a homogeneous activity confined to artists.

How did these different, and possibly contradictory modes of drawing sit within James Nasmyth? There is plenty of discussion in his *Autobiography* of the importance of drawing, backed up by Nasmyth's drawings in the sketchbooks in the National Library of Scotland, but these two sources do not provide adequate answers this question. That is because they share an emphasis on one mode of drawing - artistic sketching -which obscures James Nasmyth's extensive ability in, and use of, mechanical and technical drawing. The NLS sketchbooks

[220] Woolrich 1998:65.

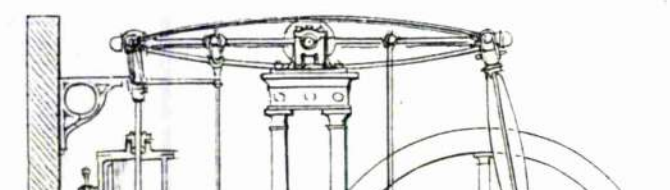
[221] Hooke 1665:55-67;the illustrations are taken from part of Scheme xxxviii facing page 244; and part of Scheme vi facing page 60 (actual size).



FIRST DRAWING OF STEAM HAMMER, 24TH NOV. 1839.

Figure 25: James Nasmyth, *First drawing of Steam Hammer 24 November 1839* wood engraving (Nasmyth 1883:241).

Figure 26: James Nasmyth, *Sectional Model of Condensing Steam Engine* c. 1827 wood engraving (Nasmyth 1883:111).



SECTIONAL MODEL OF CONDENSING STEAM-ENGINE. BY JAMES NASMYTH.

do not contain any examples of technical drawing, and although the *Autobiography* mentions mechanical drawing,[222] it prefers to use the language of inspiration -*disegno*- in relation to drawing, with its emphasis on 'graphic eloquence'...'a few effective touches'...'a few graphic strokes of the pencil', to take three examples from just one passage.[223] This emphasis extends into Nasmyth's description of his invention of the steam hammer:

> I got out my 'Scheme Book', on the pages of which I generally thought out, with the aid of pen and pencil, such mechanical adaptations as I had conceived in my mind, and was thereby enabled to render them visible. I then rapidly sketched out my Steam Hammer, having it all clearly before me in my mind's eye. In little more than half an hour...I had the whole contrivance, in all its executant details, before me in a page of my Scheme Book... [224]

Figure 25 is the illustration from the *Autobiography* of this passage; a 'reduced photographed copy' of that Scheme Book page, with its sprightly freehand pen drawings and scribbled calculations. This can be contrasted with the images (also drawn by Nasmyth) in the final chapter of 'Inventions and contrivances' which are simply inserted modestly into the text; Figure 26 is an example.

Nasmyth did, however, produce some other writing on technical drawing, not discussed in the *Autobiography,* and also the scheme book and technical drawings now held in the library of the Institute of Mechanical Engineers. The issues raised by that body of material will be considered in Chapter IV.

[222] For example, Nasmyth 1883:125; on Nasmyth's crucial visit to Maudsley in 1829 he took with him in order to demonstrate his seriousness not only a working high-pressure engine made by himself, but also mechanical drawings: 'I was the more desirous of exhibiting the ability which I possessed in mechanical draughtsmanship, as I knew it to be a rare and much-valued acquirement'.
[223] Nasmyth 1883:99.
[224] Nasmyth 1883:240.

Chapter III: Plutonic landscapes

Chapter II introduced the work of James Nasmyth's father, Alexander Nasmyth, whose paintings and landscape architecture displayed several interesting aspects of the picturesque movement. His work seems to illustrate Rosalind Krauss's definition of the picturesque as a 'beautifully circular relationship'[225] in which external landscape features were perceived in terms of prior images.

In a pattern he passed on to his son, his working methods relied on a constant feedback between external observation and inner conceptualizing whereby he visualized and constructed landscapes in his own workshop through direct hand contact. The picture conjured up by James of his father is of a kind of landscape *bricoleur* attempting to marry his inner conceptions with external reality:

> When the day's work was over, friends looked in to have a fireside crack...my father would go on with the artistic work he had in hand... He would model a castle or a tree, or proceed with some proposed improvement of the streets or approaches of the rapidly-expanding city[226] . (-He is referring here to the construction of the New Town of Edinburgh)

James himself assimilated this hands-on exploration of materials and structures, not only in his father's workshop, but also in his schoolboy activities in the 1820s. In his *Autobiography*, he remembers very specific practical experiences. For example, of metal-working, he remembers being taught the fine levels of observation and judgement required to harden and temper steel in forging by a foundry superintendent called Johnie Syme,[227] and, of chemistry, recalls that he and his friend made it a rule always to prepare their own basic chemicals such as acids, alcohol, and phosphorus from raw materials.[228]

[225] Krauss 1986:166.
[226] Nasmyth 1883: 52.
[227] Nasmyth 1883: 92-4.
[228] Nasmyth 1883: 94-6.

Figure 27: James Nasmyth, *The Alchemist just detecting a* glorious *passage in Geber,* 1833, pen drawing with pencil underdrawing 9.4 x 9.7 cm. (NLS MS3241 no. 129).

Figure 28: James Nasmyth, *Roger Bacon,* 1845, lithograph drawing 19 x 23 cm. (NLS3242 no. 136).

He ends this passage of reminiscence with the moral:

> The truth is that the eyes and the fingers -*the bare fingers* -are the two principal inlets to sound practical instruction...No *book* knowledge can avail for that purpose. The nature and properties of the materials must come in through the finger ends.[229]

This self-reliance and working by hand was fundamental to James Nasmyth; the many examples in the *Autobiography* show how important this was to his own sense of self-worth.[230] With Alexander Nasmyth, it has been suggested that his modelling and depicting of landscape had a circular aspect; in effect by modelling landscape in order to understand it, Alexander Nasmyth became his own Creator - the landscapes of Scotland he was so celebrated for coming partly from his own workshop. Although James Nasmyth was not a landscape painter, he helped his father in model-making and in collecting sketches in his youth, and he continued to be interested in producing images of landscape throughout his life, including some paintings.[231] However, this section is not about the influence of Alexander Nasmyth's paintings on those of his son, but rather will aim to show the transmutation of this earlier picturesque way of working through some unexpected industrial and scientific channels, before resurfacing in the production of the Moon illustrations in the 1870s.

The two youthful experiences recalled by James Nasmyth as support for the value of working with both 'eyes and fingers' (that is, the examples of chemistry and metalworking) both involve the transformation and metamorphosis of inorganic nature by forces such

[229] Nasmyth 1883:97.
[230] And his editor in this book, Samuel Smiles.
[231] One example, *Alexander Nasmyth and Robert Burns at Rosslyn Castle* from the Royal Scottish Academy (undated) helps to show James Nasmyth's use of the Nasmyth family re-cycling ethos, for a note pasted to the back reads: 'this picture painted by Me from a small pencil sketch By My Father which he made on the spot when he and Robert Burns had walked to Roslin, 13 June 1786' from the notes at the National Galleries of Scotland exhibition *Rosslyn: Country of Painter and Poet* April-July 2002; see also the catalogue of James Nasmyth paintings in Johnson and Money 1977:57-9.

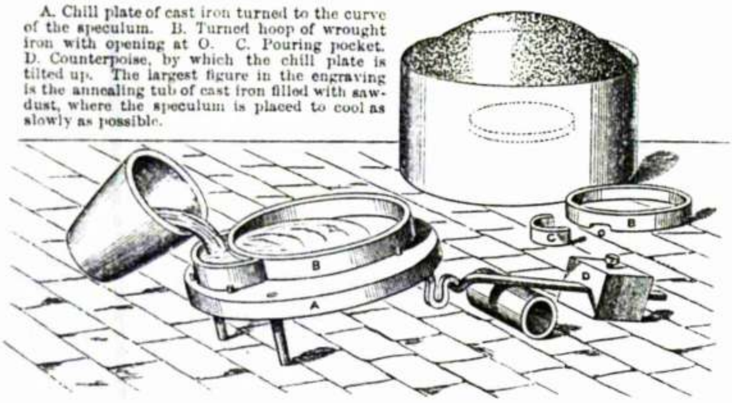


Figure 29: James Nasmyth, *A Method of Casting Specula for Reflecting Telescopes* wood engraving (Nasmyth 1883: 405)

as fire and pressure. He emblematised his interests and his mode of working through his own personal iconography of the alchemist. One of these is shown in Figure 27, a sketch of 1833 *The Alchemist just detecting a* glorious *passage in Geber. Found it at last.*[232] There are 32 drawings connected with alchemy in the NLS sketchbooks; 27 of them feature the alchemist himself, a balding, staring-eyed, bearded fellow surrounded with a plethora of mortars, retorts, bellows, old gothic chairs and vaults. The five alchemist drawings without a figure are cluttered assemblages of these same alchemical props.[233] The images are possibly derived from engravings of the work of Joseph Wright of Derby which were widely known after 1770.[234] Most of the drawings, like Figure 27, are pen and ink drawings using a very fine but hastily-scribbled line. Figure 28 is a line lithograph *Roger Bacon* signed and dated (in reverse) 1845,[235] one of several images made with experimental mediums by Nasmyth in the NLS sketchbooks.

Even before James left home in 1829, he began to turn the full focus of experiential working with 'eyes and fingers' to the production of machinery and philosophical instruments through a direct involvement with materials. For example, he describes in his *Autobiography* how he determined to make his own reflecting telescope, starting with the casting of the speculum as illustrated in Figure 29 (a speculum is a reflecting mirror made of metal, not silvered glass):

> 1828. A Method of casting Specula for Reflecting Telescopes, so as to ensure perfect Freeness from Defects, at the same time

[232] NLS MS 3241 no.129.
[233] NLS MS 3241 and 3242.
[234] One image which is full of very similar props is *The Alchymist* of 1771 (reworked 1795) from Derby Museum (Daniels 2000:26-7); Wright's engravers included Wm. Pether, Valentine Green and J.R. Smith (Turner 1996 33:413). *The Alchymist* was engraved by Pether in 1775; there is a copy in the BM Print Room: 1862-5-17-178.
[235] NLS MS 32. The fine lines and reversed signature suggest that this was drawn by Nasmyth onto transfer paper with the express intention of reproducing it by lithography. Nasmyth had several scenes of 'fairies and mediaeval alchemists' printed by the lithographic printer McClure in the 1850s to give as presents to friends and people he admired. (Stevenson 1989:25)

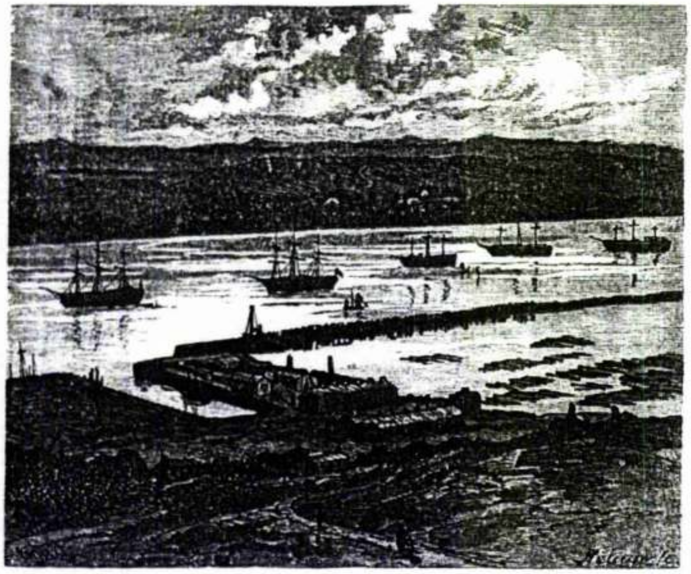
enhancing the Brilliancy of the Alloy.[236]

This passage included details of how he followed 'the best book instructions' in casting, only to have his very shiny (but exceptionally brittle) cast alloy break up during its final polishing, and his subsequent invention of a more satisfactory method of producing a less brittle cast.[237] To explain the technical details briefly; metal will be less brittle and more malleable if it is annealed, that is, cooled as slowly and evenly as possible -in the case here of the speculum the entire block had to be poured and cooled as one without any preliminary drops or splashes in the mould which would cool at a faster rate and hence have different (less desirable) qualities from the parent block.[238] This exacting metallurgical work was seen by James Nasmyth as an integral prelude to the process of observation and recording astronomical bodies which became his principal passion after his retirement in 1854:

> I may mention that I know of no mechanical pursuit in connection with science, that offers such an opportunity for practising the technical arts, as that of constructing from first to last a Newtonian or Gregorian Reflecting Telescope... Buy nothing but the raw material, and work your way to the possession of a telescope by means of your own individual labour and skill. If you do your work with the care, intelligence, and patience that is necessary, you will find a glorious reward in the enhanced enjoyment of a night with the heavens -all the result of your own ingenuity and handiwork.[239]

Through his belief that 'the nature and properties of the materials must come in through the finger ends' it seems that Nasmyth was able

[236] Nasmyth 1883:405.
[237] Perhaps Nasmyth learnt these 'book instructions' at the School of Arts as the optics lectures included these topics. (Appendix II of P56/14: 'SYLLABUS of Mr Galbraith's LECTURES')
[238] Nasmyth had to be very alert, nimble-fingered and canny to produce a piece of metal with exactly the right balance of reflectivity and brittleness; amateur astronomers in the 20th century were told instead to make themselves glass reflectors: 'the chief reasons for abolishing the use of speculum are the difficulties in casting and figuring'. (Kuiper and Middlehurst 1960:36) However, this was not so much the case in the 19th century, where Nasmyth was not alone in casting metal speculae for his own use. See T.N. Clark et al. (1989) for other Scottish examples; and Allan Chapman (1998) *The Victorian Amateur Astronomer* : 102-9.
[239] Nasmyth 1883:327.



SPACE TO BE ENCLOSED AT THE HAMOAZE.

Figure 30: *Devonport Docks* wood engraving (Nasmyth 1883: 273)

to link a subjective intimacy with the most colossal external natural forces and bodies. To step up the scale from the modest speculum, in Nasmyth's description of his most famous invention, the steam hammer, hand- and eye-contact was still maintained and insisted on in the transformation of materials:

> The attendant could, by means of the steam slide-valve lever in his hand, transmit his will to the action of the hammer , and thus *think* in blows. The machine combined great power with gentleness. The hammer could be made to give so gentle a blow as to crack the end of an egg placed in a wine glass on the anvil; whilst the next blow would shake the parish...[240]

Here Nasmyth is seen to value magnified hand working, describing how an experimental self-acting arrangement was reversed in favour of the flexibility of the hand-gear.[241] The steam hammer was invented to allow previously impossible massive forgings;[242] but as the scale of this 'hand-working' exceeds that on the speculum, Nasmyth's other important heavy engineering invention, the steam pile-driver, allowed a further increase in the scale of forces over which Nasmyth had control. The pile-driver was a modification of the steam hammer used not simply to transform materials but to remodel the landscape, as for example, in its first application, the construction of a tidal barrage at Devonport Docks for the Royal Navy.[243] (Figure 30) Other major landscape interventions permitted by this mechanism included bridges, forts and other tidal barrages, for example on the Nile and at Yokohama.[244] It is possible to draw together the intimate scale of Nasmyth's personal mythology of the alchemist with these huge enterprises of forging and earthmoving because of Nasmyth's extension of 'eyes and fingers' into the working of his engines. The

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240 Nasmyth 1883: 249.

241 Nasmyth quoted the *Report on the Vienna Exhibition* (1873) which praised this aspect of the steam-hammer's working. (Nasmyth 1883: 249)

242 Nasmyth attributed the invention of the steam hammer to the desire for a wrought-iron paddle shaft of 30" diameter, for the *Great Britain* steamship. (Nasmyth 1883:239)

243 Nasmyth 1883: 271-6.

244 Nasmyth 1883: 276-7.

alchemist drawings are complemented by the following story, of a visit to Vesuvius in 1842:

> I mounted the volcanic ashes with which it is strewn, and got to the top. There I could look down into the pit from which the clouds of steam are vomited forth. I went down to the very edge of the crater, stood close to its mouth, and watched the intermittent uprushing of the blasts of vapour and sulphureous gases...I rolled as big a mass of cool lava as I could, to the edge of the crater and heaved it down; but I heard no sound. Doubtless the depth was vast , or it might probably have fallen into the molten lava, and thus make no noise. On leaving this horrible pit edge, I tied the card of the Bridgewater Foundry to a bit of lava and threw it in, as a token of respectful civility to Vulcan, the head of our craft.[245]

Here it seems as if he respected Vulcan as a kind of fellow technologist. Since James Hutton's theories had been published in 1795,[246] volcanoes had become a focus of ideas about the formation of the Earth, and hence he and his followers were called plutonists.[247] Hutton's friend and colleague, Sir James Hall of Dunglass (after whom James Nasmyth had been named[248]) was able to test these theories in the laboratory, and his experiments played an important role in winning converts to Hutton's theory of the earth.[249] The metallurgist C.S.Smith has placed these experiments by James Hall in a wider context in which industrial processes of ceramics and metallurgy were used at this period to support geological theories,[250] citing one particular experiment which was concerned with the effects of different rates of heating and cooling on the formation of different rocks. In 1790, James Hall had demonstrated by heating and cooling a crucible of local whinstone (basalt) at an Edinburgh iron foundry that it could be converted at will either to black lava-like glass, or back to

[245] Nasmyth 1883:263.
[246] Hutton (1795) *Theory of the Earth* Edinburgh: Messrs Cadell, Junior and Davies.
[247] Smith 1981: 174.
[248] See Chapter II, part 1.
[249] Smith 1981:174.
[250] Smith 1981:174-90.

basalt, depending on the control of the rate of cooling,[251] and on a trip to Vesuvius in 1785,[252] Hall then collected 'samples of lava directly from the molten stream' to be used in further experiments.

These controlled applications of different rates of cooling in order to produce different qualities in the same materials are directly analogous between James Hall's experiments on rock and James Nasmyth's speculum casting. James Nasmyth knew Sir James Hall, and knew of his work both as a young man[253] and as a working engineer and scientist.[254] Furthermore, he included geological interests and observations amongst his other activities as did many others of his generation. For example, on a trip to Londonderry as a young man, he had visited the Giant's Causeway, a feature noted for its hexagonal columns of basalt.[255] In addition to his appreciation of the power and duration of geological processes, Nasmyth also paid tribute to their human usefulness:

> Volcanic action, in some inconceivably remote period of the earth's crust history, has been the *Plough*, and after denudation by water, has been the *Harrow*, by which the originally deep-seated mineral treasures of the globe have been brought within the reach of man's industrial efforts... This great subject caused me, even at this early period of my life, to behold with especial interest the first peep at the structure of the moon's surface, as revealed to me by an excellent Ramsden 'spy-glass', which my father posessed, and thus planted the seed of that earnest desire to scrutinise more minutely the moon's wonderful surface, which in after years I pursued by means of the powerful reflecting telescopes constructed by myself.[256]

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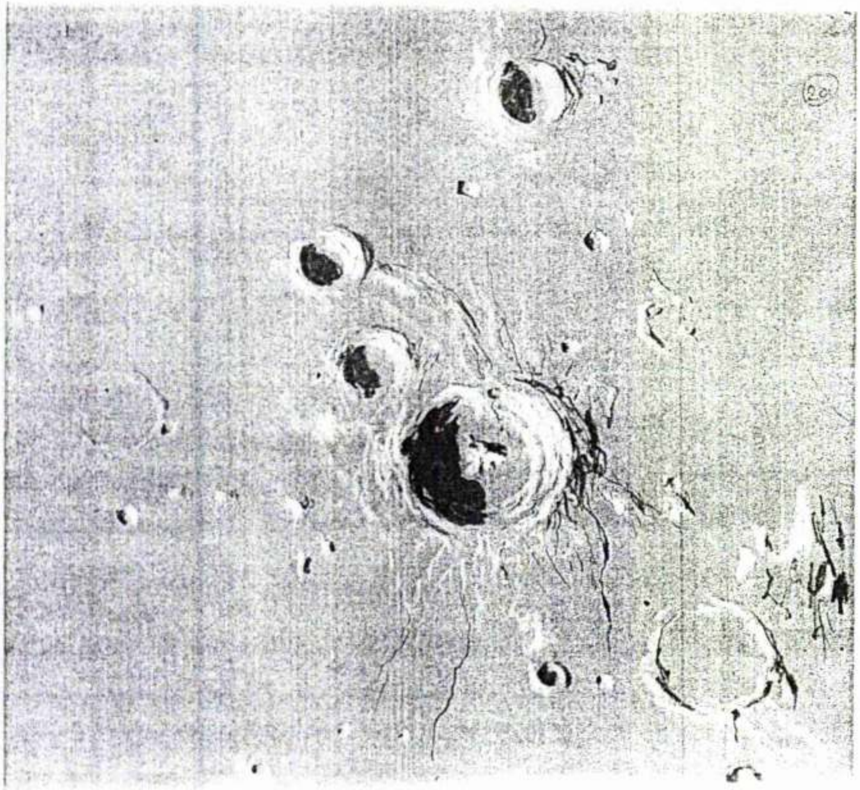
[251] Smith 1981:185.
[252] Smith 1981:185. Vesuvius had been the focus for volcanic observation by artists and scientists since the British envoy at Naples Sir William Hamilton began sending samples of volcanic rock from Vesuvius to the Royal Society and the British Museum in 1768 onwards, providing patronage for many visiting artists including the Scot David Allan. (Jenkins 1996: 160-2; 242-6)
[253] Nasmyth 1883: 50-1; 100-1.
[254] See, for example his description of the British Association meeting and subsequent discussions in Edinburgh 1850. (Nasmyth 1883:338-44)
[255] Nasmyth 1883:343; There is a pencil sketch of this scene in the NLS MS .
[256] Nasmyth 1883:101-2.



LUNAR MOUNTAINS AND EXTINCT VOLCANIC CRATERS.

Figure 31: James Nasmyth, *Moon surface Feb. 3 1868* , black and white drawing on fine grey paper 28.5 x 22.8 cm. (NLS MS 3242 no. 201) Below: a wood engraved illustration (Nasmyth 1883: 335) to illustrate the passage on the 'awful grandeur of lunar scenery'.

This passage ties together James Nasmyth's interests in geology, landscape, picture-making, and the Moon. Nasmyth was interested in the Moon as a geological case-study, and it is his picturesque work on the Moon which is the next stage in this argument.

James Nasmyth has been recognised as an important observer of the moon in the 'final generation of astronomers who looked at the moon with their eyes',[257] that is before shorter, sharp exposures allowed the first major photographic surveys of the moon. It is worth quoting a passage from his *Autobiography* at some length here:

> In 1842 I began my systematic researches upon the Moon... My method was as follows:- I availed myself of every favourable opportunity for carrying on the investigation. I made careful drawings with black and white chalk on large sheets of gray-tinted paper, of such selected portions of the Moon as embodied the most characteristic and instructive features of her wonderful surface. I was thus enabled to graphically represent the details with due fidelity to form, as well as with regard to shade. I thus educated my eye for the special object by systematic and careful observation, and at the same time practised my hand in no less careful delineation of all that was so distinctly presented to me by the telescope -at the side of which my sheet of paper was handily fixed. I became in a manner familiar with the vast variety of those distinct manifestations of volcanic action, which at some inconceivably remote period had produced these wonderful features and details of the moon's surface. So far as could be observed, there was an entire absence of any agency of change, so that their formation must have remained absolutely intact since the original cosmical heat of the moon had passed rapidly into space. The surface, with all its wondrous details, presents the same aspect as it did probably millions of years ago... the total absence of water as well as atmosphere has removed from it all those denudative activities which, in the earth, have acted so powerfully in effecting changes of its surface as well as in the distribution of its materials... Hence the building up of those enormous ring-formed craters which are seen in such vast numbers on the moon's surface -some of them being no less

[257] Whitehouse 2001: 138.

