The Herschels: A scientific family in training

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Declaration of originality: I declare this is my own work and where I have used the work of others, it has been appropriately referenced.

Abstract

This is a study of the Herschel family over three generations. The focus is on their education, and specifically on what that tells us about the hopes and aspirations each generation had for itself and its off spring. To what extent did successful men and women of science want their children to follow in their footsteps? Did this ambition vary from generation to generation? Were the Herschels typical among their scientific peers or were they an anomaly?

In chapter one I examine the life of William Herschel arguing that his transition from music to astronomy was gradual and motivated by a desire for social mobility. In chapter two I consider the life of Caroline Herschel to show how different her experience of education was to that of her brother and why her role in astronomy should be judged with that in mind. In chapter three I examine the childhood education of John Herschel, arguing that his early successes in mathematics can best be understood with reference to his father's ambition for him and carefully designed curriculum. In chapter four I then considered how John modified his education as an adult. I argue that he deliberately distanced himself from his father's work to build an independent reputation and following friends and mentors set out to present science as part of what makes us civilised. In chapter five I introduce John's wife, Margaret Brodie Stewart. I argue that her religious background informed her views on education, and that John looked to her to create a happier home life than he had experienced himself. Finally, in chapter six, I examine the education John and Margaret provided for their 12 children. I argue that science, in the education of this generation, was presented first as a hobby and only later as a possible career.

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Introduction

This thesis is a study of the educational strategies and aspirations that existed within the Herschel family or dynasty during the period 1738 to 1874.[1] At its heart is the question of what nineteenth century men of science and their families wanted for their children, themselves and those around them. My focus is on how the Herschel family used education as a means of achieving their professional, intellectual and social ambitions.

I argue that their initial interest in science came in part from a desire for social mobility. Over the years various social and intellectual roles were assigned to different members of the family, and this had important repercussions both for their education and the contribution they were able to make to science. However, once they had reached a certain level in the scientific establishment, the value of that prize, of simply being a part of the scientific elite, began to be questioned. Other ambitions, some introduced through marriage, became increasingly important. Financial considerations also played a part, so that by the third generation of the Herschel dynasty, a variety of careers and roles, (not all of which were scientific) were deemed both acceptable and desirable.

In this thesis I use tools from biography to understand the way in which this family evolved over time. Over three generations, I look at the choices made by junior and senior members of the Herschel family regarding education in order to gain an insight into the way the family's social and intellectual ambitions were intertwined.

The Herschels, I argue, are an example of a *scientific dynasty*. Certain aspects of the family's history invite comparison with other, contemporary families: for example, John, like his peers in the Cambridge Analytical Society, was brought up to learn Continental mathematics. A generation later, John joined others in selecting Clapham Grammar School and careers in India for one or more of his sons. These choices indicate shared attitudes to science, mathematics and education held by the

[1] 1738 was the year William Herschel was born; 1874 was the year the youngest of John and Margaret's children, Constance, went to Cambridge.

Herschels and other families. These scientific families were often part of what Susan Cannon has termed the 'Cambridge Network.'[2]

The study of a family, especially one that has left such a rich set of letters and papers, allows a multitude of often marginalised voices to be heard. A considerable amount of this archive has not been used before, and my use of these untapped resources reveals new insights into the way the family worked, their values and aspirations. The evolution of the Herschels' views on science and science education was not just the product of their clan's more famous scions, but was the result of a plethora of ideas and experiences coming both from lesser known family members as well as from other contemporaries. Women in this family experienced a different education from their husbands and brothers. As adults they had different expectations and responsibilities, and these had an impact not only on the roles they could play, but also on the ambitions they in turn had for their children. Similarly, not all the men in this family were trained to join the scientific elite. Some followed occupations that had nothing to do with the study of the natural world, while others worked in areas that required a greater or lesser acquaintance with science. A study of the whole family allows those central and marginalised scientific roles to be considered side by side, and highlights the relationship between education, aspiration and professional success.

The Herschels were products of, and indeed contributed to, the changing status of science education during the nineteenth century. Therefore, the Herschels, and families like them, must be understood in terms of a background of contemporary debate about the role of science and the purpose of education. A detailed study of this family highlights the role they played in these debates and how this related to their private lives. In the case of John Herschel and his wife Margaret, the choices they made about themselves and their children had repercussions for how they campaigned for the role of science and science education in the public domain. As we shall see, the ideals they expressed for society's relationship with science were closely bound up with the way they chose to educate their children. By looking at the Herschels in this way, a new understanding of each generation, and each individual Herschel, emerges which differs substantially from received accounts.

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[2] Susan Faye Cannon, "Chapter 2: The Cambridge Network," in *Science in Culture: The Early Victorian Period* (New York: Science History Publications, 1978).

1: Herschel scholarship to date

Several of the more prominent members of the Herschel dynasty have received considerable attention in the history of science. However, there has been no extended study of the family as a whole, nor within a comparative context as an example of a major nineteenth century scientific family. Instead, research on the Herschels has been shaped by general trends in the history of science.[3] During the nineteenth century a few biographical accounts of William and John were published in the style of 'exemplary lives'. Caroline's autobiographical memoir and correspondence was published in 1876, edited by a relative.[4] There were also a number of portraits of William and John, circulated as was common at the time, as pull outs in improving magazines, again presenting their lives as exemplary.[5] In the early twentieth century, there were more biographies of the Herschels including a number of accounts written about Caroline's life that were made to fit the authors' image of the proper role for women in science.[6] Several studies of particular episodes in the scientific careers of William or John were produced, giving a more detailed understanding of their contributions to science.[7] Obituaries of some of John's children found their way into print, and John's daughter Constance Lubbock edited and published a now well used account of William and Caroline's lives told through the medium of their correspondence.[8] A couple of important catalogues were also published around this

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[3] Janet Browne, "Presidential Address: Commemorating Darwin," *British Journal for the History of Science* 38, no. 3 (2005) – Browne looks at scholarship on Charles Darwin to illustrate trends in the history of science. Scholarship on the Herschels seems to follow more or less the same patterns.

[4] Samuel Smiles, *Self-Help* (1859); E. S. Holden, *Sir William Herschel: His Life and Works* (New York: 1881); Robert S. Ball, *Great Astronomers* (London: 1895); Mrs. J. Herschel, ed., *Memoir and Correspondence of Caroline Herschel* (London: 1876); Agnes Mary Clerke, *The Herschels and Modern Astronomy*, *The Century Science Series* (London: Cassell, 1895); James Sime, *William Herschel and His Work* (Edinburgh & New York: Charles Scribner's Sons, 1900).

[5] Anthony J. Turner, "Portraits of William Herschel," *Vistas in Astronomy* 32 (1988).

[6] Marianne Kirlew, *Famous Sisters of Great Men* (London: 1905); Alice Cockran, *The Romance of a Woman's Influence* (London: 1906); Alexander Macfarlane, *Lecture on Ten British Physicists of the Nineteenth Century* (New York: 1919); Hector Macpherson, *Herschel* (London: 1919).; Margaret Tabor, *Pioneer Women* (1933); Helen Ashton and Katharine Davies, *I Had a Sister* (London: Lovat Dickson, 1937).

[7] E. S. Cornell, "The Radiant Heat Spectrum from Herschel to Melloni – 1. The Work of Herschel and His Contemporaries," *Annals of Science* 3 (1938); Beaumont Newhall, "Sir J. F. W. Herschel," *The Complete Photographer* 5 (1943); E. Scott Barr, "The Infrared Pioneers – 1. Sir William Herschel," *Infrared Physics* 1, no. 1 (1961); H. C. King, "Sir William Herschel and the Discovery of Radiant Heat," *Journal of the British Astronomical Association* 1955; D. J. Lovell, "Herschel's Dilemma in the Interpretation of Thermal Radiation," *ISIS: International Review devoted to the History of Science and its cultural influences* 1968.

[8] Lady Constance Anne Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel* (Cambridge: Cambridge University Press, 1933).

time. Dreyer produced his catalogue of William's scientific papers in 1912, while Steavenson catalogued the instruments and artefacts found at the Herschel family home in Slough before it was demolished.[9]

In the second half of the twentieth century, Brian Warner at the South African Astronomical Observatory and Michael Hoskin in Cambridge made major contributions to research into the Herschels. Warner specialised in John Herschel's time at the Cape.[10] Hoskin began work on William and Caroline and later their siblings.[11] Hoskin has enriched our understanding of this generation of Herschels and their impact on the history of astronomy. However, he has not studied in any detail William and Caroline's reasons for taking up astronomy, how they first developed their expertise in that subject or the impact this had on their relationship with John. These are all areas I address in the following chapters. In the 1970s there was renewed

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[9] John Louis Emil Dreyer, ed., *The Scientific Papers of Sir William Herschel*, 2 vols. (London: Royal Society and the Royal Astronomical Society, 1912); W. H. Steavenson, "Catalogue of Instruments Made and (or) Used by Sir William Herschel, as Preserved at Slough and Examined There in 1924, May and June," *Transactions of the Optical Society* 1925; W. H. Steavenson, "A Peep into Herschel's Workshop," *Transactions of the Optical Society* 1925.

[10] Brian Warner and Nancy Warner, eds., *Maclear and Herschel: Letters & Diaries at the Cape of Good Hope 1834-1838*, *South African Biographical and Historical Studies* (Cape Town: A.A. Balkema, 1984); Brian Warner, "Herscheliana," *Vistas in Astronomy* 30 (1987).; Brian Warner, "Herschel, William, 1738-1822," *Transactions of the Royal Society of South Africa* 47, no. 2 (1989); Brian Warner, ed., *Lady Herschel: Letters from the Cape 1834-1838* (Cape Town: Friends of the South African Library, 1991); Brian Warner, "The Years at the Cape of Good Hope" (paper presented at the John Herschel (1792-1871): A Bicentennial Commemoration, Royal Society, London, 1992); Brian Warner, "Herschel, John, 1792-1871," *South African Journal of Science* 88 (1992); Brian Warner, "John Herschel at the Cape of Good Hope" (paper presented at the John Herschel, 1792-1992: Bicentennial Symposium, Herschel School, Claremont, South Africa, 1992); Brian Warner, "Introduction" (paper presented at the John Herschel, 1792-1992: Bicentennial Symposium, Herschel School, Claremont, South Africa, 1992); Brian Warner et al., *Flora Herscheliana: Sir John and Lady Herschel at the Cape 1834 to 1838* (Houghton, South Africa: Brenthurst Press, 1998).

[11] Michael Hoskin, *William Herschel: Pioneer of Sidereal Astronomy* (London: Sheed and Ward, 1959); Michael Hoskin, *William Herschel and the Construction of the Heavens* (London: Oldbourne, 1963); Michael Hoskin, "The Elder Herschel," *History of Science* 2 (1963); Michael Hoskin, "Herschel's Dilemma," *The Listener*, 18 April 1963; Michael Hoskin, "William Herschel and Sidereal Astronomy," *Endeavour* 1964; Michael Hoskin, "The English Background to the Cosmology of Wright and Herschel," in *Cosmology, History and Theology*, ed. Wolfgang Yourgrau and Allen D. Breck (New York: 1977); Michael Hoskin, "William Herschel's Early Investigations of Nebulae: A Reassessment," *Journal for the History of Astronomy* 10 (1979); Michael Hoskin, "Herschel's Determination of the Solar Apex," *Journal for the History of Astronomy* 11 (1980); Michael Hoskin and Brian Warner, "Caroline Herschel's Comet Sweepers," *Journal for the History of Astronomy* 12 (1981); Michael Hoskin, "Astronomical Correspondence of William Ronan Hamilton," *Journal for the History of Astronomy* 15 (1984); Michael Hoskin, "John Herschel's Cosmology," *Journal for the History of Astronomy* 18 (1987); Michael Hoskin, "Herschel, William and the Construction of the Heavens," *Proceedings of the American Philosophical Society* 133, no. 3 (1989); Michael Hoskin, "Herschel, John and Astronomy – a Bicentennial Appraisal" (paper presented at the John Herschel, 1792-1992: Bicentennial Symposium, Herschel School, Claremont, South Africa, 1992); Michael Hoskin, *The Herschel Partnership: As Viewed by Caroline* (Cambridge: Science History Publications Ltd, 2003); Michael Hoskin, *Caroline Herschel's Autobiographies* (Cambridge: Science History Publications Ltd, 2003).

interest in Caroline Herschel with the rise of feminist histories.[12] There was also a new fascination with the fact that William Herschel had personally constructed his own instruments, as the history of scientific instrumentation emerged as an independent discipline.[13] In 1970 Günther Buttmann published the first and to date the only full length biography of John Herschel.[14] The book concentrated on John Herschel's scientific work, rather than his training or family life. As a consequence, the role of John's parents in his early upbringing was not considered in any detail. Similarly, John's role in bring up his own children was overlooked.

Since the 1970s, there have been three major Herschel anniversaries, each resulting in a significant increase in secondary material on the family. The first was the bicentennial anniversary of William Herschel's discovery of Uranus in 1981. The second celebrated the tercentenary of John Herschel's birth in 1992, while the third (in 2000) was held in order to celebrate 250 years since Caroline Herschel's birth. The 1981 celebrations saw the establishment of a museum (Herschel House in Bath) and two Herschel societies.[15] It also inspired, for the first time, secondary material on John's children, the third generation of Herschels.[16] 1992 was marked by two conferences: one at the Royal Society in London, the other in South Africa.[17] Papers from these conferences were published and further papers and projects followed on

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[12] H. R. Calvert, "The Presentation of Caroline Herschel's Telescope to the Society by Sir John Herschel," *Quarterly Journal of the Royal Astronomical Society* 11 (1970); Marylin Bailey Ogilvie, "Caroline Herschel's Contributions to Science," *Annals of Science* 32 (1975).

[13] Jim A. Bennett, "William Herschel's Large Twenty-Foot Telescope," *Quarterly Journal of the Royal Astronomical Society* 17 (1976); Jim A. Bennett, "'on the Power of Penetrating Space': The Telescopes of William Herschel," *Journal for the History of Astronomy* 7 (1976).

