Publisher's Note - Part 2

Part 2 of our project *Industrial Revolution; A Documentary History* covering the Boulton and Watt Archive and Matthew Boulton Papers from the Birmingham Central Library concentrates on the Notebooks and Papers of James Watt and family from the 8 boxes of material in Muirhead I.

James Watt was born at Greenock in January 1736 and began work in Glasgow at the age of 18. His father was a builder, contractor, instrument-maker, ship owner and merchant. In 1755 the young Watt spent a year in London learning how to make precision mathematical instruments. Two years later he opened a shop in Glasgow and by 1759 had entered into partnership with John Craig. He became involved in canal construction and made various journeys to London on canal business. Watt, of course, is famous for his pioneering work on steam power and his steam engine became known as 'the work-horse of the Industrial Revolution'. After repairing a Newcomen engine model in 1763 belonging to the College of Glasgow his work on the separate condenser steam-engine started in earnest around 1765. Before he moved to Birmingham, Watt's circle of friends and peers included Joseph Black (who described latent heat) and Adam Smith.

Watt, according to his memoir of Boulton written in Glasgow in September 1809, first visited Soho Works in Birmingham in 1767. He was introduced to Dr William Small and his partner Mr Fothergill who then showed him round the works. In 1768 he was again at Soho, on his return from London where he had been taking the necessary steps to obtain a patent for the improved steam engine. On this visit he was introduced to Matthew Boulton who had been absent on the previous occasion. Watt records:

"I had much conversation with Mr Boulton … On my part I explained to him my invention of the Steam Engine and several other schemes of which my head was then full, in the success of which he expressed a friendly interest. My stay at Birmingham at that time was short, but I afterwards kept up a correspondence with Mr Boulton through our mutual friend Dr Small."

In 1774 Boulton took over Roebuck's share in the patent of Watt's invention. Watt moved to Birmingham (details of the journey are recorded in one of his notebooks) and continued his experimental work on the engine with great success. He quickly became an active member of the Lunar Society. The patent was extended for 25 years from 1775 and a partnership between Boulton and Watt was concluded for a similar term.

The material in Part 2 is a rich source for Watt's developing interest in steam power including details of his experiments. Four notebooks cover his early notes on this subject and there is also a substantial section of correspondence, for the period 1778-1785, between James Watt and Joseph Priestley, Joseph Banks, Mr de Lue, Joseph Black and Mr Kirwan concerning various experiments with air, conversion of water to air and the composition of water.

Notebooks and other papers also contain much material on his canal surveys (at least 30 items are devoted to this topic - particularly the Strathmore, Monkland, Crinan, Borrowstonness, and Caledonian Canals); early negotiations with Roebuck and Boulton 1772-1774; insights into the patent process; other engineering works [for example, Greenock Harbour and Waterworks, Port Glasgow Dry Dock and Harbour, Ayr Harbour, Hamilton Bridge, Rutherglen Bridge and numerous River Surveys]; Watt Engines in Cornwall and throughout England and Scotland; notes of Watt's journeys to London, Cornwall and Scotland; and a strong collection of printed items including Directions for Erecting and Working the Newly-Invented Steam Engines by Boulton and Watt (annotated copy 1779), memoirs of James Watt, and an account of James Watt's Improvements upon the Steam Engine.

There are also some documents relating to his early life, family matters, to his father, James Watt, and also to the death of his first wife, Margaret.

Two boxes of material relate to his son, James Watt, Jnr. These include a diary of a journey to visit mines in Germany and Bohemia (1787), his travels in France, Italy, Switzerland and Germany (1792-3); substantial documentation on the Soho Manufactory and Foundry including materials for new engines, wages for workmen, pricing policy, a plan to establish watchmen at the Soho Manufactory (1801), visits to various mines and engines in the north of England (Manchester, Bradford, Newcastle, Durham, 1798), visits to the collieries and iron works of South Wales, a notebook containing a geographical list of engines and mines (1808); notes of experiments with steam boat engines; and notes on various engines at Water Works in Lambeth, Chelsea, West Middlesex and elsewhere. James Watt Jnr was very active in the Boulton and Watt businesses by the mid 1790's and the papers included here reflect that. The firm of Boulton, Watt and Sons was established in 1794.

These notebooks and related papers feature very full entries and include some excellent diagrams, plans and drawings. This microform edition enables the scholar to examine closely the impact of Watt's invention and see clearly the ties between business, industry and scientific inventions.

Each part of this project has a clear theme and unity. Libraries can acquire the project part by part confident that each area has clear research and teaching potential. The paperback guide contains full contents of reels, background information such as data on prominent individuals, detailed listings, chronologies and other relevant bibliographic details.

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Technical Note

Our microform publications have been prepared and produced in accordance with recommended and established guide-lines for the production of microform of superior quality. These conform to the recommendations of the standard guides to good microforming and micropublishing practice.

Attention should be drawn to the nature of the original material. Part 2 contains a substantial number of notebooks, correspondence, drawings and plans, printed items and other material. Item numbers are marked on individual documents in pencil. A few documents are in rather fragile condition, a few are faintly legible or have been written on both horizontally and vertically with text merging in a cross-hatch pattern. A few manuscript documents consists of faintly legible records written with a variety of inks, pens or pencils and on paper which has become severely discoloured or stained, or which is so thin that there is show through that renders the original document difficult to read. A few notebooks have text running in reverse as well as in the normal manner. Certain items which have been written upon both in ink and in pencil have been filmed twice at different light densities to effectively capture all the pencil annotations. Items consisting of rolled up documents tied as bundles or as scrolls have been flattened prior to filming. Targets have been inserted to show where blank pages or folios of notebooks have not been filmed. Some items are especially fragile and have necessitated extreme care and attention. A few other items consist of photocopies of documents or transcripts. Where necessary fragile material has been mounted on sheets of plain white paper to reproduce the item more clearly. Occasionally volumes have been tightly bound an documents are partially obscured in the inner margin resulting in a small amount of text loss or distortion.

These original characteristics present problems of image and contrast which stringent tests and camera alterations cannot entirely overcome. Every effort has been made to minimise these difficulties. The outside covers of all files, folders and volumes have been filmed. Where the item number is difficult to read this has been filmed again on a sheet of plain white paper. A few very large oversize items, such as a small number of printed maps and newspapers, have been filmed in CINE mode or in sections.

The most responsible care has been exercised in the filming of this unique collection and every effort has been made to ensure that this microform publication meets the standards established by the Association for Information and Image Management (AIIM), the American National Standards Institute (ANSI) and prevailing European standards

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Detailed Listing - Part 2

MUIRHEAD I

Box 1

MI/1/1:
Day Book, Journal and Ledger of John Watt of Greenock [Brother of James Watt], 1759-1761

MI/1/2:
Invoice Book of John Watt of Greenock, 1761-1762

MI/1/3:
Waste Book and Journal of John Watt of Greenock, 1761-1762

MI/1/4:
Ledger of John Watt of Greenock, 1761-1762

MI/1/5:
Burgess Ticket of The City of Perth granted to James Watt. With Seal. 9 April, 1770

MI/1/6:
Burgess Ticket of the town of Hamilton granted to James Watt. Hand painted crest. 7 June, 1770

MI/1/7:
Letter announcing election of James Watt as a Fellow of Royal Society, 29 November, 1785

MI/1/8:
Certificate of election of James Watt to the Batavian Society, Netherlands, 1787

MI/1/9:
Burgess ticket of the town of Paisley granted to James Watt. Hand painted crest. 9 October, 1800

MI/1/10:
Letter from Paisley Council accompanying the above, 9 October, 1800

MI/1/11:
Honorary Degree of Doctor of Laws awarded to James Watt by University of Glasgow. With seal (in metal box). 15 May 1806

MI/1/12-13:
Letter of nomination to membership and certificate of election of James Watt to the National Institute of France, 20 June 1808

MI/1/14:
ournal Notebook of James Watt. Includes: notes of expenses on a journey to London; notes about Patents; observations on Water of Leven, The Kinneil Engine and Survey of Strathmore canal, 1768 and 7 April-7 May 1770

MI/1/15:
Journal Notebook of James Watt. Includes: Strathmore canal survey (contd.), Monkland canal survey, River Clyde survey, Dumbarton road survey and Hamilton Bridge survey, May-October, 1770

MI/1/16:
Journal Notebook of James Watt. Includes: Monkland canal survey, Hamilton Bridge and Strathmore canal, October 1770 April 1771

MI/1/17:
Journal Notebook of James Watt. Includes: Monkland canal survey, Ayr harbour, Port Glasgow Dry Dock, Crinan canal and Borrowstoneness canal, April 1771 November 1771

MI/1/18:
Journal Notebook of James Watt. Includes: Monkland canal survey, Port Glasgow Dry Dock and Harbour and Ayr Harbour, November 1771 July, 1772

MI/1/19:
Journal Notebook of James Watt. Includes: Monkland canal survey, Crinan canal survey, Tarbert Report, Greenock Harbour, Greenock Waterworks, Lord Cochranes Steam Engine and Boulton and Roebuck negotiations, July 1772 April 1773

MI/1/20:
Journal Notebook of James Watt. Includes: Monkland canal, Campbeltown canal and harbour, Survey of River Forth, Survey of Caledonian canal, Boulton/Roebuck Settlement, steam experiments and death of his first wife, Margaret, May 1773 March, 1774

MI/1/21:
Journal Notebook of James Watt. Includes: Greenock cistern, Gilmerton coal mine, Rutherglen bridge, journey to Birmingham and note on Mr Smellies engine pit and Mr McGrigors mill at Glasgow (1775), March May 1774

MI/1/22-24:
Statement of cash received and paid on account of the Monkland canal by James Watt, 1770-1775

Box 2

MI/2/1:
Cash memorandum book of James Watt, 1761

MI/2/2:
Cash memorandum book of James Watt, 1763-1765

MI/2/3:
Cash memorandum book of James Watt, 1765-1767

MI/2/4:
Cash memorandum book of James Watt (includes expenses of a visit to London, 1767

MI/2/5:
Cash memorandum book of James Watt (includes notes on canal locks, Darwins medical theories etc.), 1767

MI/2/6:
Cash memorandum book of James Watt (includes travel expenses to London, Scotland etc.), 1774-1775

MI/2/7:
Cash notebook of James Watt (includes expenses in London, Birmingham and Sheffield and purchases of mathematical and musical instruments, household goods, jewellery, toys etc.), n.d., c.1769

MI/2/8:
Notebook of James Watt (steam and atmospheric experiments, notes on the power of various engines, the condenser, etc.), 1770-1781

MI/2/9:
Account Book of James Watt for repairs at Newhall Hill, travel to and expenses in Cornwall etc, 1775-1779

MI/2/10:
Engine Book (printed tables for performance and additional notes), 1774-1781

MI/2/11:
Cash Book (expenses in Cornwall), 1778-1783

MI/2/12:
Cash Book (Birmingham), 1786

MI/2/13:
Cash Book (journeys to London, Scotland etc.), 1787-1789

MI/2/14:
Cash Book, 1789-1793

MI/2/15:
Cash Book, 1793-1802

MI/2/16 (1):
Cash Book, 1802-1807

MI/2/16 (2) :
Cash Book, 1807-1808 [16a-j : Various receipts and engravings in /16 (1)]

MI/2/17:
Journal notebook of James Watt (includes visit to London; Albion Mill engine; pressed herb, paper silhouette etc.), 1786-1787

MI/2/18:
Notebook of James Watt (twisting cast iron, wood; lenses; velocity of water etc.), c. 1786-1789

MI/2/19:
Notebook of James Watt (various engines; collieries near Newcastle, and engines; journey to Cornwall; copying machines etc.), 1795-1797

MI/2/20:
Journal of James Watt, 1795-1803

MI/2/21:
Table of Cornish Engines with times and places of erection and removal, 1777-1800

MI/2/22-38:
List of Engines in the Two Old Drawing Books and details of various Engines in Cornwall and elsewhere, 1775-1780

MI/2/39:
Parchment pocket of James Watt. Heathfield.

MI/2/40:
Report relating to the Lomond Passage for the Great Canal by James Morison, Land Surveyor, 1767

MI/2/41:
Report of James Watt concerning navigating the Rivers Forth and Leven and making a navigable communication between the Forth and Loch Lomond [incomplete] n.d.

MI/2/42:
Notebook of James Watt with details of expenses, wages etc. for surveying for canals, 1769-1774

MI/2/43-51:
Miscellaneous receipts, accounts, 1769-1774

MI/2/52:
Report concerning the possibility and expense of carrying an artificial navigation into Strathmore by James Watt, 1771

MI/2/53:
Field Book of Surveys of the Monkland Canal (1769-1770) and Strathmore Canal (1770)

MI/2/54:
Notebook containing: reports on the River Clyde from Broomielaw Quay to Dumbuch Ford; copy letters to John Golborne concerning surveys; Monkland Canal Survey; proposals for Port Glasgow Harbour and dry dock (1769); observations on Mr Golbornes estimates for deepening the River Clyde; and copy letters to John Smeaton; William Alexander (Cluny Engine); Strathmore Canal (1770) lock estimates etc, 1769-1770
MI/2/55: Draft report on the Strathmore Canal, 1-18 [1770]
MI/2/56-79: Letters, notes, calculations etc. from MI/2/54. Includes proposals for Cluny Engine alterations (65-66); report on the River Clyde Level; letter from James Watt of Greenock re: Port Glasgow (/59) Letter of Smeatons re: Monkland Canal (/60) Crieff Canal distances (/73).

MI/2/80:
Corrected copy of A Scheme for Making a Navigable Canal from The City of Glasgow to The Monkland Coalierys by James Watt (printed), 1769

MI/2/81:
An Account of the Scheme for Rendering Navigable the Rivers Forth and Devon by James Watt (printed), 1774

MI/2/82:
Draft Report concerning the isthmuses of Tarbert and Crinan by James Watt [c. 1771]

Box 3

MI/3/1:
Report by John Smeaton concerning navigation of River Devon, Clackmannanshire from Mellockfoot to River Forth, 1767

MI/3/2-10:
Letters, draft reports, surveys etc. of River Devon and River Forth, 1767-1769

MI/3/2-3:
Including: Draft letter concerning levelling the canal to Tullibody Bridge, 9 October 1767

MI/3/4:
References to James Morisons plan of the Lomond passage, with various calculations, 1767

MI/3/5:
Letter from John Golborne advising employment of James Watt [to Lord Cathcart?], 2 August, 1769

MI/3/6:
Letter from Lord Cathcart enquiring about a Report [to James Watt], 13 September, 1769

MI/3/7:
Description of River Forth from Craigforth New Miln to Alloa Shore with estimates of expense of canal, [1767]

MI/3/8:
Description of Course of Canal between the Forth and Loch Lomond, [1767]

MI/3/9:
Description of the Navigation of River Leven, [1767]

MI/3/10:
Report relating to the Lomond passage by James Morison with Mr Watts opinion on it, 1767

MI/3/11-17:
Rough notebooks of survey of River Forth etc.

MI/3/18-35:
Draft reports on River Forth, Lomond passage etc.

MI/3/36-52:
Miscellaneous calculations, notes etc. relating to the above surveys.

MI/3/53:
Report of John Smeaton on The Harbour of The City of Aberdeen [Printed], 1770

MI/3/54:
A Proposal for deepening and improving The Harbour of Ayr [1771]

MI/3/55a-c:
Observations on the present state of Ayr Harbour.