> than a hundred miles in diameter, with which those of Etna and Vesuvius are the merest molehills in comparison...While earnestly studying the details of the moon's surface, it was a source of great additional interest to me to endeavour to realise in the mind's eye the possible landscape effect of their marvellous elevations and depressions. Here my artistic faculty came into operation... One of the most prominent conditions of the awful grandeur of lunar scenery is the brilliant light of the sun, far transcending that which we experience upon the earth. It is enhanced by the jet-black background of the lunar heavens, -the result of the total absence of atmosphere. One portion of the moon, on which the sun is shining, is brilliantly illuminated, while all in shade is dark.[258]

Figure 31 is taken from one of Nasmyth's observational drawings of the Moon done with black and white crayons on fine-toned gray paper;[259] below it is a wood engraving from the *Autobiography* which was used to illustrate the passage quoted above.[260] Nasmyth exhibited his drawings, and a six-foot map of the Moon generated from them, at the British Association meeting of 1850 in Edinburgh, where, as noted above, he also enjoyed many geologizing talks and outings.[261] Nasmyth clearly valued the moon as a plutonic landscape; one in which the results of volcanic action remained frozen and unsullied by factors of change such as a climate of water and air.[262] Furthermore, his accumulated observations and intimate knowledge of the moon's appearance drove him to some of the landscape procedures characteristic of his father; he modelled by hand the features of the moon using his maps as a basis, and then photographed the results. These pictures were used as illustrations for his book *The Moon, considered as a Planet, a World, and a Satellite* (1874) as carbon process photographic prints.[263] In other words he reproduced through

[258] Nasmyth 1883:329-35.
[259] NLS MS 3242 no.201.
[260] Nasmyth 1883: 335.
[261] Nasmyth 1883:338-44.
[262] Nasmyth actually called the craters on the moon 'Plutonian amphitheatres'. (Nasmyth and Carpenter 1874:90)
[263] See Chapter V.

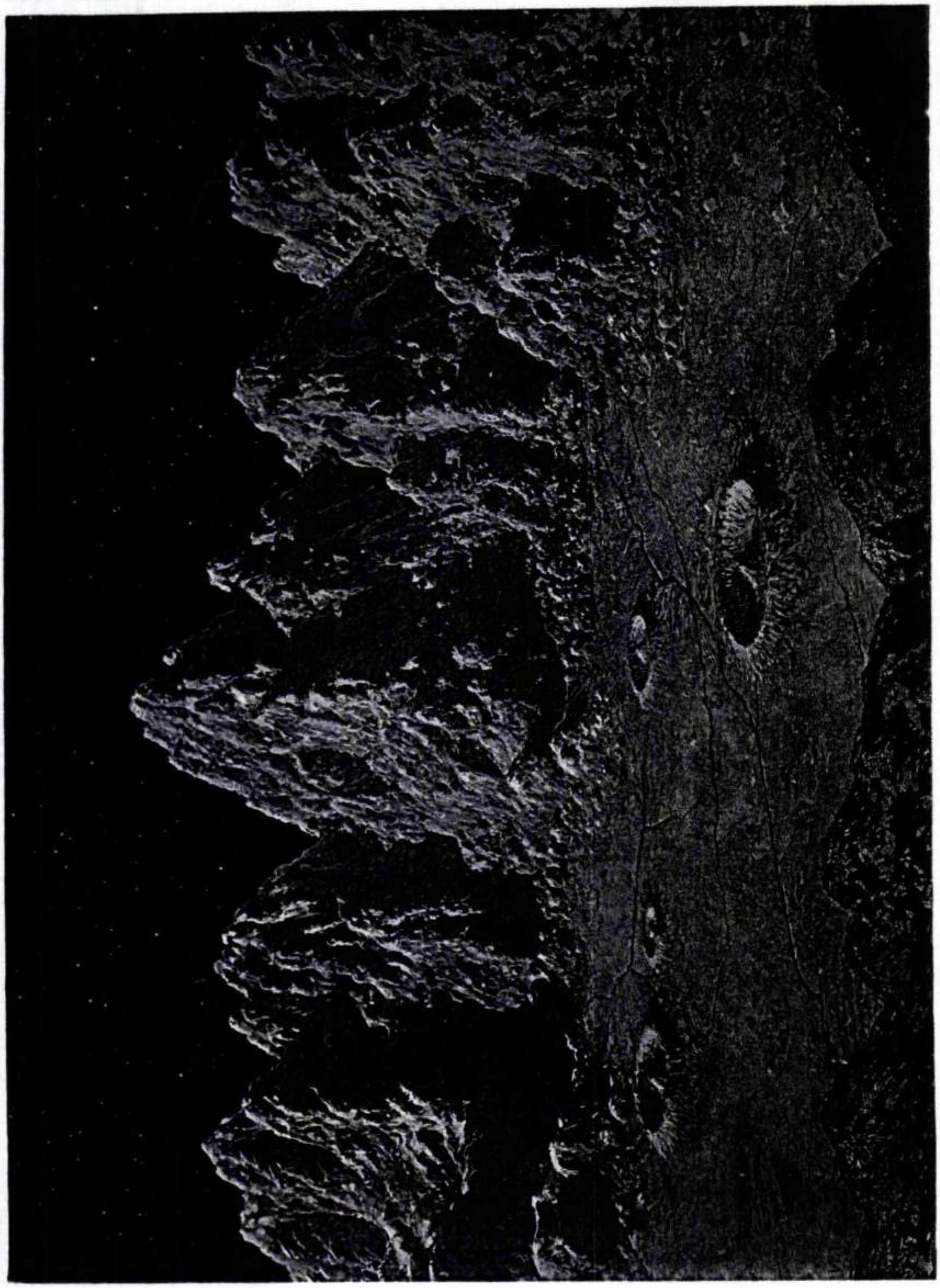


Figure 32: *Group of Lunar Mountains* (Nasmyth and Carpenter 1874: Plate XXIII).

hand modelling his conception of volcanic landscape formation, placed it within a photographic *mise-en-scene*, and produced an image from that. The qualities of photography at that time which made it difficult to photograph the Moon direct were ideal for imitating the harsh tonal contrasts of the airless moon landscape, described so clearly by Nasmyth himself above. In his assemblages of lunar landscape views, James Nasmyth was using photography for its drawing, or mark-making function, to unify the elements into an illusory whole, and he was one of the first photographers to appreciate the paradox of using a small piece of black cardboard speckled with white paint to stand for the infinite depths of space.[264] Figure 32 is one example of the lunar landscapes produced in this way: Plate XXIII from the 1874 edition: *Group of Lunar Mountains*. Other images were more homely, for example the famous image in Figure 33, intended to demonstrate the shrinking effects of age 'in the old earth, in an old apple, and in an old hand'.[265]

As Alexander Nasmyth had modelled trees and castles by his fireside, so James Nasmyth also had been able, through his imaging and modelling practices, to interiorize, indeed domesticate, the external landscape and its geology. Plutonic theories of landscape formation were especially understandable and agreable to him as having been performed through the actions of 'Vulcan, the head of our craft'. Nasmyth represented the external world to himself through hand work, and wished to control it through these means. If culture is a form of objectification -the process of bringing out and putting into sight a part of yourself as an object of knowledge,[266] then James

[264] One of these pieces of cardboard has been lovingly preserved in the NLS collection of Nasmyth sketches NLS MS 3243 no.10.
[265] Nasmyth 1883: 333. The fact that the hand is Nasmyth's own lends this image a poignancy that seems to align it with current fine art practices and gives it a place in exhibitions such as *The Fine Art of Photography* SNPG October 2001. For the purposes of this study, it stands as yet another example of Nasmyth's drive to absorb and reflect on natural phenomena through his hand work, here given a very self-referential slant.
[266] Miller 1987:32-3.

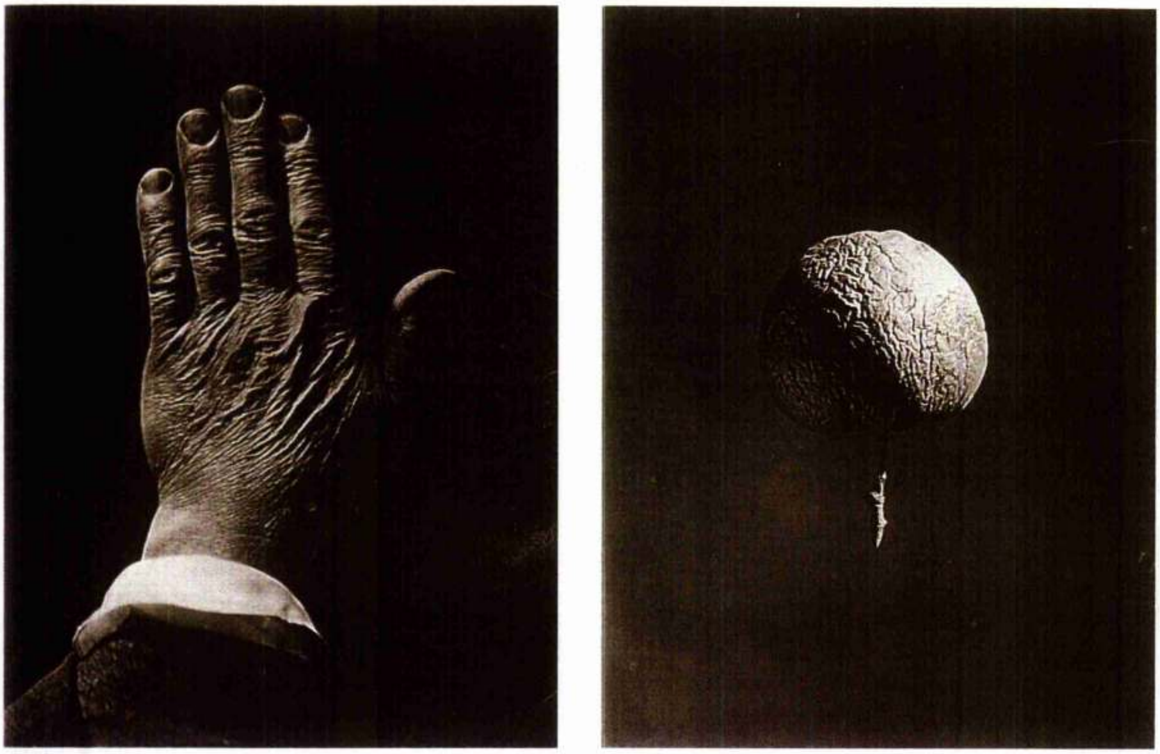


Figure 33: *Back of Hand and Shrivelled Apple* heliotype Nasmyth and Carpenter 1874: Plate II (Frizot 1998:375)

Nasmyth's cultural production here seems to be as intimate a secretion as the oyster's pearl, with a constant insistence on somatic contact.

The argument of this section has depended on showing a connection in Nasmyth's ideas between the very small (the speculum casting) and the colossal (the formation of the Earth and the Moon). This connection is supported by the closing passage of his book *The Moon: considered as Planet, a World, and a Satellite*: 'On the Moon as a Medal struck by the Creator':

> We trust that we, on our part, have shown that the study of the moon may be a benefit not merely to the astronomer, but to the geologist, for we behold in it a mighty 'medal of creation' doubtless formed of the same material and struck with the same die that moulded our earth; but while the dust of countless ages and the action of powerful and disintegrating and denuding elements have eroded and obliterated the earthly impression, the superscriptions on the lunar surface have remained with their pristine clearness unsullied, every vestige sharp and bright as when it left the Almighty Maker's hands.[267]

This section has been concerned with James Nasmyth's use of 'eyes and fingers' as a mode of engaging with and changing the external world, including his representation of it. The importance of hand contact and individual judgement to Nasmyth has been stressed here although he did not necessarily value this unequivocally. His fortune was built up through the development of machine tools which removed this engagement from his workforce, and enabled other manufacturers to do so:

> The rapid extension of railways and steam navigation...occasioned a largely increased demand for machinery of all kinds...It increased the demand for self-acting tools, by which employers might increase the productiveness of

[267] Nasmyth and Carpenter 1874:179.

> their factories without having to resort to the costly and untrustworthy method of meeting the demand by increasing the number of their workmen. Machine tools were found to be of much greater advantage. They displayed hand-dexterity and muscular force. They were unfailing in their action. They could not possibly go wrong in planing and turning, because they were regulated by perfect modelling and arrangements of parts. They were always ready for work, and never required a Saint Monday.[268]

The next chapter will consider some effects of this opposing tendency on Nasmyth's work from other sources.

[268] Nasmyth 1883:307; 'Saint Monday': OED *arch. slang* Monday spent in idleness as a consequence of drunkenness on the Sunday; this phrase was in vogue between 1753 when it appeared in the title of an article in the *Scots Magazine* 'St. Monday; or, the tipling tradesmen' to the later 19th century.

Chapter IV: 1: In the Age of Mechanical Reproduction: Introduction

Despite his stress on skilled handwork and 'inspiration'[269] in valuing his own work, Nasmyth equally owed his fortune to an opposing drive, which was the substitution for fallible human judgement of mechanical accuracy, excellence and repeatability through his development of machine-tools and so-called self-acting machines.[270] This contradiction is apparent in his *Autobiography.* For example, in one chapter he described 'a thriving colony of skilled mechanics'[271] .. 'all of them *handy* men'[272] in warm personal detail.[273] This was immediately followed by one devoted to the opposing virtues of machine-tools:

> These tools for the most part rendered us more independent of mere manual skill and dexterity, while at the same time they increased the accuracy and perfection of the work...At the same time they had the important effect of diminishing the cost of production, as was made sufficiently apparent by the balance-sheet prepared at the end of each year.[274]

This section is intended as an introduction to some of the issues contained by this contradiction.

Nasmyth's pride in his skills of 'eyes and fingers' has already been noted in Chapter III. This pride also extended to the skills of his '*handy* men', who, he at one point implied, were equal to himself and other captains of industry such as Brindley, Smeaton, Watt, Rennie,

[269] See the discussion at the end of the previous section.
[270] 'Self-acting' is the word applied at the period by Nasmyth and his contemporaries to machines whose sequence of movements were built in and self-regulating, as for example in the slide rest principle described in part 3 of this Chapter. As Nasmyth expressed it: 'the substitution of a mechanical contrivance in place of a human hand, for *holding, applying,* and *directing* the motions of a cutting tool to the surface of the work to be cut, by which we are enabled to constrain the tool to move along or across the surface of the object with... *absolute precision*'. (Nasmyth 1841:395) The intention was to do away with human judgement. The phrase is still used and understood by writers on engineering, for example Cantrell 1984:242.
[271] Nasmyth 1883:216.
[272] Nasmyth 1883: 226.
[273] This was Chapter XII in which workmen were singled out for praise by name.
[274] Nasmyth 1883:238.

Cubitt, and Fairbairn. They had all advanced from working as millwrights and instrument-makers;[275] exactly the the kind of men he advertised for and recruited for the Foundry, initially from amongst the 'skilled workmen in South Lancashire and Cheshire...in the neighboorhood of Manchester, which forms the centre of a population gifted with mechanical instinct.'[276] Nasmyth's high opinions of the hand skills in his workforce, given in the narrative of the opening of the Bridgewater Foundry around 1836[277] were gradually modified for a variety of reasons during the period in which he directed the Foundry before his retirement in 1857.[278]

It is notable, for example, that Nasmyth tended to displace his esteemed handy men with younger (and cheaper) workers:

> Besides selecting clever labourers, I made an extensive use of active handy boys to superintend the smaller class of self-acting tools. To do this required very little exertion of muscular force, but only observant attention. In this way the tool did all the working (for the thinking had before been embodied in it), and it turned out all manner of geometrical forms with the utmost correctness.[279]

Examples of these tools were detailed in the final chapter of Nasmyth's *Autobiography*, 'Inventions and Contrivances'. One example, from 1836 was *An Instrument for finding and marking the Centres of Cylindrical Rods or Bolts about to be turned on the Lathe.* This replaced the previous long and expensive trial-and-error method, which had relied on skill, experience, and judgement, with a 'simple instrument...the use of this enabled any boy to find and mark with absolute exactness and rapidity the centres of each end of bolts, or suchlike objects'.[280] Another machine from this chapter, for planing

[275] Nasmyth 1883:226.
[276] Nasmyth 1883: 214.
[277] Nasmyth 1883:205.
[278] Nasmyth 1883: 364-5.
[279] Nasmyth 1883:308.
[280] Nasmyth 1883:411-2.

small detailed parts of machinery (Nasmyth's Steam Arm), also from 1836, was described in very similar terms:

> (It) should enable any attentive lad to execute all the detail parts of machines in so unerring and perfect a manner as to not only rival the hand work of the most skilful mechanic, but also at such a reduced cost as to place the most active hand workman far into the background.[281]

It may be asked: what is remarkable in an industrialist putting into practice 'The Blessings of the Factory System'?[282] Nasmyth was highly self-aware and efficient in the industrialization of his business, using his own steam engines to drive his machine tools. These in turn produced heavier goods such as railway engines, steam hammers, etc. He was one of the earliest manufacturers to think of selling ready-made, not bespoke, machines, and one of the earliest 'pioneers of assembly-line production'.[283] Even at the time, the effects on the workforce of such changes were remarked on. As W. Cooke Taylor, in *Notes of a Tour in the Manufacturing Districts of Lancashire*, wrote in 1842: 'The manufacturing poulation is not new in its formation alone: it is new in its habits of thought and action'.[284] Nasmyth had chosen Manchester, one of the 'centres of commercial and manipulative energy', as the place where he might 'contrive to get on'.[285] This district of rapid change was also the focus for wider social concern and analysis which is relevant here because Nasmyth was developing in his workforce the kind of alienation that changes 'the external relation

[281] Nasmyth 1883:415.

[282] This refers to a section from Andrew Ure (1835) *Philosophy of Manufactures*: 1835:25-9. Andrew Ure (1778-1857) was a chemist and scientific populariser who began teaching at the Andersonian Institute after George Birkbeck left in 1804, where his lectures to working men were later observed by Baron Dupin (see Chapter II part 3 above). He was also one of the founders of the Glasgow Observatory. *DNB* 58: 40-1.

[283] Musson and Robinson 1979:494;495. As they note, in 1839 this was a spontaneous development before the wider influence of American ideas of standardization and assembly line production. Nasmyth's experience was later to be called on by the government Small Arms Committee of 1853 to evaluate the Colonel Colt's American system of small arms production. (Nasmyth 1883:362-363)

[284] Thompson 1963:209; Thompson's material also includes here the writings of Engels and Gaskell on the impact of industrialization in Lancashire in the 1840s. Asa Briggs in his *Victorian Cities* refers to Manchester as the 'shock city of the 1840s, attracting visitors from all countries'. (Briggs 1968:56)

[285] Nasmyth 1883:182.

of the worker to Nature and to himself'.[286] The former craft worker had produced an object, for example a nut and bolt, which clearly bore to him the traces of his mental processes and concepts based on his accumulated actions and experiments over time. This corresponds to the type praised by Nasmyth, no doubt because these were the skills he valued in himself. Paradoxically, Nasmyth used his own skills to develop machine tools, so despite the value that Nasmyth placed on skills of 'eyes and fingers', there is clear evidence therefore that he also valued their antithesis. One reason for that was given above; the 'balance-sheet'. Related to that was the issue of control and the importance of machine tools in replacing 'the costly and untrustworthy' workmen with their annoying observance of 'Saint Monday'.[287] Nasmyth's *Autobiography* contained various generalized references to troubles with trade unions, and a more detailed narrative of his struggle to break a strike in 1836. He described this as an opposition between 'Free Trade in Ability' and the 'indolent equality which Union men aim at...one of the greatest hindrances to industrial progress'.[288] In fact, there were several serious strikes at the Bridgewater Foundry: in November 1836, and again in 1851-2 when employers combined to crush the demands of the newly founded Amalgamated Society of Engineers.[289] This resulted in an increase of machines and unskilled workers in the Foundry. As Nasmyth told the Royal Commission on Trade Unions in 1868: 'instead of having the old proportion of one boy to four mechanics, I had four boys to one mechanic nearly'.[290] In relation to this study, it would be worth asking whether this a simple case of double standards. That is, did Nasmyth believe simply that he should maintain his 'craft skill' whilst thwarting others from doing so, or was this double standard

[286] Bottomore and Rubel 1963: 176-177; here quoting Karl Marx 'EPM (1844) MEGA I/3:91-92'.
[287] See the end of Chapter III, above.
[288] Nasmyth 1883:226.
[289] Cantrell 1984:240-2.
[290] Musson and Robinson 1979:506; more detailed information on labour relations at the Foundry is here also(Musson and Robinson 1979:505-7); Cantrell 1984:237-42.

more internalized? If Nasmyth was attempting to put into practice two incompatible beliefs about the value to be placed on hand- and eye-judgements, it could produce some unexpected results in his chosen means of representation.

Nasmyth approved of machine production not simply as a substitute for specific human skills, but furthermore as an improvement or enhancement. The machine was valued as a superhuman deputy engaged at a more truthful level with matter and physical forces. Nasmyth's Steam Arm, already noted above as being suitable for the 'superintendence of...intelligent lads' was seen as being far superior to them: 'any deficiency in their physical strength is amply compensated by these self-acting machines. The factory engine supplies the labour or the element of force, while the machines perform their work with practical perfection...geometrical accuracy'.[291] In relation to the railway expansion of the late 1830s Nasmyth pointed out: 'self-acting tools were now enabled to complete, with precision and uniformity, machines that before had been deemed almost impracticable.'[292] These examples suggest that machines were valued as an extension of will, that is, as the physical magnification of an interior impulse.

Machine tools embody highly abstract concepts in that they are designed to produce almost perfect attributes: for example, plane surfaces; accurate and minute divisions; spiral cuts, etc. Nasmyth's Steam Arm, as described in the preceding section, is one example of a planing machine which superceded the previous craft method of filing and testing against a standard plane surface.[293] Machine tools operate in actions of 'geometrical accuracy',[294] applied to materials, or in

[291] Nasmyth 1883:416.
[292] Nasmyth 1883:237.
[293] Nasmyth 1883: 148-9; Birkbeck 1827:7 'there are few problems of practical geometry more difficult than to form a straight-edge'. The standard plane surface had itself already been produced by a long process of filing and testing against two other plane surfaces in rotation, although this is described by writers such as Nasmyth and Birkbeck, it is plain that this was a long-established craft procedure.
[294] Nasmyth 1883:416.

Nasmyth's words: 'the various details of which the machine is composed, we shall find...consist of six primitive or elementary geometrical figures, namely, *the line, the plane, the circle, the cylinder, the cone,* and *the sphere'.*[295] Machine tools were used to mould raw materials on the basis of a systematic analysis of the separate simple actions required to build up a complex form. James Nasmyth was an active inventor of such tools.

James Nasmyth's training in London from 1830 with one of the most important innovators of machine tools of the early nineteenth century, Henry Maudslay, had a formative influence on Nasmyth, partly because of Maudslay's exacting accuracy but also because of his analytical approach to manufacture. As Nasmyth describes in his *Autobiography,* in place of the 'annoyance, delay, and cost, of this utter want of system'[296] of previous craft methods which had produced, for example, non-standard pairs of nuts and bolts,[297] Maudslay aimed to produce instead machines which would then be (in this particular example) 'the parent of a vast progeny of perfect screws'.[298] Nasmyth's first tasks at Maudslay's factory were to assist in refining screw-cutting machines[299] and to design a collar-nut cutting machine.[300] After Maudslay's death his successor Joshua Field helped Nasmyth set up his own business with a generous (and prescient) gesture: 'he kindly permitted me to obtain castings of one of the best turning-lathes in the workshops. I knew that when I had fitted it up it would become the parent of a vast progeny of descendants -not only in the direct line, but in planing machines, screw-cutting lathes, and

[295] Nasmyth 1841: 394.
[296] Nasmyth 1883:132.
[297] Nasmyth 1883: 131-2.
[298] Nasmyth 1883:140.
[299] Nasmyth 1883:139-41.
[300] Nasmyth 1883:145-6. The collar-nut cutting machine produced accurate hexagonal heads on nuts; replacing the laborious previous system of hand-filing and checking angles,etc. The machine designed by Nasmyth in this example produced the tiny nuts required for the model of the engine for *H.M.S. Dee* now in the Science Museum, London. (Rolt 1986:116)

many other minor tools'.[301] Nasmyth's expertise in designing and making machine tools can be seen not only through his own account in the *Autobiography*, but through the high regard accorded to him by his contemporaries.[302] The importance of this kind of mechanical reproduction in Nasmyth's work when set against his declared valuation of craft work does seem to suggest that he believed 'two incompatible things', as suggested at the end of the previous section. But even so, it could be asked, what do machine tools *per se* have to do with modes of drawing and visualization?