[14] Günther Buttmann, *The Shadow of the Telescope: A Biography of John Herschel* (New York: Scribner, 1970).

[15] The William Herschel Society, set up in 1977 to galvanise support to preserve Herschel House and the Herschel Society of Japan established after the 1981 celebrations. Patrick Moore, *William Herschel: Astronomer and Musician of 19 New King Street, Bath* (Sidcup: P.M.E. Erwood in association with the William Herschel Society, 1981); Carole Stott, "The Herschel House in Bath," *Sky and Telescope* 1981.

[16] Peter M. Millman, "The Herschel Dynasty – Part 1: William Herschel," *Journal of the Royal Astronomical Society of Canada* 74, no. 4 (1980); Peter M. Millman, "The Herschel Dynasty – Part 2: John Herschel," *Journal of the Royal Astronomical Society of Canada* 74, no. 4 (1980); Peter M. Millman, "The Herschel Dynasty - Part 3: Alexander Stewart Herschel," *Journal of the Royal Astronomical Society of Canada* 74, no. 5 (1980); Eileen Shorland, "Sir William James Herschel and the Birth of Fingerprint Identification," *Library Chronicle of the University of Texas at Austin* 1980. Before the 1981 anniversary the only material on John Herschel's children were the obituaries of Alexander and Francisca and an entry for Alexander in the Dictionary of National Biography from 1911. See T. H. H., "Professor A. S. Herschel, 1836-1907 – an Obituary," *Proceedings of Royal Society* A80 (1907-08); Mira F. Hardcastle, "Obituary of Francisca Herschel," *Monthly Notices of the Royal Astronomical Society* 1933; P. H. Hollis, "Herschel, Alexander Stewart (1836-1907)," in *Dictionary of National Biography (Second Supplement, 1901-11)* (London: 1911).

[17] D. G. King-Hele, "John Herschel 1792-1871: A Bicentennial Commemoration. Proceedings of a Royal Society Meeting Held on 13 May 1992" (London, 1992); Warner, "Introduction".

John and his children.[18] In 1991 Brian Warner published an edited volume of John's wife, Margaret Brodie Herschel's correspondence from the Cape.[19] The 1992 anniversary also marked the beginning of a six year project to catalogue all of John Herschel's extant correspondence.[20] The 250th anniversary of Caroline's birth was marked with a few articles in the popular astronomy press.[21]

None of these accounts situated individual Herschels in a familial context and none give any attention to the educational strategies and aspirations that were so important for the Herschels and families like them. It is partly this gap in the literature that I set out to fill with this thesis. From Caroline's *Memoirs*, Constance Lubbock's *Herschel Chronicles*, and Hoskin's work, a narrative emerges that is repeated again and again in the secondary literature on this family. William had a natural talent for astronomy which he taught himself quickly and without help; Caroline was the selfless assistant, trained passively by her brother, while John was born a gifted mathematician. By looking at each Herschel's early years and the relationship between education and parental ambition, I present a more detailed and informative picture of how the Herschels became scientific than has previously been allowed.

Of the rest of the family, Margaret has been almost entirely ignored, except to have her Cape diaries edited and published by Brian Warner. In his introduction, he describes her only in terms of the profession of her father, and the happiness she brought to John. Her own role, education or aspirations are not considered. John and Margaret's children have similarly received only very brief introductions, and although

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[18] Ann Spokes Symonds, "Herschel's Retirement Years," *Fingerprint Whorld* 1990; Martin Beech, "The Herschel-Denning Correspondence, 1871-1900," *Vistas in Astronomy* 34 (1991); Howard C. Nightingale, "Distinguished Members of the Herschel Family - 3 - Colonel John Herschel F.R.S., F.R.A.S.," *Bulletin of the William Herschel Society* 39 (1992); Howard C. Nightingale, "Distinguished Members of the Herschel Family," *Bulletin of the William Herschel Society* 38 (1992); Howard C. Nightingale, "Alexander Stewart Herschel," *Bulletin of the William Herschel Society* 37 (1992); Anon, "The Hon. Caroline Lady Hamilton Gordon," *Bulletin of the William Herschel Society* 42, Autumn (1993); Anon, "Sir William Herschel's Biographer - Lady Constance Lubbock," *Bulletin of the William Herschel Society* 45, Autumn (1994); Patrick Moore, *Alexander Herschel, the Meteor Man* (Bath: 1993).

[19] Warner, ed., *Lady Herschel: Letters from the Cape 1834-1838*.

[20] Michael J. Crowe, "The John Herschel Correspondence Project" (paper presented at the John Herschel, 1792-1992: Bicentennial Symposium, Herschel School, Claremont, South Africa, 1992); Michael J. Crowe, ed., *A Calendar of the Correspondence of Sir John Herschel* (Cambridge: Cambridge University Press, 1998).

[21] David W. Hughes, "Caroline Lucretia Herschel – Comet Huntress," *Journal for the British Astronomical Association* 109, no. 2 (1999); M. Millar and I. Millar, "Birth of Caroline Herschel – March 16th, 1750," *History Today* 2000; A. Gunn, "Caroline Herschel: Female Astronomer," *Astronomy Now* 2000.

the fact that they came from a scientific family is always acknowledged, the significance of this fact is not explained. In this thesis, the individual Herschels are placed within the context of their family, allowing the role and significance of the family, to become apparent. By comparing the Herschels with other families, I argue for a broad notion of the 'scientific' or 'intellectual' family in the nineteenth century.

2: Intellectual families

Two main approaches have been taken when trying to explain the existence of the kind of high-achieving family the Herschels exemplify. At one extreme has been a tendency to treat such families as a very rare phenomenon that can only be explained by genetics. At the other has been a proclivity to view these families as part of a very broadly defined intellectual class. In this thesis I argue that neither approach is very helpful in understanding the various successes and failures of the Herschel family over three generations. Some historians, such as Peter Millman, have drawn limited attention to the familial settings in which various Herschels were nurtured.[22] Helen Ashton and Katharine Davies point to the fact that it 'is rare for men of genius to have distinguished children, but John Herschel, when he grew up, became possibly even more famous than the father in whose footsteps he followed.'[23] Similarly John Panter states:

> The sons of famous men who themselves become famous are very few; fewer still must be such sons who in their own lifetime match or even eclipse their father's fame. The Bach and Strauss families of music; the Huxleys and Braggs of science and the Pitts of politics come readily to mind, but not many others.[24]

However, these observations do not offer an adequate explanation of why John or any of these other sons of successful men should have done so well. The implied assumption is that the famous sons who follow famous fathers are rare statistical anomalies that occur by accident rather than intention.

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[22] Millman, "The Herschel Dynasty – Part 1: William Herschel."; Millman, "The Herschel Dynasty – Part 2: John Herschel."; Millman, "The Herschel Dynasty - Part 3: Alexander Stewart Herschel."
[23] Ashton and Davies, *I Had a Sister*, p. 209.
[24] John R. Panter, "Sir John F. W. Herschel and Scientific Thought in Early Nineteenth Century Britain" (University of New South Wales, Australia, 1977), p. 35.

The heritability of scientific talent is, at first sight, an attractive and plausible explanation for the existence of scientific dynasties, especially if they are assumed to be rare statistical anomalies. In the 1960s for example, Ronald Clark made a study of the Huxley family, concluding that the family's success was due to genetic characteristics gradually diluted through successive generations.[25] He does not explain where these genetic characteristics originate or how a strictly fair comparison between the generations can be made. Similarly, Karl and Irene Geiringer's study of the Bach family of successful musicians attributed their success and later decline to genetics. In successive generations, they claim, this family 'showed typical symptoms of degeneration' as '[p]hysically and artistically the strength of the family was ebbing away.'[26]

These types of genetic explanation, by far the most common for explaining successful scientific and musical families, ultimately take their lead from Francis Galton. In 1869, Galton declared that it should be possible:

> to obtain by careful selection a permanent breed of dogs or horses gifted with peculiar powers of running, or of doing anything else, so it would be quite practicable to produce a highly-gifted race of men by judicious marriages during several consecutive generations[27]

Galton described the Herschel family in this same book, though curiously labelled them as a musical rather than a scientific family. Following his brief summary of the Herschels' various individual scientific achievements he stated that it was musical ability that was passed down through the generations. Later he cited the Herschels as an example of a family with 'artistic gifts who have adopted some other more regular, solid or lucrative occupation.'[28] However, as I will show, science was not regarded by any generation of Herschels as a regular, solid or lucrative occupation.

The problem with these types of genetic explanation is that they assume an unproven relationship between scientific or musical ability and genetics. They make no allowances for social rather than intellectual factors acting as obstacles or enablers to greatness. Nor is it considered that society might change its values so that certain

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[25] Ronald W. Clark, *The Huxleys* (London: Heinemann, 1968).
[26] Karl Geiringer and Irene Geiringer, *The Bach Family: Seven Generations of Creative Genius* (London: George Allen & Unwin Ltd, 1954), p. 481.
[27] Francis Galton, *Hereditary Genius* (London: Macmillan, 1869), p. 1.
[28] Ibid., p. 321.

abilities might be deemed great in one generation, but irrelevant in the next. One of the notable features of the Herschel family, as I show in the following chapters, is the way in which members of each generation developed their inheritance. They did not simply reproduce the successes of the previous generation, as a genetic argument would suggest, but used their abilities to different ends. One generation built telescopes; in the next there was a mathematician who then successfully reinvented himself as a new kind of scientist. This breadth of achievement surely casts serious doubt on any simple genetic model of scientific success.

An alternative analysis of scientific, or rather, intellectual families, is offered by Noel Annan. In his essay, *The Intellectual Aristocracy*, Annan observed that a small number of interconnected families dominated Britain's universities, public schools and the Indian civil service in the late nineteenth century. In Annan's account, a family of this period could be classed as intellectual if several of its members played some part in 'English intellectual life'.[29] The families in this class were included less for the members' individual achievements than for the jobs they held. Jobs that counted as intellectual included university professors, civil servants in Britain and India, masters at public schools, museum curators, publishers, journalists and secretaries of philanthropic societies. The problem with this definition of an intellectual family however, is that it is too vague to account for the details of how a particular family functioned in elite circles over an extended period of time. Annan does not attempt to explain how these kinds of family reproduced their social and intellectual status from one generation to the next, other than a brief suggestion towards the end of his essay that certain values were transmitted through 'family tradition'[30]. Moreover, the emphasis on intellectual jobs excludes any role for women in determining a family's inclusion into this group. It cannot explain how or why a family might first join the intellectual aristocracy. Nor can it explain why a family such as the Herschels should make the seemingly drastic move in one generation from world famous scientist to Indian civil servant and engineer. In Annan's intellectual aristocracy these are all considered intellectual careers and so no explanation is deemed necessary.

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[29] Noel Gilroy Annan, "The Intellectual Aristocracy," in *Studies in Social History. A Tribute to G. M. Trevelyan*, ed. John Harold Plumb (Longmans, 1955), p. 244.
[30] Ibid., p. 285.

Such a generalised treatment fails to capture the rationale behind the lives of many individuals whose subsequent careers fail to fit a certain pattern. Indeed, many of those who depart from the beaten track of 'success' are patronised by historians who see them as failures. In a paper on Charles Darwin's sons, for example, Jim Moore argues that Darwin did not have any specific ambitions for his sons, beyond giving them a more balanced education than he felt he had received himself. However, Moore ends up singling out those sons that went to Cambridge for applause, noting sadly that 'Leonard Darwin did not attend Cambridge and achieved nothing noteworthy in science.'[31] Moore claims this despite remarking that Leonard Darwin 'did "all kinds of scientific odd jobs" in the Royal Engineers'[32]. He accounts for this by suggesting that Leonard suffered from low self esteem.

Similarly, Charles Babbage's biographer Anthony Hyman explained the decision to send Babbage's youngest son Henry Prevost to India in terms of Henry's boredom. 'Left behind in England while the other two brothers were abroad, he decided to enter the Indian Service and started on a military career.'[33] In both cases, the assumption is that education can explain sons following their fathers into science, but failure to do so can only be explained in terms of some innate personal defect on the part of the son.

The example of the Herschels, as I show in this thesis, indicates that this assumption is not correct. Instead, I show that India, and engineering in India especially, was regarded as a good, secure yet scientific career for the son of a scientific man. While some men of science wanted their children to follow exactly in their footsteps, others, particularly those with large families and comparatively modest fortunes, were more pragmatic.

Susan Cannon's 'Cambridge Network' appears to be a much more suitable group than Annan's 'intellectual aristocracy' against which to compare the Herschels. This network, as Cannon describes, was 'a loose convergence of scientists, historians, dons and other scholars, with a common acceptance of accuracy, intelligence, and novelty. It was made up of persons each of whom knew many but not all of the others

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[31] James R. Moore, "On the Education of Darwin's Sons," *Notes and Records of the Royal Society* 32 (1977), p. 63.
[32] Ibid., p. 62.
[33] Anthony Hyman, *Charles Babbage: Pioneer of the Computer* (Oxford: Oxford University Press, 1982), p. 200.

intimately.'[34] Most, though not all of this group were first generation Cambridge graduates. They were John Herschel's peer group, and many shared some aspects of his background as well as some of the same aspirations for their children. They offer a useful source of comparison because of these shared experiences and values. Generally these members of the Cambridge Network have been studied as individuals with little attention paid to their hopes, aspirations and actions in regard to their children. By considering them as examples of scientific *families*, however, new insights emerge as to their underlying views on science and science education.

My focus on the importance of education, as playing a deciding role, in conveying intellectual ability within a family, is not entirely novel. When John Stuart Mill published his famous autobiography, a few years after Galton's *Hereditary Genius*, he presented his intellectual ability as having been entirely shaped by the education provided by his father. Not only were his successes attributed to the intense academic training to which his father subjected him, but so too was his nervous breakdown.[35] Nothing in Mill's account is attributed to his own innate ability, personality or genetic disposition. In this study of the Herschel family, I look to Mill's rather than Galton's approach as the most productive way of understanding the creation and development of a scientific family. I will look, for example, at John Herschel's success not in terms of innate ability, but as a result of his intense academic training.