MI/3/56:
Report of John Golborne on The Deepening of River Clyde and Harbour of Port Glasgow [printed], 1768

MI/3/57:
Report concerning the Harbour of Port Glasgow by James Watt [printed], 1771

MI/3/58a-j:
Expenses of repairing Port Glasgow Dry Dock and report on the harbour, 1771

MI/3/59:
Draft report on the Borrowstowness Canal by James Watt, 1771-1772

MI/3/60-76:
Papers concerning various drainage schemes, bridge construction etc. VIZ:

MI/3/60-64:
etter from John Smeaton concerning the bridge at Hamilton on The Clyde with building estimates by William Purdie, Mason, 1770

MI/3/65:
Note of some particulars relating to the produce of cotton in Island of Cariacon, 1772

MI/3/66:
A Report to Charles Campbell of Barbreck concerning the drainage of his lands at Loch Sanish, by James Watt, 1773

MI/3/67:
The Opinion of James Watt concerning the tide miln Lord Cochrane proposes to erect at Culross, February 1773

MI/3/68:
Letter from James Watt concerning draining of Craigs Meadows and bringing water to Campbeltown Mills, June 1773

MI/3/69:
Report and estimate for draining of Craigs Meadows.

MI/3/70:
Report concerning the draining of the Craigs Meadows by James Watt [fire damaged], 1773

MI/3/71:
Letter and estimates for proposed cuts in the water of Saddell by James Watt [fire damaged] July 1773

MI/3/72:
Letter with James Watts opinion on the proposed cut of The Erecht, August 1773

MI/3/73:
Letter with opinion of James Watt on The Navigation of River Caradel, August 1773

MI/3/74:
Report by James Watt concerning a new Breast in Campbeltown Harbour [fire damaged], n.d. [1773]

MI/3/75:
Letter to the Magistrates of Renfrew concerning a proposed cut and navigation to Renfrew Bridge. n.d.

MI/3/76:
Regulations for the Undertaker of Rutherglen Bridge.

MI/3/77:
Plans of Crinan Isthmus by James Watt (unfinished), 1771

MI/3/78-80:
Sections of Crinan by James Watt, 1771

I/3/81:
Facts relative to Crinan and Tarbert in copy of a letter from James Watt to Henry Barclay, 1771

MI/3/82:
Draft Report and estimates by James Watt concerning the Isthmuses of Crinan (1-42) and Tarbert n.d. [1772]

MI/3/83:
Draft estimates and notes for the Report concerning Crinan and Tarbert (1-11) Isthmuses, n.d. [1772]

MI/3/84:
Prospectus of The Advantages to be derived from the Crinan Canal, by John Rennie. With map [printed], 1792

MI/3/85-89:
Estimates and notes on the Crinan Canal, 1793

MI/3/90:
Map of The Proposed Crinan Canal surveyed by John Rennie. Scale : 27/8 to 1 mile, 1792

MI/3/91/1-6:
Bundle of papers including: Mr. Rennies boreings of Crinan (1792); copy of letter from Rennie to the Duke of Argyll (1792); Mr Rennies estimate of the Dell passage (1792); estimate of Auchinshellach passage (1793); letter from Duke of Argyll (1793).

MI/3/92:
Plan of The Proposed Crinan Canal by John Rennie. Scale: 4 inches to 1 mile. Copied from Mr Rennies plan by William Bell. Hand coloured, 1793

MI/3/93:
Draft letter from James Watt to The Duke of Argyll concerning The Crinan Canal, February 1793

MI/3/94-95:
Copy letters from James Watt to William Patteney concerning The Crinan Canal, 1793

MI/3/96:
Lord Cathcarts Instructions to James Watt to survey the area between Fort William and Inverness and The Lochs Lochie, Oich and Ness etc, 30 August 1773

MI/3/97:
Draft report on the proposed Caledonian canal (1-41) n.d. [1773]

MI/3/98:
Draft estimates for cutting canals from Inverness to Fort William n.d. [1773?]

MI/3/99-110:
Various notes and calculations concerning the Caledonian Canal [1773]

MI/3/111:
Plan of The Caledonian Canal. Scale to 1 mile, printed [1773?]

MI/3/112:
Plan of Loch Eil to Loch Ness. Scale: 1 to one English Mile [1773?]

MI/3/113:
Plan of Lomond Passage surveyed and drawn by James Morison. Coloured. Scale: 1 to 2 English miles, 1767

MI/3/114:
Letter to James Watt from Lord Cathcart with amended preface to the report on the Caledonian Canal by James Watt, December 1773

MI/3/115:
Letter to James Watt from William Small concerning the advantages of a deep canal and probable use of it; experiments with curves; Dr Roebuck etc, January 1774

MI/3/116-123:
Miscellaneous

MI/3/116:
List of bounds of The Muirs of Lesmahagow as mentioned in The Decreet: The Duchess of Hamilton against The Fewars of Lesmahagow, 1675. 1734

MI/3/117:
Letter from [?] at Aberdeen to Lord Cathcart reporting on a survey of Aberdeen Harbour etc. and proposals to curb emigration from Scotland by various landholding reforms, January 1774

MI/3/118-122:
Lists of ships and sailing dates, 1771-1772

MI/3/123:
Miscellaneous calculations

Box 4

MI/4/1-5:
Surveys of lands of Demarnock by River Clyde [now Dalmarnock, Glasgow]. Scale: 35 or 3 Scots chains to 1 inch. Field names etc. given, February 1734

MI/4/6-10:
Five drawings by perspective machine, VIZ: table; chair; Mr Johnston; lower walk of college grounds [Glasgow]; Rutherglen Farm, 1763-1772

MI/4/11:
Plan of the new Tongue, Port Glasgow designed by James Watt, 1771/2

MI/4/12:
Plan of Port Glasgow Harbour showing the new Tongue, 1772

MI/4/13:
Plan of The Monkland Canal in Queensly lands. Scale: 2 chains to 1 inch [English and Scots measures given] n.d. [1770]

MI/4/14-19:
Perspective drawings of Crinan Canal and Loch Gilp, n.d. [c. 1771]

MI/4/20-23:
Plans of Crinan Canal, n.d. [c. 1771]

MI/4/24:
Section of The Auchinshellach Line of Crinan Canal by John Rennie, 1792

MI/4/25:
Section of the Dunamuck Line of Crinan Canal by John Rennie, 1792

MI/4/26-29:
Drawings of Rutherglen Bridge. n.d.

MI/4/30:
Plan of Foundation of two middle piers of Coldstream Bridge by John Smeaton. Scale: 4 feet to 1 inch. n.d.

MI/4/31-33:

Drawings of Greenock cistern and Bleaching Mill. n.d. [c. 1772]

MI/4/34:
Drawing of Glasgow Dock Gate. n.d.

MI/4/35-37:
Copy of Mr Edgers map of Loch Lomond. [Fragile]. nd.

MI/4/38:
Plan of Loch Lochy. n.d. [c. 1772]

MI/4/39-41:
Plans of the projected Caledonian Canal. n.d. [c. 1772]

MI/4/42:
Plan of Loch Eil and Loch Arraig. Scale: 1 inch to 1 mile. Very fragile, n.d. [c.1772?]

MI/4/43:
Plan of a fort? n.d.

MI/4/44-45:
Harbour measurements? n.d.

MI/4/46-69:
In separate bundle

MI/4/46:
Plan of the intended Canal from Perth to Forfar part of the Strathmore Canal, 1770

MI/4/47:
Plan of Borrowstowness Canal, surveyed by James Watt. Drawn by Mr Pinkerton. Scale: 10 Scots chains to one inch, 1771

MI/4/48-49:
Plans of Avon water, part of Borrowstowness survey. n.d. [c. 1771]

MI/4/50:
Plan of Ayr Harbour by James Gregg. Scale: one inch to two chains, fragile, 1771

MI/4/51:
Unfinished copy of above [c. 1771]

MI/4/52:
Section of Tarbert isthmus [c. 1771]

MI/4/53:
Section of Tarbert and Crinan isthmuses [c. 1771]

MI/4/54-56:
Plans of Tarbert and Crinan [c. 1771]

MI/4/57:
Plan of Greenock Harbour. Scale: one inch to eleven yards. Surveyor: ? James Watt, 1772

MI/4/58:
Plan of Greenock Harbour and Port Glasgow, 1772

MI/4/59:
A Draught of the New Harbour at Greenock. Scale: one inch to 72 feet (approx.). Surveyor: Henry Pate, Hand coloured, 1772

MI/4/60:
Survey for Campbeltown Canal [1773]

MI/4/61-69:
Graphs and calculations of boiling point of water etc, 1765-1802

Box 5

MI/5/1:
Correspondence from Joseph Priestley to James Watt concerning various experiments (1-17) with air, conversion of water to air and giving examples of Priestleys shorthand, 1778-1785

MI/5/2:
Extracts from correspondence between Watt and others on the composition of water. Correspondents include Joseph Priestley, Joseph Banks, Mr de Luc, Joseph Black, Mr Kirwan etc, 1782-1784

MI/5/3:
Rent book and Ledger for Watts estates in Wales and elsewhere (16 enclosures), 1798-1808

MI/5/4:
Ledger for Watts estates in Wales and accounts with James Crummer (12 enclosures), 1809-1813

MI/5/5:
Cash book of James Watt for Welsh estates, 1810-1813

MI/5/6:

Minutes of the Committee for the erection of a monument to the late James Watt (2 enclosures), 1824-1827

MI/5/7:
Notebook of Subscriptions for a monument to the late James Watt with Coutts & Co, 1824-1832

MI/5/8:
Notebook with Subscriptions for a monument to the late James Watt with Spooner, Attwood & Co, 1824-1832

MI/5/9:
Notebook of Subscriptions towards the fund for erecting a monument to the late James Watt from Soho Foundry [c. 1824]

MI/5/10:
Notebook of Subscriptions for the erection of a monument to the late James Watt and Subscriptions received in Birmingham [c. 1824]

MI/5/11:
Enclosures: Copy of Birmingham Chronicle with notice concerning subscriptions to the National Monument to the late James Watt, 15 July, 1824

MI/5/12:
Detailed accounts for labour and materials in erecting a Gothic Cemetery at Handsworth to the late James Watt by W. Hollins, 1825-1827

MI/5/13:
Abstract and codicil of the late James Watts will, letters and receipts concerning (1-14) erection of a monument to him etc, 1819-1830

MI/5/14:
Papers and newspapers concerning the funeral of James Watt, deceased (1-11). Includes: lists of friends and those to have mourning rings; Order of Funeral; expenses for Faculty to erect a chapel and vault at Handsworth parish church (1825); copies of The Courier; The Times; Ariss Birmingham Gazette; the Birmingham Chronicle; announcing the death and funeral of James Watt, August-September, 1819

MI/5/15:
Correspondence, accounts etc. concerning Handsworth Cemetery and Chapel, dispute (1-106) with W. Hollins, builder of the memorial chapel etc. Correspondents: George Barker; R. Bridgens; M. Burden; J. & J. Carline; F. Chantrey; F. Clayton; Revd. E. Dales; Thomas Dixon; Revd. T. L. Freer; Henry M. Griffiths; James Haden; J. W. Higgins; Benjamin Hollins; William Hollins; V. H. Miller; John Molt; W.C. Mylne; Rickman & Hutchinson; R. Thomson, 1825-1829

MI/5/16 :
Bundle of newspapers with obituary notices for James Watt and articles on James (1-7) Watts early life, his ancestors etc, 1819-1838

MI/5/17:
Schedule of Deeds and Papers at Messrs. Barker & Griffiths, Trustees of James Watt, Jnr. [catalogue of Watt family papers], 1848

MI/5/18:
Bundle of miscellaneous letters etc. including: notes on prevention of escape of heat (1-18) by confined air; arbitration of Dalzel contra Baxter & Hood; tables and instructions for calculating the velocity of water in pipes; bill for delivery of books etc. (1825); letter on printing Watts articles on The Production of air from water (1784); letters from Sir Joshua Banks about experiments, Royal Society etc. (1784); article on Handsworth for Lewis Topographical dictionary, 1784-1843

Box 6

MI/6/1:
Diary-notebook of James Watt, jnr. Describing a journey to The Erzgebirge and Bohemia with visits to various mines at Marienberg; Annaberg; Carlsbad etc. in English and German, 1787

MI/6/2:
Account book of James Watt, jnr. (Travel expenses to Paris, Italy, Sicily, Switzerland, Germany: List of books purchased etc.), 1792-1793

MI/6/3:
Ledger of James Watt, jnr., for wages of workmen; materials of new engines; engine manufactory, 1794-1801

MI/6/4:
Notebook of James Watt, jnr. Includes: List of prices for making copying machines and equipment; counting house machines; materials; paper; ink etc. Also Minutes of meeting to consider a plan for establishing watchmen at Soho Manufactory (1801), 1796-1828

MI/6/5:
Notebook of James Watt, jnr. (Soho Foundry Work), 1797-1799

MI/6/6:
Medical Journal of James Watt, jnr. (visit to Bristol to try Dr Beddoes Pneumatic Apparatus and Fumigation Chamber; curative baths; chemical remedies etc. Visit to Brecon, Abergavenny, Kingswood Collieries.), 1797-1799

MI/6/7:
Notebook of James Watt, jnr. recording a journey to Manchester, Bradford etc. across to Newcastle, Durham. Visits to engines and mines. Various notes, calculations and sketches, May-July, 1798

MI/6/8:
Household memorandum book of James Watt, jnr. Lists of furniture and goods at The Rookery and at Soho Foundry, 1798, 1802

MI/6/9:
Catalogue of books belonging to James Watt, jnr., 1798

MI/6/10:
otebook of James Watt, jnr. (Soho Foundry and Engine business), 1797-1801

MI/6/11:
Notebook of James Watt, jnr. With descriptions of coal, collieries and Iron Works in the Forest of Dean and South Wales (Neath, Swansea, Brecon, Merthyr etc.), c.1800. And Loose Papers: Copy of Codicil of Will of James Watt 7 July, 1819. Notes on Coals and Iron Stone in Forest of Dean.

MI/6/13:
Notebook of James Watt, jnr. Includes: Coal trade; Foundry engines; Servants agreements; Well in Engine Yard; Populations of European States; Improvements at Soho Foundry; Duties on property etc, 1801-1804

MI/6/14:
Notebook of James Watt, jnr. Includes: Notes and tables for physics experiments; Toasts; job descriptions for bricklayers, glaziers etc; notes on Slide Rule; Solids; prices of piping etc, 1800-1804

MI/6/15:
Cash book showing payments for building and repair work on various cottages etc, 1802

MI/6/16:
Notebook of James Watt, jnr. with extracts for various guides to Ireland and Arran and itinerary of a journey round Scotland and North-East England in 1801, 1801-1805

MI/6/17:
Notebook of James Watt, jnr. with various accounts, expenses, addresses, notes about the taxes on iron etc, 1806

MI/6/18:
Notebook of James Watt, jnr. describing travels in Wales and Belgium, c.1806

MI/6/19:
Notebook of James Watt, jnr. with notes on dock yards and saw mills and various steam engines, 1807

MI/6/20:
Notebook of James Watt, jnr. with measurements of house at Ystrad, expenses at Doldowlod etc. 1806-1809

MI/6/21:
Notebook of James Watt, jnr. containing geographical list of engines and owners, various sketches etc., 1808

MI/6/22:
Address notebook of James Watt, jnr. [c. 1809]

MI/6/23:
Notebook of James Watt, jnr. with notes on various engines, eg. Lambeth Water Works, Chelsea Water Works, West Middlesex and Adelphi Water Works, Witham Engine Grand Junction Water Works etc., 1811

MI/6/24:
Memorandum book of James Watt, jnr. (various calculations, notes on Wales, boat drawings etc.), 1818

MI/6/25:
Notebook of James Watt, jnr. (steam boat engine experiments etc.), 1818

MI/6/26:
Notebook of James Watt, jnr. (steam boat engine experiments etc.), 1820-1821

MI/6/27:
Notebook of James Watt, jnr. (steam boat engines, boilers etc.), 1824-1827

MI/6/28:
Cash Book (postage, travel etc.), 1824

MI/6/29:
Memorandum book of James Watt, jnr. (Servants wages etc.), 1823-1835

MI/6/30:
Notebook containing tables of measurements, temperature, weights etc. Various enclosures (a-k), n.d.