Many machine tools, such as Jesse Ramsden's graduating engine,[303] used to produce surveying and mapmaking equipment, have been intimately connected with technologies of observation and the resulting notation as drawings of those observations.[304] Without precision built in to these instruments, there could have been no accuracy of orientation, nor any subsequent detailed observation and representation. It seems noteworthy in this context also that these examples are directly relevant to landscape and astronomical imaging; both were of interest to James Nasmyth. And although Nasmyth's master Maudslay did not produce any astronomical instruments as such, he certainly worked on and further perfected one vital component of such observations, the micrometer.[305]

The reciprocal relationship between optical and measuring instruments and representation has been explored by writers in

[301] Nasmyth 1883:178.

[302] For example, Buchanan (1841) *Essays on Millwork* gives 21 of Nasmyth's machine tools as against 33 from all other makers put together. (Musson and Robinson 1969:498-9)

[303] Crone 1978:101; Ramsden's graduating engine 1763 made possible an improved theodolite for surveying. In that sense, it permitted observations not seen before, in that land could be more minutely mapped into a drawn representation of itself.

[304] Another product of Jesse Ramsden's engine was the five-foot diameter Meridian Circle for the Palermo Observatory of 1789, which enabled Piazzi to establish the places of 7646 stars in his 1814 star catalogue. (*DNB* 47: 265; Chapman 1990: 119)

[305] Chapman 1990: 40-45.

several disciplines.[306] The links between machine-tools, instruments of observation, and image reproduction can seem to become almost circular at times, because from the sixteenth century onwards, instrument-making was often combined with engraving.[307] Once again, Jesse Ramsden's career gives an example of this. From 1785, as an apprentice to a mathematical instrument maker, he gained 'such skill in engraving that the best artists employed him'.[308] Another example of this assembly of skills is that of John Drain, the machine-tool maker and engraver of Birmingham, who was visited by James Nasmyth on his 'walking tour' of 1830.[309] Nasmyth was particularly interested in seeing some small foot-turning lathes made by Drain after seeing examples of his workmanship in Edinburgh: 'he had some exquisitely-finished lathes completed and in hand for engraving the steel plates for printing bank notes. They were provided with the means of producing such intricate ornamental patterns as to defy the utmost skill of the forger.'[310] John Drain's skills as a machine-tool maker were addressed not to facilitating observational images, but to producing new forms in engraving. To close, it would be worth reiterating some of the qualities of machine tools in relation to modes of drawing which will be considered in this section:

1) machine tools were designed to apply abstract attributes to matter; the agents, if that is not too fanciful, of the Platonic Forms, allowing endless repetitions of each conception. In relation to drawing, machine tools performed in three dimensions actions that were very similar to the actions of ruler-and-compass geometrical drawing. 2) The marks, or the forms, produced in this way were of value because they were

[306] See for example Chapman 1988:11; Alpers 1983:125-45; and Hambly 1988:11.
[307] In a brief survey of this topic, Hambly notes this link from as early as the sixteenth century with Humphrey Cole(1560-1591) who worked as an instrument maker, die sinker, engraver, etc. (Hambly 1988: 23)
[308] *DNB* 47: 265.
[309] Described above in Chapter II part1; Nasmyth 1883:153-71.
[310] Nasmyth 1883:168.

similar, not different. 3) They were intended to produce as many identical multiples as possible. Eli Whitney in America used the language of image reproduction in describing the basis of his projected mechanized arms factory in 1798: 'to make the same parts of different guns, as the locks, for example, as much like each other as the successive impressions of a copper-plate engraving'.[311] The infinite production of 'legitimate descendants'[312] was not only part of the nature of such tools, however. In pragmatic terms, also, infinite production was necessary because in terms of investment, the expense of a machine tool could only be justified through increasing productivity.[313] In relation to handwork, machines were valued as an enhancement, an improvement, or even as a substitute for the skills of 'eyes and fingers'. By definition, machines were intended to produce an infinite, or at least indefinite, number of products. Applied to drawing, this could mean that the differences between drawing and reproduction could start to evaporate, especially in a medium where the image was formed directly on the matrix. 4) Machine tools allowed the observation and recording of the visual qualities of the material world at an unprecedented level of detail, while encouraging a systematic and analytical approach to the making, recording and disseminating of such observations through images. 5) And finally, to return to the first point, machine tools provided the means of shaping, controlling and exploiting materials. For this, rather than the earlier *ad hoc* methods described in Chapter II, the design and detailing of such machines began at this period to be worked out in geometrical drawings, as urged by Charles Babbage in *On the Economy of Machinery and Manufactures* of 1835:

> all the contrivance... ought first to be represented in the drawings... It can never be too strongly impressed upon the

[311] Quoted in Rolt 1986:150.
[312] Nasmyth 1883:179.
[313] Rolt 1986:46; he points out that the development of machine tools in heavy industry (in Nasmyth's manner) only became economically feasible with cheap, available, transport such as canals or railways.

> minds of those who are devising new machines that to make the most perfect drawings of every part tends essentially both to the success of the trial and to the economy of the result.[314]

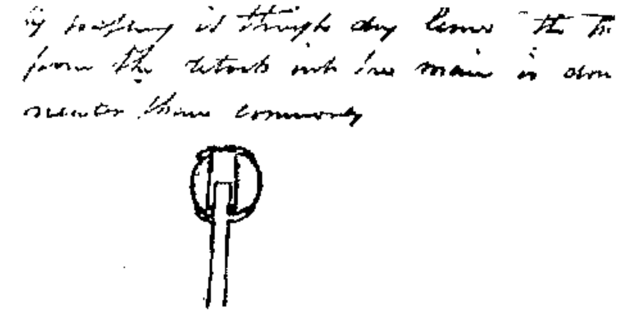
Babbage's advice also covered another quality of drawing in relation to machine tools which has so far only been implied. That is the growing corporate or impersonal nature of the production of drawings during this period when manufacturers began to establish drawing offices in their companies, and thereby form a demand for draughtsmen.

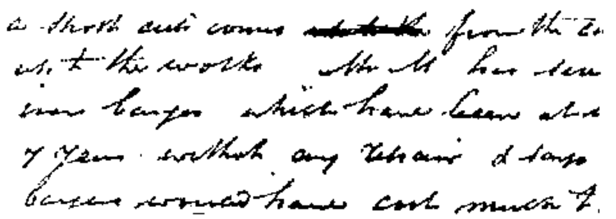
> The arts of contriving, of drawing, and executing, do not usually reside in their greatest perfection in one individual... employ a respectable draughtsman; who if he has had a large experience in his profession, will assist in finding out if the contrivance is new.[315]

Within the limits of this dissertation, this will be considered further in the discussion of the Nasmyth & Gaskell technical drawings in part 3 of this chapter.

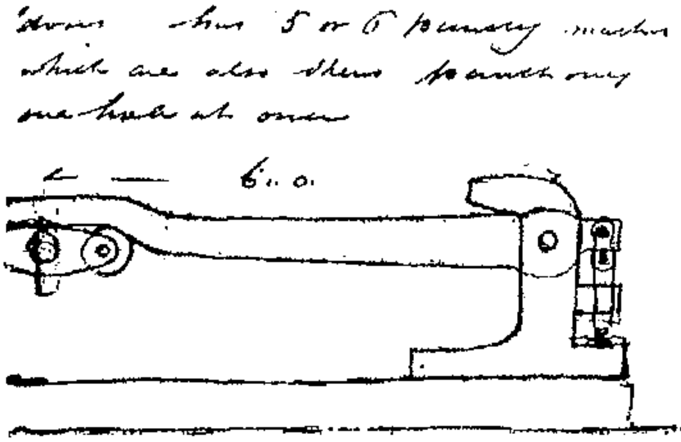
[314] Babbage 1835:262.
[315] Babbage 1835:266.

saw the plate iron roof made for the Birmingham Theatre but not put up in consequence of some accident happening while it was putting together, by which several men were kiled. It is neither very judiciously or very neatly made but





would have answered the purpose. He is making a large gasometer & cistern several land boilers and one small boat boiler. He has a good deal of room, but



works mostly out of doors,—has 5 or 6 puncing machines which are also shears, punch only one hole at once

Figure 34: Joshua Field,1821, annotated facsimile sketchbook page (Hall 1925-6:26).

Chapter IV: 2: Technical drawings and Nasmyth's scheme book

Chapters II and III made use of Nasmyth material either from Scottish collections or from the *Autobiography*, which arguably has a certain character and coherence as a whole group.[316] The remainder of this chapter is mainly concerned with another collection of drawings held in the Institute of Mechanical Engineers in London, comprising a group of technical drawings from Nasmyth's Bridgewater Foundry, Nasmyth's 'scheme book' mentioned in the *Autobiography*, and some other drawings and letters.[317] This group forms an interesting counterpoint to the material already discussed. As the scheme book was used as a record of first ideas, it will be considered first.

1: Nasmyth's Scheme Book

Nasmyth gives credit to Joshua Field for suggesting to him that he should begin to use a scheme book at some point during his period at Maudslay, Son & Field's works in 1830-1831:

> I found Mr. Field to be a most systematic man in all business affairs. I may especially name one of his arrangements which I was quick to take up and appreciate. I carried it out with great advantage in my after life. It was, to record subjects of conversation by means of graphic drawings. Almost daily, persons of note came to consult with him about machinery. On these occasions the consultations took place either with reference to proposed new work, or as to progress of orders then in hand. Occasionally, some novel scheme of applying power was under discussion, or some new method of employing mechanism. On ordinary occasions rough and rapid sketches are made on any stray pieces of waste paper that are about, and after the conversation is over the papers are swept away into the waste basket and destroyed. And yet some of these rapid drawings involve matters of great interest and importance for after-consultations. To avoid such losses, Mr. Field had always

[316] See Chapter I, part 2 for a discussion of sources.

[317] I.Mech.E.: the Nasmyth Company drawings (in END 14) Scheme book IMS 98 and letters IMS 99 and 100 were made available with the very helpful cooperation of the Mr. Keith Moore the Senior Librarian and Archivist. All this Nasmyth material was donated by Sir Holberry Mensforth (1871-1951) on Nov. 20 1940.

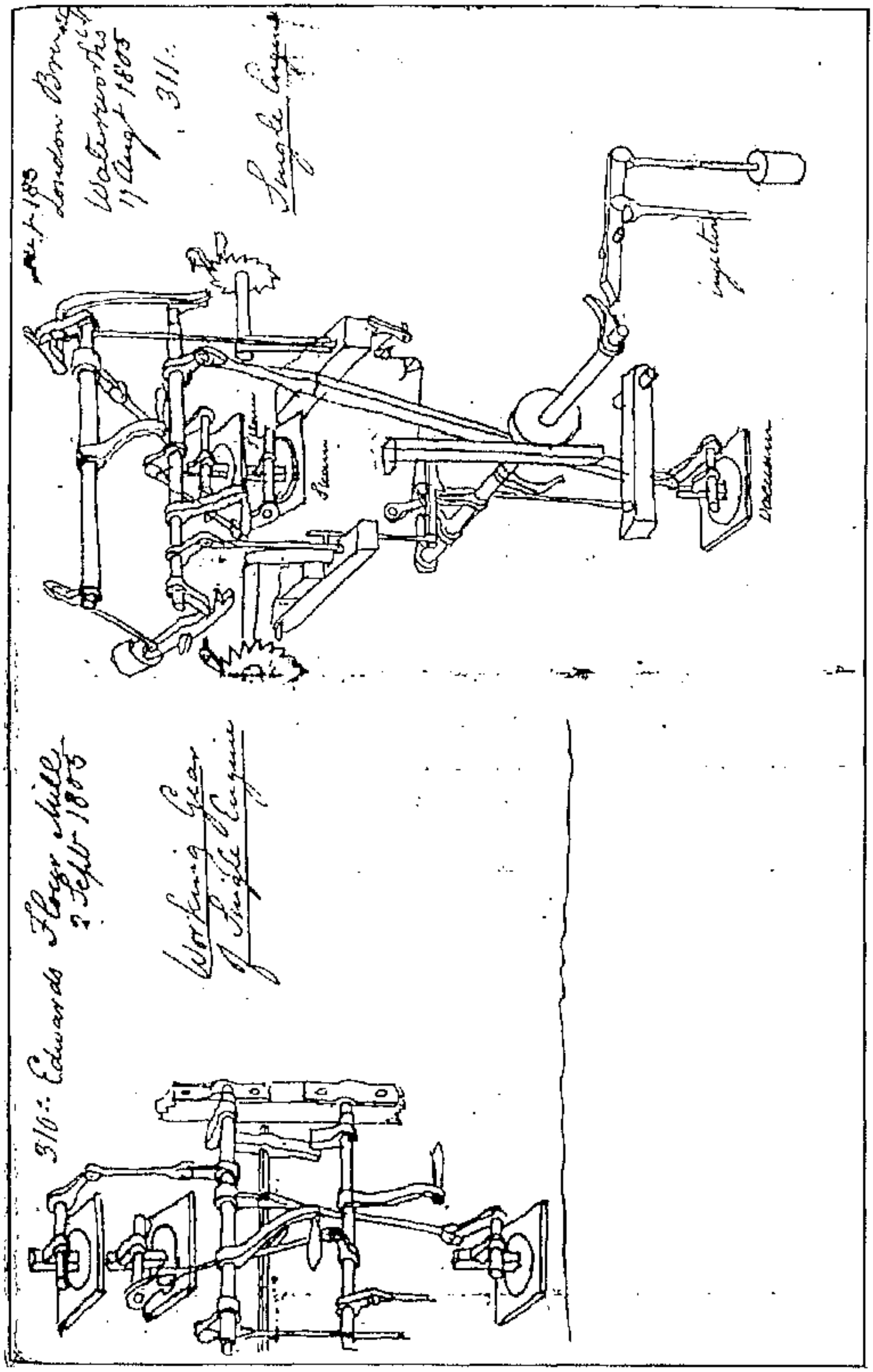


Figure 35: John Farey, sketchbook page, 1805 (Woolrich 1998: 51).

> placed upon his table a 'talking book' or 'graphic diary'. When his visitors called and entered into conversation with him about mechanical matters, he made rapid sketches on the successive pages of the book, and entered the brief particulars and date of the conversation, together with the name and address of the visitor...[318]

Joshua Field (1787-1863) had been an Admiralty draughtman as a young man. Two of his notebooks have been preserved and were handsomely reproduced in the *Newcomen Society Transactions* in the early twentieth century.[319] However, these notebooks are not the 'talking books' described by Nasmyth, but are instead diaries of visits to other works; Figure 34 is an example. These kinds of sketchbooks were extremely common and were kept by almost every engineer or engineering draughtsman during their training and later working life. Figure 35 is an example of one of John Farey's very early observational drawings from the same period, but sketchbooks like these can be seen as a continuation of the notebooks and apprentice books kept from mediaeval times.[320] Field's sketching was a rapid, diagrammatic representation, whereas the drawings by Farey reproduced here were closer to the mode of pictorial representation current since the publication of the Diderot-d'Alembert *Encyclopedie* in the late eighteenth century.[321] This had become the current mode by the early nineteenth century and was the most common style of drawing at this time, described by Booker as 'craftsman level' pictures, or 'true shape' views.[322] From this point onwards these will be referred to as 'pictorial views'; a good example of this style of drawing is that of Blunt's *An Essay on Mechanical Drawing* of 1811.[323]

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[318] Nasmyth 1883:177-8.
[319] See also Bibliography: Hall 1925-6:1-41; Smith 1932-3:15-20.
[320] Well-known examples include *The Sketchbook of Villard de Honnecourt* (c.1225-50) reproduced in full and edited by Theodore Bowie (1959); also Leonardo da Vinci's 'exploded views' of machinery from the *Codex Atlanticus*. (Booker 1979:29)
[321] Baynes and Pugh 1981:99.
[322] Booker 1979:128-130.
[323] See Chapter II part 3 above.

Nasmyth's scheme book, then, is related to these working notebooks, but is different in that it may contain records of evolving thought in drawing, in addition to notes of existing configurations. This difference makes it unusual within the holdings of the Institute of Mechanical Engineers, which is surprising, because it has material from other engineers who trained at Maudslay, Son & Field from this period, such as Whitworth.[324] It contains several modes of drawing, and different methods of mark-making which seem to show change and development over time:

The scheme book has been conserved and bound in hard covers. It is surprisingly large at 494x331mm; not a convenient size for carrying around. There are 131 leaves which have been labelled on the top right recto corner in numbered sequence from 1-131, preceded by two unnumbered pages on which are mounted photographic reproductions. The first is a photograph of the Steam Hammer with James Nasmyth;[325] the second is apparently a photographic contact print copy of the famous Steam Hammer drawing which was reproduced as a wood-engraving in the *Autobiography* as 'a page in my Scheme Book',[326] and was captioned *First Drawing of Steam Hammer, 24th. Nov. 1839.* This has been reproduced above as Figure 25 (from that wood-engraving).[327] The original drawing is not in the scheme book, or anywhere else known. The photographic reproduction has a caption written next to it: 'cut out of my scheme book June 24 1845'.

This immediately raises some questions, not least: where exactly was the original cut from? This photographic reproduction is in portrait format, and it was very accurately reproduced in the *Autobiography*

[324] Verbal communication from the Archivist, I.Mech.E.
[325] John Dancer: *James Nasmyth with a Steam Hammer* 29 August 1855.
[326] Nasmyth 1883:240.
[327] Chapter II part 3 above.

(as a wood engraving) where its dimensions were 12x9 cm.[328] This suggests that the steam hammer sketch would have been placed vertically in the normal scheme book orientation. However, there are no whole pages apparently missing within the page numbering, nor do any whole pages appear to have been cut away. There is a half page missing, the lower portion of page 34, but this is the wrong shape, unless the steam hammer drawings were produced in retrospect, as the page could have been rotated (possibly) to get in this drawing. In addition, it is on a tighter and smaller scale than the other scheme book drawings, (assuming that the photographic reproduction is a contact print from the original) which also suggests a retrospective production. The excised portion is from a section of the book with dates around 1844 -for example, the remaining half of the missing page is dated 18 June 1844 with the phrases: 'improve principle of propellers' and 'Earl of Dundonald'. The dated page preceding this is Page 32 'Sept 1. 1842' and after this is Page 37 '8 Nov. 1844'.[329] This suggests that the steam hammer drawing may have been either: 1) produced retrospectively, possibly on this cut page; 2) was drawn on a page that was completely effaced before the scheme book was numbered; or 3) was drawn separately on a loose sheet, then photographically reproduced and attributed to the scheme book. It seems possible that the first suggestion is the correct one, for the following reasons:

1) The dates of the surrounding pages and the note: 'cut out of my scheme book June 24 1845' accompanying the photographic copy not only agree with each other, but 2) also agree with the appearance and date of some Nasmyth photographic material in the National Library of Scotland sketchbooks.[330] (Nasmyth took up photography in the early 1840s and used it not only to take conventional photographs but

[328] Nasmyth 1883:240.

[329] All the pages have been numbered in sequence, but the appearance of dates had become more random and sporadic by page

[330] See for example NLS MS 3242 no.152. (c. 1849); NLS Ms 3242 nos.187, 188, 188A.

also experimented with the medium as a method of copying.) In relation to the scheme book, the dating, 1839, and provenance of the original steam hammer drawing is therefore dependent simply upon Nasmyth's assertion in the *Autobiography* caption. A later dating would be in accordance with the more complex gestation of the steam hammer uncovered by Cantrell.[331] This differs from Nasmyth's own account of inventing the steam hammer in 'little more than half an hour', including 'the whole contrivance with all its executant details' on the 24th November 1839.[332] This difficulty of dating and placing a scheme book entry before addressing the scheme book pages themselves helps to illustrate some of the questions the book raises.

The first entry (on the reverse of Page 1) was dated: '27 Sept. 1838'. The final dated entry is on the reverse of Page 128: 'Mr. Bagley Aug. 18. 53'; however, this follows a more chaotic run of pages, some of which are blank, some slightly later, (the latest date given is 'Oct. 31. 1856' on Page 72) and some a lot earlier (for example Page 66: 'Nov. 27.1839, and Page 68: 'Oct 24. 1839'). The first part is generally more orderly and neat, with entries following a roughly chronological order, although entries may be tucked in to blank spaces (for example, Page 16 begins: '19 August 1839', continues '10 August 1839' and on the reverse has: '23 March 1839'). After around Page 60 ('Sept 11.1851') this orderly sequence breaks down as described, and Page 94 onwards is almost blank, apart from occasional entries and pasted-in loose-leaf additions. Not all the entries were dated, nor do they all appear to be the record of a meeting with a named person (although there are 36 entries which seem to fit clearly into this category). As with the steam hammer image, there are some discrepancies of dating in comparison

[331] Cantrell 1984:138-53; there was a dispute between Nasmyth and the le Creuzot ironworks around 1841-3 over priority of invention. In addition, the first idea and patent (only applied for in 1842) were still very general. The detailed operating mechanisms of the valves which gave the famed subtlety of use were only solved by Robert Wilson in April 1843, which allowed commercial manufacture to go ahead. (Cantrell 1984:150-3)
[332] Nasmyth 1883:240.

to other sources. For example, there seem to be references to Arab names which are already familiar from the *Autobiography*, but with a different dating. The *Autobiography* discusses various men from Egypt who trained and worked on various Nasmyth projects in connection with the period of the steam pile-driver production for the Naval Dockyards around 1845.[333] The scheme book has entries on Page 4: '24 Oct. 1838 H.E. Edem Bey' and on Page 7: 'lesson to Iffiffic (Lula?) Dec. 15.38'. If these references do refer to the same people, it implies that the dates in both sources have to be treated with some caution.[334] Other Nasmyth sketchbooks, for example the group in the National Library of Scotland, appear to have been dated to some extent retrospectively.[335] It seems that Nasmyth at some later stages of his life was in the habit of ordering and annotating earlier sketchbooks to form a narrative.

The dating of the scheme book runs from late September 1838, to October 1856. Nasmyth's full description of Joshua Field's 'talking books' makes them sound extremely copious and systematic, almost analogous to a laboratory notebook. Nasmyth's own scheme book is not like this, and interestingly enough it does not begin until some years after Nasmyth had begun his second Manchester business, the Bridgewater Foundry, in 1836, that is not until five years after his reported conversation with Joshua Field. It is possible that there is another lost scheme book from these earlier years, but the nature of the existing scheme book suggests this is not so. In stylistic terms, there is a clear development through the book with careful and timid entries on the opening pages, leading on to careful drawings with

[333] Nasmyth 1883:282-4.

[334] Cantrell (1984: 80) also puts Nasmyth's first links with 'Edhem (sic) Bey, Egyptian Artillery General' to 1839 which agrees with the Scheme Book, but not the Autobiography.