3: Women and the dominant story of science

One of the advantages of studying a whole family is that it allows the quieter voices within the history of science to be heard in their own terms. In recent years, there have been a number of studies on the less high profile figures within the history of science. There have been studies of the wives, sisters and daughters of great men of science, and of their assistants, technicians and engineers, all of which enrich our understanding of what science is and how it is created. In this thesis, I look at the way certain members of the Herschel family were trained, or educated themselves, for these

[34] Cannon, "Chapter 2: The Cambridge Network.", p. 30.
[35] John Stuart Mill, *Autobiography* (London: Longmans, Green, Reader and Dyer, 1873); Bruce Mazlish, *James and John Stuart Mill: Father and Son in the Nineteenth Century* (London: 1975); Michael J. A. Howe, *Genius Explained* (Cambridge: Cambridge University Press, 1999).

marginalised roles. These figures, I argue, were in many cases deliberately trained to take on these supporting roles. They did not 'fail' to become men and women of science in their own right since that was never the ambition chosen for them. They were not trained to become scientific experts, despite the family's knowledge and experience in this type of training. Instead, I argue, they were trained for support work which they regarded as both useful and necessary.

Although the female Herschels were brought up to be 'useful', none of them were trained to see science as the sole means by which that usefulness might be achieved. They were all given a scientific education, but in no generation was their education confined to science or even to purely academic subjects. The roles they found as adults were not necessarily imposed on them, nor, I argue, were they in all cases roles that could be described as part of their duties as good wives and mothers. In many ways the whole Herschel family, with the exception of William and John, have suffered from what Lynette Hunter and Sarah Hutton term '[t]he 'great' men account of the history of science'. As Hunter and Hutton point out, literature on women and other social inferiors can be roughly divided into two main groups. Some historians try to re-discover lost heroes and heroines of science and are often left justifying their actor's relative lack of achievement. Others accept that there are many different roles in science:

> Whether by accident or design, we have inherited a 'story of science' which is organized around the achievements of 'great' scientists who happen to be men. The 'great' men account of the history of science also happens to be a model which excludes not just women but other social inferiors: the technicians of science, for instance, who made experiments possible; the journeymen whose practical involvement afforded a model of reorganizing methods of investigation.[36]

In the case of the Herschels this dominant 'story of science' has usually meant that Caroline's achievements have been contrasted unfavourably with those of her brother. Meanwhile all the other women in the family and most of the third generation of Herschels have been entirely ignored.

The education of the women within this family was in most cases different from that of their brothers. Ellen Jordan has suggested that all female education in the nineteenth century was justified in terms of its ability to prepare girls to become good

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[36] Lynette Hunter and Sarah Hutton, *Women, Science and Medicine, 1500-1700: Mothers and Sisters of the Royal Society* (Stroud: Sutton, 1997), p. 3.

wives and mothers.[37] She argues that this was the case whether traditional female accomplishments, a Cambridge degree or anything in between were advocated. This claim seems to be supported by individual studies of particular families. Barbara Caine in her account of the Potter sisters' education argued that the purpose of their academic training was to enable them to find suitable husbands.[38] Janet Browne has made a passing reference to the Horner family having similar aims in the education of their daughters.[39] However, as I will show, for the Herschel family this explanation appears over simplistic. While each generation was different, not one seems to have regarded marriage and motherhood as the sole reason for female education.

One way to understand the roles for which many of the Herschel women may have been prepared is to compare them to other families. M. Jeanne Peterson, in her detailed study of women within the Paget family, gives a rich account of the various roles wives, mothers and sisters might have played within intellectual families.[40] She argues that modern scholarship takes a whiggish view of the role of the wife within academic families. Scholars, she suggests often project back from the mid-twentieth century the notion of an 'incorporated wife' and suggest that Victorian families followed the same model. This 'incorporated wife' who was 'tied to her husband's career as a status symbol and decorative companion but who dares not enter into his professional life intellectually or politically'[41] was not, Peterson argues, a typical description of a Victorian wife. Instead she found, using the extended Paget family as her example, that in many cases the family would regard itself as a 'single career family' with both husband and wife contributing towards the same goals. As an equal partner, the wife would often take on the role of assistant, collaborator, and/ or social secretary building and maintaining work related social networks.

In *Pandora's Breeches* Patricia Fara describes the working relationships of a number of scientific couples, demonstrating that the Paget example was far from unique. Her examples include William and Caroline Herschel, Marie Paulze and Antoine Lavoisier, Émilie du Châtelet and Issac Newton and Johannes Hevelius and

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[37] Ellen Jordan, ""Making Good Wives and Mothers"? The Transformation of Middle-Class Girls' Education in Nineteenth-Century Britain," *History of Education Quarterly* 3, no. 4 (1991).
[38] Barbara Caine, *Destined to Be Wives* (Oxford: 1986), p. 33.
[39] Janet Browne, *Charles Darwin: Voyaging* (London: 1995), p. 357.
[40] M. Jeanne Peterson, *Family, Love, and Work in the Lives of Victorian Gentlewomen* (Bloomington: Indiana University Press, 1989).
[41] Ibid., p. 186

his second wife Elizabeth.[42] Fara looks at each pairing in turn and examines on the one hand how these women were able to use these relationships to educate themselves and take part in science, but on the other how they were entirely dependent on the goodwill of the men in their lives for this role. In the case of William and Caroline Herschel, Fara looks at the importance of Caroline's work for her brother's research and of her style of presentation within a contemporary context. In my thesis, building on Fara's work, I look at the training that led Caroline to her role within her brother's research project and the role of her family in helping to shape her particular style of self presentation. I show how not only her astronomy training but also her earlier training and experience informed her choices as an adult. I show that the Herschels did not justify the education of the women within the family in terms of their future roles as wives and mothers. Neither did they have the same education as their brothers.

Scientific wives and other marginalised characters in the history of science form part of many scientific families, including the Herschels. Science was part of what Pierre Bourdieu would term their cultural capital or what Annan calls 'family tradition'.[43] Science formed part of the tacit knowledge passed down through the generations; it was also given a high value in their formal education. This in turn added to the family's worth in terms of marriage and entry to the social and scientific elite. It also provided the groundwork necessary for allowing the various members of the family to contribute towards science in a multitude of different roles.

4: Biography

In this thesis I use biographical approaches to provide the tools for understanding the ways in which the Herschel family thought of education and what that reveals about their underlying ambitions for themselves and their children. Thomas Söderqvist asserts that the modern aim of biography should be to convey 'an understanding of what it means to live a life in which scientific work and rational thinking are part of an

[42] Patricia Fara, *Pandora's Breeches: Women, Science and Power in the Enlightenment* (London: Pimlico, 2004).
[43] Jeremy F. Lane, *Pierre Bourdieu: A Critical Introduction* (London, Sterling, Virginia: Pluto Press, 2000); Annan, "The Intellectual Aristocracy."

existential project, and involves existential choices.'[44] That is, biography, at its best, should be focused on the choices an individual makes, and the details of how they lived their life and how science was integrated into that life. Applying Söderqvist's ideas to the family, I focus in this thesis on the choices made by each generation for its own and their children's education, and how science was integrated into the lives of all three generations. Whether conscious or unconscious, each choice the family made regarding the education of successive generations was based on their underlying views as to the purpose of that education. A focus on the choices made by this family is then revealing in terms of their evolving views as to the purpose of education.

Biographies such as Robert Skidelsky's account of John Maynard Keynes, [45] Ray Monk's narrative of the life of Bertrand Russell[46] and Janet Browne's treatment of Charles Darwin have all situated their subject's formative development within a family environment. Skidelsky and Monk tend to use these early years as evidence for early genius in their subject rather than as a means of showing how that genius was made. Browne on the other hand uses everyday events and experiences to illustrate and explain the gradual development of Darwin's intellectual outlook.[47] Desmond and Moore's earlier biography of Darwin looked at the broader socio-political setting in which Darwin grew up and used these to explain the origin of his ideas.[48] Browne's biography of Darwin in contrast is focused more narrowly on Darwin himself, his immediate environment and the choices he made about his life.

In this sense her biography is similar to Rob Iliffe's work on Newton or Michael Howe's work on a number of great men and women of the nineteenth century, or indeed Warwick's work on Cambridge which focuses on the way an institution shapes students' understanding of the physical world. In all cases, undisputed geniuses are considered as products of a particular set of circumstances and ambitions, of education and hard work combined with an aptitude for their studies.[49] What are

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[44] Thomas Söderqvist, "Existential Projects and Existential Choices in Science: Science Biography as an Edifying Genre," in *Telling Lives in Science: Essays on Scientific Biography*, ed. Michael Shortland and Richard Yeo (Cambridge: 1996), p. 75.

[45] Robert Jacob Alexander Skidelsky, *John Maynard Keynes: A Biography. Hopes Betrayed 1883-1920*, vol. 1 (London: Macmillan, 1983).

[46] Ray Monk, *Bertrand Russell: The Spirit of Solitude* (London: Jonathan Cape, 1996).

[47] Browne, *Charles Darwin: Voyaging*.

[48] Adrian Desmond and James R. Moore, *Darwin* (London: Penguin, 1992).

[49] For example, Rob Iliffe, "Isaac Newton Lucatello Professor of Mathematics," in *Science Incarnate: Historical Embodiments of Natural Knowledge*, ed. C. Lawrence and S. Shapin (Chicago: 1998); Howe, *Genius Explained*.; Andrew Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics* (Chicago & London: University of Chicago Press, 2003).

missing from these accounts are the motives of parents and their hopes for their children. My study is original in that it approaches the formation of successive generations of the Herschel family primarily in terms of the family's aspirations and enablement.

5: Liberal education and the professionalization of science

The intergenerational story of education within the Herschel family needs to be understood against the backdrop of the professionalization of science and broader contemporary debates about the purpose of education. This family's history introduces a new perspective to this narrative, and that is the role of class and social mobility. When the Herschels were trying to raise their social status they needed to prove their scientific ability and to excel in their field, and this I argue resulted in a focused, technical and specialist scientific education. In securing that position, similar attention was paid to developing and displaying expertise. When the family was firmly established in their social position however, scientific excellence became less of a necessity and more a desirable but non-essential accomplishment. For this reason, their education became a more general, scientifically biased liberal education than for previous generations.

The Herschels joined the British scientific scene in the late eighteenth century when science was a fashionable pursuit. This was the age, as Alice Walters describes, of 'polite science' when science was popular with the aristocracy and social climbers.[50] Those looking for a deeper understanding of contemporary scientific knowledge could buy textbooks, encyclopaedias and tailor-made journals such as the *Lady's Diary* all aimed at an audience calling themselves 'philomaths'.[51] William Herschel, I argue, was a social climber, and reasoned that he would need a deeper understanding of mathematics and science than the aristocracy possessed if he was to be accepted within their circles. In mastering these areas he was welcomed into elite circles and when by chance he discovered a new planet, rose even higher.

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[50] Alice N. Walters, "Conversation Pieces: Science and Politeness in Eighteenth-Century England," *History of Science* 35 (1997).

[51] Larry Stewart, *Rise of Public Science: Rhetoric, Technology and Natural Philosophy in Newtonian Britain* (Cambridge: Cambridge University Press, 1992); Olaf Pedersen, "The 'Philomaths' of Eighteenth Century England," *Centaurus* 1963.

Nicholas Hans concluded in his study of eighteenth century education that while science could be used as a means of social mobility this ended sharply at the end of that century.[52] For the Herschels however, they had already risen socially and needed only to maintain their position. Their use of science put them in a new rising class of industrialists and intellectuals, who, as Thackray and Morrell put it, 'found in natural knowledge an appropriate focus for their new values'.[53] At the vanguard of this class, the Herschels, like a number of their contemporaries, actively campaigned in the early nineteenth century to promote science to the wider public. Walters, Hans, Thackray and Morell have all described these broad trends in the popularity of science among the different classes between the eighteenth and nineteenth century. Here I show, through the example of the Herschel family, how these broad trends were experienced and used in practice.

The literature on childhood education in the nineteenth century is dominated by studies of parliamentary changes affecting school provision for the working class, and studies on home schooling for middle class girls. There is very little good historical analysis of the range of schools aimed at upper middle class boys or on those schools' curricula. Yet, the example of the Herschels show these must have varied and that considerable thought went into selecting the right school. In this thesis I show the process that went into selecting the right schools for each generation and what those choices reveal about the family's underlying aims for that education.

Despite a considerable literature on Cambridge in the late eighteenth and nineteenth centuries, little has been written on why parents chose to send their sons and later daughters there. As Andy Warwick has shown, the teaching of mathematics at Cambridge changed dramatically in the decades around 1800, and continued to change throughout the nineteenth century. Broadly speaking, the ability to solve mathematical problems in geometry and mechanics became the hallmark of intellectual ability, the key attribute used for selecting the nation's elite at Cambridge.[54] However, there is no corresponding study of how parents responded to this change in purpose. In this thesis I show the reasoning that went into sending three of the Herschels to Cambridge.

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[52] Nicholas Hans, *New Trends in Education in the Eighteenth Century* (London: Routledge & Kegan Paul, 1951), p. 212.
[53] Jack Morrell and Arnold Thackray, *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (Oxford: Oxford University Press, 1981), p. 14.
[54] Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics*.

The three Cambridge educated Herschels studied in this thesis are John and his two children Alexander and Constance. John was at Cambridge in the 1810s while his children were there in the 1850s and 1870s respectively. As we shall see, for William Herschel the purpose of sending John to Cambridge was to teach him mathematics and to firmly establish his social status from the start of his scientific career. For John's children, Alexander and Constance, the motive was slightly different. Alexander was deliberately despatched to Cambridge in order to set him on the path of a scientific career while Constance was sent to prove her mother's point that girls were academically equal to boys given the right opportunity. By looking at the whole family, the reasoning behind the selection of certain schools, colleges and universities becomes apparent. In each case, as we will see, they were chosen because some of their educational aims were shared with the educational aims of the family.