Box 7

MI/7/1:
Letter book containing correspondence of James Watt, jnr. with T. & R. Walker of Manchester from France and Italy on business matters, 1792-1793

MI/7/2:
Notebook recording flower and vegetable seeds and plants at Aston Hall and The Rookery, 1800-1810

MI/7/3:
Notebook recording plants in the Flower Garden and Fruit Trees at Aston Hall, 1819-1836

MI/7/4:
Notebook of plants and trees in Aston Hall kitchen garden, 1819-1824

MI/7/5:
Notebook of plants and trees in Aston Hall kitchen garden, 1825-1828

MI/7/6:
Notebook of plants and trees in Aston Hall kitchen garden, 1829-1830

MI/7/7:
Notebook of Fruit Trees planted in Aston Hall Terrace and kitchen garden, 1831-1832

MI/7/8:
Notebook of Fruit Trees planted in Aston Hall Terrace and kitchen garden, 1833

MI/7/9:
Notebook of Fruit Trees planted in Aston Hall Terrace and kitchen garden, 1835-1836

MI/7/10:
Notebook of Fruit Trees planted in Aston Hall Terrace and kitchen garden, 1839-1843

MI/7/11:
Notebook recording management of fish in Aston Hall pools, 1823-1846

MI/7/12:
OS Map of West Radnorshire. Scale: 1 inch to 1 mile (in leather case), 1833

MI/7/13:
OS Map of East Radnorshire. Scale: 1 inch to 1 mile (in leather case)

MI/7/14:
Account book of James Watt: businesses, Welsh estates etc, 1802-1808

MI/7/15-37:
Papers from MI/7/14: balance sheets, price lists, notes etc, 1800-1828

MI/7/38-53:
Bundle of correspondence concerning the late Mr Hampers collection of manuscripts for a history of the parish of Aston, 1831-1839

MI/7/54: Manuscript of: -
1) Mr Watts first sketch of his notes and corrections of Professor Robinsons Articles Steam & Steam Engines in the Encyclopaedia Britannica (1786, 1797) made in 1814.
2) Mr James Millers first copy of the same, March 1814
3) Mr John Southerns letter to Mr Watt with Experiments on Steam, 27 March 1814
4) Notes by Mr Southern and Mr Watt, etc.

Box 8 Printed Items

MI/8/1:
Directions for Erecting and Working the Newly-Invented steam Engines by Boulton & Watt (annotated copy) [1779]

MI/8/2:
Specifications of an Invention of certain new improvements upon Steam or Fire Engines for raising water etc. by James Watt, 1782

MI/8/3:
the Philosophical Magazine, No. I, London 1798 (includes article on Mr Cartwrights Steam Engine)

MI/8/4:
The Arguments of the judges in two causes relating to the Letters Patent granted to James Watt etc, 1799

MI/8/5:
An Essay on the Warming of Mills and other buildings by Steam, by Robertson Buchanan, civil engineer (signed by the author, Glasgow 1807)

MI/8/6:
Annals of Philosophy. January 1813 No. I (contains biographical account of Hon. Henry Cavendish)

MI/8/7:
An Act for settling and securing the lands and estate of West Boreland and others in the County of Stirlingfor payment of debts contracted by the said William Morehead, deceased, 1813

MI/8/8:
The Edinburgh Magazine and Literary Miscellany (includes an account of the late Professor Playfair p. 163, August, 1819)

MI/8/9:
Experiments on the Gas from Coal, with a view to its practical application by William Henry (signed by the author, Manchester 1819)

MI/8/10:
Observations on Larch: together with two experiments of the strength and resilience on the timber etc. by John, Duke of Atholl, London 1819

MI/8/11:
Expos Sommaire : Pour Mr Humphrey Edwards ingnieur hydraulique, Contre Mr Louis Didier Lecour, entrepreneur du Chauffage des Pompes a feu avec le Rapport de Mr Girard, ingnieur en chef des Ponts et Chaussees. (2 copies of Girards Report, Paris 1819)

MI/8/12: The monthly magazine, Vol. 50. No. 345, London, October 1820 (includes thirteen letters from the late James Watt to Dr James Lind (1764-1799)
MI/8/13a-b: The European Magazine, London, October 1820 (includes memoir and portrait of James Watt, 2 copies)

MI/8/14:
Articles by Professor Robinson on Steam and Steam Engines in The Encyclopaedia Britannica corrected by James Watt in 1814. (with note by James Watt, jnr. 1846), 1822

MI/8/15:
The Birmingham Spectator No. VII (includes memoir of James Watt and appeal for subscriptions towards a monument for him), 10 July 1824

MI/8/16:
Copy of The Birmingham Chronical Vol. II No. 81 with list of subscribers to the Watt monument and description of it, 15 July 1824

MI/8/17a-d:
History of the Steam Engine from its first invention to the present time, by Elijah Galloway, Engineer (parts 1-4 only), London 1826

MI/8/18:
Letters respecting the Watt family, by George Williamson, Greenock, 1840

MI/8/19-23:
Letters concerning Watts early life, family matters, inscriptions for Watts monument etc from MI/8/18, 1832-1840

MI/8/24:
Correspondence of the late James Watt on his discovery of the theory of the composition of water ed. J. P. Muirhead, 1846

MI/8/25a-c:
An account of James Watts Improvements upon the Steam or Fire Engine (3 copies) n.d.

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Watt Engines of the Sun and Planet Type, 1775-1802

(Site by geographical location)

Please refer to this map for locations

Country	Region	No of Engines	Please see Portfolios on Reel Nos:
SCOTLAND	Ayr	1	29
	Lanark	8	29
	Renfrewshire	4	29
	Stirling	1	29
	Clackmannan	2	29
	Edinburgh	3	29
	Fife	1	29
	Forfar	4	29
ENGLAND	Lancashire (Cotton Mills)	48	30 & 31
	Lancashire (Other than Cotton Mills)	11	31
	Yorkshire	20	31
	Cheshire	14	32
	Cumberland	3	32
	Northumberland	8	32
	Durham	8	32
	Lincolnshire	1	32
	Middlesex	34	33 & 34
	Surrey	16	34
	Worcestershire	1	34
	Derbyshire	4	34
	Leicestershire	3	34
	Shropshire	16	34
	Warwickshire	5	34
	Oxfordshire	2	34
	Gloucestershire	3	34
	Herefordshire	1	34
	Northamptonshire	1	35
	Nottinghamshire	17	35
	Staffordshire	19	36
	Kent	4	36
	Essex	1	36
WALES	Anglesey	1	36
	Glamorgan	2	36
IRELAND		2	36
FRANCE		1	36
SPAIN		2	36
		TOTAL 272	

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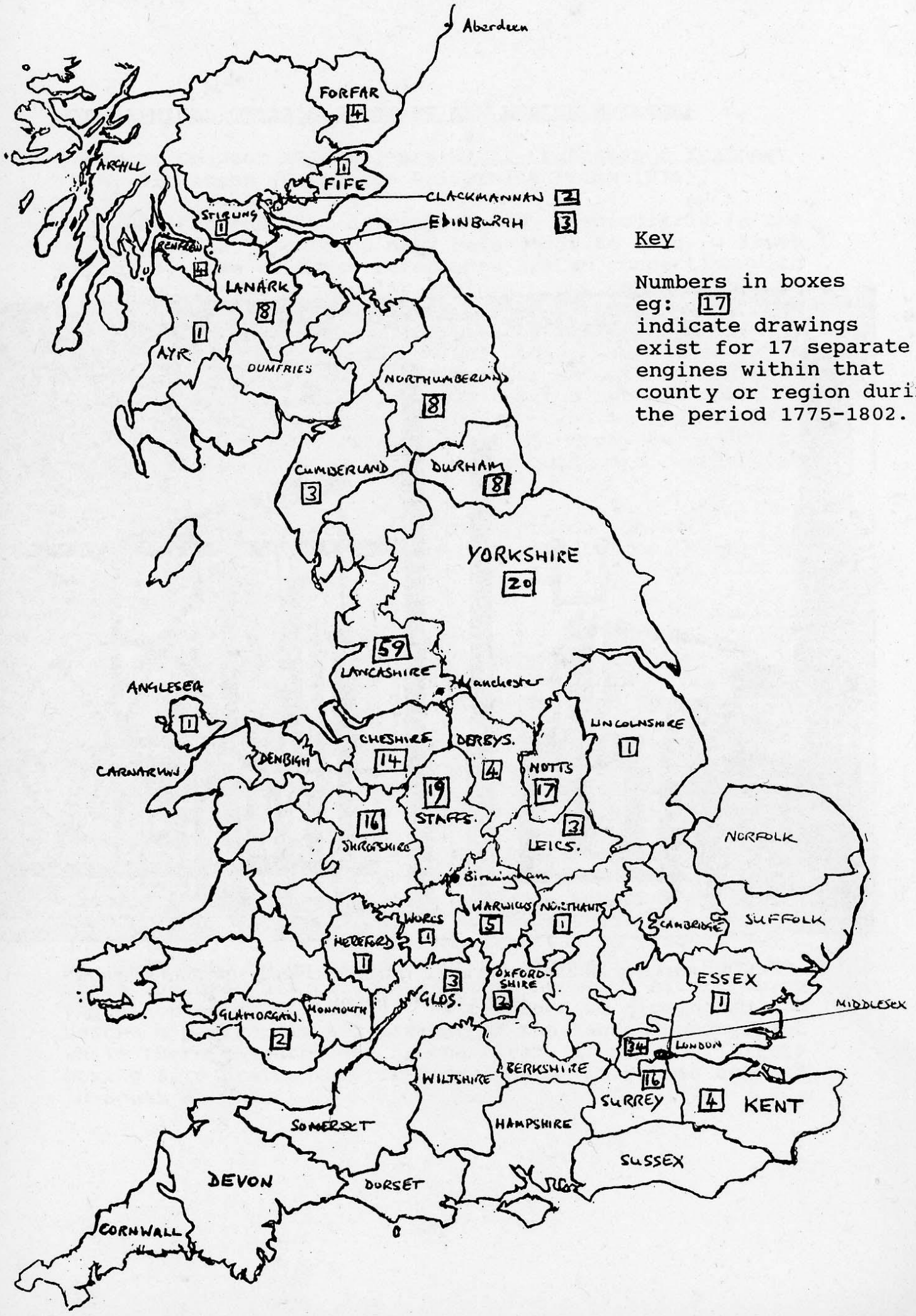

Key

Numbers in boxes
eg: 17
indicate drawings exist for 17 separate engines within that county or region during the period 1775-1802.

BIOGRAPHICAL DETAILS OF STAFF AND ENGINE ERECTORS

[Source: Chapter XXI in *James Watt: Craftsman & Engineer* H.W. Dickinson (Cambridge University Press 1936)].

"The Boulton and Watt correspondence, particularly in the early period, contains many references to the workmen employed; some of these references are in connection with the erection of particular engines, but many relate to difficulties in the Soho workshop arising from the drunkenness and irregularities of the men. As time went on there is less evidence of this; no doubt the organization was improved, a steadier lot of men were got together, and it became possible to weed out the worst of them; indeed, later on, Soho men came to have a high reputation and the establishment may truly be said to have been a nursery for millwrights and mechanical engineers."

Set out below are some brief biographical details on a number of individuals, arranged in alphabetical sequence:

William Brunton

In 1796 Gilbert Hamilton was engaging men in the Glasgow district for Boulton and Watt. Among others he took on Brunton, who had been working under his (Brunton's) father, "making iron and brass machinery" for the New Lanark Mills. He came with a testimonial that he "is an ingenious lad in his business, that he has received a virtuous education, & is accordingly both temperate and attentive". Brunton very soon made his mark with Boulton and Watt. A little more than twelve months after he was engaged, we find John Southern reporting: "William Brunton is a very valuable hand, and has more "gumption" than most of his contemporary engine erectors." Less than five years after this he was made superintendent of the engine yard at Soho, a position that he retained until 1808, at a salary rising from £80 to £100 a year. He left Soho to go as engineer to Butterley Ironworks, where he made his celebrated steam horse. After seven years or so at Butterley, he returned to Birmingham to become a partner in and manager of the Eagle Foundry, and while there invented one of the first (if not the first) moving fire grates for furnaces. Later on he was engaged in South Wales.

Richard Dayus

Richard Dayus was employed by Boulton and Watt from 1786 until 1804. In 1791 he was sent to Nantes in France to erect an engine for a corn mill and seems to have witnessed some of the more exciting scenes of the French Revolution. In 1800 he was Boulton and Watt's principal erector in London. Rennie thought very highly of him and reports that Dayus was earning over half a guinea a day by this time.

Peter Ewart

The name Peter Ewart occurs in the Boulton and Watt correspondence at a comparatively early date. Thus in 1781 we find Boulton writing to Watt: "I have had a letter from Lady Hopton recommending a young man of ye name of Ewart, 15 years of age, but I presume he wishes to be a practical engineer and millwright. Enclosed you have a letter upon the same subject. I think he is a very likely subject from her Ladyship's description of him, and may be of use to us in time, and therefore if it is agreeable to you it will be so to me to take him. We shall find it conv^{t} to breed up a few

young men as our business will, I am persuaded, increase." Just before, Boulton had been alluding to the necessity of getting Watt some assistance in the drawing office.

The letter enclosed by Boulton was probably the letter from Professor Robison to Watt, given in Muirhead, in which Robison solicits-

"employment for a young lad, a near relation of mine, Peter Ewart by name, who wishes to be educated as a millwright or in any good branch of the business of a civil engineer. I could not find him so proper a master as yourself, and I flatter myself that you would find him a very deserving pupil. His father is a clergyman near Dumfries, and has given the boy a very good education, but with no other views. But the boy's inclinations are so much turned to mechanics, and his mind so much caught by anything of this kind, that we all agree that it is the line of business in which he is most likely to succeed. His constitution is healthy and strong, so that he is perfectly fitted for the hard labour by which he is to get his living. If therefore you can find employment for him I shall look on him as setting out in the most favourable manner."

Ewart, however, seems first to have been apprenticed to John Rennie at Musselburgh. When the latter came south to put up the Albion Mills in London Ewart accompanied him; and it was not until about 1790 that he became connected with Boulton and Watt in a more permanent fashion.

In 1788, Ewart was sent to Soho by Rennie to erect a water-wheel and other machinery for Boulton's rolling-construction of the millwork and machinery for his mint. From 1790 to 1792 Ewart was engaged in erecting Boulton and Watt engines in the Manchester district. In 1791 he informs Watt that he had taken a shop in Manchester, and was engaging some hands to begin upon the millwrighting and other work he had undertaken. This business was not of long continuance, for in September 1792 he entered into partnership in a bleaching and calico-printing firm; but this lasted only for a year. In 1795 and 1796 we find him again at Soho laying out shops and plant and devising machinery for Soho Foundry, and for the Engine Shop at Soho Manufactory, including the designs for the boring mill. In reference to the latter, he wrote early in 1797 from Manchester to James Watt junior, "I am exceedingly mortified by your account of the boring mill. I cannot think that the jarring is owing to the weakness of the wheel, for every part of it is much stronger than the rod in proportion to the distance from the centre."