[335] See discussion of sources, Chapter I which covers not only the NLS sketchbooks, but also the sketchbook of his father Alexander Nasmyth, now in the National Gallery of Scotland D.3727, which has been fairly thoroughly annotated and dated retrospectively, apparently by James Nasmyth during the 1870s.

ruler, compass, and fine pen and pencil lines, giving way to much more free and expressive drawing with thick, modulated pen and pencil marks. The first entry, on the verso of Page 1, is not only timidly drawn, in careful (although freehand) light pencil lines, but appears to be a copy of existing machinery: '27 Sept. 1838 Fouquet's Slide Rest', with one part slightly more accentuated and the legend: 'attend to this'. Another alternative form of machinery is below on the same page : '19 Sept. 1838 Horsley Slide Rest' which is drawn with thin unmodulated black pen lines over a pencil underdrawing, in a similarly careful but freehand manner. The style then moves through an increasingly confident use of fine pencil, thin black pen, both freehand and with the use of ruler and compass, to the emergence of a coarser, more scribbling and energetic pencil freehand (Page 8: '18 Jan. 1839') which is supplemented by a thick, spluttering sepia pen, again used freehand, later that year (Page 13: '10 April 1839'). The earlier, more careful modes are still used also, apart from a few frenzied pages (24-6) which are undated but seem to fall between April 1840 and November 1841 and are covered with the most forceful and free tangle of coarse pencil and thick sepia ink scribbles, diagrams, figures, and lists of outstanding work.[336] There are examples of some of these styles given later in this section in Figures 38-40. The section after this, from Pages 27-60, seems to follow a steady and purposeful sequence from November 1841-September 1851, but the entries after that become more and more broken up as described above, with the pages finally becoming largely blank after Page 94. On the basis of this development of style and the gradual breakdown of entries, it is suggested that this is Nasmyth's only book of this nature, and that it was begun well after the conversation with Field given at the head of this section.

[336] This pattern in the sketchbook seems to be linked with the progress of Nasmyth's business; there was an influx of capital in 1838 from two large backers, (Cantrell 1984:23) which led to 'an important period of expansion and establishment' in 1839-42 (Cantrell 1984:197).

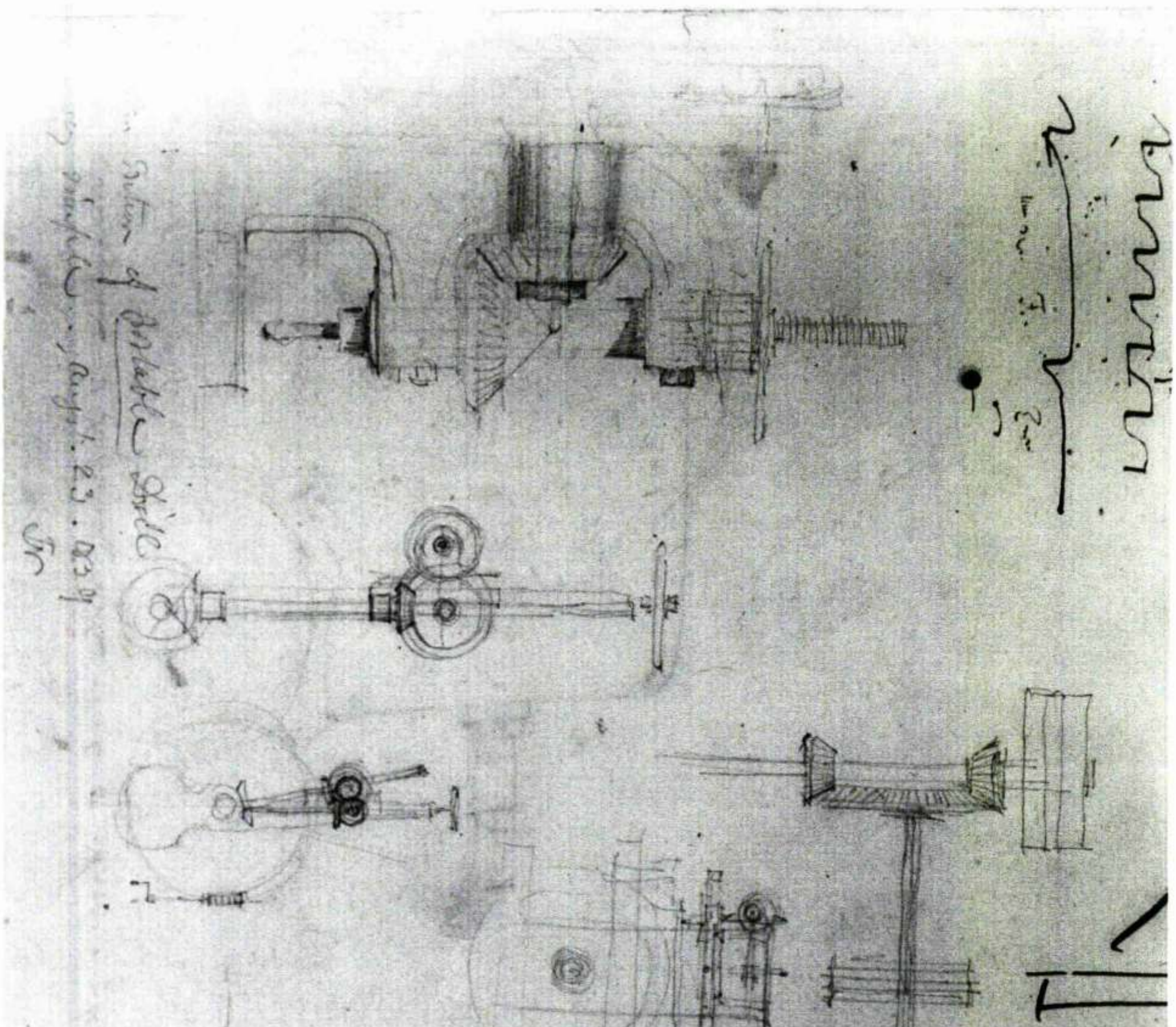


Figure 36: James Nasmyth. Scheme book, Page 19 (I.Mech.E. IMS 98).

All the entries are line drawings, apart from one entry on the right-hand side of the recto of page 15 '12 June 1839 New shut-off valve'. This is an exact-looking technical drawing done with pen, ruler, compass, ink and filled in with blue and black washes, in a style similar to the technical drawings discussed below. Interestingly, this rather severe diagram is offset by two superimposed freehand pencil drawings on the left-hand side of the page: the first is a diagram of the pipe system into which the shut-off valve is to be inserted, and the second is what appears to be an ideal productive landscape[337] with a deep river gorge plied by boats, spanned by an 'iron bridge' and backed by imposing mountain peaks.[338] This river view is one of the few 'pictorial views' in the notebook. Most drawings in the scheme book are conceptual or diagrammatic representations of machinery, with details, given a flat, frontal, or sectional treatment. The few other perspectival 'pictorial views' are of machinery: on Page 44 there is a very sketchy blocked-in representation of a machine which resembles a pulley-block shaping machine -'7 Aug.1851'; on Page 3 '17 Oct. 1838 Foreign Railway Station'; and on Page 7 a picturesque juxtaposition of (on the left) an elevation view of a boring mill done with pencil, compass, and ruler in fine pencil, and on the right a freehand but detailed perspectival representation of two men working on the same imposing structure with additional thumbnail sketches of poses and legs in gaiters. The remaining examples of pictorial perspective are more analogous to schoolboy doodles; on Page 23: '12 April 1841' these are scattered around the edge of a 'scheme for shaft and axle

[337] That is, according to Nasmyth's conception. There are two small sketch drawings in the John Murray archive (uncatalogued) which seem to show some youthful Nasmyth daydreams: 1) *Ideal* (1823) pencil 11x13.6 cm. shows a picturesque industrial scene with a crowded townscape filled with many jostling architectural styles, mainly mediaeval and vernacular, with smoking small factory chimneys and a sweep of canal plied by sailboats. *Gay Leith Quarry Engine* (1821) pencil 11x14.6cm. shows a small factory with busily smoking chimney perched over a tree-lined pond on a rocky outcrop.

[338] There is an anonymous drawing of Ironbridge Gorge in the Elton Collection, Ironbridge Gorge Museum Trust which shows a very similar landscape scene, dated 1789, reproduced as Figure 18 in Briggs 1979:51.

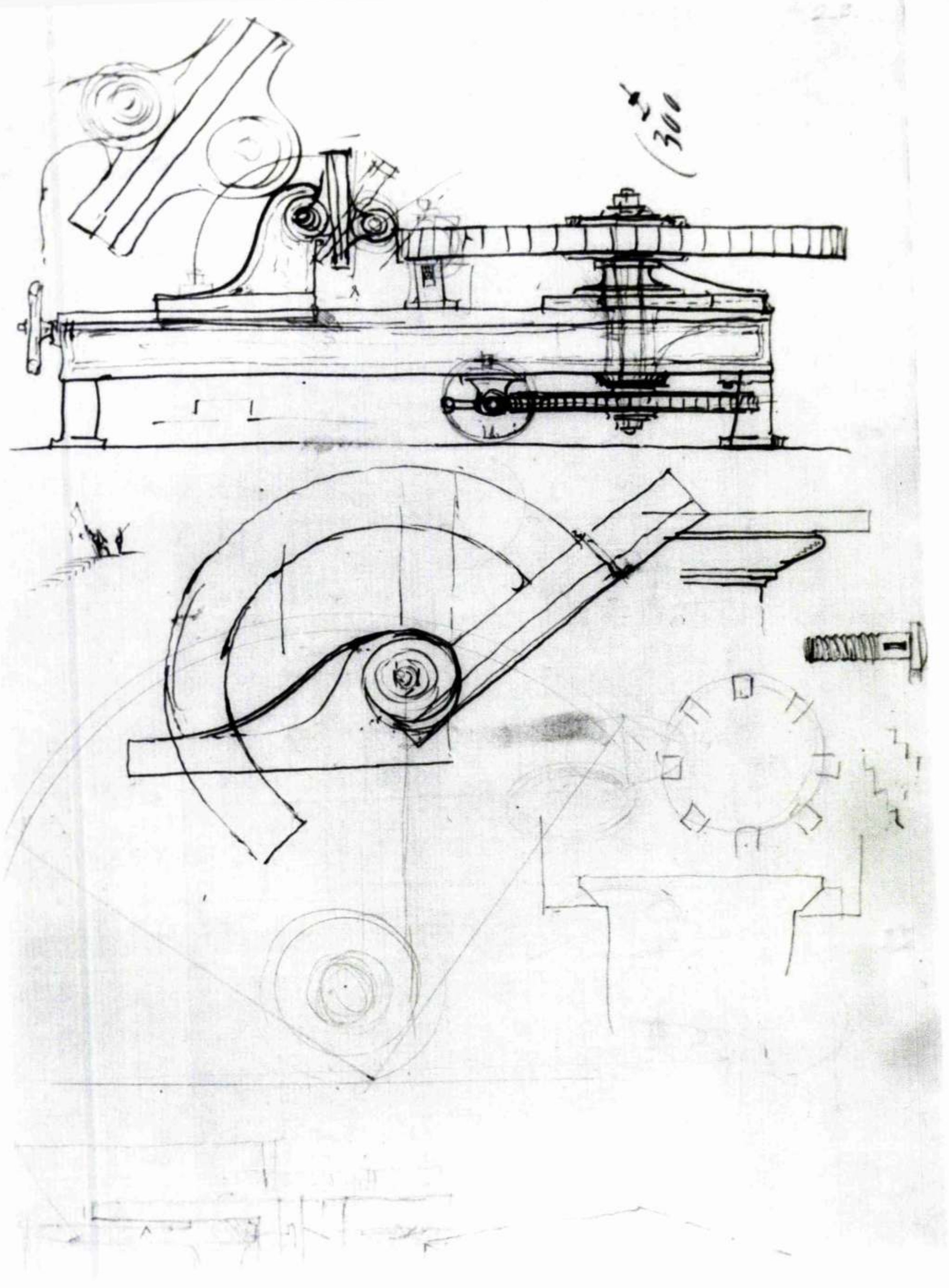


Figure 37: James Nasmyth, Scheme book, Page 28(I.Mech.E. IMS 98).

grooving machine for great Western Railway' as some ellipse-practice drawings of structures such as cannon mouths and millwheels, seen obliquely. It is interesting that the grooving machine drawing was done freely and forcefully in pen and ink, whereas the ellipses were more tentatively drawn in pencil, and seem to be repeated attempts to form the perfect shape in one stroke.

In addition to the majority of 'non-pictorial' line drawings there are various marginal thumb-nail sketches and other kinds of memoranda. for example, there are occasional tracings and imprints of actual objects such as on Page 5: 'Mr. Thomas Tyzack's tooth from soft wood 3 Nov. 1838' which is the tracing from a template of a circular saw. These short extracts show that the scheme book is potentially a very rich source which would repay detailed referencing against the mass of other Nasmyth material. In this current section, three illustrations will be discussed:

Figure 36 is the lower half of Page 19: '23 August 1839 new system of portable drill very simple'. This is in a careful freehand pencil style and shows various frontal elevation and plan views of the new machinery with some parts more accentuated than others. The sketch on the left has some applied shadow to give an impression of volume. This careful drawing, however, shares a page with a much more forceful pen drawing: 'Mr. Dugdale Dec. 16 1839' which seems to be the record of a meeting (some of these pen lines can seen at the top of the figure).

Figure 37 is the upper half of Page 28; it has no caption but seems to be part of a sequence running from early to late November, 1841. This is an interesting record of the visual working-out of the details of a cutting machine. The heavy, modulated pen line is used to repeat and

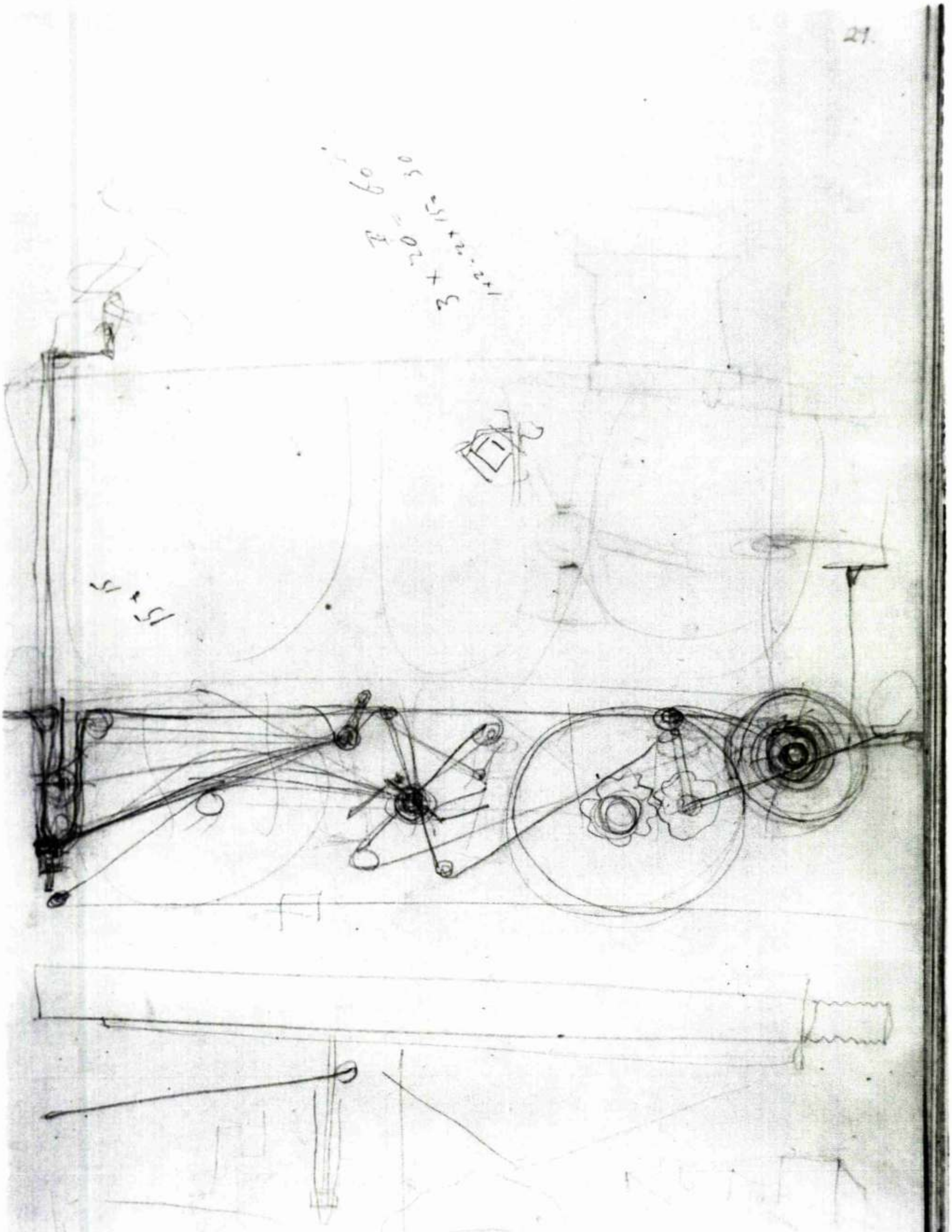


Figure 38: James Nasmyth, Scheme book, Page 29(I.Mech.E. IMS 98).

vary the rotating detail being worked on, supplemented by the pencil, ruler and compass outline, and this insignificant-looking pencil detail gives an important clue to the nature of the drawing both here in the scheme book and in the accompanying technical drawings.[339] It shows one of the links used to marry together these very flat two-dimensional technical drawings with the three-dimensional machinery and abstract forces depicted. These simple geometrical operations - line extension and rotation -are the basis for the new conventions of drawing being developed in the many, and expanding, drawing offices of the period. Another small detail is that of the two tiny figures at a summit, gesturing with pride to the gargantuan completed machine above them.[340] This drawing is a good example of 'design-by-drawing'[341] in which Nasmyth is using the drawing to: 1) 'plot trajectories of moving parts',[342] and 2) 'storing tentative decisions concerning one part while another part is being attended to'.[343]

Figure 38 is the upper part of Page 29: '25 Nov. 1841' and is a locomotive drawing, where Nasmyth was thinking about the movement of load-bearing wheels along the sectioned track. The free pencil drawing here is supplemented by another page (Page 30 -not shown) where the problem, repetitive strain on couplings, was visualised through reiteration, both across the page, and then on down the page, of drawings of railway tracks in sections with many groups of wheels passing over. In these drawings, Nasmyth seemed to be using repetition of gesture not simply as a way of plotting trajectories, but rather as an attempt to absorb or embody the concept of

339 The technical drawings are discussed in the section immediately following this, where these conceptual issues will be expanded.
340 These are not, as might be expected, indications of the scale of the machine, but of the scale of achievement.
341 Jones 1970:20-35; this is described as a way of 1) splitting up the production work, and 2) looking at the design as a whole without having to make it, very much in the manner outlined by Babbage 1835:261-6.
342 Jones 1970:22.
343 Jones 1970:28.

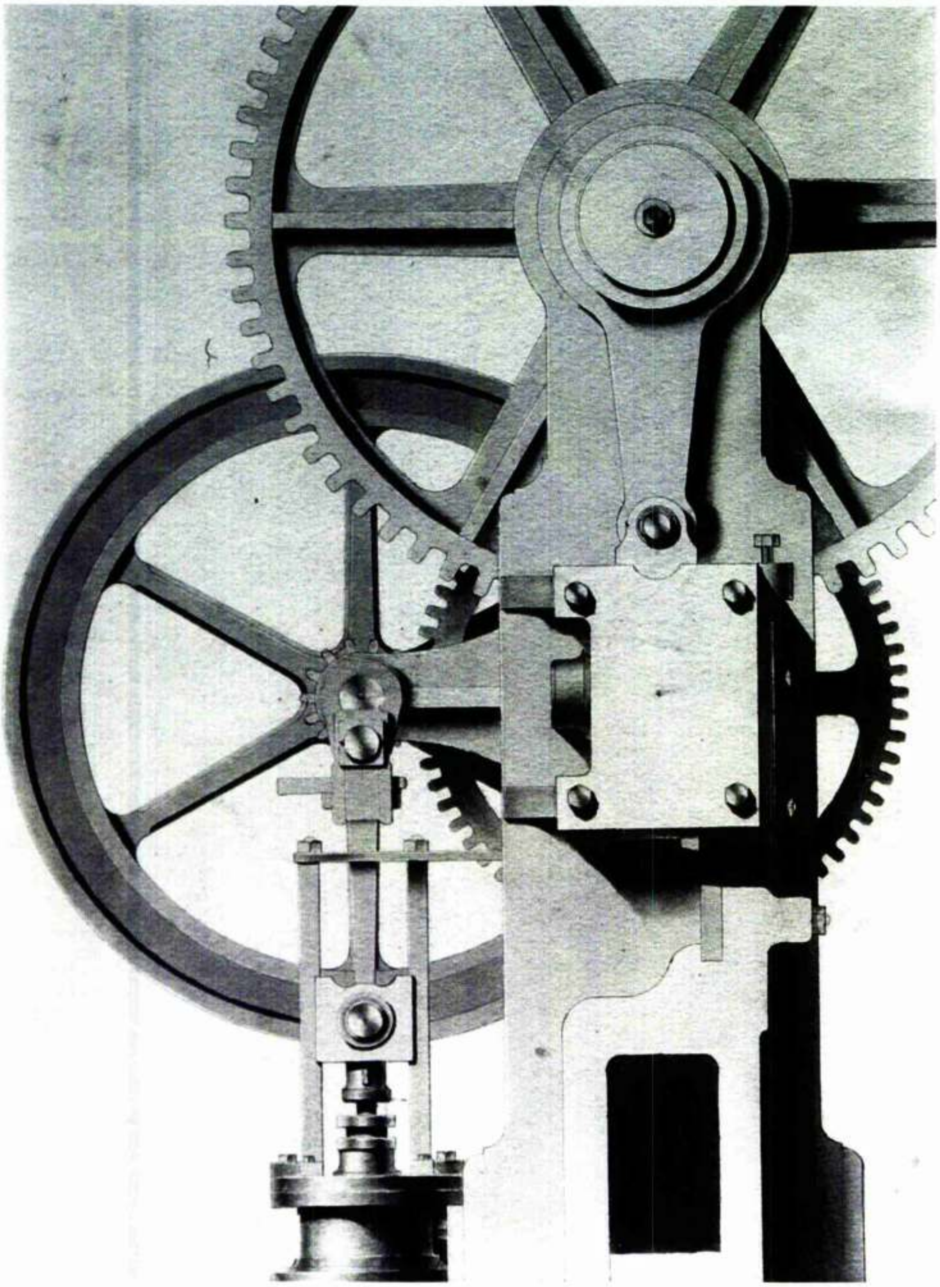


Figure 39: James Nasmyth detail of END 14/7/6 (I.Mech.E.): a large toothed gear wheel still shows the remnants of the simple operations used to build up more complex curved outlines.

repetition; to 'play it out', as it were. This constant drive to nail abstractions and give them some physical, indeed intimate, bodily expression, has already been discussed in relation to Nasmyth's treatment of the volcanic Moon landscape. Another related example is his commissioning 'a piece of white calico on which I had got printed *one million spots*. This was for the purpose of exhibiting one million in visible form'.[344]

The flat, frontal representation as used in Figure 36 is very close to the style of the technical drawings discussed in the section below, where the lack of pictorial perspective seems to give a very stiff and literally airless feel to this mode. However, the freer, gestural drawing of Figures 37 and 38 suggests some of the conceptual force behind this style. Both these drawings adhere to the same frontal mode of representation, which was then used as an anchor to play and re-play the relationships of imagined three-dimensional parts in motion. This aspect of technical drawing will be one of the issues discussed at greater length below.

This discussion of James Nasmyth's scheme book has been brief, necessarily, in the context of this study. It has been used as evidence that the *Autobiography*, despite being used as a single, straightforward source in Art history, has certain drawbacks.[345] In addition, this section has served as an introduction to the more extended discussion of some aspects of technical drawing of this period which now follows.

[344] Nasmyth 1883:388-9.

[345] See also the discussion of sources, Chapter I, part 2.