Plan of Thesis

The issues outlined above are addressed in this thesis in the following way. In chapter one I begin by looking at the role played by William and Caroline's parents in preparing the groundwork for establishing a scientific family. I will look at the way in which William was trained as a child, the values and skills that training instilled in him, and how he then applied these to the learning of science in adult life. Through this process William learned to equate the acquisition of intellectual accomplishments with social mobility. In this chapter I consider how the broad trends in science at the time – the fashion for polite science and the philomath industry – were experienced and used on an individual level. In chapter two I look at Caroline, again in terms of the values and skills she learned from her family, but here I also contrast what she was taught herself with what she saw taught to others around her, and what she learned from observing her brothers' education. In this chapter I show that Caroline's training had a different purpose from that of her brothers'. She was not trained to be an expert musician and later, an astronomer, but was taught to see her usefulness to the family in a supporting role. Gradually she came to take ownership of that supporting role and her own training for that role.

The next two chapters, three and four, are devoted to William's son, John. Chapter three considers his education at the hands of his parents leading up to and

including his time at Cambridge. Chapter four focuses on how he then transformed himself into a new type of scientific man. In chapter three I consider the work that went into John's childhood education and the lengths his father had to go to in the late eighteenth and early nineteenth centuries to ensure it contained all the mathematics he wanted. In chapter four I look at the process by which John developed his education as an adult, transforming himself from a mathematician into a 'scientist'[55]. Through his contact with various people, I argue, he came to a new way of looking at science. He began to see it, and promote it to others as the means by which, as a society, we might call ourselves civilised.

In chapter five I introduce John's wife, Margaret, and return her voice to the family narrative. Margaret I argue brought a religious dimension to the family's relationship with science and science education. She and John had 12 children leaving her little time to take on the kind of scientific assistant role that might have brought her greater attention within the history of science. Instead I argue that the scientific role she played was in researching, designing and defining the purpose of the education she and John provided for their children. Finally, in chapter six, I examine the way in which John and Margaret educated their 12 children. This generation, I argue was taught science as part of a broad liberal education. Boys and girls were taught roughly the same while at home. The boys were sent away to school at the age of 10, and later to college to train for specific careers. The girls continued their lessons at home until they reached their early twenties. Both the girls and boys were taught science with a view to making it an enjoyable activity they might choose to pursue in some way in adult life. While their parents saw scientific careers for their sons as desirable, they recognised there were very limited opportunities available in the 1850s and 1860s. With that in mind, they invested in training them for more reliable career options. Science continued to play a part in family life, and ad hoc opportunities for scientific activity were passed between family members, but the life of a fulltime gentleman natural philosopher was no longer regarded as a sensible or realistic ambition.

As a scientific dynasty the three generations promoted and adapted nimbly to contemporary trends in science and the broader society. Each educated its children to fulfil particular roles, the children then adapting their parents' ambitions in light of new trends and opportunities. Overall, each generation used science as much for

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[55] Sydney Ross, "Scientist: The Story of a Word," *Annals of Science* 18, no. 2 (1962).

social advancement as for an end in its own right. In this sense, my story runs counter to the fundamental assumption of most studies of scientific families. It is normally assumed that great men would wish similar greatness on their children. My study shows that having acquired social status in mid-Victorian society, the Herschels sought stability in traditional professions, rather than outstanding scientific achievement.

Chapter one: William Herschel's education

William Herschel was made famous by his work in astronomy, first as the discoverer of the planet Uranus, and later for his work classifying star groupings. He came to astronomy relatively late in life, and originally trained and worked as a musician. Between 1760 and 1781 he gradually turned his attention away from music and towards philosophy and then more specifically astronomy and instrument making. This was 20 years of consideration, reading, discussion and practice yet it has been almost entirely overlooked in biographies and histories of William Herschel and his career. In this chapter I will focus on this period, to understand what prompted this change of direction and how it was achieved. To date, biographies of William Herschel have all focused on his astronomical work. His life before 1781 has been considered purely in terms of its use in preparing him for his later work in that field. The emphasis has been not on why he chose astronomy, but on how his previous career shaped the type of astronomy he later did. Where this transition is discussed at all, it is given only passing consideration and as a result, the reasons for it tend to have been overlooked. Jim Bennett refers to William having been 'led naturally'[56] from music to astronomy through reading two books by Robert Smith and this is typical of how this transition has been described. Michael Hoskin similarly describes this change in direction as seamless. Hoskin suggests that by 1767 William's 'insatiable curiosity had taken him from the mathematical theory of harmony to geometrical optics; from optics to the construction of telescopes; and from telescopes to astronomy.'[57]

In this chapter I will use new archival materials to examine in much more detail William Herschel's early upbringing and adult life as a musician to see how he came to astronomy and natural philosophy. In the following chapter I will argue that much of William's motivation for entering and pursuing certain branches of science came out of the connection he made between education and social elevation. His father had been trained as a child in one discipline, but later he taught himself another, music, which had better prospects and a higher social position. He then ensured his sons were

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[56] Jim A. Bennett, "The Discovery of Uranus," *Sky and Telescope* 1981, p. 188.

[57] Hoskin, "William Herschel and Sidereal Astronomy.", p. 18; also in Hoskin, *William Herschel: Pioneer of Sidereal Astronomy*, p. 9 he states that William 'read about harmony in its mathematical aspects, and from there he was led to other branches of mathematics, including optics.'

coached in that second discipline from as early an age as possible. William used science as a means of self-fashioning, consciously creating a persona that enabled him to mix as an equal with people of an elevated class. As a musician he had special access to this class but always as an employee. Early on however he identified education and scientific education in particular, as a means through which he could overcome that hierarchical division.

Growing up in Hanover, 1733-1756

Caroline and William grew up in Hanover where their father, Isaac Herschel, earned his living playing for a militia band called the Hanoverian Guards. His father (William's grandfather) had been a gardener and had trained his son to be the same but Isaac had chosen instead to train himself in music and so found work in the Hanoverian Guards. A militia band was not an especially prestigious post for a Hanoverian musician, but posts at Court were few and far between while the market for private concerts and music teachers was too underdeveloped to support a musician full time. Compared to his father's status as a gardener however, this was an improved position and one Isaac had been able to attain for himself through self-education. When it came to training his sons he again looked to education as a means of improving their financial and social circumstances.

Caroline, William's younger sister and later assistant, wrote of her father that it was his greatest hope to 'see his children arrive at that eminence in this his favourite science [music], which he himself had not had the opportunity or time to attain';[58] according to William it was 'my father's greatest attachment to music [which] determined him to endeavour to make all his sons complete Musicians'.[59] In 1745 when Isaac had the opportunity of a more profitable post at Hamburg, he turned it down on the grounds that, music was 'in too low an estimation' there. For this reason, Hanover was 'a place more likely to afford the desired improvement'[60] to his sons. He disapproved of his elder daughter Sophia's choice of husband, who also played in the Hanoverian Guards, because 'he knew him at least to be but a very middling

[58] Hoskin, *Caroline Herschel's Autobiographies*, p. 19.
[59] 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, p. 6.
[60] Hoskin, *Caroline Herschel's Autobiographies*, p. 21.

musician'[61]. Isaac Herschel had used education to provide himself with a job more prestigious and more lucrative than the one his father had held. Comments by his children suggest that Isaac intended to use education to ensure they would find work in a more prestigious field of music than his. To this end, Isaac began by giving each of his sons music lessons from a very early age. Like his brothers Jacob, Alexander and Dietrich, William was taught 'to play on the violin as soon as I was able to hold a small one made on purpose for me'.[62] While his father was ultimately responsible for the structure of his musical education, there was still a good deal left to the student. His father would give lessons and set work, but would then often be away for long periods of time with the Hanoverian Guards.

The Hanoverian Guards were Hanover's main army and like much of Europe's military had by this time its own militia band. Music in European armies had existed since at least the fourteenth century when drummers and later fifes were used to keep time, keep the soldiers moving and acting together. They were also used as a call to arms and as a means of transmitting messages across the battlefield. Later more instruments were added and the idea of making music rather than solely performing practical functions with those instruments began to be introduced.[63] Isaac and musicians like him were employed primarily as a means of improving morale. Although less dangerous in principle than fighting, this did mean that they tended to be needed on the battlefield and close to the action.

Hanover, in lower Saxony, though not a particularly affluent or sophisticated region at this time, was strategically and symbolically important to the British as the ancestral home of its ruling monarch. Because of its significance to the crown, the defence of Hanover was used to justify Britain's involvement in two large scale European wars of the eighteenth century: the war of Austrian Succession (1740-48), and the Seven Years' War (1756-63). The net result of these wars for the British Empire was seen further afield, with the acquisition of more colonial land, particularly in the Americas. For the Hanoverian Guards, it meant many years of fighting, and for

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[61] Ibid., p. 23.
[62] 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, p. 6; Angus Armitage, *William Herschel* (London: Thomas Nelson & Sons Ltd, 1962),p. 18; Macpherson, *Herschel*, p. 8; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xiv.
[63] The Department of Musical Instruments pages on 'Military Music in American and European traditions', at the Metropolitan Museum of Art.
http://www.metmuseum.org/toah/hd/ammu/hd_ammu.htm

Hanover itself disruption and a brief period of French occupation between July 1757 and February 1758.

During his periods away from home, Isaac's wife Anna was left to ensure the children kept up with their music practice following the lessons he had set. Her own lack of musical training however, meant that she was not able to help with any problems, nor could she offer variety in their daily lessons. As a result, William learned music through tuition followed by long, intense periods of private study and repetitive practice. Gradually, what he had learned was put to the test in front of public audiences as his father organised small concerts, and finally in an audition for the Hanoverian Guards. He passed the audition, joining the Guards in 1753 at the age of 14, thus giving external verification of his musical skill as well as an income. Besides learning enough about music to obtain a professional post, this experience also presented him with clear evidence that the route to successfully mastering a skill was continuous, relentless, repetitive practice and gave him experience of just how much work was necessary.

At around the same time he was given his first lessons on the violin, William was beginning to learn 'basic literacy, arithmetic and religion'[64] at the local Garrison school. The school took pupils, the children of military men, between the ages of 2 and 14.[65] As was common practice in certain parts of Germany at the time, older boys taught mathematics to their younger cohorts. This gave William another tool in his self-education for his understanding of a subject could be tested through teaching. Only the very best pupils were selected to teach, and by this means they were able to discover how well they really understood what they had learned. Up to the age of 14, William's education consisted of learning to read and write in German; gleaning basic mathematics (from older students in the first few years and by teachers in the later years); some sort of education in religion and, according to Caroline, Latin.

Little is said either by William or Caroline about William's religious education at home or at the Garrison school, though Caroline's confirmation is mentioned, suggesting they were a family of practising, if not particularly fervent, Christians. Given how little mention is made of religion in their reminiscences, it would seem plausible to suggest they followed the dominant religion of the region. This would

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[64] 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, p. 6; Macpherson, *Herschel*, p. 8; Dreyer, ed., *The Scientific Papers of Sir William Herschel*., p. xiv.
[65] Ages at which the school took in pupils given in Herschel, ed., *Memoir and Correspondence of Caroline Herschel*, p. 3

have been what was taught at the Garrison School. William's lessons at school were followed each day by either a lesson from their father in music, or more often than not, by practice sessions under the watchful eye of their mother. Towards the end of his time at the Garrison school, William began to take additional private lessons in French, encouraged and possibly paid for by his father. There is some inconsistency about this, both within William's own accounts and also between his own narrative and that of his sister.[66] French would have been considered useful to his future career as a musician if, as his father appears to have wished, he was to perform at Court or in the homes and concerts of the aristocracy. There French was often spoken and music from French and Italian operas performed and taught.

Aside from mathematics and French, William was also introduced to philosophy while still living at his parents' home in Hanover. This was originally through his French teacher who encouraged 'the taste he found in his pupil for the study of philosophy, especially logic, ethics and metaphysics which were his own favourite pursuits.'[67] According to Caroline (who was 6 years old when William left home and so cannot have had a great understanding of what they were discussing) William continued his philosophical discussions at home with his older brother and father where she says 'the names of Leibnitz, Newton and Euler'[68] were often quoted. Although this evidence gives us little to go on regarding exactly what they were discussing, it does suggest that Isaac Herschel was keen to encourage his son's interest in natural philosophy. This introduction to philosophy, in William's own accounts, is

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[66] William's account of these lessons in his 1784 letter to Charles Hutton states that 'he [William's father] provided me with a private instructor for the French language', William Herschel to Charles Hutton, 1784, Harvard: MS Eng 1414 F(29); BL: microfilm M/541; Owen Gingerich, "Herschel, 1784 Autobiography," *Sky and Telescope* 1984, p. 317 ; Caroline's account of these lessons states that William and his brother Jacob were taught together: 'And when the two brothers began at the same time to receive lessons in French, my brother Wm was master of it in less than half the time the elder wanted' Hoskin, *Caroline Herschel's Autobiographies*, pp. 21-22; William's Memorandum meanwhile leaves out any mention of his brother or father in his account of these French lessons: 'This engagement [with the Hanoverian guards in 1754] furnished me the means for my improvement not only in music, which was my profession but also in acquiring a knowledge of the French language, with the advantage of studying above two years under a very well informed teacher, who, taking a great liking to me did not confine his instructions to language only; but encouraged the taste he found in his pupil for the study of philosophy, especially logic, ethics and metaphysics which were his own favourite pursuits.' 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, p. 7.

[67] 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, p. 7; Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 7; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xv.

[68] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 5; Herschel, ed., *Memoir and Correspondence of Caroline Herschel*, p. 7; Macpherson, *Herschel*, p. 9; Rob Iliffe and Frances Wilmoth, "Mrs Flamsteed and Caroline Herschel," in *Women, Science and Medicine*, ed. Lynette Hunter and Sarah Hutton (Sutton, 1997), p. 257.

presented as one step in the story of how he broke away from his family's musical traditions. The encouragement he received at home, however, suggests that this study was not so much a breaking away from family tradition, as a continuation of the family's ongoing enthusiasm for education in all its forms.