From 1798 to 1835 Ewart was concerned in cotton-spinning in Manchester; he was then appointed chief engineer and inspector of machinery in the Royal Dockyards. He died at his official residence at Woolwich in September 1842, in the 76th year of his age, in consequence of injuries caused by the breaking of a chain while he was superintending the removal of a large boiler. Ewart took out three patents: the first in 1813 for working looms; the second in 1822 for coffer dams (this invention was used at the Liverpool docks); and the last in 1833 for spinning machines.

Joseph Harrison

The "father" of the Soho workmen was undoubtedly Joseph Harrison. Nothing is known of his antecedents, but it is reasonable to suppose that Boulton picked out a man who had some experience in the erection of the Newcomen engine. At any rate it was Harrison who re-erected the Kinneil engine at Soho, and in 1775, when the Bill for the

extension of Watt's patent was before Parliament, he was one of the witnesses examined by the Committee of the House of Commons; he then described himself as "a smith at the Soho Manufactory at Birmingham". With the increase in the engine business and the consequent enlargement of the staff, Harrison became the leading man in the Soho engine-yard, but he was frequently sent out erecting, and many of the earlier engines – Bow, Chelsea, Richmond – were put up or completed by him. One gathers that he was a genial, modest sort of man, not given to making difficulties about his work.

In 1779 Hallamannin, one of the first Boulton and Watt engines put up in Cornwall, was doing badly, the result mainly of faulty erection, and the firm decided upon sending Harrison to put it right.

Harrison's failing was the common one. From time to time he gave way to drinking bouts, moreover he was not a man of any education, so in 1778 when the firm decided to appoint a foreman at Soho, a man called Hall was bought in. Hall's tenure of the position was but a short one, and soon after he left Harrison seems to have been put in charge, and we find him referred to as foreman; possibly his duties were of a more restricted nature than the firm had had in view when engaging Hall. Harrison continued to be sent out erecting for a few years after this; he was erecting Shadwell and repairing Bloomfield in 1781; then, the work at Soho increasing and a number of other men having been trained for erecting, he seems to have remained at head-quarters for the rest of his life. His son, William Harrison, was in due course taken on at the works, was an erector for some years, and then was made foreman of the small engine manufactory in the 6-horse shop at Soho Foundry, 1st January 1800, and continued in that station until his death, 24th August 1815.

Logan Henderson

The first technical assistant engaged by Boulton and Watt was Henderson. Lieutenant Logan Henderson, according to Smiles, had been an officer of marines, and afterwards a sugar planter in the West Indies; he had lost all he possessed in Jamaica, but had gained a knowledge of levelling, draining, and machinery. In the Boulton and Watt correspondence, Henderson is met with for the first time early in the year 1776. He had submitted to Boulton, from Liverpool, a scheme for a rotary engine, and Boulton in reply had sent him an account of the performance of the rotary engines that had been tried at Soho and invited Henderson to call. Henderson paid a visit to Boulton, and being satisfied that his own scheme was inferior to that of Watt, laid it aside. The visit, however, resulted in his being engaged as an assistant, and early in 1777 we find him in London with Boulton, but living at Deptford and travelling to and fro every day. While in Birmingham he lived in Boulton's house. He had charge of the erection of the Torryburn and Byker engines in 1778, and in 1781 he was in Cornwall with Watt. Boulton had thought that Henderson would have lived with Watt and been an intelligent companion with whom he could have discussed engineering matters. Henderson, however, set up an establishment of his own where he lived with a lady referred to as "Miss Peggy"

Perhaps it was as well that Watt and Henderson did not live together; as it was Watt was far from pleased with him, and his letters of this period to Boulton contain frequent references to Henderson's bad temper and sullenness, and show that there was a good deal of friction between him and Wilson, the firm's agent in Cornwall. With Murdock, Henderson got on very well; indeed it is said that he had a great influence over him, and

that he, Henderson, had asserted that Murdock would leave Boulton and Watt if he did so. In 1782 Henderson returned to Birmingham, and about the beginning of the following year he terminated his connection with the firm very abruptly. In 1784 it seems that he was concerned in a foundry in London, and then in 1790 we find him applying, without success, for the post of Engineer to the Dublin Waterworks.

Jabez Hornblower

The son of Jonathan Hornblower the elder, he came from Cornwall to Soho in the same year that Murdock went from Soho to Cornwall; the firm had offered him work at a guinea a week, the same pay as Murdock was receiving, and he was for a few years one of their erectors. He worked on the Ketley, Donnington Wood, and Penryndee engines. However, after a few years he left the services of Boulton and Watt as he did not get on well with the other workmen or with his employers. He went on to become a rival engine-maker leading to further conflict with Boulton and Watt.

James Lawson

James Lawson started work at Soho in 1779 and for many years was connected with Boulton and Watt, Boulton's mint, and Boulton, Watt & Co. He was the son of the Reverend Archibald Lawson of Kirkmahoe, near Dumfries. When he first came to Birmingham he seems to have been in the office, for in 1781 we find him among others, signing letters on behalf of the firm. In the following year, however, he was one of the staff of engine erectors in Cornwall, and Boulton says of him that he can "manage the working of an engine better than any of their engine men."

When men like Lawson were not erecting engines, they were paid, not by Boulton and Watt, but by the person or firm for whom the engine was being erected. There were intervals when, due to the non-arrival of materials or for other reasons, no work was going forward, or there was not enough work for all the Soho men. In one such interlude in 1783 Lawson had taken up mine-surveying and for a long time he was at the Poldice mine in Cornwall.

In 1784 Boulton wrote: "Lawson is making plans and sections at the Cornish mines, certain of the mines propose employing him to record the progress of the workings. He can survey land or dial mines, & is expert under-ground, & I think it would answer to the mines to pay him to keep their drawings in course with their mine. The plans & sections which is Lawson's only employment at present will prove of great importance as they serve to detect great mistakes and to enable the adventurers to see clearly with their own eyes."

It is not clear how long Lawson was engaged on the mine-survey work. By 1791 he was engaged under Boulton himself at the Soho mint. He was in charge of the multiplication of the dies and of one press; he had also the office of Inspector of the 2 fire engines. Although there were many problems with the dies and Lawson was even talking of leaving, Boulton wished to retain him in some capacity or other, for although he found ground for complaint he fully recognized Lawson's skill and intelligence. Later on, in November 1793, when he had gone back to engine erecting, Boulton having entered into a contract to supply fifty tons of cooper coin, asks him if he can leave his business at Leeds and "come to Soho for about a week, in order to see that the 6 presses are in the best order. I should be much obliged to you for I fear Busch is not so much master of

that subject, besides, he has his hands too full, & Perhaps Bill Harrison would like to spend his Xmas with his mother & at the same time could render us a little assistance which with all expenses I will pay with pleasure."

A few months before this he had been in London assisting in preparing models and in getting a case for Counsel for one of the lawsuits relating to Watt's patent.

By this time Lawson was taking a leading position as an outdoor man under Boulton and Watt, and he was representing the firm in Leeds and Manchester. He had formed a friendship with James Watt, junior, and in the autumn of 1800 the two made tour in North Wales; terminating in "a fortnight amongst our Lancashire friends & engines". At the conclusion of this tour Lawson entered into an agreement to act for the Soho firm in Scotland for five years, at a salary rising from £250 to £300 per annum with a commission of 1 per cent on all goods sent to Scotland and ½ per cent upon all orders procured by him elsewhere, the firm guaranteeing that in all he should receive not less than £350 per annum during the first half of the term and £400 during the latter half.

James Watt, junior, was not altogether satisfied that the terms were fair to Lawson, whose services he says he would be sorry to underrate. Some years later, about 1811, Lawson was appointed superintendent of machinery to the Royal Mint at a salary of £800 per annum with a residence, but he continued to transact business, in London, for the Soho firm, and received an allowance from them until his death. Lawson was elected a Fellow of the Royal Society in 1812; he died in London on April 9, 1818.

Malcolm Logan

Malcolm Logan was employed to erect engines both in Italy and in Spain. In 1782 Boulton refers to him as "a handy, active and industrious fellow"; he seems soon after this to have given way to drink, but to have pulled himself up in time, for in 1788 when it was a question of selecting a man to go to Naples, "I think", writes Boulton, "he is the properest man we have to send to Naples, as he is a handy fellow either in wood or iron, or engine, or mill, or pumps." He must in addition have been a man of quick intelligence. Later on, 1795-6, he was at work in Spain.

William Murdock

Murdock's entire life was spent in the service of the firm and his story is closely connected with that of James Watt.

Murdock entered the service of Boulton and Watt in the year 1777, when he was 23 years of age; his name first appears in the books of the firm as "Wm. Mordach"; he was paid at the rate of 15s. a week, and some of his first work seems to have been at pattern-making. He very soon made his mark as a man of ability and intelligence, and as early as January 1779 we find Boulton writing: "I think W^{m}. Murdock a valuable man & deserves every civility & encouragement." Murdock was at this time engaged in repairs and alterations to the Bedworth engine. A few months later was sent to take charge of the erection of the Wanlockhead engine, and Boulton writes of him to one of the proprietors: "He hath a good deal of experience in our engines and is capable of putting your people to rights in any matter they may not understand, & we doubt not but he will acquit himself to you & to our satisfaction, as he is a man we have a good opinion of. Pray don't keep him longer than necessary as we want him in Cornwall."

About the same time Watt informed the same customer that he is "a very sober, ingenious young man, who has a good deal of experience under us in putting engines together and knows all the little niceties, the omission of which might cause a bad performance in your engine."

Upon his return from Scotland, Murdock was sent to replace Jabez Hornblower in the erection of the Ketley and Donnington Wood engines; in September he and another erector, James Law, were sent to Cornwall. As a precaution, in case of their being taken by the press-gang on the way, they were furnished with letters addressed to prominent men in Bristol and Exeter requesting protection. For the first twenty years Cornwall was Murdock's home; there he married, and there his sons were born. From the first he assimilated with the Cornish men far better than Watt ever did, and with occasional interludes of disfavour he was well liked by the great majority of the people concerned in the mines during the whole of his stay in Cornwall. Temperance in the matter of strong drink was a characteristic that distinguished him from most of his fellow erectors. He was particularly dexterous and resourceful in erecting new engines and repairing the old ones, and he was very hard-working – "indefatigable" is the term applied to him in some of the letters. Thus Boulton, writing on September 30, 1782 from Cosgarne, says:

"Murdock hath been indefatigable, ever since they began he has scarcely been in bed or taken necessary food, for everyone seems helpless in comparison of him….After Murdock had been slaved day & night on Thursday & Fryday last, he rec^{d}. a letter from W1. Virgin in the West insisting upon his coming over directly as they could not se their engine to work, & if he did not come instantly they would let out ye fire. He accordingly went on Saturday morn^{g}, set ye engine to work, wch. went on very well during 5 or 6 hours, & then left it & returned back to ye Cons^{d}. Mines about 11 at night and was employed about the engines till 4 this morn^{g} & then went to bed. I found him at 10 this morn^{g} in Poldice cistern, searching for pins & cotters that had jumped out, and I insisted upon his going home to bed for he had a bad cold."

Two years later Boulton, again writing from Cornwall, expresses his satisfaction in even warmer terms in a letter to Watt, November 8, 1784:

"We want more Murdocks, for of all others he is the most active man & best engine erector I every saw, of w^{ch} I had a strong proof this day. They stoped Polidice lower engine last Wednesday & took her all to pieces, took out the condenser, took up out of the shaft the greater part of the pumps, took the Nossells to pieces, cut out the iron seatings and put in brass ones wth new valves, mended ye education pipe & did a great number of repairs about the beam & engine, put the pumps down into the new engine shaft, did much work at the new engine, & this day about noon both the engines, new and old were set to work again compleat. When I look at the work done it astonishes me & is entirely owing to the spirit & activity of Murdock who had not gone to bed 3 of the nights, & I expect the mine will be in fork again by Wednesday night. I have got him into good humour again without any coaxing, but have spoke plainly to him in presence of Wilson, have prevail'd upon him not to give W^{1} Virgin engines up, which he has resolved to do from the ungenerous treatment he rec^{d}. from ye Capt^{n}."

Although he was such a valuable man, his pay, for the first few years at any rate, was on a very low scale. When he started in Cornwall in 1779 he received 21s. a week; Law, his travelling companion, had 20s. Twelve months later he wanted an increase of pay,

and thought he was entitled to two guineas a week. Boulton seems to have sympathized with his wishes, but Watt objected and thought it would be very wrong to give this sum, "an example of that kind would ruin us by stimulating every other man we had to similar demands". It is not very clear why Boulton and Watt should have kept the pay so low; it affected them only in so far as it increased the total cost of the engine; the erectors were not paid by them, but by the adventurers for whom the engine was being erected. Boulton managed to stave off the difficulty by persuading one of the mine companies to make Murdock a present of ten guineas, to which he added another ten on behalf of Boulton and Watt. At about this time John Budge, one of the most highly respected of the Cornish engineers, was pressing Murdock to enter into partnership with him. It was the practice in Cornwall for the mine-owners to entrust the management and supervision of their engines to an engineer, such as Jonathan Hornblower or John Budge, who made periodical visits, and might have a number of engines in his care. In this instance Budge has offered Murdock the half of all his engines. However, towards the end of 1782 Murdock obtained an appointment of this nature on his own account – the seven new Boulton and Watt engines at Wheal Virgin and Poldice were placed in his charge at a fee of £6 per month. Boulton seems to have been in high glee at this event.

"Murdock will be well off but it fixes him firm to us and our interest." This fee was in addition to his pay for erecting engines, and no doubt, as time went on, Murdock had more work of this and other kinds, and possibly he was getting into such a position that he could make his own terms with the mine companies for erecting new engines. We find Boulton writing from Cornwall in 1784 that "people in general are much prejudiced in fav^{r} of W. Murdock and he is thereby intoxicated to a great degree." And in the same letter we have an indication that he was undertaking work on his own account. "He hath erected a new balance bob at W. Maid wch. hangs in a joint & rolls upon a vertical plane, but it is not so good as your old one and I don't believe he now prides himself upon it."

Moreover, he was now taking upon himself, in erecting new engines, to depart in important features from the drawings supplied from Soho. Thus:

"The small rotative engine at W1. Maid will be set to work in a day or two, but he hath in that varied from your drawings, for he hath hung the spear upon the top of the beam, i.e. ye centre of motion of the top end of the spear or connecting rod is upon the beam whilst the centre of motion of the beam itself is under the beam. This he hath done on order that the revolving wheel shall always stand right to begin its stroke."

Murdock's connection with the invention of the sun-and-planet gear and his iron cement were notable contributions. A more important invention with which his name is identified is the introduction of coal-gas as a lighting agent. His first experiments in this direction were made in Cornwall in 1792, but it was not until his return to Birmingham that anything was done on a commercial scale. The Soho Manufactory was fully equipped for lighting by gas in 1803, and the manufacture of gas-making plant became a distinct branch of the business at the Foundry, which became the training-ground of the early gas engineers.

Another project that Murdock engaged upon during his stay in Cornwall, much to the distaste of Watt and his partner, was that of steam carriages. Murdock had in view an air-cooled surface condenser, and a variable-speed gear; apparently he intended to use the sun-and planet gear with a set of plant-wheels of different diameters.