Chapter IV: 3: Roll 52: Technical drawings of Nasmyth, Gaskell and Company

This section is concerned with the group of 81 drawings given to the Institute of Mechanical Engineers in 1940.[346] The majority were on one roll (no. 52) and are drawings of machines produced at the Bridgewater Foundry with dated items ranging from 1841 to 1862. Most are finished drawings in ink and watercolour in paper, with a few drawings in pencil, and depict plan, side elevation, and section views of machines or their details. There are some drawings by Nasmyth himself, with the remainder being produced by the drawing office staff, some of whose names appear on the drawings, for example, J.F. Burgess, 4 May 1849 or E. Barlow, 1 July 1848, amongst others.[347]

Some general aspects of technical drawing have been discussed in Chapter II above. That chapter focussed on two kinds of drawing: 1) theoretical, or geometrical drawing, as advocated by Monge or Farish, and 2) technical illustration, as epitomised by Farey's work. Other uses of drawings include: 3) designers' conceptual drawings (as in Nasmyth's scheme book), 4) presentation drawings (these are very well-finished drawings used as publicity to enhance the company image and increase sales), and finally, 5) production drawings. Roll 52 contains both production drawings and presentation drawings, and both are a characteristic product of large industrial enterprises. The need for those drawings grew out of the division of labour and the need to control and co-ordinate work at a distance, initially within the works, and later on both with sub-contractors and for on-site installation. Some of the first engineering drawings of this type were

346 I.Mech.E. END 14. Part of the material donated by Mensforth in 1940 (see part 1 above).
347 There is a block of about 10 names before 1850, and a replacement block of 9 new names after that date.

produced by James Watt (1736-1819) and illustrate this development very well. Before 1781, Watt produced any necessary drawings himself, although many details would be finalized during construction, without drawings; between 1781 and 1790 he had one assistant, John Southern; after this date Boulton and Watt had an established drawing office.[348] The moves to standardization through machine-tools described in the introduction to this chapter, and the accompanying de-skilling of engineering workers, led to a corresponding increase in master-drawings as the central record of an engineering concern. These drawings on heavy paper would have been be pasted onto a linen roll (as in Roll 52) and stored, with tracings being taken off as required. Starting from around the period of James Watt, engineering drawings acquired a distinctive style of their own, with their own conventions, drawing tools, and mediums; these techniques were not simply an aesthetic convention, but provided a means 'to create and organize the man-made world in unprecedented and Promethean ways'.[349] This may seem a grandiose claim; that a two-dimensional drawing could shape the three-dimensional external world. This section will aim to demonstrate how the characteristic drawing tools, marks, and representational conventions were used toward that end.

Technical drawing expanded in the nineteenth century through the demand of enterprises such as the Ordnance Survey, and the development of railways.[350] Drawings were produced in newly-established drawing offices, so that by 1859 draughtsmen were

[348] Baynes and Pugh 1981: 63.
[349] Baynes and Pugh 1981:6.
[350] Hambly 1988:14

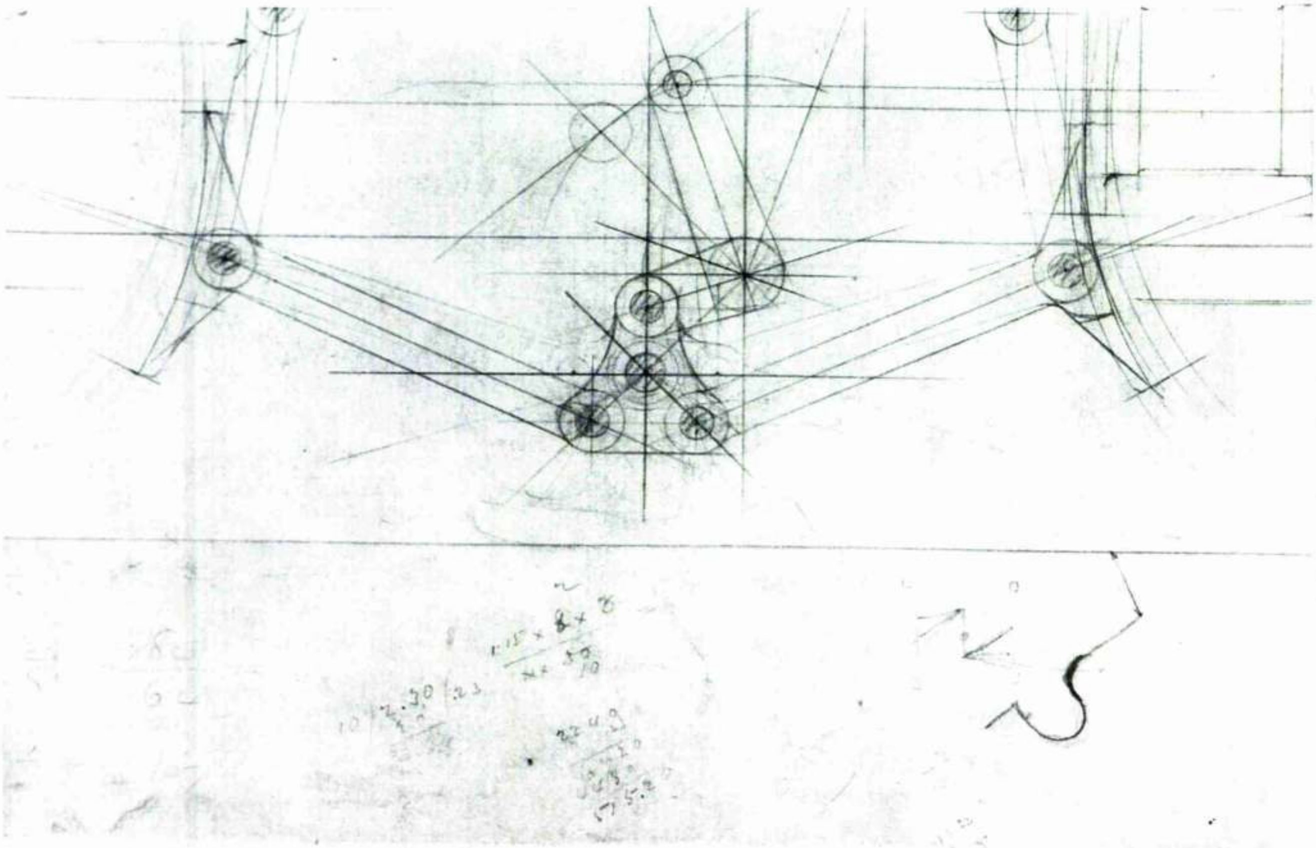


Figure 40: Workshop of Nasmyth &Gaskell, detail of END 14/7/1 (I.Mech.E.): preliminary design drawing of an automatic speed regulator.

recognized as a separate group of workers,[351] such as the 'Lads'[352] who produced most of Roll 52. Unlike the relatively sophisticated tools used to produce the aggressive neatness and accuracy of technical illustrations, such as the elliptograph and centrolinead,[353] drawing office tools were much simpler, comprising drawing-board and T-squares; compasses and straight edge. Of these, the oldest elements, compass and ruler (that is, straight edge) were the most reliable.[354] All the drawings in Roll 52 can be seen to have been constructed simply with these two instruments and it will be argued that this is not just a case of 'needs must', but because of the technical and conceptual roles of these instruments as the mediums of exchange between two- and three-dimensional structures.

The use of compass and ruler to construct the drawings can be seen in the traces of guidelines and pinpricks left in drawings such as that shown in Figure 39 where a large toothed gear wheel still shows the remnants of the simple operations used to build up more complex curved outlines.[355] Another very good example is what may be a preliminary design drawing of an automatic speed regulator END 14/7/1 in pencil only, where the guidelines and sweeping compass lines can be clearly seen (Figure 40).[356] The ruler and compass carry out operations of line extension and rotation in two dimensions; the pencil marks are the trace of abstract, universal elements which can, by definition, be repeated unvaryingly. These are the kind of

[351] Booker 1979:133; 'in the early part of the nineteenth century most engineering drawings were produced by engineers or craftsmen. By the middle of the century this had all changed and there was a considerable proportion of draughtsmen. They were not all of a likeness however... some were virtually engineers... some were production experts... (with) a very much larger group equivalent to what we would call tracers, although nevertheless virtually artists.' Booker also describes here a controversy in *The Engineer* of 1859 in response to a call for a Society of Engineering Draughtsmen in which the claims of these various specialisms were thrashed out.
[352] Letter of Nasmyth to Robert Wilson 24 July 1856: IMS 100
[353] See Chapter II:3 Figure 18 and the accompanying discussion on John Farey's 1830 article in the *Edinburgh Encyclopaedia*.
[354] Even during the 1830s, drawing manuals warned students only to trust the lower left-hand right-angle of their drawing board (Booker 1979:120).
[355] END 14/7/6: '14 May 1853 W. Richardson'.
[356] END 14/7/1.

qualities sought in machine operations, an idea clearly expressed by James Nasmyth himself in an essay published in 1841:

> Viewing abstractedly the forms of the various details of which the machine is composed, we shall find that they consist of six primitive or elementary geometrical figures, namely, *the line, the plane, the circle, the cylinder, the cone,* and *the sphere*; and that, however complex the arrangement, and vast the number of the parts that the machine consists, we shall find that all may be as it were decomposed and classed under these six forms; and that in short, every machine, whatever may be its purpose, simply consists of a combination of these forms, more or less complex, for the attainment of certain objects and performance of required duties. It therefore follows, that the more near to absolute mathematical truth we can have the forms of those parts, the more perfectly will the machine perform its duties.[357]

This passage is taken from the appendix of the 1841 edition of Buchanan's *Essays on Millwork*, which will be discussed again below.

All the elements in Nasmyth's list can be generated and represented in two dimensions by straight edge and compass, and from these simple operations, worked through in elevation, side elevation and plan, systematically testing parts in movement and meshing them together, the 'complex arrangement' and 'vast number of parts' of machines and machine tools can spring. The drawing method, and the appearance that method controls, can then be proliferated in a boundless series of material forms spreading through the environment. This new convention of drawing is therefore not only descriptive of appearances, but prescriptive.

The mediums used with these tools were: pencil, eraser, pen and ink, and watercolour washes. There was a tendency for every mark to be made in an ungraded or unmodulated way. For example, both pen and

[357] Nasmyth 1841:394.

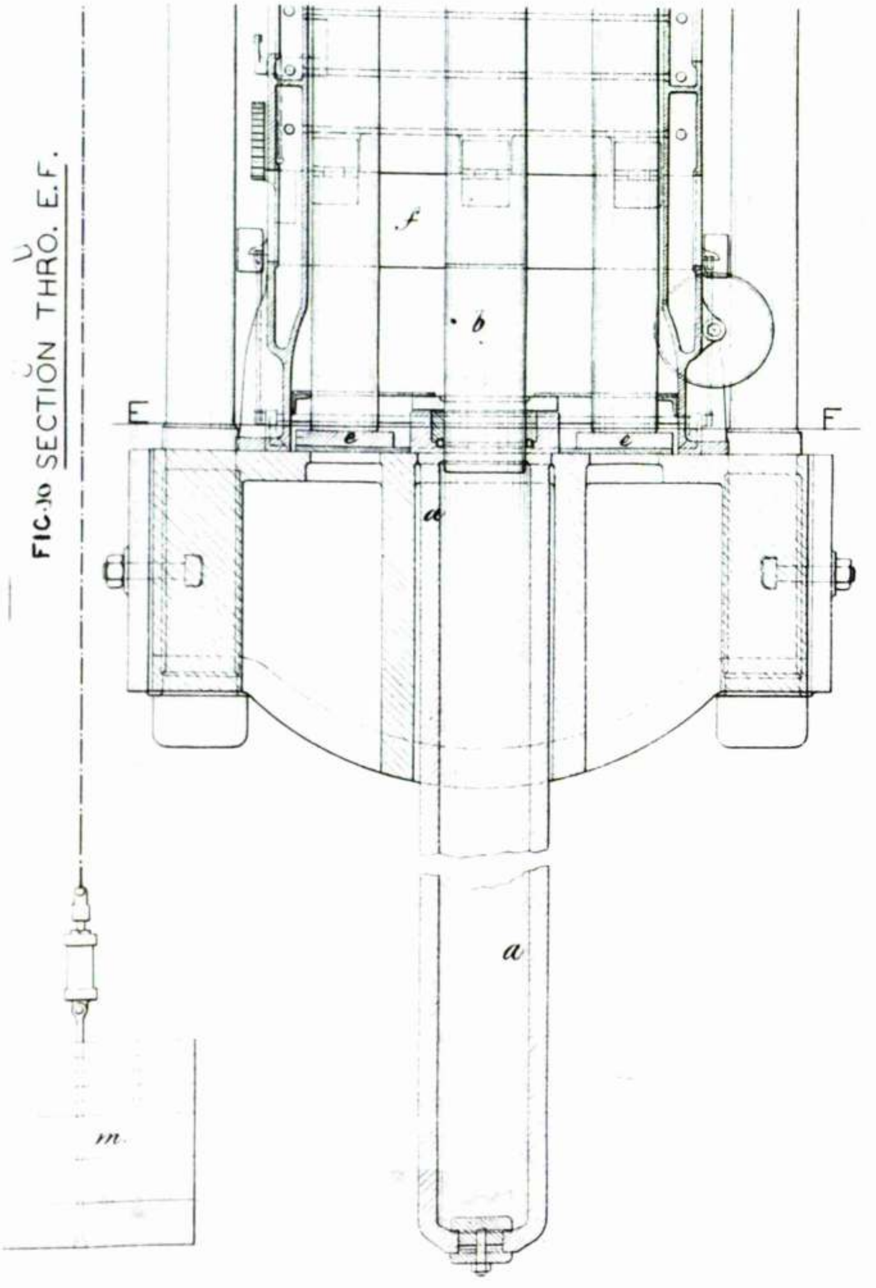


Figure 41: Workshop of Nasmyth &Gaskell, detail of END 14/3/4 (I.Mech.E.): 'shadow-lining', used to indicate light falling from the upper left. Note that *b* is therefore a solid cylindrical form, whereas *a* is a hollow shown in section.

pencil marks were laid in as straight, unmodulated lines, no doubt to signify their conceptual status clearly.[358] Watercolour was generally laid in as a flat, ungraded wash, although layered washes were used to simulate effects of light. However, the conventions for using these materials, even within this one company, were not entirely consistent; there were no universal standards at this date.[359] For example, in Roll 52 there are variations in how line thicknesses were to have been interpreted. The evolving convention (which became codified in the legal standard) was that any differences in line width had a purely symbolic status. For example, outlines might be treated as 'thick but sharp' in relation to 'thin and continuous' lines of projection.[360] However, there are one or two examples of 'mixed conventions' in the Nasmyth technical drawing collection. For example, in the drawing shown in Figure 41,[361] line width was used to denote an effect of light, with the upper and left-hand outline of solids being given a narrower line than their lower and right-hand counterparts; this gave an effect of light falling from the upper left in accordance with illusionistic, fine-art conventions. Similarly, in the same drawing, very fine lines at decreasing spacing were drawn from the centre to the edges of a circular column, not to indicate details of structure, but to indicate tonal variation on the receding cylinder.[362] This example is unusually ambivalent in its use of conventions, that is, in its vacillation between conceptual and observational drawing at this stage of line-drawing. Most of the purely line drawings were clearly conceptual drawings, used to design, and then produce, three-dimensional structures in movement in the way described above. However, when these

[358] That is, that there are 'no edges in nature'.
[359] There was no official legal standardization until well after WWI, in 1927. (Booker 1979:175)
[360] These phrases are from the post-legislation primer: Forbes, R.S. (1946) London: Batsford.
[361] END 14/3/4.
[362] This is what Booker calls 'shadow-lining'; it was still used in 1979 in technical illustrations in journals. The convention originated with Trevithick, Watt and other draughtsmen in the late 18th century who used it, as Booker writes, 'almost instinctively'. (Booker 1979:171) The reason why they did that is no doubt due to this convention having been established in engravings to denote tonal gradation. This can be seen in Lowry's engraving 'Delineators' used as Figure 22 in Chapter II part 3 above.

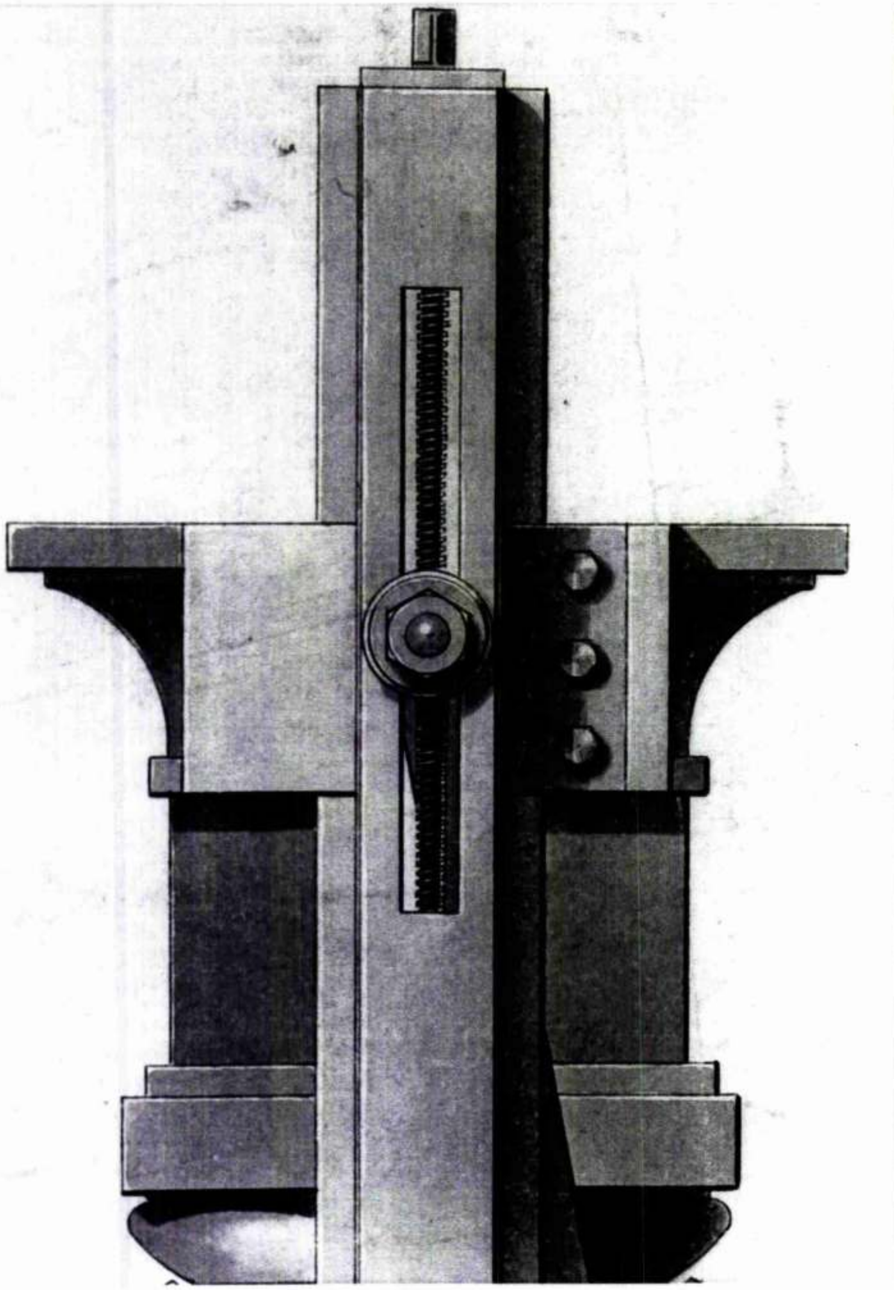


Figure 42: Workshop of Nasmyth &Gaskell, detail of END 14/5/1 (I.Mech.E.): detail of finished presentation drawing with applied flat washes of colour.

drawings were worked up with washes to a 'presentation' standard, a very interesting shift takes place.

Very highly-finished presentation drawings in Roll 52, such as that shown in Figure 42,[363] often showed side views of entire machines, with coloured washes applied. The colours, from a narrow range, had a 'mixed' function; they were symbolic, but as they were also derived from observation, they gave an appearance of verisimilitude. Green, for example, was used to denote an exterior (painted?) surface; blue and grey for naked iron and iron interiors; yellow for brass; and pinkish red for sections. However, the drawings were not simply coloured in, despite the flat application of non-graduated washes. Instead, paint was applied in layers to give an illusion of light effects: the smooth reflections on a cylinder, or the distinctive planed surface, dully gleaming, of a hexagonal nut. (As in Figure 42) With the addition of paint applied in this way, the completely two-dimensional conceptual drawing has lurched into another mode, that of three-dimensional illusion. This is achieved through the simulacrum of effects of light; in addition, strong shadows were often applied, for not only did they increase the illusion of volume, but they also displayed through their shape the details of projecting forms which could otherwise not be discerned in the face-on view. This was the functional use of sciagraphy as taught in draughtman's manuals such as *The Engineer and Machinists' Drawing Book* with its illustrated examples as seen in Figure 43.

This 'phase change' during the sequence of processes is perhaps responsible for the strangely airless feeling created by these presentation drawings; neither wholly two- nor three-dimensional. Their aggressive neatness and accuracy, frequently combined with a

[363] END 14/5/1.

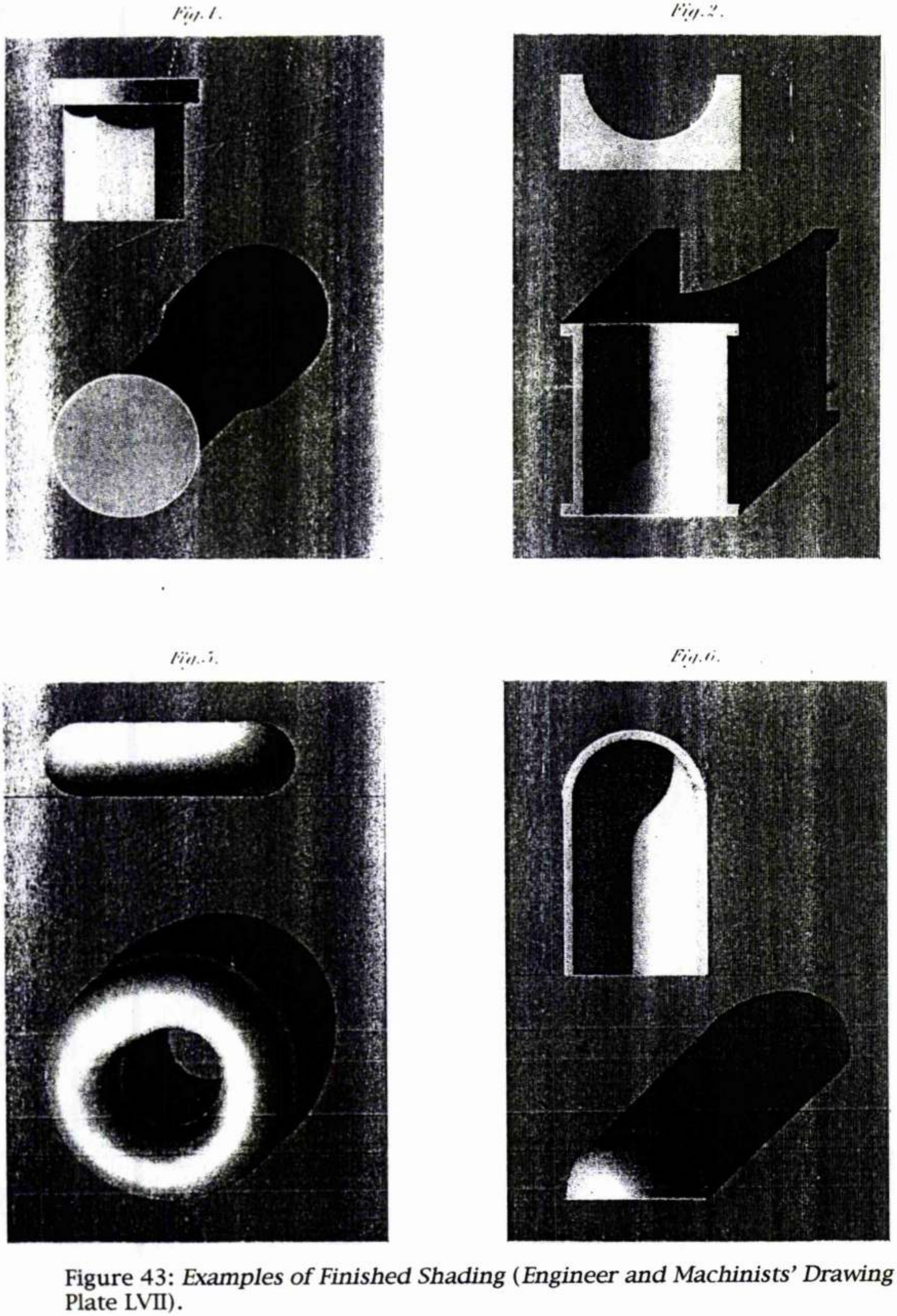


Figure 43: *Examples of Finished Shading* (*Engineer and Machinists' Drawing Book* 1868: Plate LVII).

striking use of contrast, gives a sense of hyper-realism which owes nothing to observation, but is related to the 'visual rhetoric of accuracy and efficiency' already noted in the technical illustrations of John Farey.[364] This feeling of dislocation is, if anything, increased by the inclusion of human figures. People feature in some of James Nasmyth's own drawings, often appearing in the role of 'stooge' next to the more imposing and energetic machine, as in his drawings of the Steam Hammer.[365] People were included not only to give scale, but in order to underline the labour-saving nature of the operations carried out with Nasmyth machines; most famously in the 'before' and 'after' drawings of the Safety Foundry Ladle (not illustrated) where an unmodernized foundry with thirteen anxious workmen and a man in flames were contrasted with two calm Safety Ladle operatives and two lookers-on.[366] Another similar example showed the proposed working situation of a Steam Hercules in a smithy with the team of men required.[367]

Presentation drawings were used for publicity and to create a good impression in potential customers. The best drawings on Roll 52, such as that shown in Figure 42, were very handsome, but nevertheless they were not finished to quite such such a high level as the drawings of other engineering concerns such as those of Robert Napier. Napier's surviving drawings from the same period, such as those for the *Thunderbolt* (1842),[368] used the same conventions as those in Roll 52, but developed them further to striking effect. The detail in Figure 44 shows these small but significant differences: the lines used were extremely thin, but continuous, and the effects of light (including

[364] See above Chapter II part 3 p.
[365] One example is END14/8/7: 'James Nasmyth's Patent Steam Hammer drawn by J.Nasmyth' (no date).
[366] END 14/4/1; this drawing seems to be the basis for the illustrations of the Old Foundry Ladle and Safety Foundry Ladle given in the *Autobiography*. (Nasmyth 1883:209 and 210)
[367] END14/3/3.
[368] Glasgow *Museum of Transport* (Napier) TD 232/10.