Isaac Herschel's admiration for natural philosophy also had an impact on his children's leisure activities. As a means of relaxation they were encouraged to make their own scientific instruments. For example, in a letter to her nephew, Caroline referred to 'your dear Father's books and self constructed Globes &c &c'.[69] Within the context of this family William's later hobby (making his own telescopes) was not unusual. According to Caroline, another of her brothers, Alexander 'often sat by us and amused himself with making all sorts of things on pasteboard, or contriving how to make a twelve-hour cuckoo clock go a week'.[70]

From his own background we know that Isaac was trained by his father to follow in his footsteps as a gardener and had then trained himself to become a musician. From this experience and his children's comments regarding his aspirations for them, it seems plausible to conclude that Isaac saw in education a means of improving his and his children's situation. He seems also to have been aware of a social hierarchy within music, whereby the knowledge of additional subjects outside of music might be an advantage in this competitive market. This would explain his encouragement of his sons to learn French, a subject that would have direct vocational application only if they were to find work in civilian life as singing teachers and performers. Similarly his encouragement of his sons' philosophical discussions may be seen in the same light. It is impossible to say with certainty whether or not William's father equated philosophy with social mobility. However, the directed quality of all other aspects of the children's lives suggest that the activities of instrument making and philosophical discussion were probably seen as a means of making his sons more cultured than competing musicians and thus would aid them in a competitive market. His mother's opinions are difficult to gauge, due to her illiteracy and limited mention in William's accounts of his own life. While she was an extremely important presence in the up-bringing of Caroline, William appears to have seen her as a relatively minor figure. She provided him with food, clothing and care of

[69] Caroline L. Herschel to John F. W. Herschel, 8 May 1827, BL: Eg.3761 f64.
[70] Herschel, ed., *Memoir and Correspondence of Caroline Herschel*, p. 6; Ashton and Davies, *I Had a Sister*, p. 160.

course, but in educational terms was only standing in for their father when he was away.

For William, much of this early education was in the hands of his parents. From a very young age he was sent to the Garrison school and then had lessons in music filling much of his free time at home. Neither he nor Caroline mentions any other child whose family they had anything to do with, suggesting that their experience of other models of childhood and family life was extremely limited. The Herschels were indeed a very close knit family. It is therefore not surprising that at this stage in his education William did not question his parents' plans for him but rather went along with the education provided.

England and William's growing interest in Natural Philosophy, 1756-1766

William left Germany to live in England in 1757. This was during the Seven Years' War when the threat of a French occupation in Hanover provoked his parents to help both him and his elder brother Jacob to escape. William arrived in 1758, a trained musician with five years professional experience working with the Hanoverian Guards. He also had some basic knowledge of mathematics, French and natural philosophy. Jacob arrived with much the same level of accomplishment in each area but did not stay to find work, returning instead to Hanover to take up a post in the Court Orchestra. Jacob succeeded in fulfilling his father's professional ambitions for him.[71] His position in the Court Orchestra relied on his musical accomplishments (which his father had ensured were superior to his own) but also some knowledge of French. William meanwhile was left to find work in England.

As a profession, in eighteenth century England, music was undergoing an expansion, as the new industrialist class joined the aristocracy in search of polite leisure activities. Musicians began to find work outside Court circles, and a new breed of musician came into being - a jobbing musician, picking up work playing in concerts, in country homes and giving private music lessons rather than relying on a patron. This was perhaps the only profession in England where foreigners, mainly Italian and German, outnumbered the English. In part this was because of music's

[71] Hoskin, *The Herschel Partnership: As Viewed by Caroline*, p. 17.

associations with the theatre and 'well founded suspicions of theatres as centres of sexual freedom and permissiveness'[72]. Those able to afford music lessons for their children were wary of letting their child pursue a career in that field. It was also, as Cyril Erlich has observed, one of the few professions that allowed its members access to socially elevated positions:

> Few occupations offered so many opportunities to cross frontiers of wealth and class which were closed to most people: entering rich households to play and teach, sometimes mingling with the company or even achieving a degree of intimacy with ones betters. In most cases the crossing was temporary and constrained, to be followed by a return from maison to garret, the expensive uniform carefully put away for the next engagement. But for many musicians it provided incentives, and for some opportunities, of more permanent social elevation.[73]

William Herschel was one of the few musicians to succeed in this pursuit of a more permanent social elevation. To begin with he could only find work in another militia band, exchanging the Hanoverian Guards for a military band in the North of England run by Lord Darlington. Over the next eight years he found work playing concerts and giving music lessons in fashionable homes across the north-east. Through this work as a jobbing musician William, like those musicians observed by Erlich, mingled with his social betters and became acquainted with the advantages of their lifestyles. He also came to learn something of their intellectual interests. It was this latter observation, coupled with the preparation he received from his father and teachers back in Hanover that was the key to William's transition from music to astronomy.

In 1761 William applied for the post of leader of the 'Band of Musicians in Edinburgh'. William's description of the audition for this post gives particular prominence to his introduction to David Hume the famous eighteenth century metaphysician:

> On my arrival there [in Edinburgh], I was introduced to Mr Hume, the metaphysician; and a few days after at one of their regular concerts, I was appointed to lead the Band of Musicians, while some of my symphonies and solo concertos were performed. Mr Hume, who patronised my performance, asked me to dine with him and accepting of his invitation I met a considerable

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[72] Roger Fiske and H. Diack Johnstone, *Blackwell History of Music in Britain, Eighteenth Century*, ed. Ian Spink, 6 vols., vol. 4 (Oxford: Blackwell, 1988-1995), p. 5.
[73] Cyril Ehrlich, *The Music Profession in Britain since the Eighteenth Century: A Social History* (Oxford: Oxford University Press, 1985), pp. 31-32.

> company, all of whom were pleased to express their approbation of my musical talents.[74]

The incident he describes implies that the job, had he got it (in the end the holder of the post decided to stay), would have allowed him to socialise with members of an elevated social class. He clearly made a good first impression, to the extent that Hume asked him to dine with him. Not successful in this first attempt in this particular audition, he returned to the north-east of England. Instead of returning to Darlington's militia band however, William set about making a living as a jobbing musician, giving lessons and concerts at nearby country homes.

Natural philosophy now played an increasingly important part in William's life. He read John Locke's *On Human Understanding*[75], a book he later referred to in biographical interviews as his means of learning English. 'I applied myself to learn the English language and soon was enabled to read Locke on the Human Understanding.'[76] Locke, while perhaps a curiously complicated choice for language learning, does have a strong focus on describing and analysing how we learn. In it Locke argued that our understanding of the world around us is based on learned ideas. He then went on to explain how this learned knowledge might be gained. Much of what he described, regarding practice and repetition as a means of learning and perfecting skills, had clear parallels with William's earlier experience of learning music and languages. In its application to other areas of knowledge however, it served as a guide to show William how he might master other subjects.

Letters between William and his brother Jacob after the latter had moved back to Hanover made frequent reference to philosophy, and to the books William was reading at the time. In April 1761 he wrote to Jacob (originally in German):

> You don't perhaps know that I have already some time been thinking of leaving off professing Musick and the first opportunity that offers I shall really do so. It is so very well, in your way, when one had a fixed salary, but to take so much for a Concert, so much for teaching, and so much for a Benefit is what I do not like at all, and rather than go on in that way I would take any opportunity of leaving off Musick; not that I intend to forget it, for it should

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[74] 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, p. 13.
[75] John Locke, *An Essay Concerning Human Understanding. In Four Books ... A New Edition Corrected*, 3 vols. (Glasgow: printed by Robert Urie, 1759).
[76] 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, pp. 7-8; Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 8.

> always be my chief study tho' I had another employment. But Musick ought not to be treated in that mercenary footing.[77]

In addition to his increased interest in philosophy, William indicates here that he was, at this time, actively looking for a more stable and respectable career though it is unlikely that he saw the solution in natural philosophy just yet. Nevertheless, he began to build up his knowledge in natural philosophy. He started with texts that had some relevance to his own experience and knowledge base, books for example, written by well known philosophers, on religion and morality:

> As to Leibniz, he is certainly a good philosopher, but in his Theodicée he goes too far and would have all actions necessary. His foreordained harmony is not the least credible nor feasible If you can get a book entitled: An Essay on the Origin of Evil, by Dr W. King, you will find a much better solution of the question: 'whence comes evil?' Leibniz does indeed reconcile it all with the goodness of God, but not nearly so reasonably as Dr King.[78]

Though it only gets a passing mention, in his and Caroline's accounts of William's early life, religion was still a subject on which he felt he could have a reasonably informed opinion.

Around this time William also read at least one book, Robert Smith's *Harmonics, or the philosophy of musical sounds*[79], on the relationship between philosophy, mathematics and music. It was perhaps in part as a response to this that he began in 1764 to write his own *Treatise on Music.*[80] In this text he brought together many of the ideas he had previously discussed through his correspondence with his brother Jacob. William's treatise was never published, and has never before been examined. Details within it suggest it was written after he read *Harmonics* but some time before he began his reading on natural philosophy. This makes it a significant source for this in-between stage in his education. The treatise began by explaining

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[77] William Herschel to Jacob Herschel, 12 April 1761: JHS papers FC B3 quoted in Ehrlich, *The Music Profession in Britain since the Eighteenth Century: A Social History*, p. 30. Also in Anthony Turner, *Science and Music in Eighteenth Century Bath* (1977), p. 24.

[78] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 27.

[79] Robert Smith, *Harmonics, or the Philosophy of Musical Sounds* (Cambridge: 1749).

[80] William Herschel, *Theory of Music*, Edinburgh: Ms. No. Dk.2.35 – the estimated date of its authorship comes from references he makes to his letters to his brother Jacob. Lubbock quotes a note by William regarding these letters. 'When I visited our family at Hanover in 1764, my brother, knowing that I was about writing a Treatise of music, allowed me, on account of their musical contents, to take these letters back again.' Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 16.

how music works, what the rules are, and ended with a section on the rules of producing composition. He referred his readers to Smith for an understanding of the mathematics behind certain concepts telling them that his:

> intention here is to confine ourselves to what immediately concerns music, we shall not inquire into the cause of the pitch of sounds; but, admitting that it proceeds from a certain degree of velocity of the vibrations of the sonorous body refer those of our readers who would inform themselves upon this subject to the learned Dr Smiths Harmonics.[81]

This treatise was the first piece of work William produced that put forward his own ideas on music in terms of a philosophical discussion. He began by describing what music was not. It was not he claimed, 'the rattling of a carriage, the roaring of the sea or blowing of a tempest, and all other agreeable or disagreeable noises that may proceed from various causes. They are not musical as they admit of no such comparison by which sound is referred to another or strands in relation of harmony with it.'[82] He then went on to discuss various aspects of music, what pitch, harmony, sharps and flats are and how in each case they should be used. He talked about how to write music and about the rules of composition.

The content, or at least the intended content (the contents list is complete but not the manuscript) suggests that this treatise may have come about partly as a pedagogical aid. There are however aspects of the work that suggest an attempt to integrate music, his area of expertise, with his new and developing interests in philosophy. In the middle of the treatise, William devoted a whole chapter to musical language. In it, using ideas similar to those expressed in Locke's *Essay,* he explains the importance of language to music. Locke claimed that language and the importance of precise terms were an essential component of philosophical understanding. William began chapter two of his treatise:

> This may be called the musical language for by that term in general we understand the method of conveying our ideas to others. The perfection of these methods consists in the clearness and preciseness; and those languages and expressions are the most perfect that convey exactly the ideas we would have them represent. In this respect we are particularly happy in our musical

[81] William Herschel, *Theory of Music*, Edinburgh: Ms. No. Dk.2.35, Book C, Chapter I, pp. 1-2.
[82] William Herschel, *Theory of Music*, Edinburgh: Ms. No. Dk.2.35, Book C, Chapter I, p. 1.

> language, it being undoubtedly the most perfect in its kind not subject to ambiguity or misinterpretation.[83]

Though William did not refer to Locke directly in this passage there is a similarity in argument, which coupled with evidence that he had recently read Locke's *Essay,* suggests Locke was William's major source. It is interesting that it is Locke's arguments regarding the importance of language that William made use of first in his own writing. Language, in the sense of learning foreign languages, had played an important part in his education to date. As a child William had been taught French and Latin, in England he had, out of necessity, needed to master a working knowledge of English quickly. He had then gone on to study other languages as a means of improving his professional prospects. He studied Italian which he 'looked upon as necessary for my business'[84] a claim he then qualified by suggesting that his main motive was 'an insatiable desire for knowledge'. It was this desire he claimed, rather than the desire for professional advancement, that drove him to study 'French, Italian, Latin, English &c'.[85] He also took up Greek although he later dropped this for lack of time.[86]

Smith's *Harmonics* is the only book William cited in the whole treatise, citing it once in the quote given earlier, and again a few pages on. 'For a mathematical Division and account of these intervals' he tells his reader, 'see Dr Smiths Harmonics, Art: 1. Sect. II'.[87] However, while he cited Smith, he also argued against reducing music to mathematical rules:

> But let us even suppose (which wants confirmation) that the degrees of pleasure arising from musical sounds answer'd perfectly the order of the simplicity of the ratios, still then we should be no nearer the resolution of the above question, for having received the answer that the interval of G to C was agreeable because the ratio of the velocities of the vibrations of the strings founding these notes were as 3 to 2 we should then ask in the next place, why

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[83] William Herschel, *Theory of Music*, Edinburgh: Ms. No. Dk.2.35, Book C, Chapter II, p. 3.
[84] William Herschel to Charles Hutton, 1784, Harvard: MS Eng 1414 F(29); BL: microfilm M/541; quoted in Gingerich, "Herschel, 1784 Autobiography.", pp. 317-318; Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 15; Angus Armitage, *William Herschel* (London: Thomas Nelson & Sons Ltd, 1962), pp. 20-21; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xix.
[85] William Herschel to Mr Lichtenberg, 15 February 1783, RAS: WH. 1/1, pp. 62-65.
[86] Gingerich, "Herschel, 1784 Autobiography.", pp. 317-318; Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 15; Armitage, *William Herschel*, pp. 20-21; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xix.
[87] William Herschel, *Theory of Music*, Edinburgh: Ms. No. Dk.2.35, Book C, Chapter V, p. 9.