Watt at this time was engaged in draughting the specification for his patent of 1784, covering the parallel motion and other inventions, and he at once proceeded to incorporate in it such a description of a steam carriage as he could do in the time and space at his disposal. This procedure effectually forestalled other steam-carriage projectors for the time being and allayed Murdock's fears on this point.

Boulton and Watt were, however, keen for Murdock to devote most of his time to sorting our various engines (such as North Downs, as mentioned in a letter from Boulton to Watt, November 8, 1784) rather than to experiments with steam carriages. Boulton made this known to Murdock and the latter modified his activities in line with Boulton's wishes. Yet Murdock did not stop his activities with steam carriages altogether. On the contrary, two years later, there is a distinct evidence that a model had been made, for in August 1786 Wilson writes from Chacewater to Watt: "W^{m}. Murdock desires me to inform you that he has made a small engine ¾ dia. & 1½ inch stroke that he has applied to a small carriage which answers amazingly." From the terms of the letter that can be little doubt that this was, as far as Wilson knew, Murdock's first model, and that it had been made quite recently.

The next invention of Murdock's that we learn of is for raising water "without pumps or great beam." This is news that Boulton hears in London and transmits to Watt. Wilson a little later sends a more circumstantial account which suggests something in the nature of air-lift pumping; he says that Murdock "let me see his new method of raising water; it is by compressing air at the surface which is forced down small pipes to the bottom of the shaft & there communicates with the main pump & forces up the water, what machinery he has at the bottom I cannot tell, only there is no bucket, but there is a clack to prevent the water falling back; his present machinery is a copper tube of 1 inch dia^{r}. & 9 inches long, in this he works a wooden plug, from the side is a very small tube, which goes from the top of his house to his well 40 feet & another larger tube by the side up which the water ascends & runs off continually in an equal stream…He proposes writing to you on the business. He says pipes of 3 inches diameter will do for forcing down the air to work 17 inch pumps; if so there must be a great saving in erecting for deep mines. He has a very small string which goes down to the bottom, which he pulls when he sets to work, I suppose to open a valve."

We learn nothing more about this scheme, so presumably it did not answer Murdock's expectations. Ten years later, just before he left Cornwall for Soho, he was constructing a water-pressure engine at Wheal Fanny, and about the same time he was sending mica to Soho for use in the packing of pistons.

Murdock's sojourn in Cornwall was now drawing to an end. Watt's original patent and the Boulton-Watt partnership would terminate in 1800. Watt himself had ceased to take an active share in the direction of affairs; his son James, and Boulton's son, Matthew Robinson, had now taken over the reins, and the Soho Foundry had been commenced. Business in Cornwall was likely to fall off, and the young men felt, no doubt, that it would be wise to have a man of Murdock's experience, capacity, and energy at their disposal. So Murdock was given a post at head-quarters. He did not finally leave Cornwall until the end of 1798, but he had, before this, visited Birmingham to assist in the deliberations upon the new establishment. At the beginning of 1796 we find a letter from James Watt, junior: "P. Ewart leaves us this evening. The last three days have been spent in scheming between him, Murdock, Mr. Southern and A. Story, they have concluded upon the different lathes, boring and drilling apparatus and drawings of all are made." Peter

Ewart, as we have explained, had been bought to Soho for the purpose of designing the machinery for the new works which were being planned; Storey was the manager of the foundry.

From the early part of 1797 James Watt, junior, was calling for the presence of Murdock at Soho, but there were still many jobs to finish. It had by this time become known in the county that he was leaving Cornwall, and the Cornishmen had begun to realize what his departure would mean to them. An engine was to be put up at Wheal Jewel, and at first the adventurers declined to sign the agreement unless a clause was inserted that Murdock was to erect the engine; on this occasion one of the adventurers said that "two years ago M. might have gone to the devil for anything the county cared, but that by the blessing of God their eyes were now opened", and even after he had left Cornwall he was pressed to come back to their assistance at North Downs and other mines.

Upon his arrival at Soho, Murdock set himself with great vigour to getting the boring-mill completed. When this had been done, it seems that it did not answer very well, and there was some delay in settling the plan of a new mill.

Murdock then felt himself at a loose end: "he will begin to think he is losing his time here", writes the younger Boulton; "I have endeavoured to occupy his attention with several other schemes which are going forward, but the construction of the boring-mill being his principal hobby-horse, his thoughts are continually recurring to this favourite subject."

Possibly as one means of occupying his attention about this time, Murdock, with Storey the foundry manager for his companion, was sent on a voyage of discovery to Leeds. Matthew Murray was turning out iron castings and smithwork far superior to the Soho productions, and it was desired to find out how he managed this.

Another project in which Murdock's aid was enlisted was the production of a smaller and cheaper engine than had been made hitherto at Soho. The young partners were convinced that there was a wide field for such engines, and Murdock appears to have been responsible, in the main, for the design of a self-contained engine, known as the "bell-crank" engine. It did not prove a success, but it embodied one of Murdock's most important inventions – the long D-slide valve. This is one of the inventions covered by his patent of 1799. Another is the use of a worm and wheel for driving the bar of a boring-mill; this was applied at Soho both for boring and for large turning-lathes. In his specification he says that the screw "I have commonly used has three threads, is 16 inches diameter, and the advance by one revolution is 6 inches." Probably this was the size used for the boring-mill referred to above.

No doubt from time to time Murdock paid business and other visits to Cornwall. One such visit was in the early part of 1800, and he writes to James Watt, junior, that some of the Cornish mining people say they "are going to make an offer that will be greatly for my benefit if I will remain in Cornwall", and he asks for directions as to the answer he is to make. It appears, too, that Murdock had been asked to recruit smiths for Soho, and in the same letter he states: "I hoped to have sent three before this, but there is a report circulates here that you have starved Simon [Vivian] and his family and at this time I cannot prevail on any of them to go."

Murdock's position at Soho was put on a definite basis in the year 1800 when he entered into an agreement to serve for five years at a salary of £300 per annum, with an

allowance of 1 per cent on all orders for Soho Foundry. This arrangement prevailed up to the year 1810; but he was then getting, in addition, a commission of 1.5 per cent, on all the gas-lighting apparatus made, and his total income amounted to £684.

He was in 1810 put on the footing of a partner at Soho Foundry, but in lieu of a share in the profits, he elected to take a salary of £1000 a year, and this he received for the next twenty years, up to 1830, nine years before his death.

Isaac Perrins

One of the first engines put up by Boulton and Watt was that at Bloomfield Colliery. The proprietors had arranged to put up a Newcomen engine and an engineer named Perrins had undertaken the erection. When they were induced to put up a Boulton and Watt engine instead, Perrins retained his position and erected it; afterwards he was concerned in the erection of Bedworth, Bog Mine, and Minsterley engines. Perrins seems to have been advanced in years; he died in 1780 and is then referred to as "old Perrins", although the adjective may have been used merely to distinguish him from his sons. One of the sons, Issac, was offered a job under the firm in Cornwall in 1780, and this he declined, but early in 1782 he applied for work and was taken on at twelve shillings a week. He was connected with Boulton and Watt for some years, and of all the men under the firm, Issac Perrins was the best known to contemporaries and his name must have been an even more familiar one to the public than that of James Watt himself, for he was a prize-fighter. One morning in 1788 Watt, in Boulton's absence, dealing with the correspondence of the firm, opened a letter from a gentleman in London enclosing a newspaper cutting, and saying "In the enclosed paper of mine is an offer from a person living with you, to fight any man in London; would you please to inform me by a letter of what age Perrins is, what weight he has been known to carry, and something of his mode of life, that I may see whether a match cannot be made for him."

One can picture the consternation with which the staid Watt must have perused this letter, Watt who for a few years before had made it a condition in engaging Southern that he was to enter into a bond to give up music! It is clear that Watt was not aware of Perrin's proclivities, for he minuted the letter "Mr. Roberts, please inform me of the truth of this matter, that I may write to Mr. Boulton." Boulton, however, was not in such ignorance; five or six years before Perrins had fought "the famous Jimmy Sargent" and had beaten him thoroughly, and Boulton was dully informed of that event by Scales. The fight that followed Perrin's challenge on the present occasion terminated quite differently, for he was badly beaten by his opponent, Thomas Johnson, a smaller and lighter man. Perrins was a big fellow, over six feet high and judging from the picture, which is extant, of the fight, he must have been a fine-looking man.

His defeat does not seem to have checked his ardour for fighting; eighteen months after we find James Watt, junior, writing to Southern:

"I advise you to get I. Perrins sent off into the country as soon as you can, for he has received a letter from Mendoza pressing him to fight Big Ben, and offering to back him with £100. If the Birmingham gamblers hear of this, as he seems well inclined to inform them, I am certain they will find it no difficult matter to work up his passions, so as to induce him to challenge his rival, in which case you may bid adieu to him for ever."

Soon after this Perrins was sent to erect engines in Manchester and towards the end of 1793 he moved his household there and took a public-house, still keeping on his work as engine erector, but about a year later, having quarrelled with and threatened Lawson, Boulton and Watt discharged him from their service. Among the points made against him on this occasion was the slovenly condition in which the Boulton and Watt engines in Manchester were kept; but, as Perrins points out in a very outspoken manner, the firm had never paid him anything to look after the engines: "If you had allowed me a competency to have kept them clean, I should not be afraid of durtying my hands with doing it as some of your servants are that you send here with ruffles at hands and powdered heads, more like some Lord than an engineer. It cannot be thought that I can lose my time and neglect my own business without some consideration for it."

In spite of this shortcomings, no doubt Perrins was a capable man as an engine erector; the terms of James Watt junior's letter, referred to above, make it clear that the firm did not wish to lose him, and for years after he had ceased to be an accredited erector for Boulton and Watt he continued to be employed to put up their engines in the Manchester district. Some of the mill-owners preferred to employ him rather than rely upon the men sent from Soho, and he was able to keep a staff of men employed.

William Playfair

Early in 1778 the increase in work and some troubles with the men led to the appointment of a foreman at Soho. Hall was selected for the post, but he did not prove suitable. Watt wanted to turn him out straight away, especially as Hall had been found making things for himself at Soho with the firm's materials. In the event, he was sent out as an erector and worked on the Ketley, Wren's Nest and Snedhill engines; after which he was dropped from the firm's list of erectors.

To make up in some respect for the loss of Hall at Soho, Watt suggested to Boulton (June 27, 1778) "I would recall Playfair who can do part of the business, and I think now that you are at home you can contrive to give him proper assistance. I must warn you that Playfair is a blunderer." Playfair was brother to John Playfair, a professor at Edinburgh University, and son of the Reverend James Playfair of Bervie near Dundee; like Rennie he served an apprenticeship to Andrew Meikle. He had been employed as draughtsman and clerk to Watt for a brief period before this. Evidently Watt had not a high opinion of him; however, he bought back, but again he was with the firm for but a limited time, and his connection ceased in 1781, when we find Boulton writing (October 23rd) that he was sorry Playfair is going, only on account of Watt not having any proper assistant in drawing. Playfair went into business on his own account in London; he took out several patents, but finally dropped into literary work. He wrote a memoir of Watt for the *New Monthly Magazine* which James Watt, junior, found very displeasing; there is a bundle of correspondence on this matter among the papers at Doldowlod.

John Southern

With increasing business, Watt's work had become very heavy, and we find Boulton constantly urging him to get an assistant. After the departure of Playfair in 1781, Boulton suggested a number of young men, and among them John Southern. "I think young Southerns would be a very likely person, he seem good-humoured and very obliging. He is now with his brother as a surgeon, but says that though he is keen in the study of surgery, yet he had rather have been employed under you as a draughtsman and

assistant, and if you wish to have him I know he will gladly come. He draws tolerably neat."
John Southern was one of the sons of Thomas Southern, residing at that time at Wensley, near Wirksworth, Derbyshire, and interested in mining affairs in various parts of the country.

Boulton followed up the letter by another again recommending the employment of Southern. To this Watt, then in Cornwall, replies: "If you have a notion that young Southern would be sufficiently sedate, would come to us for a reasonable sum annually, and would engage for a sufficient time, I should be very glad to engage him for a drawer, provided he gives bond to give up music, otherwise I am sure he will do no good, it being the source of idleness."

Other letters follow, and in June 1782 Southern, then at the age of 24, starts with Boulton and Watt on a three years' agreement, and with them he remained until the end of his life. He seems to have dropped into his place without hesitation or friction of any kind, even Watt makes no complaints of him, and he soon proved a valuable assistant and relieved his chief of a good deal of work.

In 1793 Southern married the daughter of Thomas Dobbs of Kings Norton. Dobbs had a Boulton and Watt engine put up in his rolling-mill in 1787, and it may be that Southern's visits on this business led to his acquaintance with the lady.

At one time Southern seems to have interested himself with political affairs, and in 1794 we find Boulton writing that he had called on the Marquis of Stafford, and had learnt that from papers lately seized it appeared "that the country was upon the brink of a ruinous attempt to overthrow its Constitution…I hope to God our Southerns is out of the mess, & that none of his letters will be found amongst these papers, & I wish you would speak to him about it, for I have reasons for my fears & wish to guard him."

With this exception Southern seems to have passed a quiet, uneventful life, devoting himself to his business and to scientific research. Whether he gave up music in deference to Watt's desire is not known. There is good reason for thinking that he was the inventor of the steam-engine indicator, that is, as we now understand the term, an instrument with a pencil for tracing the diagram of the varying pressure in the cylinder of an engine.

When in 1791 the Birmingham rioters attacked Edgbaston Hall, then in the occupation of Dr. Withering, we learn that “Mr. Sutherne, a clerk to Boulton and Watt” was one of the party who engaged in the defence of the house.

In 1800 Southern was given in additional to his salary a percentage upon all goods produced at the Soho Engine works, or in lieu thereof £600 per annum, and later in 1810 he was admitted a partner in the firm of Boulton, Watt & Co., to receive one-sixth of the profits. After his death the firm settled £2,000 on Mrs. Southern and the children.

One imagines that Southern was not a man of robust health. In 1812 he was ill in London and in the hands of a doctor; two years later he spent some time at Aberystwyth; he seems to have had a fall and to have gone there to recuperate his health.

He returned to his duties but died at the age of 57 years, in July of the following year, 1815, at his house at Handsworth. Southern was buried in the King's Norton church in the family vault of his wife's father Thomas Dobbs.

Thomas Wilson

In connection with the affairs of Boulton and Watt in Cornwall, the name of Thomas Wilson regularly occurs. He was at Chacewater in 1777 when the Wheal Busy engine (the first Watt engine set up in Cornwall) was ordered, acting as agent for the proprietors, Fentons and the Yorkshire Copper Company. Watt stayed in his house on his first visit to Cornwall, and possibly it was on this occasion that arrangements were made with him to act as the commercial or financial agent for the firm in Cornwall, a position that he continued to hold until the expiry of Watt's patent in 1800. He was an active and intelligent man, but it would seem that he engaged in too many different undertakings to make a great success in any of them. A lively account of his activities in the year 1785 is given by Boulton, who, after discussing the conditions at Chacewater and the difficulty of making the mine pay, goes on:

"I know Mr. Wilson says he had a very good opinion if her, but I will form mine only upon facts, & not opinions. Mr W. hath now several partnerships in shares of ships, he hath always had the tickiting to attend, the assay office, the accts of the Welsh works, the several mine accounts, in wch, he, we & Wilkinson are concerned; he hath a partnership with Ned Rogers in 2 or 3 farms; he hath another with Lantie Atkinson in other farms; his candle trade is a very large concern; he hath several partnerships with difft. persons in pairs of mules. He hath B & W. business to manage, with gunpowder, candle accounts, stamps, & c., and he hath a large family. I heartily wish him success in these & all other undertakings, but it must be evident to you that he cannot bestow any attention to the mine."