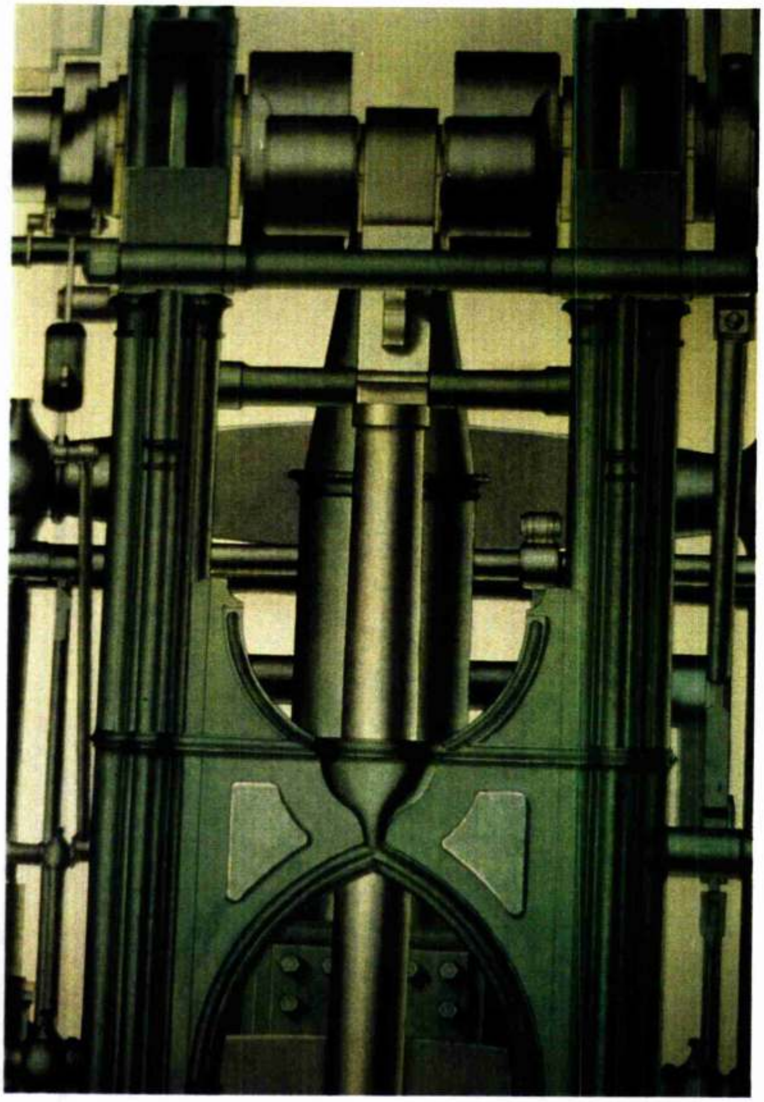


Figure 44: Workshop of Robert Napier, Glasgow details of engines of the *Thunderbolt* 1842 pen and watercolour (Glasgow Museum of Transport TD 232/10)

those of reflected lights on supposedly averted surfaces) were subtly but systematically, indeed obsessively, represented. The total effect was of a more powerful level of hyperreality than that already noted in Roll 52, and this level of finish resulted in the exhibition of Napier company drawings from the *Persia* (launched 1854) at the RA in 1861.[369]

At the same period, other firms were exploring other mediums for assembling and disseminating images of work in progress, most famously the use of photographs to document, and then publicize, the construction of the *Great Eastern* between 1854 and 1857.[370] This was the subject of Robert Powell's book, *Brunel's Kingdom*, which set out to consider 'how early photography represented the Victorian world... particularly the world of science and engineering'.[371] The *Great Eastern* was one of the first major engineering projects to be comprehensively photographed. Two series of photographs were commissioned; the first, by Joseph Cundall (1818-1895) was to document the construction stages in order to keep track of the work, and to give evidence for the fulfilment of deadlines. The second series, by Robert Howlett and George Downes, was intended for publicity, and these photographs formed the basis for wood-engraved illustrations for mass-circulation newspapers such as the *Illustrated London News*.[372]

As an amateur photographer since 1842,[373] as a member (with fellow photographers) of the Manchester Literary and Philosophical Society, and also the Manchester Photographic Society,[374] one might expect

[369] Baynes and Pugh 1981:171 refer to the 'unusually bravura display by draughtsman Mr. Kirkaldy'; see also Graves (1905) Vol.2, p.33 for the 1861 RA catalogue listing.
[370] See Emerson 1977:77; also Powell 1985:7-22.
[371] Powell 1985:7.
[372] Powell 1985:20; this newspaper sold an average 200,000 copies per issue in 1855. Powell also cites here the 'Leviathan Number' of the *Illustrated Times* of 16 January 1858.
[373] Nasmyth 1883:382; NLS MS 3242 no.105 onwards.
[374] Milligan 1974:544; Hallett 1982:73.

Nasmyth to have used photography to both document and publicize his firm's products. Certainly there are currently well-known examples of photographs of the steam hammer taken by some of Nasmyth's Manchester photographic colleagues such as Dancer, Mudd, and Sidebotham,[375] and Nasmyth himself had contributed to the experimental *Strines Journal* which used photographic illustrations at the early date of 1852.[376] Nevertheless, even with this personal experience, and the example of the spectacular newpaper illustrations of the *Great Eastern*, Nasmyth was still to exclaim in 1864, on receiving photographs of machinery from his working partner Robert Wilson:

> The Photographs are admirably done and worthy of the subjects -are they done by my friend J. Mudd or who did them? It is a most valuable art that of Photography for all such uses. The wonderful truth and precision of the ideas they convey in so condensed a form is glorious and must be a vast aid in correspondence in such subjects...I should be very much obliged if you would now and then treat me with a sight of a Photo of any new tool or machine you bring out as it is just like seeing the thing itself.[377]

In comparison to other companies, therefore, it might seem at first as if Nasmyth did not 'push' his visual material for publicity purposes, and his presentation drawings, although lively and pleasing, appear to be tied more closely to their function within the works than the more purely spectacular productions of Napier and Brunel discussed above. This might have been due to the need to attract the much larger capital investments that were required to sustain the production of

[375] Hallett 1982: 73.
[376] Hallett 1989:221-2; there is more discussion of this in Chapter VI below.
[377] Letter from Nasmyth to Wilson 9 Feb. 1864 IMS 100/10; James Mudd (1821-1906) started work as a calico-printers' designer, but by 1854 he worked as both a designer and photographer. Some of his photographs were hung at the Manchester Art Treasures exhibition of 1857. (Hallett 1982:730-3) Although Mudd also worked as an artist and portrait photographer, Mudd is most famous for his industrial photographs, most notably of steam engines. It has been pointed out by Harry Milligan that Mudd changed his oblique, 'naturalistic' views of engines in their environments, to a side-on view without extraneous details in his photographs in order to align the photographs with the style of engineering presentation drawings. (Milligan 1974:544-50)

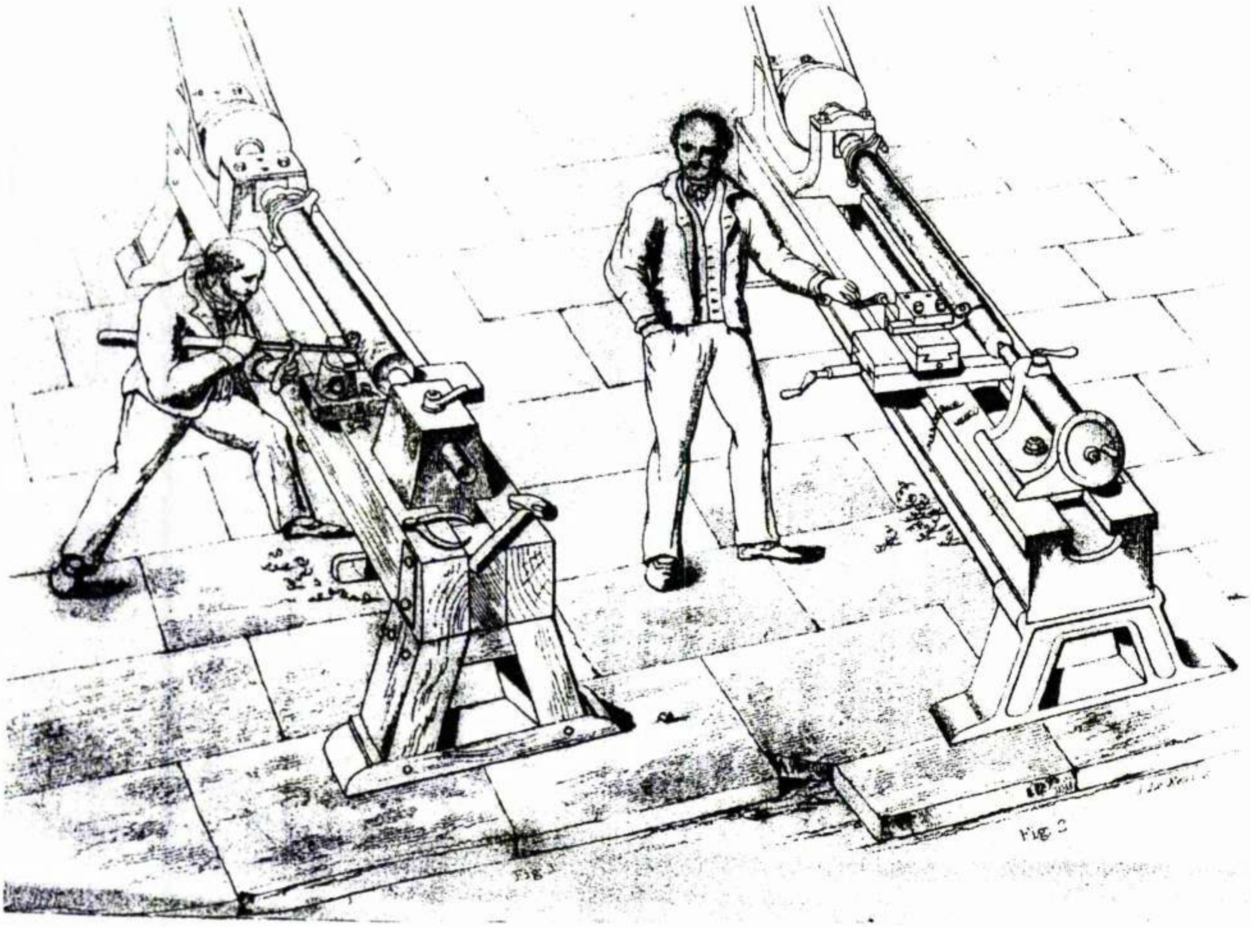


Figure 45: James Nasmyth, Two contrasting lathe operators (Nasmyth 1841:396).

ships such as the *Persia* or the *Great Eastern*, in comparison to the relatively smaller-scale, generalized production of machinery from the Bridgewater Foundry. However, it is also possible that Nasmyth felt he had already got enough publicity through drawings, by other means.

One of these means was through the re-publication in 1841, of a new, two-volume collected edition of Robert Buchanan's *Practical Essays on Millwork*. Robert Buchanan (1769-1816) had worked as a millwright in Glasgow, subsequently becoming the manager of a cotton mill in Rothesay in 1791.[378] The edition of 1841 had been revised and brought up to date by the editor George Rennie. As promised in the title these were extremely practical handbooks to enable the calculation of the most efficient forms of machinery,[379] and it was illustrated with the most up-to-date examples of machines and machine tools. James Nasmyth wrote an essay for the second volume: 'Nasmyth on Tools and Machines' in which he praised self-acting tools. This essay was illustrated with reproductions of Nasmyth's own drawings, including one in which old-fashioned lathe working was contrasted with the new self-acting lathe. (Figure 45) This is similar to the safety ladle drawing, showing on the left the old craftsman using all his skills of hand and eye, before the introduction of the new self-acting machine, shown on the right, where 'the tool did all the working (for the thinking had before been embodied in it)',[380] here accompanied by an unengaged-looking minder. But more importantly, the examples chosen to illustrate the main text itself contained a high proportion of machines from Nasmyth and Gaskell, frequently based on original Nasmyth drawings. In this way, very new equipment was shown, such as the Portable Hand Drill which was used as Plate 29 in Volume 2 of *Practical Essays on Millwork*. This appears to be the same

[378] Buchanan 1841 2:Preface; Robert Buchanan was also sometimes known as Robertson Buchanan.
[379] For example, Volume 1 was entitled 'On the Teeth of Wheels'.
[380] Nasmyth 1883:308.

drill from the scheme book which was shown above in Figure 36; the lower half of Page 19: '23 August 1839 new system of portable drill very simple'. Within two years, therefore, Nasmyth had got his drill from the sketchbook, to the factory, and out into an illustrated technical handbook. Moreover, this was very early in the lifespan of the Bridgewater Foundry; in fact it coincides with the 'important period of expansion and establishment' from 1839-1842 just before the production period of the steam hammer.[381] Nasmyth had 21 machine tools illustrated in *Practical Essays on Millwork* in relation to only 33 examples from all other manufacturers put together,[382] and seems to be an example of Nasmyth's skill at self-promotion. The Nasmyth drawings used in this work were all at the same modest level of finish as seen in Figure 45; the machine drawings were very close in appearance to the steam-engine diagram reproduced above as Figure 26,[383] but this did not hinder their use as valuable publicity.[384] Soon after this, steam hammer production generated a series of large, imposing objects which perhaps attracted more publicity through their actual presence.[385] This was certainly the case by the time of the Great Exhibition of 1851, when the *Illustrated London News* reminded visitors to make a pilgrimage to the right-hand side of the Western Nave of the Crystal Palace: 'Mechanicians regard the steam-hammer of Nasmyth as one of the more remarkable contrivances of modern days'.[386] So despite the seemingly less adventurous use of the Roll 52 drawings as outside publicity, it seems that Nasmyth did have other ways of making his machinery an object of attention.

[381] Cantrell 1984: 197; 134-9.
[382] Musson and Robinson 1969:498-9.
[383] See Chapter II part 3.
[384] Without attempting to denigrate his achievement as an inventor of machine-tools, Nasmyth's inclusion in this publication may be an indication of his involvement in a wider network of people interested in drawing and design, however. Nasmyth had been invited as a witness to the Select Committee on Arts and Manufactures in 1835/6, (Romans 1998:216) possibly because of his contacts with Lord Francis Egerton. George Rennie.
[385] The first 'steam-hammer boom' was between 1845-7. (Cantrell 1984:158-9)
[386] *Illustrated London News* 7 June 1851. There was a further illustrated article devoted exclusively to the steam hammer at the Great Exhibition in the newspaper on 6 September 1851 which noted also that since 1842, 380 machines had been constructed.

The drawings discussed in this section had a very different function and appearance from the sketches in the National Library of Scotland collection, or other 'artistic' material shown in exhibitions devoted to the Nasmyth family.[387] Despite their public nature, Nasmyth's engineering drawings have rarely been exhibited alongside his other drawings and paintings, although it could be argued that these types of drawing were far more influential because they shaped the appearance and character of the environment of the period.

In the wider context of technical drawing at this period, the involvement of many workers, owners, and managers, either as plan-readers or draughtsmen, meant that this mode had a wide currency, so that the appearance and also the theoretical aspects of technical drawing must have been widely assimilated. However, the impact of the rapid development and expansion of technical drawing on the wider visual culture at this period has not yet been fully explored.

This dissertation has been focussed on some of the different drawing strategies of James Nasmyth, and it is proposed now to turn to another, final, aspect of Nasmyth's image-making practice; the production of his book of 1874 *The Moon; considered as a Planet, a World, and a Satellite.* In relation to representation, mechanical reproduction has come to mean not simply the industrial multiplication of objects, but has also incorporated the idea of the mechanical eye, where the use of a machine as a deputy for or an enhancement of the perception of sense data has been linked to some aspects of the development of the desire to take photographs.[388]

[387]One example was *Alexander Nasmyth and his Family*. This exhibition was mounted in 1973, at Monks Hall Museum, Eccles, Manchester 'directly through the association of the Nasmyths with Eccles' that is, because of the existence of the Bridgewater Foundry and later Ordnance plant at Patricroft. (Patry 1973:1) Despite this, no engineering drawings were exhibited there.

[388] As in W.H.F. Talbot's proposed experiment to reveal the actions of people in total darkness through the use of 'invisible rays'. (Talbot 1844-6:)

Chapter V will consider whether this influenced Nasmyth's photographic illustrations.

James Nasmyth began his systematic observations of the Moon in 1842, prompted by his geological interests (described in Chapter III). This long-term project resulted in the publication of his book, *The Moon: considered as a Planet, a World and a Satellite* (in collaboration with James Carpenter (1840-99)) in 1874. This chapter is about the evolution and production of that book in relation to the technologies o visualization and image-production used during that process.

When Nasmyth began mapping and drawing the Moon in 1842,[389] the main guides to its landmarks were the topographical maps of Beer and Madler (1836).[390] These were engraved after observational drawings made over 600 nights during 1828-36. This close scrutiny led Beer and Madler to the idea that the moon was a dead world,[391] unable to support the 'lunarians' that had previously been thought to exist.[392] The prospect of this airless world pleased Nasmyth, as it seemed to offer a view of a landscape whose features preserved all the evidence of volcanic formation. His book, when it appeared, was not intended simply as a topological guide, therefore, but as a wider discussion on selenology.

Nasmyth's drawings were made from direct observation, on grey-toned paper fixed to the side of his telescope,[393] using black and white crayons to show shadow and strongly-illuminated areas.[394] Very shortly after starting this systematic study, he began making the plaster models that would eventually be used to prepare the

[389] Nasmyth 1883: 329.
[390] Pannekoek 1961: 372-3; Whitaker 1999 120-5. Wilhelm Beer (1797-1850) was a wealthy banker who owned an observatory; Johann Madler (1794-1874) was a professional astronomer.
[391] The lack of atmosphere was confirmed by Bessel in 1834. (Pannekoek 1961:371)
[392] This was William Herschel's word. (Pannekoek 1961: 371)
[393] Nasmyth 1883: 330.
[394] See Figure 31 in Chapter III; NLS MS 3242 no.201.

photographic illustrations for his book. As early as 1845 he wrote to John Herschel, in order to offer him:

> some large drawings which I have made from time to time of the various and more remarkable portions of the Lunar surface -some of these drawings are now under the charge of Sir H. de la Beche at the Museum of Economic Geology where there is also a large model of a remarkable portion of the moons surface...should there be any part of the Lunar Surface in particular of which you would desire to have a careful and effective drawing made *from Nature.*[395]

As well as showing that Nasmyth had not only started making models, this letter shows that he was actively seeking for an audience for his work; as can be seen, he was already in communication with de la Beche[396] and this letter began a correspondence with Herschel which lasted until 1871, when Nasmyth first put forward his plan to him for an illustrated book.[397] As well as producing images, Nasmyth was also developing the text, and evaluating his audience throughout this period through such public lectures as 'The Structure of the Lunar Surface' at the BAAS meeting of 1850; or at the Edinburgh Philosophical Society of 1858.[398]

Although he was a tenacious and systematic observer, Nasmyth was not a professional astronomer. It is probable that the few people working full-time as astronomers did not have time for that kind of leisurely accretion of individual drawings.[399] This was the position of James Breen in the *Popular Science Review* (1861): 'the writer of this article has made several sketches but it was found to interfere too much with the ordinary work of the (Cambridge) observatory to be

[395] Royal Society: Nasmyth to Herschel 1 August 1845 HS.13.76
[396] Henry de la Beche (1796-1855) founder of the Museum of Practical Geology in 1835; Nasmyth had also sent him a drawing and suggestion for an exhibit on the steel-making process (2 July 1842). McCartney 1977
[397] Royal Society: Nasmyth to Herschel 14 March 1871 HS.13.88
[398] Nasmyth 1883: 341-2: 378
[399] Other amateur observers producing important maps in the 19th century included Wilhelm Beer, Julius Schmidt, and Ph. Fauth. (Pannekoek 1961:372-4)

continued'.[400]

Nasmyth used his drawings as the raw data from which to synthesize either larger drawings; maps; or plaster models. He exhibited a six-foot map at the BAAS meeting in Edinburgh (1850) which was exhibited in the following year, with some drawings, at the Great Exhibition of 1851. These won him a Prize Medal, and a request to give a private view of his moon drawings later in the year to the Queen and Prince Consort.[401] This map was later photographically reduced and included in the 1874 publication, where it was praised as 'very useful' by the astronomer William Lassell.[402] The final illustrations for the book consisted of photographs of his plaster models, steel engravings, wood engravings, and lithographs, all of which will be discussed in more detail below. Only one direct photograph of the moon was used. This section is about the ways that photography was used in this book, in relation to the use of photography of the Moon by astronomers at this period.

Although Francois Arago singled out Moon mapping as one of the desired applications of the new process at the first public demonstration of photography in 1839,[403] it has been convincingly argued that photography was neither exploited by science, nor seen as particularly 'data-yielding' until the late 1870s.[404] Nevertheless, photographic images of the Moon were produced, often as daguerrotypes, because of the lure of the very sharp details produced by the grainless surface. For example, at the Great Exhibition of 1851, where Nasmyth's drawings were also on show, Whipple and Bond exhibited a daguerrotype of the Moon produced at the Harvard College Observatory,[405] although it was acknowledged that the image was of

[400] Breen 1861:612-21

[401] Nasmyth 1883: 337 (BAAS); 346.