> those ratios were agreeable and so forth. In short all questions of this kind must be ultimately resolved into the sole will and pleasure of God… Music is a kind of natural philosophy where we reason best from Experience, and matters of fact are often the best and clearest arguments we can bring.[88]

Again, his analysis had elements of Locke, such as his suggestion that the best way to appreciate music was to reason from experience. Most of all however, this passage shows William's unwillingness to reduce music to mathematics. Through music William was introduced to the benefits of natural philosophy for largely social reasons and not, as has been previously suggested because Robert Smith wrote both *Harmonics* and *Opticks*.[89]

Through his professional life as a musician William came into close contact with a higher social class. Many people he met in these circumstances were interested in natural philosophy, and his own fascination with the subject made it the obvious means by which he could embed himself further in their social stratum. He began slowly using his existing expertise in music and his experience of learning music and languages to help him master the latest writings in the field. Reading work by British writers helped him to learn English and in turn, he learned languages to quench his 'insatiable desire for knowledge'. In each case he described learning as an act of love rather than necessity, separating accomplishment from the more mundane practicalities of earning a living. Even at this stage in his education, he was aware of the importance of presentation, and of fashioning himself into a particular type of savant.

Reinvention and learning from the philomaths, 1766-1781

Two years after writing his *Treatise*, William began to take steps towards a fuller engagement with the scientific world. Up to this point his contact with philosophical gentlemen had been primarily through his work as a musician but by 1766 the emphasis had changed. Referring in a *Memorandum* dated 15 January 1766, William describes a letter from a 'Mr Grey, a philosophical Gentleman with whom I have corresponded. He was a brother of Sir Henry Grey of Northumberland and lived in

[88] William Herschel, *Theory of Music*, Edinburgh: Ms. No. Dk.2.35, Book C, Chapter V, p. 13.
[89] Bennett, "The Discovery of Uranus."

Newcastle.'[90] Sadly, the original correspondence has not survived, though from the reference to it we can deduce the writer was probably Charles Grey, the first Earl Grey and an army officer. His connection with William almost certainly came through William's role as a musician. Either William taught or played at the family's Newcastle home or they may have shared a possible mutual acquaintance in Lord Darlington. The significant thing about William's correspondence with him is that William described him as a philosophical gentleman implying that they were conducting their correspondence on that subject. This makes Grey a possible source for William's knowledge of whom and what to read to become himself a philosophical gentleman.

Another incident that points to William's increased engagement with the scientific world was mentioned in his *Memorandum*:

> 1766, Jan 1. Wheatley. [near County Durham] This was the country seat of Sir Bryan Cook, where every fortnight I used to spend two or three days. Sir Bryan played the violin and some of his relations generally came from Doncaster to make up morning concerts…
> Feb. 19. Wheatley. Observation of Venus.[91]

Bryan Cook was, as far as can be deduced, a philomath. He was not a member of the Royal Society. His dates (he died shortly after this incident) are too early for him to have been involved in any local philosophical society, yet his interest and his encouragement of William's interest in astronomy are both apparent. For William this encouragement gave him a new, potentially more equal way of engaging with his employer outside his professional reason for being in his house.

Having travelled around the north of England, teaching music to the wealthy, William eventually found a permanent post in 1766 as organist at a church in Halifax. Although he did not stay long in the post, moving almost immediately to a more prestigious post in Bath, his description of his Halifax audition is informative in showing the way he was then presenting himself to his peers. He described the audition many years later in his *Memorandum*:

> I was a candidate for the place of organist, which by the interest of the Messrs Bates and many musical families I attended, I had great hopes to obtain. About

[90] 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, p. 19.
[91] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 35.

> this time I was an inhabitant of Halifax. My leisure time was employed in reading mathematical books such as the works of Emerson, Maclaurin, Hodgson, Dr Smith's Harmonics, &c. This happened to be noticed by one of the Messrs Bates who told his brother: 'Mr. Herschel reads Fluxions![92]

This passage informs us about the authors William was reading at the time, and also tells us that his music students were aware of what he read outside of music, and that this recognition was important to him. As William began to expand his knowledge of natural philosophy he also began to develop two slightly differing ways of presenting himself to the world. To fellow musicians and the employers of musicians he began to emphasise his knowledge of natural philosophy. In particular he seems to have emphasised those areas typically least well understood by the general population, namely fluxions or calculus. To the scientific community meanwhile, he appeared less confident of his new knowledge and instead continued to emphasise his expertise as a musician. This was an intermediary period in his intellectual development, where he was still holding on to two contrasting personas developed for different audiences. By doing so he was able to practise being an expert since in each situation he emphasised the area least familiar to his audience.

As for the books referred to in the quote above, these are precisely the works on fluxions that were being read by eighteenth century 'philomaths'.[93] In terms of William's established reading patterns they show a notable shift. The books he discussed reading in the 1750s and early 1760s with his brother Jacob had been famous books by well known philosophers such as Locke. Alternatively they were books taking a philosophical look at subject areas William was already familiar with such as Smith's book on harmonics. These books by less famous authors, specifically on the subject of fluxions therefore represent a departure from the works he had read previously. They show a concerted effort to master a new subject rather than to provide new angles on subjects already known.

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[92] 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, p. 20; Ibid., pp. 35-36; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xx; 'Mr Herschel reads fluxions' is quoted in Reginald Victor Jones, "Through Music to the Stars: William Herschel, 1738-1822," *Notes and Records of the Royal Society* 33 (1978), p. 38; Fiske and Johnstone, *Blackwell History of Music in Britain, Eighteenth Century*, p. 246 identifies one of the Mr Bates: 'Joah Bates (1740-99), civil servant and organist (and native of Halifax), who in 1784 had been one of the prime movers (and conductor) of the first great Handel Commemoration festival in Westminster Abbey. Private secretary to the Earl of Sandwich he also directed concerts of ancient music from 1773 until 1793'.

[93] Niccolo Guicciardini, *The Development of Newtonian Calculus in Britain 1700-1800* (Cambridge: Cambridge University Press, 1989), p. 56 lists 12 textbooks published between 1736-1758 on fluxions that were frequently reprinted, Maclaurin, Hodgson, Emerson and Simpson (mentioned later in this chapter) are all on the list.

The books William now began to scrutinise were written as textbooks to explain fluxions to individuals wishing to study independently. They were written in response to a growing interest in the works of Sir Isaac Newton. The term philomath was relatively common in the eighteenth century, and was used, often by the protagonists themselves, to refer to a particular body of interested amateur and student natural philosophers.[94] As Olaf Pedersen has found, this group consisted of school mathematics teachers and students, as well as 'a good many belonging to the ranks of leisured country gentlemen'.[95] This latter group included some of William's employers. Typical members of this informal group were the assistants of the Royal Observatory (rather than the Astronomer Royal himself).[96] These were not the people making new theories in science but were rather engaged on the fringes of the established scientific community removed from its centre by class, ability and/or geography. They read books and journals specifically tailored to this interested but not necessarily well informed audience.

The fact that the books William was reading overlap so neatly with those popular with the philomaths suggests William may have had some guidance in choosing these particular titles. Colin Maclaurin's *Treatise of Fluxions*[97] is cited in Smith's *Harmonics*, and so could have been his initial introduction to fluxions. It is however also the most advanced of the texts he referred to in the above passage and so it seems likely he would have sought suggestions of more basic introductory texts to help him understand it.

As the above quote suggests, William was not only interested in learning fluxions, but also appears to have been keen for his educational pursuits to be common knowledge. For Messers Bates to know that William 'reads fluxions' William must in some way have made this information public. One way he did this was to introduce fluxions into some of the private music lessons he gave. Ozias Linley, son of rival Bath musician Thomas Linley was one such student. As a demonstration of his new found interest and knowledge, William introduced Ozias to fluxions as part of his music lesson. As a lesson in fluxions it was not very successful. Years later, while

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[94] Pedersen, "The 'Philomaths' of Eighteenth Century England.", p. 239.
[95] Ibid., p. 250.
[96] Mary Croarken, "Astronomical Labourers: Maskelyne's Assistants at the Royal Observatory, Greenwich 1765-1811," *IEEE Annals of the History of Computing* 25, no. 3 (2003).
[97] Colin Maclaurin, *Treatise of Fluxions* (1742).

studying at Oxford Ozias got stuck on the very first page of Simpson's *Fluxions.*[98] In teaching Ozias that William was an expert in fluxions however it worked. Having found difficulty with Simpson's first proposition, Ozias wrote to William: 'I must beg your indulgence as well as patience in perusing my following explication of the first proposition of Simpsons Fluxions... I think the last time I had the pleasure of being with you, you had some objections to some proposition'.[99]

William read books written for philomaths and advertised his understanding of these works to those members of the Halifax and later the Bath societies who employed musicians. Further evidence of his involvement with philomath culture can be found in the *Ladies' Diary* from 1780 in which there appeared a solution sent in by William Herschel to a problem incorporating both fluxions and music.[100] *The Ladies' Diary* played an important role in eighteenth century Britain propagating new ideas in mathematics to an audience outside of the universities.[101] It served as an aid to the self-taught. In one edition problems were set and in the following edition all correct answers sent in were printed in full, with all the workings out shown. An example of every correct method sent in was printed, along with names of all other senders of correct answers by each method. To have come across this problem to which he submitted an answer, it would seem likely that William read the publication regularly and would have been aware of the types of problems discussed within it.

This was the first question for which William submitted an answer to be published, the first public demonstration of his abilities to a purely philosophical (as opposed to musical) audience. That he selected a problem incorporating both fluxions and music demonstrates his caution in claiming too much for his abilities. Whereas to other musicians, in the context of an audition or music lesson, he presented himself as a master of fluxions, to other philomaths he instead promoted his authority as a musician. In his description of the event in his *Memorandum* he justified the entry in terms of the question's musical content rather than its mathematical nature noting that '[a] musical prize question being proposed in the *Ladies' Diary* for this year I sent a

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[98] Thomas Simpson, *The Doctrine and Application of Fluxions, Containing a Number of New Improvements to the Theory and the Solution of a Variety of Problems in the Mathematicks* (London: 1750).
[99] Ozias Linley to William Herschel, 22 June 1787, RAS: WH.1/13.L.53.
[100] 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, p. 83; Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 73; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xxviii; William Herschel, "The Same [Solution To ...] by Mr. Wm. Herschel," *The Ladies' Diary* 1780.
[101] Guicciardini, *The Development of Newtonian Calculus in Britain 1700-1800*, pp. 115-117.

solution of it directed as required. My solution of the question was published in the *Ladies' Diary* for 1780.'[102] He also ended his entry to *The Ladies' Diary* with the following reservation 'the above solution is not to be considered as mathematically true, but as a practical solution approaching near the truth'.[103]

These early formative years of William's life, where he was first introduced to the potential advantages of studying natural philosophy, and then spent so many years studying books on fluxions, has previously been ignored in all secondary literature. It is significant however in that it shows the evolution of William's view on the purpose of his education. As a jobbing musician William had discovered a shared interest in natural philosophy with a number of his employers. With that knowledge he set about developing his expertise in natural philosophy, using education as a means of placing himself on a more equal footing with those in an otherwise elevated social position. By selecting fluxions he was able to make the distinction between knowledge that could simply be regarded as an extension of his professional interests and knowledge that had no explicit vocational use. However, at this stage he was still cautious in presenting his new found expertise to others. While happily playing the expert in natural philosophy to his fellow musicians and patrons, he still relied on his established position as a musician, when it came to other philomaths.

Public demonstrations of learning, 1773-1781

A crucial turning point in Herschel's career came when he decided to make his own telescopes. It has generally been assumed that he did this because he was led naturally from music to astronomy and instrument making via the books of Robert Smith.[104] However, William first read Harmonics no later than 1764 (since he referred to it in his *Treatise on Music* written in that year), and did not start to make telescopes until 1773. This gap, of nearly a decade, is central to understanding William's shift of interest and self presentation from music to astronomy. Already, by looking at some of the evidence from this period – his treatise on music, his comments on the books he was

[102] 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, p. 83.
[103] Herschel, "The Same [Solution To ...] by Mr. Wm. Herschel.", p. 47; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xxix.
[104] Robert Smith, *A Compleat System of Opticks in Four Books, Viz. A Popular, a Mathematical, a Mechanical, and a Philosophical Treatise: To Which Are Added Remarks Upon the Whole* (Cambridge, 1738).

reading and the way fellow musicians and employers were beginning to see him – some of the gap has been filled. However, none of this explains the significance of the year 1773, and why he should begin telescope building at that moment. It therefore seems likely that some event happened around 1773 to trigger this new activity, and indeed a number of changes to the Herschel household in the early 1770s seem to confirm this.