For his services to Boulton and Watt, Wilson was paid a commission of 2.5 per cent on the premiums derived from Cornwall. For the twenty years 1781-1800 he received the sum of £3,485 or a little over £174 per annum on average. He died in 1820, at the age of 72 years, and was buried at Falmouth.

BIBLIOGRAPHY CONCERNING JAMES WATT

BIBLIOGRAPHY reprinted from *James Watt and the Steam Engine*. H.W. Dickinson and R. Jenkins (2nd edition 1981. Moorland Publishers).
See Appendix I, pp.359-372.
First published in 1927.

GENERAL NOTES

It is a matter for regret that James Watt, although so ready with his pen, as evidenced by his voluminous letter-writing, wrote practically nothing for publication; what he did write might be said to have been almost exclusively for professional or business purposes. He had some thoughts in 1773 of writing a book on "the elements of the theory of steam engines", in order to advertise the engine (see letter from Watt to Small, August 17, 1773). Again, in 1778 it was stated: "The result of these experiments (i.e. on the volume of steam) he intends to lay before the publick, in a treatise upon that subject." (see Pryce: Mineralogra Cornubiensis, p.309) Nothing came of these, however.

After his retirement from business, at the solicitations of his friends, his thoughts reverted to the subject of writing a history of his improvements in the steam engine, and there is evidence that about 1808 he collected and annotated a good deal of matter for the purpose. His disinclination to court publicity, and his advancing age led to the project being shelved. The occasion of the 0publication of the collected works of his old friend Robison, however, stirred Watt to action in 1814, but the result was rather annotations on the former's work than an original monograph such as we, at the present day, should have prized.

A very valuable source of information about Watt personally is to be found in the documentary matter preserved by the present representative of the family. This matter covers the whole of his life and comprises letters, letter-books, note-books, journals, accounts, reports, memoranda, patent specifications, law cases, drawings, and books on the steam engine. Of the letters alone, there are several thousands. (Referred to by Dickinson and Jenkins as the Doldowlod Papers.) Speaking broadly, this is the material used by Muirhead in his biographical works on Watt mentioned below.

An equally valuable source of information, more particularly from the technical point of view, for the period 1775-1800 and, indeed, later still, is the Boulton and Watt Collection. This material constitutes the records of the firm, and comprises upwards of 10,000 drawings with a very large number of documents such as correspondence and letter-books, together with printed books, models, and plant.

When the effects of the firm were dispersed in 1895 these objects were purchased by the late Mr. George Tangye, who presented them in 1911 to the City of Birmingham; they are now housed in the Free Reference Library (now known as the Central Library, Birmingham and referred to by Dickinson and Jenkins as the B. & W. Colln.) This matter has not been utilized hitherto to any extent and has consequently been drawn on extensively for the present volume (Dickinson and Jenkins point out).

Another collection comprising journals, deeds, ledgers, letters, printed matter, and other documents, in the main complementary to the two collections named above, was in the possession of Lionel B.C.L. Muirhead, Esq., a relative of the biographer of Watt, till September 1921 when it was handed over to the care of the Free Reference Library, Birmingham (now known as the Central Library, Birmingham and referred to by Dickinson and Jenkins as the Muirhead Papers).

About a thousand letters from Watt to Matthew Boulton, together with a few to Dr. William Small, covering the period 1768 till his death, along with a large amount of documentary matter

concerning Boulton's business undertakings, were preserved by the Boulton family at the family seat, Tew Park, Oxon., till last year when they were removed to the Assay Office, Birmingham. (Referred to by Dickinson and Jenkins as the Boulton Papers and now also at the Central Library, Birmingham.) This material was used both by Muirhead and Smiles.

The Central Library, Birmingham also possesses the following papers:

Letters from James WATT to John SOUTHERN, 1789 to 1815. In I vol.4to. (Referred to in this volume as the Southern Papers.)

Collection of original letters, &c., relating to WATT and BOULTON and SOHO (1761 et seq.) formed by Samuel TIMMINS. I vol.fol.

Letters from R. CARRUTHERS, five in number, to W.C. Aitken, relating to Burns and James WATT, 1851-69.

Letters from Samuel SMILES to W.C. Aitken relating to James WATT and James KEIR, 1861-70. (In a collection of papers of W.C. Aitken.) 8vo.

Extracts relating to BOULTON, WATT AND EGINTON, 1808-95 (c.1895), by G.N. Osborne. I vol. 4to.

Other bibliographical matter is arranged below chronologically, explanatory notes being appended to any item where this course seems to be needed. Some sifting has been effected, and mere compilations of matter already published have been excluded.

DETAILED NOTES

MACKELL, Robert, and WATT, James.
An account of the navigable Canal, proposed to be cut from the Tiver Clyde to the River Carron, as surveyed by Robert Mackell and James Watt.
London, 1767. 18pp., 4to. 1 engraved map.

This was a scheme for joining the rivers Forth and Clyde by a canal via the Loch Lomond passage. As eventually carried out by Brindley and Smeaton, the direct route for the Canal was adopted.

WATT, James.
A scheme for making a navigable Canal from the City of Glasgow to the Monkland Coalierys.
Glasgow, [1769]. 12 pp., 4to.

This was the Monkland Canal, the first part of which was carried out entirely by Watt.

WATT, James.
Report concerning the Harbour of Port-Glasgow, made to the Magistrates of Glasgow, by James Watt, Engineer, and submitted to the consideration of the Merchants.
Glasgow, Aug. 9, 1771. 8 pp., 4to.

WATT, James.
A Report to the Honorable His Majesty's Commissioners for managing the Annexed States in Scotland concerning the Isthmusses of Tarbert and Crinan.
Glasgow, Dec. 21, 1772. 107 pp., 4to.

Only known to the Editors in the manuscript state. One copy, no part of which is in Watt's handwriting, is preserved in the British Museum. (Add. MS. 9059.)

WATT, James.
An account of the scheme for rendering navigable the Rivers Forth and Devon with estimates of the Expense by James Watt.
Edinburgh, MDCCLXXIV. 4to.

WATT, James.
An account of JAMES WATT'S *Improvements upon the* Steam *or* Fire Engine.
(London 1774.) 8 pp., fcp. 4to.

This was the statement that Watt distributed to Members of Parliament when the Bill for extending his patent was before the House, as evidenced by his note on one copy in the Boulton and Watt Collection: "Delivered to the members of the House of Commons, 1774-5."

PARLIAMENT, Houses of.
An Act for vesting in James Watt, Engineer, his executors, administrators and assigns the sole use and property of certain steam engines commonly called fire engines, of his invention, for a limited time.
15 Geo. III, clxi, pp. 1587-94.
London (1775), fol.

Prior to its passage into law, it was printed as a Bill. It was reprinted subsequently in several forms.

PRYCE, William.
Mineralogia Cornubiensis.
London, 1778, fol.

In the Appendix, p. 308, a full description of and historical notes on Watt's engine are given, but no drawing. The information was supplied by Watt (Boulton to Henderson, 1777 Aug. 13) and is the first public notice of the engine in print. Both Boulton and Watt were subscribers to the book.

BOULTON and WATT.
Proposals to the adventurers in…by Boulton and Watt.
(Birmingham, 1778) 8 pp., 4to.

A form to be filled up for any one wishing to erect their engines. The experiments at Poldice on the coal consumption of the existing fire-engine are described. One paragraph reads: (3) "The profit which we require for such licence drawings and instructions is to be such sums…as shall be equal in value to a third part of the savings in fuel."

WATT, James.
Directions for erecting and working the newly-invented steam engines by Boulton and Watt.
(Birmingham, 1779) iv+24+16 pp., 6 plates, 12 mo.

Reproduced in full in Appendix II. Comprises "General Directions for building the engine house"; "Directions for putting the engine together"; "Directions for working the engine"; "Additional directions" and "Explanation of plates". These directions are detailed and precise, clearly revealing Watt's hand. The booklet was meant for private circulation among the firm's engine erectors and clients.

It is obviously a compilation. E.g. the "additional directions" are separately paged and the plates are numbered X to XII. This is known to be the case, as separate portions exist in manuscript in the Boulton and Watt Collection. Five of the copper plates are still preserved there. The date is fixed by entries in Watt's journals, see Chap. XX, showing when he was at work upon it.

PRIESTLEY, Joseph, LL.D.
Experiments and observations relating to various branches of Natural Philosophy.
Birmingham, 1781. 8 vo.

The second volume has on p. 388 an appendix Number III, entitled "Observations on this volume with which I was favoured by Mr. Watt". This is one page of notes which reveal Watt's acquaintance with the chemistry of the day.

[BOULTON and WATT.]
Directions relating to the Engine.
[Birmingham, 1784.] I sh., post.

Reproduced in full in Appendix III. The sheet was obviously meant to be hung up on the wall of the engine house.

[WATT, James.]
Remarks on a Government Paper entitled Iron Trade, England and Ireland.
(London, 1784), 3 pp., fcp.

Several copies of this paper exist in the Boulton and Watt Collection, but there is no definite evidence that Watt wrote it; the subject matter would point rather to Boulton or Wilkinson as the author. The occasion was a proposal by Mr. Pitt to impose additional duties on manufactures exported to Ireland from Gt. Britain.

There is another paper in existence, entitled "An Answer to the Treasury paper on the Iron Trade of England and Ireland", whose composition much more savours of the hand of Watt.

WATT, James.
Thoughts on the Constituent Parts of Water and Dephlogistigated Air; with an account of some Experiments on that Subject. In a letter from Mr. James Watt, Engineer, to Mr.De Luc, F.R.S. Read Apl. 29, 1784 (before the Royal Society). Printed in *Phil. Trans.*, LXXIV, pp. 329-53.
Sequel to the Thoughts on the Constituent Parts of Water and Dephlogistigated Air: in a subsequent letter from Mr. James Watt, Engineer, to Mr. De Luc, F.R.S. Read May 6, 1784. Printed in same vol. of *Transactions* : pp. 354-7.

The original letters are still in the possession of the Royal Society (Guard Book No. 74). These letters gave rise to a bitter controversy between the supporters of Watt and Cavendish as to which of them had the prior claim to the discovery of the composition of water. The letters, with much additional matter, were subsequently reprinted in volume form.

DALRYMPLE, Sir John.
Address and proposals from Sir John Dalrymple on the subject of the Coal, Tar and Iron Branches of the trade.
London and Edinburgh, 1784. 15 pp., 8 vo.

Sir John was one of the Barons of Exchequer in Scotland. Writing to Matthew Boulton on Aug. 6, 1784, he encloses a copy of what he calls "a little pamphlet" in one part of which he says: "I have done justice to your and Mr Watt's great improvements upon the Fire Engine."

WATT, James.
Heads of a Bill to explain and amend the laws relative to Letters Patent and grants of privilege for new Inventions.
B. & W. Colln. MS. 15 pages, 4 to.

Probably drafted in 1785 or 1786 when there was some talk by opulent manufacturers of combining to attack patents just as Arkwright's had been treated. Watt says:
"A pursuance of such decisions as have been given lately in several cases must at length drive men of invention to take shelter in countries where their ingenuity will be protected."

Boulton writing to De Luc was still stronger.
"Some late decisions against the validity of certain patents have raised the spirits of the illiberal, sordid, unjust, ungenerous and inventionless misers who prey upon the vitals of the ingenious, and make haste to seize upon what their laborious and often costly application has produced." (see Boulton Papers: Watt to Boulton, March, 1786).

[BOULTON and WATT.]
Short Statement on the part of Messrs. Boulton and Watt, in Opposition to Mr. Jonathan Hornblower's Application to Parliament for an Act to prolong the Terms of his Patent.
Birmingham, 1792. I sheet fcp., folded.

Hornblower was only trying to do for his compound engine patent what Watt and Boulton had done for the separate condenser patent. It appears from the Boulton MS. that Watt got thoroughly alarmed at the competition threatened by

Hornblower, and it is said that they lobbied actively against the prolongation of the patent with the result that it was not granted.

[BOULTON and WATT.]
Observations on the part of Messrs, Boulton and Watt re: Hornblower's steam engine bill.
[Birmingham], Apl. 17, 1792. I p., fcp.

WILSON, Thomas.
A comparative statement of the effects of Messrs. Boulton and Watt's Steam Engines with Newcommen's and Mr. Hornblower's. Addresses to the lords of, and adventurers in mines in Cornwall.
Truro, 1792. 25 pp., 8 vo.

WILSON, Thomas.
An address to the Mining Interest of Cornwall on the subject of Messrs. Boulton and Watt's and Mr. Hornblower's engines.
Truro, 1793. 22 pp., 8 vo.
Addressed similarly to the last.

Wilson was the agent in Cornwall of Boulton and Watt, and there can be little doubt that the above two pamphlets were prepared by him at the firm's instigation, or possibly by Watt himself, to counteract the Hornblower competition.

COURT OF COMMON PLEAS.
The Special Case in the cause of Boulton and Watt against Bull, in the Court of Common Pleas, with the arguments of the Judges thereon; and an Appendix of matters referred to.
London, 1795. 3 pp., fcp.

Quite probably edited by Watt.

The Special Case in the cause of Boulton and Watt against Bull, in the Court of Common Pleas, with the arguments of the Judges thereon; and an Appendix of matters referred to.
London, 1795. 8 pp., 8 vo.

This is merely a reprint of the preceding in handier format. Contains the shorthand report of the case. The Appendix is a list of patents in which *methods* of doing something were specified.

BEDDOES, Thomas, M.D., and WATT, James.
Considerations on the medicinal use of factitious airs, and the manner of obtaining them in large quantities. In two parts. Part I by Thomas Beddoes, M.D. Part II by James Watt, Esq.
Bristol, 1794. 8 vo. Separately paged, Part I, 48 pp., and Part II, 33 pp.

The sub-title of Part II is: Description of an Air Apparatus; with hints respecting the use and properties of different elastic fluids. By James Watt, Esq.

Consists of a series of letters of various dates from June 17 to Oct. 2, 1794, giving descriptions and drawings of the apparatus. Under date July 14th, Watt mentions that at Dr. Beddoe's desire: "Boulton and Watt have agreed to manufacture these machines for the Public."

BEDDOES, Thomas, M.D. and WATT, James.
Considerations on the medicinal use, and on the production of factitious airs Part I by Thomas Beddoes, M.D. Part II by James Watt, Engineer. Edition the second, to which are added communications from Doctors Carmichael, Darwin, Ewart…and others.
Bristol, 1795. 8 vo. Separately paged, part I has 172 pp., Part II has 40 pp., 5 copper-plates, and two tables.

In Part I there is a note that "at Mr. Chippendale's, *Salisbury Court, Fleet Street, London*, Mr Watt's Air apparatus may be seen".

Part II has the sub-title, "Description of a pneumatic apparatus with directions for procuring the facitious airs, by James Watt, engineer." The preface dated January 1795 says: "The Author has also availed himself of this opportunity to methodize and elucidate his description in a manner which the former hasty publication would not admit of."

Both second and third editions were printed also at Birmingham. "Edition the third, corrected and enlarged", appeared in 1796. Paged continuously 222 pp., 5 pl.

BEDDOES, Thomas, M.D. and WATT, James.
Considerations on the medicinal use and production of factitious airs. By Thomas Beddoes, M.D., and James Watt, Engineer. Part III.
Bristol, 1795. x + 121 pp., 3 pl., 8 vo.

Contains letters from physicians and others as to the treatment, among them being three from Watt (pp. 34, 36, and 105).