[402] John Murray Archive: Lassell to Nasmyth 3 April 1874.

[403] Thomas 1997:194.

[404] Gunthert 2001:28-48.

[405] Thomas 1997: 197.

no use for mapping.[406] But in addition, astronomers used silver chloride chemistry to make photometric comparisons of the relative intensities of starlight.[407] This suggests that the possible uses of photography by astronomers was potentially very varied, and that the production of a straightforward 'view' may not have been seen as particularly fruitful. These issues were discussed by Warren de la Rue in his *Report of Celestial Photography* in England (1860) in which he assesses the quality of photographic images against 'optical' observation:

The report stated that at that date, systematic astronomical photographic surveys were only being carried out at the Kew observatory.[408] De la Rue described some earlier successes, (including some of his own photographs of the Moon using wet collodion film in 1852) and explained the difficulty of getting a clear image whilst tracking the Moon by hand during the 10-30 seconds' exposure time; a reliable driving motion for telescopes was not available until 1857. In relation to these long exposure times, he discussed the effects of the atmosphere:

> when the telescope is employed optically, the mind can make out the proper figure of the object, although its image dances before the eye several times in a second...a photographic plate registers all the disturbances.[409]

In addition, he listed several purely practical problems which hindered the use of photography for astronomical observations:

1) Photography at this date, particularly with wet collodion, required

[406] Whitehouse 2001:137; The *Liverpool Photographic Journal* 1854: 34 to illustrate the 'great difficulty' of lunar photography reported that it took Prof. Bond 100-200 attempts to yield 1 useful image.
[407] Crosland 1967:456.
[408] 'De la Rue devised and erected the photoheliograph at Kew, (1858) afterwards transferred to Greenwich and used for the regular photographing and measuring of solar pictures as routine work'. (Pannekoek 1961: 405; see also Thomas 1997:199)
[409] de la Rue 1860:133.

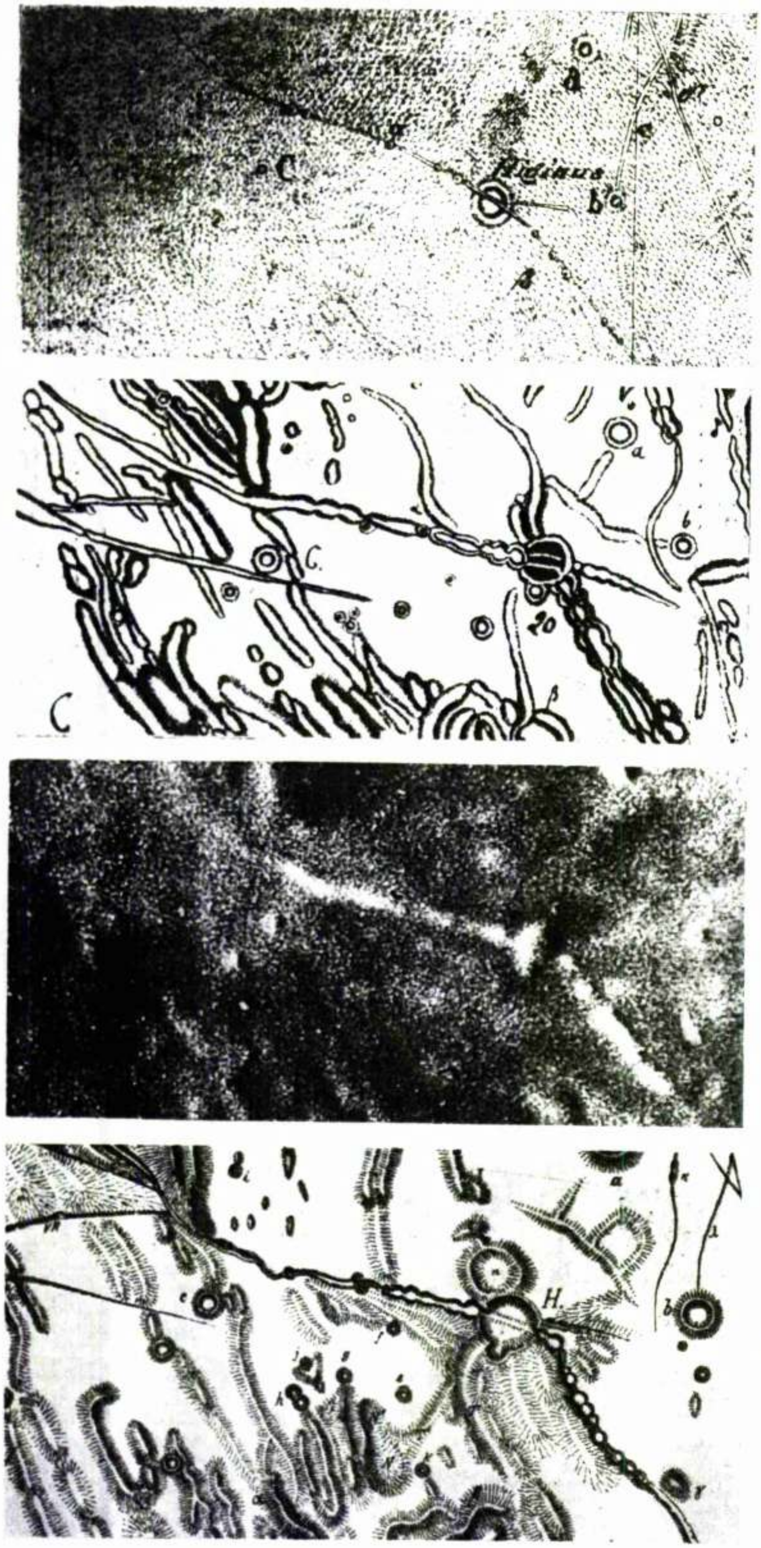
a clean water supply and heating at the site of the telescope; this was not the unremarkable norm that it is today.[410] 2) the image produced in the telescope (the negative) was frequently very small. De la Rue gave a typical diameter of just over 1", which was most usefully observed under a microscope, as a negative, because any further enlargement or reproduction would have blurred useful details. This arrangement was advantageous only because it captured many details in one exposure, but in terms of relaying and sharing those details, it left the observer still in the position of peering into a lens and then drawing. De la Rue obviously felt that photography, even on these terms, was useful in providing accurate details, however, because he suggested using this as a method of getting better maps than those of Beer and Madler. This method involved a cumbrous process of placing a negative in a microscope, then enlarging the drawing to the desired magnification with a camera lucida, then modifying and checking these drawings with further direct optical observations. (This confirms that Beer and Madler's maps were still the standard work at this date; and it also implies that the sheer time involved was the reason for their not being supplanted)

De la Rue did not simply suggest using photography to reproduce an optical view, however. He also valued photography as a means of 'extra-sensory' perception:

> portions of the moon, equally bright optically, are by no means equally bright chemically...photography thus frequently renders details visible which escape observation optically...for instance, strata of different composition evidently reflect the chemical rays to a greater or lesser extent...and may thus be distinguished.[411]

Not long after this, de la Rue was in correspondence with Nasmyth. This was originally prompted by Nasmyth's discovery and report of

[410] The Kew Observatory only obtained pure water by distillation in 1860. (Howarth 1922:164)
[411] de la Rue 1860:145.



BEER AND MÄDLER

JUL. SCHMIDT

PARIS

PH. FAUTH

11. The Hyginus Crater and its surroundings (pp. 372–4)

Figure 46: Four examples of moon maps 1836-1914 (Pannekoek 1961: Plate 11).

the 'willow-leaf' granulation on the surface of the sun in 1861, which caused de la Rue to send both a letter to Nasmyth and a tiny glass negative of a sun spot;[412] remarking: 'It is very possible that you and I could do good work together...my photographs...your independent Eye observations'.[413]

At the period when Nasmyth was gathering material for what would become his book on the Moon, photography was not perceived to have a clear advantage as a medium of representation, therefore. Innovations by Rutherfurd in 1864, and the adoption of dry silver-bromide-gelatin plates in 1871 made astronomical photography more practical.[414] In addition to the problems of taking a photograph, there were also the difficulties of reproduction. Publicly-available images remained rather austere until the end of the nineteenth century, as shown in the very good comparison plate given in Pannekoek (1961), reproduced in Figure 46. The first image is from Beer and Madler of 1836, the next one, Schmidt, was not published until 1878 (that is, after Nasmyth's book), the third, photographic image, is from the Paris observatory after 1894, and the final image (Ph. Fauth) was published in 1895.[415]

Nasmyth was not solely concerned with producing an accurate map; he wanted to share not only his observations, but also his experience of observation: 'while earnestly studying the details of the moon's surface, it was a source of great additional interest to me to endeavour to realise in the mind's eye the possible landscape effect of their marvellous elevations and depressions'.[416] It seems very possible that

[412] Nasmyth was the first person to observe this phenomenon, in 1861 (Royal Society: Nasmyth to Herschel 14 May 1861 HS.13.77); his claim was finally confirmed by the Royal Observatory, Greenwich in 1864 (John Murray Archive: Stone to Nasmyth 25 February 1864).
[413] John Murray Archive: De la Rue to Nasmyth 14 December 1861
[414] Pannekoek 1961:336.
[415] Pannekoek Plate 11 facing p. 352; discussion Pannekoek 1961: 372-4.
[416] Nasmyth 1883:335.

it was this representation of the astronomer's experience while observing, a blend of imagination, hypothesizing, and optical data, which prompted the favourable responses to Nasmyth's photographic illustrations in his book of 1874 (see discussion below). It is in comparison to the other images available, as seen in Figure 46, that Nasmyth's illustrations to his book must be considered.

Nasmyth had already seen the effect of his moon model photographs in an article in *The Strines Journal* of 1852, entitled 'The Moon and its Surfaces'.[417] (This journal had also featured, in another issue in 1852, a photograph of Nasmyth's steam hammer, very similar to the photograph by Dancer in the Nasmyth scheme book[418]) The date of this journal makes it seem exceptionally pioneering in its use of photographic illustrations; that 'edge', is however massively blunted by the fact that there only ever existed one, hand-written, copy of each issue! However, this prototype could well have suggested to Nasmyth that this mode of producing moon landscapes would produce the visual qualities he was looking for, as it is clear that Nasmyth was prepared to bide his time until certain technical processes met his approval, rather than using different mediums.[419] For example, although he had been making moon models, photographing them, and sending the photographs to Herschel for comment since 1863,[420] he did not begin to make practical plans for publication until 1871. In that year he wrote to Herschel:

> I am so glad that by the aid of those improved processes in

[417] Hallett 1989:221. This date, 1852, conflicts with Nasmyth's account in the *Autobiography* where he gives two different and later dates for starting photography: 'after 1853' (p. 364); and 'after 1858' (p.382). These in turn conflict with NLS MS3242 dated Nasmyth photographs from 1842 onwards.
[418] Hallett 1989:221-222.
[419] A report of the Manchester Photographic Society Exhibition of 1857 confirms this response: 'Photography by Mr. Sidebotham, from a model of the moon by Mr. Nasmyth, giving a better notion of a telescope view of the moon's surface than most drawings'. (*Liverpool and Manchester Photographic Journal* 1857:37)
[420] For example, in a letter about 'willow-leaves' on the Sun, Nasmyth also adds he has: 'taken the liberty to enclose a photograph from a model of part of the Moon'. (Royal Society: Nasmyth to Herschel 1 October 1863 HS.13.79)

> respect to printing Photographs in permanent ink very common printing ink and china ink the Prejeudice (sic) on the part of publishers to the use of such mode of illustration is now removed and that the wonderfully truthful and delicate minutiae which photography yealds (sic) will henceforth play its well merited part...[421]

This letter also referred to several images which seem to be versions of illustrations from the book, so it could be inferred that Nasmyth had been carefully, perhaps anxiously, building up a publishing proposal. After 1871, however, armed with praise of his models and photographs, and with the knowledge of 'improved processes' Nasmyth moved quickly. He made his first approach to John Murray on 23 June 1873, at which point it is evident that the final version of the book and its illustrations were largely in place.[422]

Before moving on to the production of the book in more detail, it would be worthwhile to consider the question: just what exactly was pictured in Nasmyth's plaster models of the Moon? Nasmyth gathered observations as drawings from his telescope in the manner described above. The best maximum magnification, in his opinion, for observing the features of the Moon was between x250 and x350, as at any greater magnification the details became ' "clothy" and tremulous' due to atmospheric effects.[423] What level of detail could be seen on the Moon at this magnification? As Nasmyth explained: 'To see an object 200 yards across we should require to magnify it 300 times; this would only bring it into view as a point...as the highest practicable power is 300 or 400 maximum it is evident that the minutest object we can perceive as a point must measure about 150 yards.'[424] The majority of images in Nasmyth's book which have been generated from the plaster models, for example Plate X: *Aristotle and Eudoxus*,

[421] Royal Society: Nasmyth to Herschel 14 March 1871 HS.13.88.
[422] John Murray Archive: Nasmyth to John Murray 23 June 1873.
[423] Nasmyth and Carpenter 1874:63.
[424] Nasmyth and carpenter 1874:64.

give the effect of a face-on fairly elevated viewpoint. In relation to the very distant and diagrammatic images of the surface of the Moon available elsewhere in print at that time these give the impression of close proximity.[425] In current terms, they look like views from a low moon orbit. In relation to Nasmyth's magnification, they therefore do not show anything that could not have been seen. On the other hand, in relation to a 'moon landscape' view such as Plate XXIII: *Group of Lunar Mountains*, the known limit of vision[426] seems to have been exceeded in this rubble-strewn valley. This view, initially so convincing, becomes more puzzling as the viewer tries to work out the scale of the objects depicted. How high are the mountains? Are those craters as wide as a shell-hole or a military camp? Nasmyth's imaginative description of the 'awful grandeur of lunar scenery'[427] seems designed for imitation using plaster models and photography: 'the intensity of the contrast between light and shade must lend another powerful effect to the scenery of the Moon...the absence of atmosphere on the moon causes the most distant of objects to appear as near as the nearest'.[428] The images that appeared in the landscape views were therefore compounded of a mind's eye view extracted from the 'dancing image' in the telescope supplemented by details beyond the limits of magnification. The recreation of the Moon view in plaster was then 'given back' to the lens. The sharp lens vision of the camera combined with the harsh contrasts of the sensitized paper chemistry to produce a facsimile of the composite optical and imaginative vision that Nasmyth described. The favourable responses from other astronomers to these pictures suggest that his images reproduced something that was close to their own imaginative observational grasp of the Moon landscape. In these images,

[425] See Figure 46 earlier in this section.
[426] That is, nothing could be seen that was smaller than 150 yards long. This image is in Chapter III as Figure 32.
[427] As quoted in Chapter III.
[428] Nasmyth 1883:336.

photography has been employed not because of any 'indexical' connection with the subject, but for its integrating, mark-making capacity to recreate the harsh conditions of an unearthly, airless landscape. Nevertheless, to the viewers, these constructed images did seem to have the charge of authenticity, especially to those with first-hand experience of viewing the Moon for themselves by telescope. In a letter from Isabella Herschel (written on behalf of her father) it seems as though it was the crumbly surface detail of the models, revealed in the photographs, that held the viewer and gave a sense of reality:

> what an advantage the photographic process is when steel engraving is so expensive but the specimen of William Barlow's engraving is certainly *most* beautiful...but the inexhaustible fullness of the photographs is even more wonderful. In fact I suppose we have not yet half seen all that is in them.[429]

The apparent verisimilitude of these images therefore seems to have been dependent on using photography from the model, carefully lit and staged, as a drawing medium, to give a reconstruction of the experience of observing the Moon through a telescope. In the first edition of *The Moon* of 1874, this seems to have been the most important aspect of the photographs to Nasmyth.

The form of the first edition of *The Moon* was fairly strongly dictated by the ideas of Nasmyth about the production and presentation of the illustrations. As could be inferred from his letter to Herschel of 1871, Nasmyth's publication plans were centred around permanent photographic reproductions as illustrations. Some of the negotiations and decisions of the production process can be guessed at from a group of letters kept in the John Murray Archive, which represent the Nasmyth to Murray half of the correspondence. After the first letter of

[429] John Murray Archive: Isabella Herschel to Nasmyth 'Collingwood March 4' (no year)

approach on 23 June 1873,[430] discussions and agreement seem to have moved quickly, for James Carpenter was named as an associate on 25 June, only two days later, when it was apparent that the publisher, John Murray(1808-1892) had agreed in principle to go ahead. There is a very intriguing letter dated 6 September 1873; Nasmyth wrote about a 'French Photocolour plate process' which must have been suggested to him by Murray, saying he had not yet seen any specimens. This was followed on 12 September by a letter in which Nasmyth praises the 'French process' of which he has just had an example; agrees to send a negative to Paris to try out; and agrees that the 'terms are fair' for the book money arrangements. The other halves of these letters (Murray to Nasmyth), currently unknown, would be a very welcome find! That is because it is hard to guess what new French process could be at issue. It seems almost impossible to believe that Nasmyth really meant a 'colour' process (as stated in the letter of 6 September). That is because: 1) all Nasmyth's extant photographs are monochrome, so they would not need colour, but more importantly; 2) even single coloured photographic images were highly experimental at this date, and multiple, commercial, colour prints suitable for publication did not exist until the twentieth century. So although Ducos in France had patented a photographic three-colour process in 1868,[431] it must be assumed that what Nasmyth was actually referring to was some French photographic carbon printing process that Murray felt would make good commercial sense. This may have been a version of the Poitevin process,[432] bought up by the large commercial printer Lemercier,[433] or possibly the woodburytype process, marketed from 1867 by Goupil et Cie as

[430] This is the letter referenced above (note 34). As none of these letters have been catalogued, the given date in the text is the main identification for each letter in this passage of discussion.
[431] Frizot 1998:413
[432] Although this had been made public as early as 1855, Poitevin had only recently (1867) been awarded the duc de Luynes' prize for the best process of photomechanical reproduction, (Frizot 1998:226-7) which may have led to this process being perceived as new.
[433] His subsequent photolithographs have been described as the first 'industrial prints'. (Rosen 1988:313)

photoglyptie.[434] Murray would have had good reason to hunt for cheap photographic print suppliers at this date. That is because the production of the illustrations for Charles Darwin's *The Expression of the Emotions in Man and Animals* (1872), one of the first books to be illustrated with heliotypes, had been a costly and nerve-wracking experience for both John Murray, the publisher, and Darwin himself.[435] In the event, no French process was considered because of a mishap that Nasmyth seems to have used to settle some points of dispute. A letter of 27 September opened with Nasmyth lamenting that he was 'exceedingly grieved, disaster has occurred to the Negative on its way to Paris'. Having made this point, he then pushed his advantage; insisting that quarto (his choice) would be the best format, as 8vo (smaller and cheaper) 'would not suit the images'. He added that for those images he would be perfectly satisfied with the woodburytype and autotype (heliotype) processes he had already researched for himself. Murray must have argued about the costs, for on 1 October Nasmyth wrote, holding out for the quarto size, and offering to 'bear the Risk'. By December 1873 the book had been printed, sold out (at a price of 30/- per copy), and distributed (with a first printing of 750), according to the accounts drawn up on 31 December 1873.[436] A second printing of 750 was put in hand immediately,[437] and in December 1874 Nasmyth received a cheque for £72.12.7.[438] Although this was not a large print run, it had made a profit; obviously enough to encourage a new edition in 1885, which was produced with a different format.

The 1874 edition was a quarto format book (11" x 9"). The cover was

[434] Mason 1984:97
[435] Desmond and Moore 1991:594;this incident with the 'French photocolour process', although slight and somewhat comical in itself, nicely demonstrates the almost haphazard alliance of cost and appearance in this edition.
[436] John Murray Archive: Ledger G Folio 376
[437] John Murray Archive: Ledger G Folio 376
[438] John Murray Archive: Nasmyth to Murray as above.

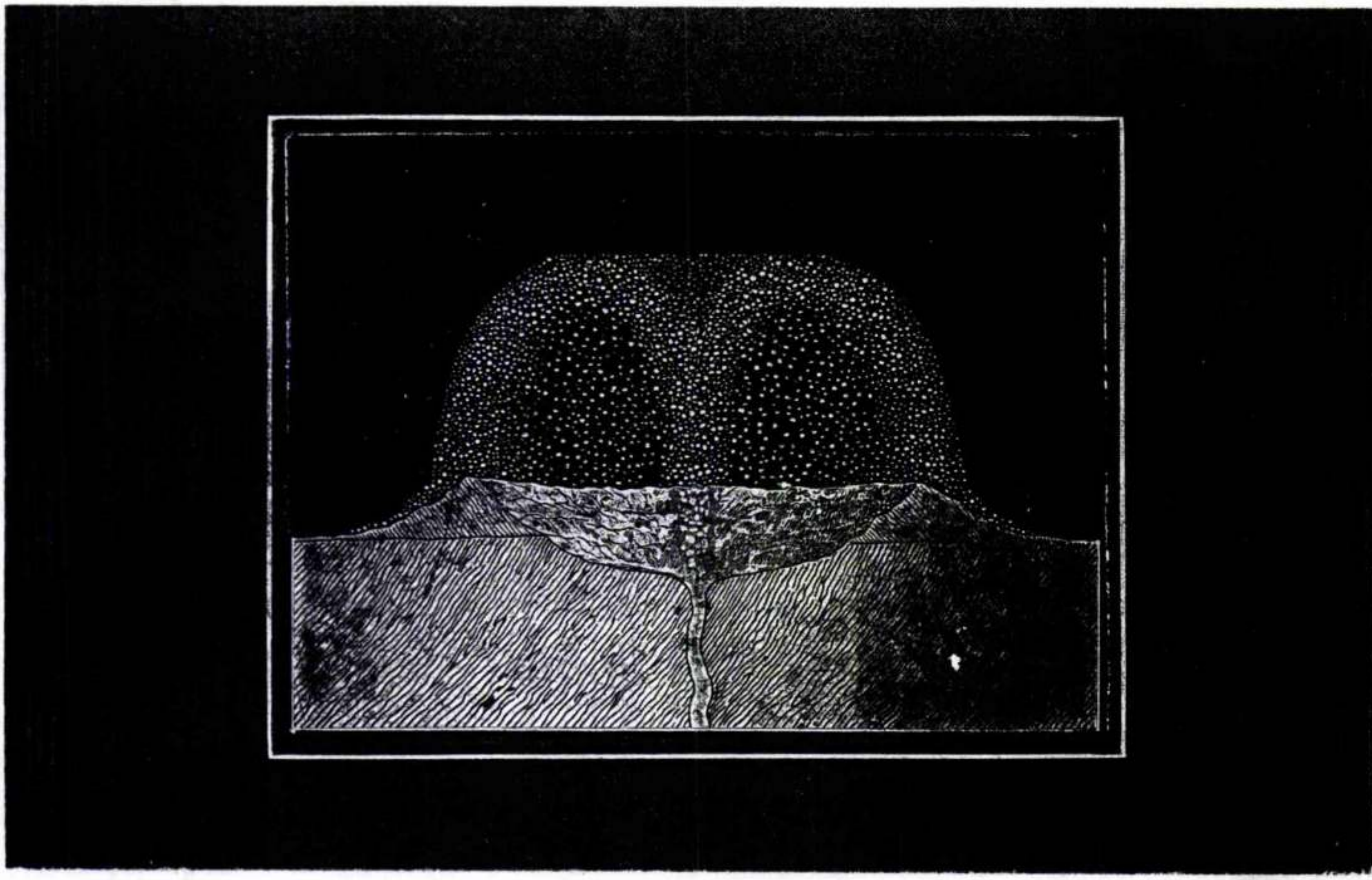


Figure 47: Stamped book cover design (Nasmyth and Carpenter 1874).

decorated with a semi-abstract gold stamped design; the schematic representation of a volcanic vent spewing forth ash, etc. and in the process forming a crater wall. (Figure 47) This diagram had appeared in a letter to Herschel of 1865 in which Nasmyth had described how the crater of Vesuvius (in Italy) had appeared on a recent visit to be 'vastly increased in size' since Nasmyth had last seen it in 1842.[439] The diagram illustrated Nasmyth's hypothesis for this process, transposed to the moon, and was reproduced, almost unaltered, within the text of the book.[440]

The book was dedicated to the Duke of Argyll, with whom Nasmyth had had meetings and correspondence both through the BAAS, and through Nasmyth's neighbour and interested early 'sponsor' the Earl of Ellesmere.[441] This dedication provides a strong eighteenth-century echo, as the Duke of Argyll had also been one of Alexander Nasmyth's patrons.[442]

The title page and preface announced the main focus of the book: the illustrations; and the volcanic 'causative phenomena' behind those illustrated features. Nasmyth described the use of models and the desire to represent 'lunar effects of light and shadow' while underlining the permanent nature of the photographs used through the 'pigment process'. There were 24 plates, including the frontispiece, and 46 black-line wood engravings as figures in the text.
Almost all the images had been generated from photographs of Nasmyth's plaster models, and this gives a visual unity to the illustrations which is deceptive, because the images have been produced through a range of print technologies, provided by several

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[439] Royal Society: Nasmyth to Herschel 26 May 1865 HS.13.86
[440] As Figure 26.
[441] Nasmyth 1883: 341-4; 208-9; this was Lord Francis Egerton, heir to the Bridgewater estates who had been a member of the Select Committee of 1835/6 (see Chapter IV part 3).
[442] See Chapter II part1.

different companies.