Having found a steady job and settled in Bath, William began to advertise the prospects available to jobbing musicians in the area, to his family back in Hanover. In 1770 his younger brother Alexander moved into William's house in Bath to find work nearby as a musician. Alexander was by all accounts a dedicated and skilful mechanic. When William's son John gave his brother-in-law permission to go through his father's correspondence, he found among them 'some curious ones of his brother Alex all confined to the subject of mechanics.'[105] When pushed further, John gave the following anecdote about his uncle, albeit referring to a time around 20 or 30 years after Alexander first moved to Bath:

> He never moved away from his own home, except to pay a yearly visit to his brother's [i.e. William's] family and then invariably came accompanied by his turning lathe and other implements, and getting himself & them established the moment of his arrival, in the workshop (now H's observatory) scarcely left that apartment during the whole period of his stay. His appearance at meals with the family was never thought of- and he was indulged by them in his humour to his hearts content - allowed to pass his time in his own way & never asked one question or interrupted in his pursuits by anything. He used to go away after his stated week of visitation had expired having scarcely seen his friends all the time, but declaring himself quite delighted with their society.[106]

No correspondence of or about Alexander pre-1781 has survived. However the level of expertise he demonstrated after 1781 and William's faith in it, suggest that his appearance was pivotal in allowing William to make telescopes. As an example of the brothers' relationship, years later, when William had become well established as both an astronomer and an instrument maker and had moved to Slough, he found Alexander's skills sorely missed and difficult to replace. In a letter to Alexander he told him, '[m]y brass man (as we call him) is a stupid fellow, but knows a good deal of

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[105] Anecdotes of John F. W. Herschel as noted down by James Stewart, September 1833, JHS papers ARM.
[106] Ibid.

the business. When you come he shall be your journeyman. He admires your workmanship much, what I have shewn him of it.'[107]

A second important factor in allowing William to take up instrument making was the arrival of his sister, Caroline in 1772. That year William returned to Hanover and collected his younger sister Caroline. He brought her back to England with him to act as housekeeper and to be trained as a singer. By this time William was doing well for himself with his position as chapel organist supplemented by concert performances and music lessons and this was reflected in the house he kept and the household staff he employed. Once arrived, Caroline soon relieved William of many of the time consuming activities he had previously had to carry out as part of living and working in Bath. She took over the supervision of household staff and in time many of their duties. As her abilities in English and music improved she also took over the task of copying out musical scores for the choir and later teaching the choir. All of this meant that William now had more spare time, as well as the technical help of his brother with which to extend his hobby and start the practical business of making his own telescopes.

A third factor in determining why William started to make telescopes in 1773, was the opportunity presented by a local amateur instrument maker's decision to give up his hobby and sell his tools. William makes no reference to the identity of this fellow amateur except to say that:

> I was however, informed that there lived in Bath a person who amused himself with repolishing and making reflecting mirrors. Having found him out he offered to let me have all his tools and some half-finished mirrors, as he did not intend to do any more work of that kind. The 22nd September when I bought the apparatus, it was agreed that he should also show me the manner in which he had proceeded with grinding and polishing his mirrors.[108]

The combination of these different factors – the content of the books he was reading, the arrival of his siblings and the opportunity presented by this fellow amateur in Bath – offered William the idea of building his own telescopes and the means to do it. His next task was to learn how to build telescopes. He began by taking lessons, as agreed, from the man who sold him his tools and half-finished mirrors.

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[107] William Herschel to Alexander Herschel, 10 March 1785, RAS: WH.1/9.2.
[108] Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xxiv.

William's tutoring under this amateur mirror maker did not, according to his own testimony, last long. '[G]oing to work with these tools I found no difficulty to do in a few days all what he could show me, his knowledge indeed being very confined.'[109] He then continued by himself in September 1773 'with the assistance of Dr Smith's popular treatise.'[110] In the same year he bought and studied James Ferguson's *Astronomy*,[111] Emerson's *Trigonometry*[112] and Emerson's *Optics*[113] and around the same time, Emerson's *Mechanics*.[114] Both Smith and Emerson were authors he had read before, and were well established as writers for the philomath audience. James Ferguson similarly wrote for the same audience. There is no evidence that William had previously come across Ferguson. However, Ferguson was lecturing in Bath around 1773 and the publicity for that, if not actual attendance at the lecture, would have made William aware of Ferguson's name and area of expertise.[115]

Smith and Emerson gave practical help in making telescopes. Smith, as Michael Hoskin and Reginald Jones have already shown, provided step by step instructions on how to build a telescope very similar to the 7ft reflector William eventually perfected.[116] Emerson meanwhile provided more general mathematical

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[109] Ibid., p. xxiv; Joseph Ashbrook, "Herschel's 'Large 20-Foot' Telescope," *Sky and Telescope* 1977, p. 174; part of this quote is in Macpherson, *Herschel*, p. 17.

[110] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 66 quoting William's own record – now at University Observatory, Oxford; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xxiv extends quote, 'popular treatise on opticks'; Hoskin, *William Herschel and the Construction of the Heavens*, p. 21.

[111] James Ferguson, *Astronomy Explained Upon Sir Isaac Newton's Principles and Made Easy to Those Who Have Not Studied Mathematics* (London: 1756) which he is quoted as having read in Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 60; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xxiv; Jones, "Through Music to the Stars: William Herschel, 1738-1822.", pp. 38-39; Hoskin, *William Herschel and the Construction of the Heavens*, p. 20.

[112] William Emerson, *The Elements of Trigonometry. Containing the Properties, Relations, and Calculations of Sines, Tangents, Secants, &C. The Doctrine of the Sphere, and the Principles of Plain and Spherical Trigonometry. All Plainly and Clearly Demonstrated* (London: W. Innys, 1749) which he is quoted as having read in Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 60; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xxiv; Jones, "Through Music to the Stars: William Herschel, 1738-1822.", pp. 38-39; Hoskin, *William Herschel and the Construction of the Heavens*, p. 20.

[113] William Emerson, *The Elements of Optics* (London: 1768); 'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8, p. 30; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xxii.

[114] William Emerson and G. A. Smeaton, *The Principles of Mechanics; Explaining and Demonstrating the General Laws of Motion, the Laws of Gravity, Motion of Descending Bodies ... Strength and Stress of Timber, Hydrostatics, and Construction of Machines.* (London: W. Innys & J. Richardson, 1754).

[115] Turner, *Science and Music in Eighteenth Century Bath*, p. 53.

[116] Jones, "Through Music to the Stars: William Herschel, 1738-1822.", p. 42. Also Hoskin, *William Herschel and the Construction of the Heavens*, p. 20 'Herschel could scarcely have hit upon a book better suited to his needs, for it gave him just the grounding he needed for his work on the construction of telescopes'. Telescope in Smith that appears remarkably similar to William's 7ft is by John Hadley.

tools with which to solve problems when varying the design of the telescope.[117] Smith's book was also useful, as Hoskin and Schaffer have discussed, in providing William with descriptions of what he should be able to see through the telescope[118] so he could begin 'to practice seeing.'[119] A further use of Smith not previously considered is that it may have offered William a means by which to use his experience of training in other fields to make the best use of his telescopes.

Besides its section on instrument making, on mathematics and on telescopic discoveries, Dr Smith's *Opticks* has a section entitled 'A Popular Treatise' within which is a chapter called 'Concerning our ideas acquired by sight'.[120] This chapter begins by framing its arguments within the context of Locke's *Essay on Human Understanding*, and his views on learned knowledge. The chapter then goes on to describe William Cheselden's training of a young man with cataracts to see colour through repetitive practice. Cheselden was a famous eighteenth century surgeon, made famous for his work on the restoration of sight, and the publication of this work in Smith's *Opticks*. William had learnt through concentrated repetitive solitary practice from a very early age, and here, described in Smith, presented as an application of the ideas of Locke, was that same type of practice applied to sight. William applied this to his own sight describing the process to his friend Alexander Aubert: 'When you want to practice seeing (for believe me Sir, - to use a musical phrase – you must not expect to see at sight or a livre ouvert) apply a power something higher than what you can see well with, and go on encreasing it after you have used it some time.'[121]

Five years of practice later, and William was happy enough with his skills as a mirror maker, if not yet as an observer, to begin comparing himself with the best. In 1778, John Mudge, a physician, amateur mirror maker and brother of the famous clockmaker, Thomas Mudge, was awarded the Royal Society's Copley medal for his

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[117] Jones, "Through Music to the Stars: William Herschel, 1738-1822.", p. 42. Also Hoskin, *William Herschel and the Construction of the Heavens*, p. 20, 'Herschel could scarcely have hit upon a book better suited to his needs, for it gave him just the grounding he needed for his work on the construction of telescopes.'

[118] Observing notebook, RAS: WH.2/1.1. Referring to the Orion nebula in his observing notebook, 1 March 1774, William writes 'its shape was not as Dr Smith has delineated in his Optics'; Simon Schaffer, "Herschel in Bedlam: Natural History and Stellar Astronomy," *British Journal for the History of Science* 13, no. 45 (1980), p. 222; Hoskin, "William Herschel's Early Investigations of Nebulae: A Reassessment.", p. 167.

[119] William Herschel to Alexander Aubert, 28 January 1782 in Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 104.

[120] Smith, *A Compleat System of Opticks in Four Books, Viz. A Popular, a Mathematical, a Mechanical, and a Philosophical Treatise: To Which Are Added Remarks Upon the Whole*, pp. 42-43.

[121] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, pp. 104-5.

paper on mirror making, published in the *Philosophical Transactions of the Royal Society* the previous year. William saw the paper, tried out the technique of mirror making described in the paper and decided his own method produced a better mirror.[122] William had discovered that his work was comparable to those who published in the *Philosophical Transactions*. The *Philosophical Transactions* was not somewhere philomaths published; this was expertise on a different scale. Yet William had found his work could meet, even exceed that higher standard. He now had evidence that he had reached a certain level of expertise, on a par with leaders in the field. Initially he had presented himself as a natural philosopher to musicians and as a musician to natural philosophers. From this point on, there are no further examples of his justifying his attempts at natural philosophical problems in terms of their musical content. Certainly he did not feel the need to present himself as a musician to the Bath Philosophical Society.

Making friends in high places, 1779-1781

In 'Herschel in Bedlam', Simon Schaffer challenged the idea that Herschel founded modern sidereal astronomy. Instead he argued that William was a natural historian studying, cataloguing and categorising the stars in the same way that his contemporaries approached the natural world. Also, he argued that the preoccupations of the Bath Philosophical Society played an important role in introducing William to this approach. In 'Uranus and Herschel's astronomy' Schaffer again alludes to the role of the Bath Philosophical Society in shaping William into a respectable man of science. In it he documents the process through which William's observations of Uranus were passed around members of the society and then friends of those members who provided William with advice on how best to get his work accepted by the scientific community at large. What is missing from this story is William's agency in this process and the role it plays in his development.

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[122] Joachim Rienitz suggested 'that Herschel made use of the zonal test method introduced by J. Mudge in 1777, which was confirmed by a letter Herschel's sister Caroline Herschel wrote in 1841' in Joachim Rienitz, "William Herschel's Mirror Test and Its Consequences," *Bulletin of the Scientific Instrument Society*, no. 6 (1985) while R. V. Jones states that William knew that ideally he should aim at parabolic surfaces as pointed out by John Mudge the clockmaker (1721-1793)' in Jones, "Through Music to the Stars: William Herschel, 1738-1822.", p. 39.

By the end of 1779 William knew that he built good telescopes. As a society musician he also had a good knowledge of who the influential people of Bath were and the parts of town they frequented. The Herschels moved house a number of times while living in Bath. Between December 1779 and March 1781 they lived at No. 27 River Street, a road towards the edge of town, between the Royal Crescent and the various musical venues at which William played. It was also the street on which the newly formed Bath Philosophical Society met and was founded.[123] Most, though not all of the houses on this street have gardens. No. 27 may have been one of those without, though William never comments on this. Indeed he gives no reason why he was observing in the street on a day, not long after they moved in, when Royal Society fellow Dr William Watson walked past. William only states that it happened:

> 1779, December. …I brought my seven feet reflector into the street, and directed it to the object of my observations. Whilst I was looking into the telescope, a gentleman coming by the place where I was stationed stopped to look at the instrument. When I took my eye off the telescope he very politely asked if he might be permitted to look in, and this being immediately conceded, he expressed great satisfaction at the view. Next morning the gentleman, who proved to be Dr Watson, jun. (now Sir William), called at my house to thank me for my civility in showing him the moon, and told me that there was a Literary Society then forming at Bath, and invited me to become a member of it, to which I readily consented.[124]

Dr Watson was a member of the short lived Bath Philosophical Society; he was also a member of the Royal Society. Watson was in addition to this a medical doctor with an interest in botany and mineralogy. He was the son of William Watson Snr, who had won the Royal Society's Copley medal in 1745. On a more modest scale, William Watson Jnr had published a paper in the *Philosophical Transactions,* on the blue shark, a year before his meeting with Herschel. In terms of William's transition from musician to natural philosopher, his involvement with the Bath Philosophical Society did two things. Firstly, it provided him with a much needed champion within the Royal Society as Watson became, in effect, his patron. Secondly, it provided him with a new way of learning, through discussion rather than solely through isolated practice.

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[123] Hoskin, *The Herschel Partnership: As Viewed by Caroline*, p. 26.
[124] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 73.

The Bath Society came about through the work of its president, Edmund Rack, who back in 1777 put an advertisement in the *Bath Chronicle* directed at 'The Nobility and Gentry in the Counties of Somerset, Gloucestershire, Wiltshire and Dorset in General, and the Cities of Bath and Bristol in Particular.' Rack proposed 'the institution of a Society in this city, for the encouragement of Agriculture, Planting, Manufactures, Commerce and Fine Arts.'[125] Rack, the son of a Quaker labouring weaver, was himself a self-made man working as a draper while at the same time cultivating literary and intellectual friendships and interests. This advertisement led to the formation of the Bath Agricultural Society. A few years later, in 1779, Rack got together with Thomas Curtis, a governor of the Bath General Hospital to form the Bath Philosophical Society. Like the Agricultural Society, this would have a strong bias in favour of agricultural development and natural history but it would also encompass more diverse scientific and literary interests.[126]

When asked to join the Bath Philosophical Society, William chose to give his first paper not on mathematics, astronomy or instrument making, but on Rack's own sphere of interest, natural history.[127] This choice, so outside William's normal areas of interest and research, suggests a real eagerness to please his hosts. The paper he gave, 'Observations on the Growth and Measurement of Corallines',[128] describes his observations over a series of days of a branch of coralline. It was a subject he had never previously studied. In it he gave his observations and a description of the apparatus he used, giving particular attention to the magnifying power of the microscope[129]. In his concluding remarks, he made a throw-away reference to Leibniz suggesting that if certain things[130] were true 'it would almost look something like an instance of Leibnitz's pre-establish'd Harmony however, without having recourse to so extraordinary doctrine'[131] he would have to limit himself to the evidence of the experiment. On the one hand, he was attempting a subject unfamiliar to him, but well

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[125] Simon Winchester, *The Map That Changed the World* (2001), p. 127.
[126] Turner, *Science and Music in Eighteenth Century Bath*, p. 82, p. 91.
[127] William Herschel, 'Observations on the Growth and Measurement of Corallines', read to *Bath Philosophical Society*, 18 February 1780 reprinted in Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. lxvi.
[128] Ibid., p. lxvi.
[129] He does not say who made the microscope.
[130] 'Now, if these Corallines are the habitation of Polypes of a shape resembling, and adapting to, their Houses, it would almost look something like an instance of Leibnitz's pre-establish'd Harmony. But without having recourse to so extraordinary a doctrine, we need but reflect on the nature of Polypes, (as far as we are already acquainted with them by experiments) to solve the difficulty.'
[131] Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. lxvii

known to the society at large. On the other, he made sure he presented himself as well informed in natural philosophy more generally.