A 'Second Edition, corrected and enlarged' appeared the following year.
Bristol, 1796. xx+178 pp., 3p., 8 vo.

BEDDOES, Thomas, M.D., and WATT, James.
Medical cases and speculations; including Parts IV and V, of consideration on the medicinal powers, and the production of factitious airs by Thomas Beddoes, M.D., and James Watt, Engineer.
Bristol, 1796. 8 vo. Part IV, XV + 168 pp. Part V separately paged, 96 + (25 to 42 bis), 2 plates
Nos. 4 and 5, is entitled: "Supplement to the description of a pneumatic apparatus, for preparing factitious airs; containing a description of a simplified apparatus and of a portable apparatus. By James Watt, Engineer." 42 pp. of this is devoted to a description of the apparatus. A price list is given. The descriptive portion of Part V was reprinted with the same title as a separate pamphlet, evidently to push the sale of the apparatus.
Birmingham, 1796. 48 pp., 8 vo.

The reason why Watt was led to the study of this branch of medicinal treatment, viz. inhalation of oxygen, &c., was that his youngest son Gregory, by his second wife, a lad of great promise, suffered from consumption. In fact, consumption was in the family, for a daughter, Jessy, had died of the complaint in 1794. In spite of all the care expended on Gregory he, too, died of the disease in 1804, while staying in Devon on account of his health; he was buried in Exeter.

Thomas Beddoes was the well-known and enterprising physician who founded the Pneumatic Institution.

WATT, James, junior.
Directions for using the patent portable Copying Machines. Invented & made by James Watt and Company of Soho, near Birmingham.
[Birmingham, 1795.] 18 pp., 12 mo.

Some copies have as a frontispiece a copperplate engraving of the desk. The pamphlet states that machines are to be had from Richardson and Harrison, Leadenhall St.

Directions for using the patent portable Copying Machines invented and made by James Watt & Company of Soho, near Birmingham.
Birmingham, 1813. 16 pp., 12 mo.

With the exception that some of the introductory matter is deleted, and a few mistakes corrected, this is only a reprint of the preceding. Reprints of this were bought out in 1818 and 1830.

Manière de se servir de la Machine Portative à Copier. Inventée & Patentée par Jacques Watt & Co., de Soho, près de Birmingham.
Birmingham, 1805. 16 pp., 12 mo.

A French translation of the pamphlet became necessary owing to the fact that a sale for the copying machine had been created abroad. This is possibly not the earliest edition.

Manière de se servir de la machine à copier. Inventée & patentée par Jacques Watt & Co., a Soho, près de Birmingham.

Birmingham, 1807. 24 pp., 12 mo, 1 plate.

Practically a reprint of the preceding. A further reprint was bought out in 1818, 16 pp., 12 mo.

Anweisung zum Gebrauch der tragbaren Kopir-Maschinen erfunden und verfertigt von James Watt und Comp. zu Soho bei Birmingham.
Birmingham (? 1805). 24 pp., 12 mo.
Probably prepared at the same time as the French translation. The agent for the machines was G. H. Busch, Hamburg.

Watt patented the press copying system, and the machine therefore in 1781. A separate firm, James Watt & Co., was formed to exploit the invention, and their letter book, the first in which the system now so wide-spread was used, is preserved in the Boulton and Watt Collection. The sale of the machine was hindered by the prejudice of bankers and business people generally, and it was not till the patent had well nigh run its course that this opposition gave way before the merits of the system. It was at this time that James Watt, the younger, saw that the firm would not reap where they had sown unless the manufacture of the machines was taken up more vigorously, as another firm was already making machines. He bought out a portable form of the machine, combined with a writing-case and, as we learn from the Boulton correspondence [Boulton Papers] which fixes the date, compiled the above "Directions" in order to push the invention. It is not unlikely that Watt may have revised the manuscript.

PRONY, Gaspard Clair François Marie Riche de. Nouvelle Architecture Hydraulique.
Paris, 1796. 2 vols. 4 to, plates.

The double-acting engine described is stated (vol. I, p. 571) to be that constructed by MM. Périer Frères in 1790, based on a model to the scale of 1 in. to a foot made by M. le Chevalier de Bettancourt as a result of a visit to England in 1788. It is stated to have been "entièrement de l'invention" of that gentleman, but this claim was afterwards withdrawn and it was aditted that the information was taken from Watt's engines. The drawings are therefore the earliest published representing the Watt engine.

BRAMAH, Joseph.
A Letter to the Rt. Hon. Sir James Eyre, Lord Chief Justice of the Common Pleas: on the subject of the case, Boulton and Watt v. Hornblower and Maberley, for infringement of Mr. Watt's patent for an improvement on the Steam Engine, by Joseph Bramah, Engineer.
London 1797. 90 pp., 8 vo.

Substance of matter prepared by him as witness for the defence in the above trial.

ROBISON, John, M.A., LL.D., F.R.S.E.
Articles "Steam" and "Steam Engine" in the *Encyclopaedia Britannica*, 3rd edition, vol. XVI.
Edinburgh, 1797. 4 to, 3 plates.

WATT, James.
Specification of an invention of certain improvements upon Steam or Fire Engines for raising water and other mechanical purposes, and certain new pieces of mechanism applicable to the same by James Watt, Engineer.
[London, 1798.] 4 to, 19 pp. + 7 pp. references, 2 pl.

Simply a transcript of the patent specification of Mar. 12, 1782 (No. 1321). It is not obvious why it was printed, as the patent had then expired – probably it was intended for private circulation.

COURT OF COMMON PLEAS.
The arguments of the Judges in two Cases relating to the Letters Patent granted to James Watt, Engineer, for his method of lessening the consumption of steam and fuel in Fire Engines. Taken in shorthand by Mr. Gurney. In two parts: with an Appendix.
London, 1799. 104 pp., 8 vo.

The first part is a transcript of Watt's first patent specification, Jan. 5, 1769 (no. 913), and of the Act for extending the patent for twenty-five years from May 22, 1775.

The second part contains the reports of the cases Boulton and Watt *v.* Bull, and the same plaintiffs *v.* Hornblower and Maberley. As to the first of these two, the pamphlet merely reprints the matter given earlier, dated 1795.

ROBISON, John, LL.D., F.R.S.E.
Two articles, "Steam" and "Steam Engines", written for the *Encyclopaedia Britannica*…with notes and additions, by James Watt…And a letter on "Some Properties of Steam" by the late John Southern, Esq.
Edinburgh, 1818. 184 pp., 8 vo., 8 plates.

This is a reprint of the article above, with much additional matter comprising corrections in the text, footnotes, and an appendix from Watt's own pen, together with a covering letter to Sir David Brewster from Watt, dated Heathfield, May 1814.

The reason which had moved Watt to take all this trouble was his great regard for the memory of his old friend, Robison, an edition of whose works (see below) was then being prepared under the editorship of Sir David Brewster. This is explained in a pencil note on the copy now in the British Museum, which Watt sent inscribed "To the Right Hon. Sir Jos. Banks, Bart., G.C.B., etc., etc., from his obliged servant James Watt." The note reads: "The book of which this forms a part will not be published till winter, and until that time Sir Joseph is respectfully requested to keep this in his own possession, June, 1818."

In the covering letter to Brewster, which, by the way, was also printed in *Edin. Phil. Journ.*, 1820, II, by permission of James Watt, junior, Watt says: "I have not attempted to render Dr. Robison's memoir a complete history of the Steam-engine; nor have I even given a *detailed* account of my own improvements upon it. The former would have been an undertaking beyond my present powers, and the latter must have exceeded the limits of a commentary upon my friend's work. I have therefore confined myself to correcting such part as appeared necessary, and to adding such matter as he had not an opportunity of knowing."

Watt takes the opportunity of correcting the statement that he had been the pupil of Dr. Black at Glasgow, and that he had owed the improvements on the steam engine to Black's instruction.

The importance of the memoranda, for we can call them nothing more, is that they are really all we have at first hand from Watt himself upon his inventions. The letter from Southern is addressed to Watt under date March 1814, and gives the result of his and William Creighton's experiments and calculations on the temperance and pressure of steam, figures which remained the authority till superseded by the more precise figures established by Rankine. One or two letters passed between Watt and Southern about this time. For example, Watt writes: "I am at work on the Proffrs acct of my invention in the Dictionary, which I find will be a difficult thing to correct leaving any of the Proffrs words." (See Southern papers: Watt to Southern, December 20, 1813).

FAREY, John
Article "Steam Engine" in Rees's *Cyclopaedia*, vol. XXXIV.
London, 1819. 4 to, plates.

The fullest practical account of the steam engine that had appeared up to that date. Written subsequently to 1816 with information obtained from Watt. The plates alluded to are dated 1812 to 1818. The author subsequently expanded the matter into book form (see below).

HACHETTE, Jean Nicolas Pierre.
Notice sur la vie et les travaux de James Watt.
Bulletin de la Société d'Encouragement, CLXXXII, August 1819.

Very brief-Hachette had just been in England and had received from James Watt, junior, a bust by Chantrey for the Société d'Encouragement.

JEFFREY, Hon. Francis, Lord.
Character of Mr. Watt. Obituary eulogy in *Scotsman* newspaper. Edinburgh, Sept. 4, 1819. This was reprinted in *Edinburgh Magazine*, September 1819, no: 203.

PLAYFAIR, William.
Original memoirs of Eminent Persons. The late James Watt, Esq., F.R.S., & c., & c., communicated by Mr. Wm. Playfair.
Monthly Magazine or British Register, XLVIII, 1819, pp. 230-9.

Playfair was in the employ of the firm from 1777 to 1782 and therefore had inside knowledge of this period.

PLAYFAIR, William.
Memoir of James Watt, F.R.S.
New Monthly Magazine and Universal Register, 1819, vol.xii, p.576.

In a prefatory note the Editor states that it was written by Mr. Playfair and remarks that he had disposed of a copy of the rival magazine (i.e. the above); the memoirs are, however, quite different in matter.

WATT, James.
Thirteen letters from the late James Watt, Esq., to James Lind.
Monthly magazine or British Register, L, 1820, p. 239.

These cover the period 1764-99 and deal with Watt's scientific pursuits.

ROBISON, John, LL.D.
A system of mechanical philosophy. With notes by (Sir) David Brewster.
Edinburgh, 1822. 5 vols., 8 vo.

The first part of Vol. II consists of the matter given above under date 1818, in fact the pagination, even to the title-page, is identical; obviously the type had been kept standing.

[WATT, James, jun., and JEFFREY, Francis, Lord].
Article "James Watt" in the supplement to the fourth, fifth, and sixth editions of the *Encyclopaedia Britannica*, vol.VI, pp. 778-85.
Edinburgh, 1824. 4 to.

The first satisfactory biographical memoir of Watt. Three-fourths is from the pen of James Watt, jun.; the rest of it is taken up by an eulogy on Watt from the pen of Lord Jeffery, being, in fact, a reprint of his *Scotsman* article (*see ante*).

[WATT, James, jun., and JEFFREY, Francis, Lord].
Memoir of James Watt, F.R.S., L & E., from the supplement to the Encyclopaedia Britannica, vol.VI.
[Edinburgh, 1824.] 32 pp., 8 vo, privately printed.

Consists of above matter paged up in book form.

[TURNER, Charles Hampden, *Chairman*.]
Proceedings of the public meeting held at Freemasons' Hall [London] on the 18th June, 1824, for erecting a monument to the late James Watt.
London, 1824. 96 pp., 8 vo. A large paper copy was also issued.

As a result of this meeting, a public subscription was started, and the outcome was the Chantrey statue in Henry VII's Chapel, Westminster Abbey.

FAREY, John.
A treatise on the Steam Engine, historical, practical, and descriptive.
London, 1827. 4.to.

An expansion in volume form of the article in the *Encyclopaedia Britannica* mentioned above. Contains a large amount of first-hand detailed information about the Watt engines.

STUART, Robert. (Pseudonym of Robert Meikleham.)
Historical and descriptive Anecdotes of Steam Engines, and of their Inventors and Improvers.
London, 1829. 2 vols, 16 mo, portraits and plates.

ARAGO, Dominique François Jean.
Éloge historique de James Watt.
Mémoires de l'Academie Royale des Sciences de l'Institut de France, vol. XVII, pp. 1xic1xxxviii.
Paris, 1840. 127 pp., 4 to.

Watt occupied the distinguished position of being one of the eight foreign Associates of the Academy, an honour which was bestowed upon him in 1814; he had been a corresponding Member of the Institute since 1808. In 1833, by direction of the Academy, M. Arago, the Perpetual secretary, was charged with the task of writing a memoir of Watt. For this purpose he came to this country, and gleaned much information at first hand, notably from James Watt, junior, and Lord Brougham. The result was this eulogy, which was read at a public meeting of the Institute on Dec. 8, 1834. The Éloge is a valuable contribution to the biography of Watt.

To the Éloge is appended a translation of an historical account of the discovery of water by Lord Brougham who, before transmitting the manuscript to Arago, submitted it to James Watt, junior. The latter added a number of notes, which Lord Brougham considered so valuable that he asked Arago to retain them in printing. This he did, and there is a note to that effect on p. clxxxviii.

It may be remarked that the above matter was printed off by itself with new pagination, pp. 128, but without a title-page. Copies were presented to his friends by James Watt, jun.

ARAGO, D.F.J.
Biographical Memoir of James Watt, one of the Eight Foreign Associates of the Academy of Sciences, by M. Arago, Perpetual Secretary.
Edinburgh New Philosophical Journal, XXVII. October 1839, pp. 221-324. 12 mo.

A translation made by Hyde Clarke of the Éloge mentioned above. To it is appended Arago's essay "On Machinery considered in Relation to the Prosperity of the Working Classes", which did not appear in the Mémoires. This essay is intended to show that inventions such as those of Watt are not detrimental to the interests of workers, as was then maintained by some.

ARAGO, D.F.J.
Life of James Watt, to which are subjoined, "Memoir on Machinery considered in relation to the prosperity of the working classes", by M. Arago; and "Historical Account of Discovery of the Composition of Water", by lord Brougham.
Edinburgh, October 1839. 142 pp., 12 mo.

This is the matter from the *Edin. New Phil. Journ.* Above, in book form. Its early appearance was apparently due to the enterprise of the Editor and proprietors of that Journal.

Although not mentioned in the title-page, the volume contains on p. 125 the *Eulogium of James Watt* by Lord Jeffrey (from the *Encyclopaedia Britannica* already cited).

This Life of Watt ran into a second and third edition the same year (1839); the latter was illustrated with engravings and ran to 222 pp.

ARAGO, D.F.J.
Historical Éloge of James Watt. Translated from the French, with additional notes and an appendix, by James Patrick Muirhead, Esq., M.A.
London and Edinburgh, November 1839. ix + 261 pp., 8 vo, portrait. A large paper copy was also issued.

Although this contains the same matter as the preceding book, the translation is different and in some respects of greater merit. The Appendix includes: The Article on the Composition of Water by Lord Brougham; the Eulogy by Jeffery; the Memoir on Machinery by Arago, and a reprint of the proceedings of the Meeting for Erecting a Monument to Watt, already cite *ante*.

WILLIAMSON, George.
Letters respecting the Watt Family.
Greenock, 1840. 69 pp., 8 vo. Privately printed.

Practically all the matter is incorporated in the author's "Memorials" (see *infra*).

BROUGHAM, Henry, Lord, F.R.S.
Lives of Men of Letters and Science who flourished in the time of George III.
London, 1845, 8 vo., steel engraved portrait.