The main block of images were face-on views of the cratered moon surface from Nasmyth's photographs of his plaster models. The majority were woodburytypes, but printed up by two different companies: Brookes, Day and Son (who printed the main block of face-on crater images from photographs of Nasmyth's plaster models);[443] and Woodbury & Co. In addition, this edition also contained some different photomechanical images, heliotypes.[444] The most well-known examples are Plate II *Back of Hand and Shrivelled Apple*, and Plate XX *Glass Globe Cracked by Heat and Pressure*. These images have a very different quality from the cooler-toned, more highly-contrasting woodburytypes, as they are much softer; sepia-toned, with a longer tonal range. The printer's name is not given on any of the heliotype plates; it may have been Gilbert &Rivington.[445] Unlike the woodburytypes, which had to be pasted onto their heavy paper support, the heliotypes would have been printed directly onto their plate paper by two lithographic printings, which would produce the very delicate grading of tones in the two plates given above.[446] Two other print processes were used for the plates: 1) Plate XXII *Aspect of an Eclipse of the Sun by the Earth*, which is a five-colour lithographic print,[447] but 2) there are also five plates which are less easy to describe. These appear to be reproductions of photographs, possibly photomechanically reproduced, as they do not contain any obvious hand marks. Each of these pages is indented from a plate, and has an acknowledgement added: for example, Plate I *Crater of Vesuvius* 'J.H.

[443] Beginning with Plate VIII, *Copernicus*.
[444] For a very clear description of these two processes, which both grew out of Poitevin's process using light-hardened bichromate of gelatine, see Jussim 1974:52-8
[445] This has been inferred from the rather terse list of expenses in John Murray Archive: Ledger G Folio 376
[446] See Jussim 1974:53-4
[447] Produced by Vincent Brookes, Day & Son.

& C.T.McQueen sculpt.' [448] It is not clear, at this time, what process was used to produce these plates. It was probably some type of photogravure, but they do not have the long shade gradients and sumptuous tones which have made photogravure such a celebrated 'art' medium. The images resemble their fellows, as the cheap photocopies used to reproduce images for this study resemble the images offered to the machine. In other words, contrasts have been accentuated and fine details and grades of tonality have been lost. However, because they have been run in with the other photographic plates they give an impression of uniformity. This impression of uniformity extends further, because the frontispiece, *Gassendi, Nov. 7, 1867 10 p.m.*, appears to be a steel engraving after a photograph with the mid-tone effects provided by very fine-ruled lines. In fact, the acknowledgements at the foot of the frontispiece: 'Jas. Nasmyth del. Thos. Barlow scult.' reveal that this image is instead a reproduction of one of Nasmyth's original drawings on mid-tone grey paper similar to the one shown in Chapter III of this study. This multiplicity of mediums continues right through this edition at every level. For example, Plate IV *Picture Map of the Moon* is a square image, reproduced photographically as a woodburytype, taken from a photograph of Nasmyth's famous six-foot map of the moon. In this image, photography has been used twice: firstly as a method of reduction and secondly as a print medium of dissemination. The expected use of photography; the 'truth-bearing' record of the original object (the moon), has not been used at any stage, although this 'full-face' image follows directly after a woodburytype reproduction of de la Rue and Beck's photographic image Plate III *Full Moon*, and so possibly gains from its distantly-reflected actual moonlight.

A description of how the six-foot map of the moon was produced must

[448] The publisher's records of this edition list expenses to 'McQueen Producing 5 plates Steelfacing and electro' John Murray Archive: Ledger G Folio 376.

be included here as an example of how thoroughly convoluted the process of reproduction could be. The map itself was sketched out following the Beer and Madler map as a guide. Every object was then given a shadow, because, as Nasmyth argued, the intensely dark shadows were often the most obvious features of an object, while trying to locate it on the Moon's surface. However, these shadows were not applied as if the entire face were being viewed at the same moment, but rather, he chose to give 'appropriate shading' showing the 'general aspect of the object'. In other words, Nasmyth 'adjusted the shading so that all objects should be shown under about the same angle of illumination'. This means that the picture map of the moon, sc carefully drawn and shaded that it gives an appearance of instantly-observed three-dimensional reality, is an amalgamation of many judgements, mixed with observations. Unlike the de la Rue and Beck photographic image, the surface of this moon is displayed with an even but fictive illumination.

As all the Plate images in Nasmyth's book, even the *Picture Map of the Moon*, had a photographic negative as their starting-point, it is strange to see such a range of processes being used to produce them in print. In the absence of any further evidence, it is necessary to guess at the intentions behind this. The edition was produced quite rapidly, between October and December 1873, and in addition the publisher was concerned about a possible financial risk. Possibly the plates were 'added in' in a fairly *ad hoc* way with negotiations and concessions on both sides. The range of mediums -both in terms of how the originals were generated, and in terms of print mediums -could also be seen, however, as fairly typical of this period of print publication; a period which has been described as a 'menagerie of the media'.[449]

[449] Jussim 1974:285.

This 'menagerie' was smoothed over in the second edition of 1885, in which woodburytypes were used to reproduce every image; even the engraving in the frontispiece was photomechanically reproduced in this way.[450] The only exception was Plate XXIV, another version of the five-colour lithographic plate noted above. The format of the book was reduced to 8vo, and the selling price was a little lower; 21/-. One thousand copies were printed, with 250 copies sold to Scribner's (in America). Nasmyth requested a certain image quality: 'I prefer the Blue Black tone to the Brownish or purplish tone: I want them all *uniform* in this respect'.[451] Unlike the mixture of tones, surfaces and colours of the first edition plates, Nasmyth therefore preferred a 'single message' approach. In addition, he preferred a colder black to an imitation of the sepia tints of older photographic processes.

The unified approach to this edition, and the use of photomechanical reproduction, give an authority and air of actuality to the images which was more diffused in the first edition by the shifts in surface and medium. However, the images were all still produced from the same set of negatives, which in turn were largely generated by the plaster models, hand, apple, and cracked glass globe which Nasmyth used as his Moon similes. In addition, although woodburytypes have a reputation for providing 'superlative continuous halftones',[452] the images in the 1885 edition of *The Moon* had lost some of their finer tonal gradations; becoming more harshly contrasting and occasionally losing definition also. This is most noticeable in the *Hand and Shrivelled Apple* images which not only lost focus and tonal quality but were reversed.

Although the images in both editions were printed using 'permanent

[450] However, the images were re-ordered and slight substitutions were made.
[451] John Murray Archive: Nasmyth to Murray 28 July 1885
[452] Jussim 1974:57.

processes', nevertheless, the plates themselves will shorten the lives of these books. Both heliotypes and woodburytypes had to be printed on, or pasted onto, heavier plate paper; the only images in these editions of *The Moon* which could have been run with the type were the wood engraved figures in the text. The heavy plate paper sheets place a tension on the structure of the book which will cause the pages to tear away from the spine; something which was apparent in the editions consulted in this study.

There was one further edition of Nasmyth and Carpenter's book in 1903: 'a new and popular edition, in a compact size, and at a greatly reduced price', 5/-. This was a straightforward re-issue of the 1885 version of *The Moon*, with all the plates photographically reproduced using a half-tone screen. This remained in stock until 1918,[453] by which time its theoretical basis had been overtaken by G.K. Gilbert's (1843-1918) ideas on the importance of meteorite impacts in forming the surface features of the moon.[454]

When the book was first published, reviewers singled out the illustrations for attention. For example, the *Popular Science Review* praised the 'new feature in giving so many grandly-executed views of the lunar planet',[455] while *Nature* also praised the methods used to achieve this: 'far more perfect than any enlargement of photographs could possibly have been... (because enlargement softened the image) whereas, the more powerful the telescope employed and the more perfect the atmospheric conditions, the more does the unevenness and sharpness of every lunar detail come across'.[456]

[453] John Murray Archive: Ledger G Folio 376; this edition had a print run of 2000.
[454] Whitehouse 2001:141.
[455] *Popular Science Review* 1874 13:193-4.
[456] *Nature* 12 March 1874:358-61; these reviews re-echo the opinion given in the 1857 in the *Liverpool and Manchester Photographic Journal* (see note 413 above).

Nasmyth's photographs re-created a landscape that already existed largely in the imagination. Every experience of the actual moon landscape at this period was mediated through a lens, and furthermore, the image danced before the eye of the viewer 'several times in a second'. Nasmyth re-staged not only that view through the lens, but simultaneously the static underlying conception of the observer, using his mediums of reproduction to create a unified illusion of actuality.

Chapter VI: Conclusion

This study opened with some general questions which were: which other drawing traditions, apart from the those of fine art, were taught and practised in the early- to mid-nineteenth century? How useful was drawing as a general professional skill? Who was involved, and how much 'overlap' and possible cross-fertilisation took place? An additional factor at this period was the possible influence of mechanical reproduction. Although mechanical processes have sometimes been characterised almost as the antithesis of drawing, it was felt that this element was too important to be left out of a study of this period. The sober opening questions are the outcome of a desire to get at the area where specific drawing practices, and attitudes towards drawing, started to come into being out of a wider social background. It was decided to study one person's drawing career in order to see how, in working examples, this wider engagement may have taken shape.

James Nasmyth's involvement in many areas of drawing suggested that he could be a fruitful subject for this study. This has been true; in terms of volume of material this has meant that there are some issues which have had to be left on one side, and some areas which could be expanded further. Nevertheless, studying his use of different drawing conventions, and the possible relationships between them, has provided some answers, not only in relation to Nasmyth himself but as the basis of more general conclusions.

Chapter II was concerned with establishing the context of Nasmyth's own education in drawing, and to locate that within a wider description of drawing instruction available between around 1820-30 in Edinburgh. This included private masters such as James Nasmyth's

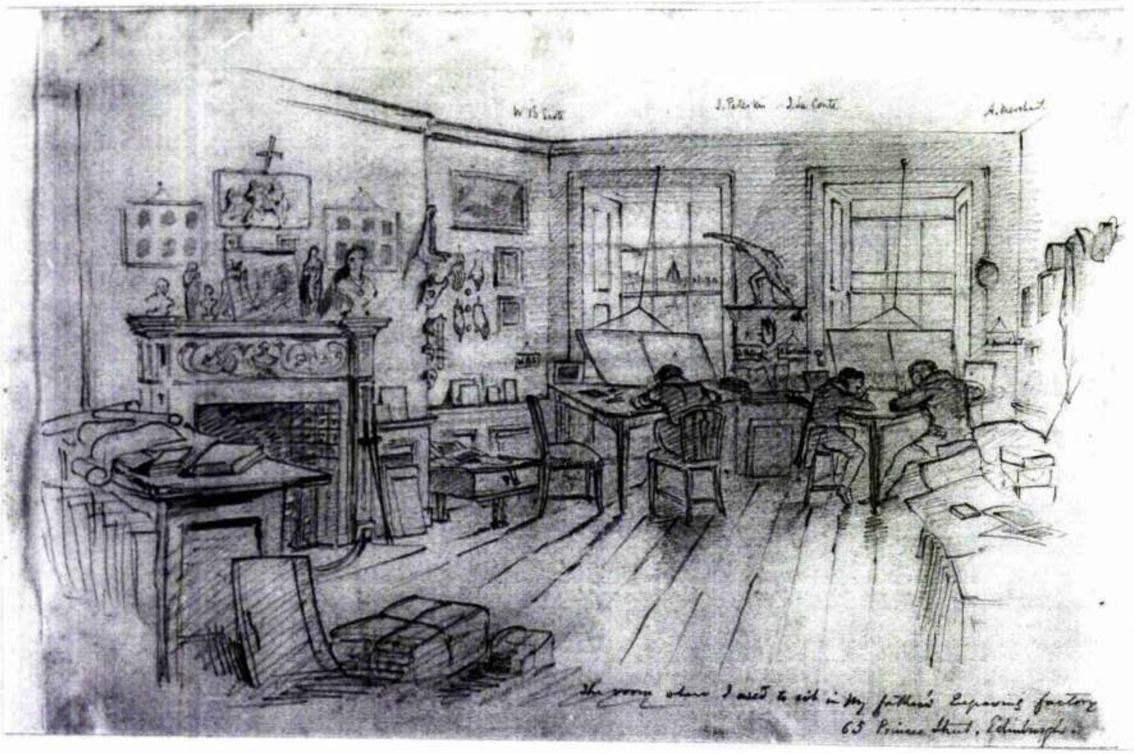

Figure 48: William Bell Scott, *The room where I used to sit in my father's Engraving factory*, undated(National Galleries of Scotland Print and Drawing Collection D4712.7).

own father, the Trustees' Academy, the School of Arts, and the Military Academy in George St. Information from these sources showed that in a year such as 1826, almost five hundred students, who were mainly apprentices or young tradesmen, took part in drawing classes. The range of trades represented in these common classes extended from artistic ones such as engraving, painting, or sculpture through to more technical ones such as brassfounding, carpentry, and smithying. Furthermore, specific examples taken from drawing manuals, letters, and surviving drawings also seemed to suggest that one person could have adopted a range of drawing modes to be used in both their working and personal lives. In addition, examples of different working lives helped to demonstrate that social categories were fairly fluid. Following on from that, different drawing practices cannot therefore be rigidly associated with only one rank.[457] In passing, it is worth noting also, despite the term 'students' (as used above), that adolescent children did not conform to current social and working roles. This short study alone has shown groups of boys (and girls) running workshops and chasing contracts in a range of visual enterprises. These include: James Nasmyth's own siblings (drawing and painting instruction); John Farey and his siblings (technical illustration and engineering); and the children of Wilson Lowry (steel engraving). Figure 48, *The room where I used to sit in my Father's Engraving Factory 65 Princes St., Edinburgh* by W. B. Scott (1811-1890) shows another such group of boys from this period.[458]

The number and variety of people involved in active drawing (outside the category of fine art training) implied by this brief survey of one city suggests one area where this study could be expanded. That is, more work could be done on the evolution of drawing through

[457] See the discussion , Chapter II of 'an agreable pastime for ladies and gentlemen of leisure'. (Bicknell and Munro 1988:14)
[458] NGS Prints and Drawings Collection D4712/7, undated.

training and working practice beyond fine art traditions and the resulting general level of active participation in the development of visual skills. There is hardly any information on this for the period before the opening of the first Schools of Design around 1837 and only a little more after.[459] This then leads on to the additional question of synthesis and assimilation between styles.

Chapter IV was concerned with some aspects of visual culture that could be seen to follow on from the wider range of drawing skills indicated by Chapter II. These included technical drawing, and some aspects of mechanical reproduction. Even this very short treatment of this subject showed that 'mechanical reproduction' cannot simply be understood as the shorthand for 'printed photographic reproduction', but was more pervasive, extending from machines to produce drawings (such as the rose lathe), to drawings to produce machines (such as technical drawings) and to mass-reproduction of drawings of machines (as technical illustrations). The importance of rights to intellectual property and the development of patent and copyright laws was a further important element in the value of mechanical reproduction in relation to drawing which was touched on but was not able to be expanded within the confines of this current study.

The main part of Chapter IV then discussed the role and nature of technical drawings in a large industrial operation such as the Bridgewater Foundry. Here it was seen that this period saw the creation of a new group of workers with visual skills (draughtsmen) in drawing offices. Technical drawing had a distinctive theoretical basis and its own visual style. This body of technical drawings was seen in

[459] For example, the 1849 Select Committee on the Government Schools of Design discussed 'the considerable number of students' who had passed through the Schools; Henry Cole gave a figure of around 15,000. (Romans 1998: 194) Because of the emphasis on 'a few original designers' both then and now, a 'bottom-up' description of the evolution of drawing conventions has not really emerged.

relation to drawings in Nasmyth's Scheme Book; this gave some insight into the evolution of design through drawing. At the other end of this process, the use of technical drawings as public, rhetorical, statements through presentation drawings and reproductions in newspapers and technical publications was considered. Technical illustrations, produced with a battery of mechanical instruments, gave an impression of superhuman accuracy and neatness. Their hard edges, combined with the application of effects of light and cast shadows gave a hyper-real sharp focus and simulated three-dimensionality to images which had started out as flat, frontal, conceptual diagrams.

In the overall structure of the argument, these chapters on mechanical reproduction and technical drawing had been intended as an antithesis to earlier material (Chapters II and III) which had given examples of Nasmyth's work in which he had valued the skills of hand working as summed up in his rule: 'The truth is that the eyes and the fingers -*the bare fingers* -are the two principal inlets to sound practical instruction'. Nasmyth's development of machine tools in which 'the attendance of the workman is entirely dispensed with by the introduction of the *self-acting principle*'[460] can be seen as a straight contradiction of his celebration of hand skills:

> Up to within the last thirty years, nearly every part of a machine had to be made and finished to its required form, by mere manual labour; that is, on the dexterity of the *hand* of the workman, and the correctness of his *eye*...the necessity of more trustworthy and productive agents rendered some change in the system imperative. (Nasmyth 1841:394-5)

Out of this conflict of values in James Nasmyth, it was hoped to see some new forms of drawing practice emerge, either in the conditions laid down for his employees, or in his own work. In the overall population of Nasmyth's workforce, the visual skills no longer

[460] Nasmyth 1841: 399.

required by the machine operators were now demanded in the drawing office.[461] In relation to 'one person' such as Nasmyth himself, it may have been the case that rather than a process of assimilation, he simply carried around a stew of undigested gobbets of approaches to drawing, each one only suitable to a particular circumstance. At an early stage of research, it had been thought that photography might have been used by Nasmyth as a medium in which his contradictory attitudes to drawing might have somehow been reconciled. In retrospect this hypothesis seems to offer a simplified and rather too cosy narrative. The material itself offered up some more complex answers. Firstly, as has just been noted in relation to the drawing office workers, visual skills were not stamped out by mechanical reproduction, but were chanelled in new directions. Secondly, in relation to Nasmyth himself, a close study of the mental and physical processes involved in his production of his images of the Moon suggested some other surprising transformations of drawing practice through his lifetime.

As described in this study, Nasmyth used many modes of drawing, ranging from freely-drawn, rapid, observational and fantastic sketches to careful technical drawings. In addition he experimented with new methods of image production such as lithography and photography, not simply because they were print mediums but because of the different quality of marks and the final images they produced. This was seen, for example, in his use of photography to produce his images of the moon in Chapters III and VI. The protean nature of the imaging processes used, for example in producing the pictures of the moon for publication, suggested a far more ambiguous and untidy approach, in which any medium which served its purpose was coopted in turn. This 'piggy-back' process of drawing and imaging

[461] This seems to be in accord with the suggestions of 'revisionist' historians in the de-skilling debate reviewed in Romans 1998: 135-50.

seems analogous to Jussim's 'menagerie of the media'.[462] Nasmyth undoubtedly developed a new process of drawing with new marks and new surfaces, but in a way that seems far from the kind of coherence implied by the idea of synthesis or assimilation. Nevertheless, his contemporaries praised the virtual reality of his photographic Moon images in the full knowledge of this complicated indirect process.

Geoffrey Batchen's book *Burning with Desire* (1999) put forward the idea that at the heart of photography right from the beginning was a resistance to definition or categorization. Photography has also been described as the producer of images which are: 'ephemeral, ubiquitous, insubstantial, available, valueless, free'.[463]

Nasmyth's use of images and his use of a range of methods and processes in the production of images seem to suggest an equal resistance to definition; it is hard to ascribe a value of truth to them, for example. However, they were not purely photographic, but assembled from a range of processes. It may be that some of this is simply to do with Nasmyth's own peculiarities; his constant pillaging and re-ordering of images has already been noted in the discussion of sources. However, the use of mechanical reproduction, and exposure to a whole range of image production also assisted this process and in that sense Nasmyth can be seen as a useful subject in the wider concerns of this study. It had been hoped that Nasmyth would be a useful bridge from 'one person' to many people, and also from known to unknown material. The 'ordinaryness' of Nasmyth has been put forward by the economic historian Cantrell, who suggested that without his partners and investors, Nasmyth would have remained

[462] Jussim 1974: 285.
[463] Berger 1972: 32. From the first essay in his influential *Ways of Seeing*, derived from the work of Walter Benjamin.

one of the many small jobbing engineers of the period.[464] In that sense, his experience of education and the uses of drawing can stand for the experience of his many contemporaries in training and in work whose stories are still not fully told. The material presented in this dissertation could suggest, equally, that being ordinary at this period included being an active participant in the new and inventive visual culture which developed under the impact of mechanical reproduction.

[464] Cantrell 1984: 13.

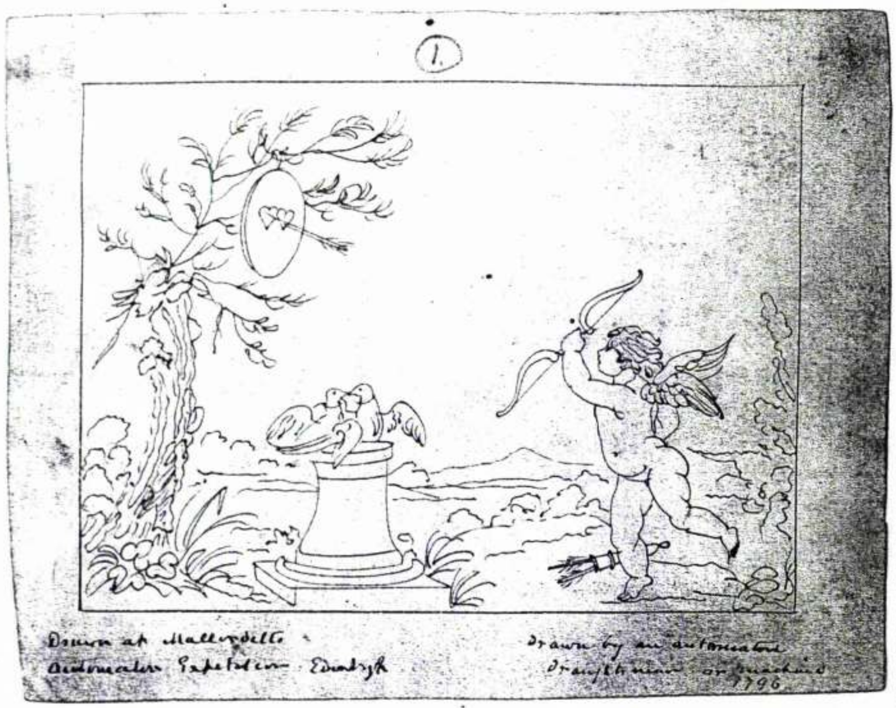

Figure 49: *Drawn by automaton draughtsman or machine 1796*; This is the first image in the Nasmyth sketchbooks in the NLS, referred to in Chapter I: 2. (NLS Ms 3241 no.1).

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