The biography of Watt occupies pp. 353-401 and includes an appendix on the discovery of the theory of the composition of water.

MUIRHEAD, James Patrick, M.A., F.R.S.E.
Correspondence of the late James Watt on his Discovery of the theory of the Composition of Water with a letter from his son. Edited with introductory remarks and an appendix by James Patrick Muirhead, Esq., F.R.S.E.
London, 1846. 264 pp., 8 vo, portrait. A large paper copy was also issued.

As we have said above, acrimonious discussion arose between the partisans of Watt and Cavendish as to their respective claim to priority in the discovery of the composition of water. The writer, being a relative of Watt, is naturally biased. It is now conceded that while Watt was the first to adduce reasoned arguments to show that water was not an element, Cavendish independently supplied the experimental data on which accurate knowledge alone could be founded.

ENGLISH, Henry.
Mining Almanack.
London, 1849. 8 vo.

English was the Editor of the *Mining Journal*. On p. 301 there is a "Life of James Watt" by the Editor and on p. 302 we read: "An éloge has been published by M. Arago, translations of which had been written by Mr. Muirhead and Mr. Hyde Clark."

ANON. (Religious Tract Society.)
James Watt, and the Steam Engine.
London, 1852. 192 pp., 16 mo.

[MURRAY, Thomas, LL.D., Secretary.]
Inauguration of the Statue of James Watt in connection with the Watt Institution and Edinburgh School of Arts.
Edinburgh, 1854. 23 pp., 8 vo.

In 1824 a public meeting was held in Edinburgh for the purpose of erecting a memorial in honour of Watt. The original idea was to erect a building "for the accommodation of the Edinburgh School of Arts, whereby the memory of Watt may be for ever connected with the promotion, among a class to which he himself originally belonged, of those mechanical arts from which his own usefulness and glory arose".

Eventually the fund was devoted to the purchase in 1852 of the premises that had been long used for the purposes of the School of Art, when the name was changed to the "Watt Institution and Edinburgh School of Arts". It was felt that, in addition, something distinctive should be done to mark the concatenation: accordingly a statue was erected in front of the School. The School is now merged in the Heriot-Watt College.

MUIRHEAD, James Patrick, M.A., F.R.S.E.
The Origin and Progress of the Mechanical Inventions of James Watt illustrated by his correspondence with his friends and the specifications of his patents.
London, 1854. 3 vols., 8 vo., portrait. A large paper copy was also issued.

Based almost entirely on letters in the Doldowlod Papers, it is undoubtedly the rischest mine of information about Watt.

The first volume is mainly taken up with an account, not sufficiently discriminating perhaps, of Watt's life. The second is devoted to transcripts of his letters commencing in 1765, and continuing till the year before his death. Possibly the letters have been chosen too much for their social and literary rather than for their scientific interest, but on the other hand such a choice appeals to the widest circle. The third volume gives the patent specifications and reprints of the Patent Cases already referred to.

WILLIAMSON, George.
Memorials of the lineage, early life, education, and development of the genius of James Watt.
Printed for the Watt Club.
(Greenock), 1856. 4 to.

Authoritative on Watt's ancestry and early life. There are two portraits: one, frontpiece, an engraving of the Henning portrait, 1803; the other facing p. 120, a lithograph of the oil painting by Partridge.

COMMISSIONERS OF PATENTS.
A.D. 1769, No. 913. Specification of James Watt. Steam Engines, &c.

New invented method of lessening the Consumption if Steam and Fuel in Fire Engines. Dated Jan. 5, 1769. It is important to note that the patent only covered England, Wales, and the Colonies.
London, 1855. 3 pp., 4 to.

A.D. 1769, No. 913*. Extension of Patent of James Watt. Steam Engines, &c.
London, 1857. 6 pp., 4 to.
An Act for vesting in James Watt, Engineer, his executors administrators and assigns, the sole use and property of certain Steam Engines commonly called Fire Engines, of his Invention, described in the said Act, throughout his Majesty's Dominions, for a limited time (22nd May, 1775).

A point to be noted is that this Act extended the Patent to Scotland.

A.D. 1780. No. 1244. Specification of James Watt. Copying Letters, &c.

A new method of copying letters and other writings expeditiously. Dated Feb 14, 1780.
London, 1856. 4 pp., 4 to.

A.D. 1781. No. 1306. Specification of James Watt. Steam Engines.

Certain new methods of applying the vibrating or reciprocating motion of steam or fire engines to produce a continued rotative or circular motion round an axis or centre, and thereby to give motion to the wheels of mills and other machines. Dated Oct. 25, 1781.
London, 1855. 9 pp., 4 to, plates.

A.D. 1782. No. 1321. Specification of James Watt. Steam Engines

Certain new improvements upon steam or fire engines for raising water, and other mechanical purposes, and certain new pieces of mechanism applicable to the same. Dated Mar. 12, 1782.
London, 1855. 16 pp., 4to, plates.

A.D. 1784. No. 1432. Specification of James Watt. Fire and Steam Engines, &c.

Certain new improvement on fire and steam engines, and upon machines worked or moved by the same. Dated Ap. 28, 1784.
London, 1855. 14pp., 4to, plates.

A.D. 1785. No. 1485. Specification of Hames Watt. Furnaces and Fireplaces.

Certain newly improved methods of constructing furnaces or fireplaces for heating, boiling, or evaporating of water and other liquids, which are applicable to steam engines and other purposes; and also for heating, melting, and smelting of metals and their ores, whereby greater effects are produced from the fuel, and the smoke is in a great measure prevented or consumed. Dated June 14, 1785.
London, 1854. 4pp., 4to, plates.

SCHIMMEL PENNINCK, Mary Anne.
Life of, edited by Christiana C. Hankin.
London, 1858. 8 vo.

Reminiscent character sketches written in 1856 of Matthew Boulton, James Watt, and the family of the latter as they were in 1788-90.

MUIRHEAD, James Patrick, M.A., F.R.S.E.
Life of James Watt, with selections from his correspondence.
London, 1859. 8 vo.

This is in substance the memoir from the author's *Mechanical Inventions* referred to above. It ran into a second revised edition, 1859.

HART, Robert.
Reminiscences of James Watt. *Trans. Glasgow Archaeological Society*, Pt. I, i.
Glasgow, 1859. 8 vo.

Valuable recollections of Watt in his old age, i.e. in 1813 or 1814.

SMILES, Samuel, LL.D.
Lives of Boulton and Watt, principally from the original Soho MSS. comprising also a History of the Invention and Introduction of the Steam Engine.
London, 1865. xvi+521 pp., 8 vo in 1 or 2 vols.

Attractively written, avoids the introduction of technical detail, but is not always accurate. This ran into a second edition the following year.

COMMISSIONERS OF PATENTS.
Contributions to the History of the Steam Engine being two deeds relating to the Erection by Messrs. Boulton and Watt of Steam Engines on the United Mines at Gwennap, Cornwall, and at Werneth Colliery, near Oldham, Lancashire, from the originals in the Patent Office Library.
London, 1872. 16 pp., 8 vo.

The date of these deeds is 1779 and 1799 respectively. The title should read: "…Werneth Colliery in the parish of Prestwich, Lancashire…"

TIMMINS, Samuel.
James Watt, from *Trans. Archaeol.* Section of the Birmingham and Midland Inst., 1872.
Birmingham, 1873. 4 to.

SMILES, Samuel, LL.D.
Lives of the Engineers. The Steam Engine-Boulton and Watt, New and revised edition.
London, 1878. Plates, 12 mo.

Vo.IV of the "Lives" slightly abridged from the author's larger work, *ante*.

COWPER, Edward A., M.I.Mech.E.
On the Inventions of James Watt and his models preserved at Handsworth and South Kensington. Excerpt *Proc. Inst. Mech Eng.*, 1883. Pp. 599-631, and plates 55-87.
London, 1883. 8 vo.

Written by a capable engineer who had made a study of the subject; perhaps the best description extant of Watt's inventions.

TANGYE, [Sir] R[ichard] and G[eorge].
James Watt and William Murdock.
Birmingham (1888). II pp., 2 prints, 12 mo.

Comprises: "The Earliest Locomotive in England" and "James Watt's Garret".

BARR. Archibald, LL.D.,D.Sc.
James Watt and the Application of Science to the Mechanical Arts: An Address.
Glasgow, 1889. 27 pp., 8 vo.

PREECE, Sir William H., C.B., F.R.S., M.Inst.C.E.
Watt and the Measurement of Power. Watt Anniversary Lecture delivered before the Greenock Philosophical Society, 1897.
Greenock, 1897. 13 pp., 8 vo., 2 figs.

THORPE, Sir Thomas E., D.Sc.,LL.D.,F.R.S.
James Watt and the Discovery of the Composition of Water. Watt Anniversary Lecture delivered before the Greenock Philosophical Society, 1898.
Greenock, 1898. 19 pp., 8 vo.

A full, impartial, and judicious summing up, by a chemist of world-wide fame, of the long drawn-out controversy among the partisans of Watt, Cavenish, and Lavoisier, as to what were their respective shares in this great discovery.

BRAMWELL, Sir Fredick, Bart., LL.D., F.R.S., M.Inst.C.E.
Article , "James Watt" in *Dictionary of National Biography*, vol. 1x, pp. 51-62. Also paged up separately as a booklet of 24 pp.
London, 1899. 8 vo.

The best short biography extant, by an engineer of ripe experience.

BECK, Theodor.
Beiträge zur Geschichte des Machineenbaues.
Berlin, 1900. 582 pp., 8 vo.

THOMSON, William, Baron Kelvin, P.R.S.
James Watt, an Oration delivered in the University of Glasgow on the commemoration of its ninth Jubilee.
Glasgow, 1901. 2 pp., 8 vo.

Deals in the main with Watt's connection with the College of Glasgow.

THORPE, Sir Thomas E.,F.R.S.,&c.,
Essays in Historical Chemistry.
London, 1902. 8 vo.

Essay V, pp. 98-122, is devoted to "James Watt and the Discovery of the Composition of Water". This is a reprint of the Watt Anniversary Lecture noted above. This Essay was not, of course, in the author's earlier volume under the same title published in 1894. A third edition appeared in 1911.

JACKS, William, LL.D., D.L.
James Watt.
Glasgow, 1901. 215 pp., portrait, 12 mo.

Repeats some misstatements of former writers, and is not sufficiently critical.

HELE-SHAW, H.A., F.R.S., M.Inst.C.E.,M.I.Mech.E.
James Watt, Inventor. Watt Anniversary Lecture delivered before the Greenock Philosophical Society, 1902.
Greenock, 1902. 28 pp., 4 plates, 8 vo.

PEMBERTON, T. Edgar.
James Watt of Soho and Heathfield. Annals of Industry and Genius.
Birmingham 1905. 233 pp., portrait, 3 plates, 12 mo.

The Pemberton family occupied Heathfield from 1857 to 1876. Gives matter relative to Watt's connection with the house and estate, his associates at Soho, and with the Lunar Society. From 1876 to 1920 Heathfield was occupied by the late Mr. George Tangye.

CARNEGIE, Andrew.
James Watt.
London, 1905. 240 pp., 8 vo.

Painstaking and eulogistic, but brings out no new facts.

CARNEGIE, Andrew.
James Watt. (Famous Scots Series.)
Edinburgh and London [1905]. 164 pp., 12 mo.

Condensed from the preceding.

MATSCHOSS, Conrad, Ph.D., Dipl. Eng.
Die Entwicklung der Dampfmaschine.
Berlin, 1908. 2 vols., 4 to.

Appraises Watt's experiments and discoveries, pp. 339-72. Comments upon his influence on the progress of machine design.

BURSTALL, Henry Frederic William, M.A.M.Inst.C.E.
Nine Famous Birmingham Men. Lectures delivered in the University, edited by J.H. Muirhead, LL.D.
Birmingham, 1909. Portraits, 8 vo.

The Fourth Lecture, pp. 109-30 is devoted to James Watt, by Prof. Burstall.

FOX, Howard, F.G.S.
Boulton and Watt.
Reprinted from the Report of the Royal Cornwall Polytechnic Society for 1909.
Penryn, 1910. 20 pp., 8 vo.

Letters, or extracts there from, received by Thomas Wilson, agent of Boulton and Watt in Cornwall, during the period 1794-1802.

CAIRD, Robert, LL.D., F.R.S.E., M.Inst.C.E.
James Watt's Contribution to the Advancement of Engineering. Watt Anniversary Lecture delivered before the Greenock Philosophical Society, 1910.
Greenock, 1910. 23 pp., 8 vo.

CORMACK, J.D., C.M.G.,D.Sc.,M.Inst.C.E.
In the Days of Watt…Watt Anniversary Lecture delivered before the Greenock Philosophical Society, 1915.
[Greenock, 1915.] 17 pp., 8 vo.

DICKINSON, Henry Winram, M.I.Mech.E.
Some unpublished letters of James Watt. Excerpt *Proc.Inst.Mech.Eng.*,pp.487-534.
London, 1913. 8 vo.

Annotated transcripts of letters from the Boulton and Watt Collection and from the Boulton Papers, bringing out points of technical interest.

GRANT, John W
James Watt and the Steam Age.
London, 1917. pp.223, portrait, 8 vo.

A gossiping sketch.

BOARD OF EDUCATION.
Catalogue of Mechanical Engineering Collection in the Science Museum, South Kensington. Pt.I, 6th edition, with a supplement containing illustrations.
London, 1919. 8 vo.

Includes technical description of original Watt models preserved at South Kensington.

HENDERSON, H., *Librarian*.
James Watt Centenary Exhibition [at the Watt Monument, Greenock], Sept. 4, 1919.
Greenock, 1919. 19 pp., portrait, 8 vo.

WATT CENTENARY COMMITTEE.
James Watt Centenary Commemoration, Sept. 16-20, 1919. Souvenir Guide Book of Special Exhibit in the Art Gallery, Birmingham.
Birmingham, 1919. 60 pp., 8 vo.

BOARD OF EDUCATION, Science Museum.
Catalogue of Watt Centenary Exhibition.
London, 1919. 45 pp., portrait , 8 vo.

A Collection of portraits, drawings, holograph letters, original models, books, &c.

GALLOWAY, T. Lindsay, M.A.,F.G.S.
James Watt.
Proc.Roy.Phil.Soc.Glasgow, vol.L, 154.
Glasgow, 1921. 16 pp., 8 vo.

FLEMING, James Arnold, O.B.E.,F.R.S.E.,F.S.A,Scot.,F.C.S.
Scottish Pottery.
Glasgow, 1923. 8 vo.
Gives *inter alia* an account of Watt's connection with pottery manufacture-a hitherto little-known activity of his.

LORD, John, B.A.
Capital and Steam-Power, 1750-1800.
London, 1923. 8 vo.

Deals with the economics of the introduction of the steam engine into industry. Uses the history of the firm of Boulton and Watt as the basis of his thesis. Employs the same material very largely, although from a different angle, as do the authors of the present volume, in conjunction with which it should be read.

MARSHALL, Thomas Humphrey, M.A.
James Watt (1736-1819). Roadmaker Series.
London and Boston, 1925. 8 vo.

Racily written - effectively uses the known material, including the preceding volume, well set in relationship to contemporary events.

JENKIN, A.K. Hamilton, M.A.B.Litt.
Boulton and Watt in Cornwall. Excerpt Rept. Roy.
Cornwall Polytechnic Soc.,N.S., vol.V.1926.
Camborne, 1926. 8 vo.

Extracts are given from a collection of about 1,000 letters from the firm to Thomas Wilson, their agent. The letters are now the property of the Society and are preserved in their Library.