Further evidence of William's wish to ingratiate himself with the society's members was his collaboration with Rack's fellow founder, Thomas Curtis. This is the only example of William working on a project with anyone outside of his immediate family. His collaboration with Curtis demonstrates his enthusiasm for fully engaging with this society. The papers themselves – all rather short descriptions of experiments performed - came out of discussions from a previous meeting. The discussions were on electricity, following William's paper on his reading of Joseph Priestley's *History of Vision.* [132]

In between his papers on natural history and electricity William also began to report to the society on observations made with his telescopes.[133] Two of these papers, 'Astronomical Observations of the periodical Star in Collo Ceti' and 'Astronomical Observations relating to the Mountains of the Moon', Watson read to the Royal Society on William's behalf at meetings in 1780. The first of these was in essence an edited transcript of two years of his observing journal for the star Collo Ceti. The second was more ambitious. He began by explaining that his reason for observing the Moon was to repeat the observations of 'Galileo, Hevelius, Kircher' as 'their instruments were far from being arrived to that degree of perfection we now have obtained'. In doing so he not only aligned himself with great astronomers of the past, but also advertised the quality of his own home made telescopes. In both papers he quoted Joseph-Jérôme Lalande, in the second solely because he was 'one of our most eminent modern astronomers who, agrees with the sentiments above cited'. This suggests that here was another natural philosopher with whom he wished to be

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[132] Initial paper on electricity was William Herschel, 'Propositions and Queries', read to the *Bath Philosophical Society*, 23 March 1780 reprinted in Ibid., p. lxxxi; Schaffer refers to Priestley's membership of the society in Simon Schaffer, "The Great Laboratories of the Universe: William Herschel on Matter Theory and Planetary Life," *Journal for the History of Astronomy* 11 (1980); William's collaboration resulted in two papers, William Herschel and Thomas Curtis, 'Electrical Experiments', read to the *Bath Philosophical Society*, 7 April 1780 reprinted in Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. lxxix; William Herschel and Thomas Curtis, 'Experiments in Electricity continued', read to the *Bath Philosophical Society*, 21 April 1780 reprinted in Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. lxxxiii.

[133] All reprinted in Dreyer, ed., *The Scientific Papers of Sir William Herschel*, 'Observations on the Mountains of the Moon'; Continuation of the Observations on the height of the lunar Mountains; Astronomical Observations on the Periodical Star in Collo Ceti'; 'Communication of my letter to the Rev Dr Maskelyne, On the Measurement of the Lunar Mountains'; Observations on the Occultation of Gamma Virginis, made with a view to determine whether any Effect of a Lunar Atmosphere could be perceived' (read 17 August 1780); 'On the periodical star Collo Ceti' (read 2 February 1781); 'Account of a Comet' (read March 1781).

associated. In William's progression of papers to the Bath Philosophical Society, there is a gradual shift in how he presented himself. He began politely flattering his host, but soon moved to positioning himself alongside the greatest historical and modern astronomers and presenting his telescopes as the best ever.

William's choice of wording in his papers was designed to project an image of himself as a particular type of natural philosopher. However, he was sometimes in danger of getting a little over-confident and as Schaffer has shown, needed the Astronomer Royal Nevil Maskelyne, with Watson's help, to rein him in. The finished product allowed William's work, and in particular the quality of his telescopes, to be known to a much larger audience. As Schaffer has pointed out, Maskelyne, Watson and Royal Society secretary Henry Maty helped William put together his first published papers. With their advice, he was able to present his work in such a way that it might convince a Royal Society audience.[134] In passing on one message from Maskelyne, Watson not only alerted William to how important a man Maskelyne was, and how honoured he was to have him take time to help him improve, but also advised him on how he should reply.

> I take it extreamely obliging in Dr Maskelyne to take the pains of giving an account of what was wanting to the further improvement of your paper, and am very certain that the motive for pointing out further illustrations is from a desire he has of having the subject thoroughly handled by so accurate and ingenious a Philosopher. I think you would do right (pardon my giving you advice) either to add the desired improvements, or to write over again the paper and send it to Dr Maskelyne, who, as he is Astronomer Royal, will be pleased, I believe, with the compliment paid him, and he will present it anew to the Society.[135]

William took both Watson and Maskelyne's advice and continued to turn to them for both professional help and friendship throughout his life. He not only made important contacts, but maintained them.

On 13 March 1781, having just moved house, William discovered what he thought was a comet. That comet turned out to be a planet, the first planet to be discovered since antiquity and was later named Uranus. Thanks to his involvement with the Bath Philosophical Society, and crucially, with the Royal Society William

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[134] Simon Schaffer, "Uranus and the Establishment of Herschel's Astronomy," *Journal for the History of Astronomy* 12 (1981), pp. 16-18.
[135] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 76.

was able to use this opportunity to make his name as a natural philosopher. As Schaffer has already shown, William began cautiously, first showing the comet to his patron William Watson, who suggested he tell his father, William Watson Snr, in London. On the advice of his son, Watson Snr passed on the news to other astronomers connected with London. William also wrote to Dr Hornsby, and between them, these professional astronomers came to the conclusion that it was not a comet at all, but a planet. This new planet was named George III by William, Herschel by the French and Uranus by the Germans.

This period, in which William joined and then worked with the Bath Philosophical Society, was the final stage in his transition from musician to astronomer. The society represented a step up the scientific hierarchy from the philomaths and William actively pursued their acceptance. The Mudge paper had allowed him to compare his own ability as an instrument maker with that of someone whose skills were recognised by the Royal Society. Once confident in his comparable talent, he set about finding ways into this circle using his telescopes as a means of introduction. Where music had previously been his area of assured expertise, now instrument making took its place. Having used his ability as an instrument maker to make new contacts however, he then made every attempt to make his broad range of philosophical knowledge, outside of purely instrument making, known to them.

William the natural philosopher

By 1782 William had very quickly become an established figure, towards the top of Britain's social and scientific hierarchies. He had a Royal pension, which allowed him and his sister to give up music and move to Slough to devote their full time to astronomy. Once established in Britain, William now began to build contacts abroad. This development was not so much a part of William's social ambitions as a necessity in terms of his scientific reputation. The astronomical community in England was essentially limited to Maskelyne, Herschel, Hornsby and Aubert, so much of the work on Herschel's planet was done in France. Britain and France were at war for most of the eighteenth century, fighting over land in Europe, including Hanover, and control of the colonies as they set about establishing the boundaries of their new Empires. Ignoring the politics, some English philosophers, rather unfashionably, kept up contact

with philosophers across the channel and were rewarded accordingly. Nevil Maskelyne, Henry Cavendish and Joseph Banks were all awarded associate membership of the Institut National des Sciences et des Arts in Paris in 1802. For the acceptance of this award all three were heavily criticised by their English peers.[136]

In addition to this political rift, there was also a technical divide between the two countries. Mathematics developed on each side of the Channel differed enormously and increasingly over the course of the eighteenth century. Following the Newton/Leibniz dispute over priority in establishing calculus (or Fluxions as it was called in England) this particular area of mathematics developed in very different forms on the two sides of the channel. The rift was widened in the mid-eighteenth century when a pamphlet, published by George Berkeley, accused the English mathematicians of veering too far away from practical applications in the mathematics they were creating and in doing so being un-Baconian and therefore unpatriotic.[137] For those engaged in mathematical study, this nationalistic divide meant that expertise could generally only be achieved in the mathematics of one country or another. William had studied fluxions, but this he slowly discovered was of limited use in understanding the work of his French colleagues.

In 1781 Maskelyne informed Charles Messier, the Astronomer to the Navy of France and Academy of Sciences in Paris, of William's discovery.[138] Messier and other French mathematicians began to work on this information, calculating the planet's orbit. These calculations, carried out by Messier, Lalande, Mechain and Dagelet, were then communicated to William, by Lalande in May 1782.[139] This was the first letter of their long running correspondence. This correspondence, not previously examined in any detail, is significant in the development of William's expertise because it was through this that he came to find its limits. He was indisputably a great instrument maker and observer but to be a true gentlemen natural philosopher (he felt) he needed to excel in mathematics. This is apparent in his early (publically witnessed) readings in fluxions and also in his correspondence with his

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[136] Derek Howse, *Nevil Maskelyne: The Seaman's Astronomer* (Cambridge: Cambridge University Press, 1989), p. 195.
[137] Guicciardini, *The Development of Newtonian Calculus in Britain 1700-1800*, pp. 37-39.
[138] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 86.
[139] Joseph-Jérôme Lalande to William Herschel, 1 May 1782, RAS: WH. 1/13.L.1; Ibid., p. 126 ('calculations have been omitted').

French contemporaries. What this correspondence forced him to face, was that there was a limit to what he could master in this field.

Lalande's first letter contains simply a list of the results of the calculations carried out on William's planet by himself and his colleagues, followed by a request for information both about William's life and about the telescope he had used. William's reply began effusive in its gratitude:

> How much I think myself honour'd by your letter will perhaps be easier for you to conceive than me to express, when you reflect that my enthusiasm for astronomy must render extremely valuable to me a correspondence with a person who has distinguished himself so eminently in that noble science by his immortal works, the 4th volume of which I have just now received.[140]

He then continued by thanking him for the results and answering his questions telling him that 'I was born in the city of Hannover Nov 15 1738, and brought up to Music; my leisure hours were generally devoted to mathematics and other studies.' In other words, highlighting his breadth of interests at an early age in all aspects of natural philosophy, and specifically emphasising his mathematical knowledge whose lack of publicity he perhaps felt diminished his reputation as a natural philosopher.

For a time, the correspondence between William and Lalande continued in a routine way. Lalande would pass on the results of new calculations and introduce various natural philosophers from around Europe. William meanwhile would offer descriptions and sometimes whole papers that he was about to have published. Then in the summer of 1788, not long after William, at the age of 50, had married the widow Mary Pitt, Lalande visited England. In England Lalande met Maskelyne and Cavendish in London and also visited William in Slough. This visit seemed to mark a turning point in their correspondence. It seems likely that there was some discussion during his stay of the mathematics Lalande and his colleagues had applied to William's planet. The correspondence immediately following this visit was filled with explanations and demonstrations of this mathematics.[141]

Following Lalande's visit William sent him one of his papers, asking him to show Jean Baptiste Joseph Delambre rather than have him mark it himself. Lalande's reply related Delambre's corrections line by line. For example, he wrote, on 'page 373

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[140] William Herschel to Joseph-Jérôme Lalande, 5 September 1782, RAS: WH. 1/1 pp. 57-58, referring to Joseph-Jérôme Lalande, *L'astronomie* (1792).
[141] Joseph-Jérôme Lalande to William Herschel, 9 September 1788, RAS: WH. 13.L.12.

you have calculated the positional angle of heliocentric longitude but by using geocentric longitude as must necessarily be the case one finds 12° 19' 3"'[142] Ending the letter, Lalande offered that 'if you had sent observations in more detail to M de Lambre more rigorous determinations would have been attempted.'[143] William's reply was defensive, and apologetic for his mistakes. He was embarrassed at having made the mistakes and was quick to explain them away. He began by offering his 'best compliments to Mr De Lambre, to whom I am no less obliged for the trouble he has taken to go over the tedious calculations contained in that paper' and then straight away set about making excuses telling him:

> I have so little leisure for practice that it would be no wonder, on account of the multiplicity of things that take up my time, and continually disturb my thoughts, when I am calculating, if I had made many more blunders than I have made… The using of the heliocentric instead of the geocentric place of the G. S. was an oversight in the calculation of the angle of position, which I have since corrected… The last column on page 371 was calculated from tables that give the motion of the satellite to decimals of minutes so that an error of a few seconds may easily take place but can not be of any consequence. Upon the whole I once more return you and Mr De Lambre thanks for your friendly notice of my blunders which I hope you will ascribe to my busy situation.[144]

William continued to stay friends with Lalande and to build on other contacts across the Channel. He even visited certain astronomers and mathematicians on a family trip to Paris during the Peace of Amiens in 1802. He continued to pass papers to them, and they in turn sent him papers and books (including an edition of Lalande's *l'Astronomie* in which he is mentioned) making his library unusually diverse for an English philosopher.

Having established a position for himself within the English class system through his scientific education William was able to correspond with peers throughout Europe. What he found however was that not all of his skills were translatable; in mathematics he had trained himself using English authors who in turn were developing Newton's work. His correspondence with his French colleagues however suggested

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[142] 'page 373 vous avais calculé l'angle de position de longitude héliocentrique mais en employant la longitude géocentrique comme il le faut nécessairement on trouve 12° 19' 3"'.

[143] 'si vous aves rapporté les observations avec plus de détail au De Lambre on aurait essayé des détermination plus rigoureuse.' Joseph-Jérôme Lalande to William Herschel, 2 October 1788, RAS: WH. 1/13.L.13.

[144] William Herschel to Joseph-Jérôme Lalande, 17 October 1788, RAS: WH. 1/1 p. 168; Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 198.

that this was not enough. His limits not only in his higher mathematics but even in some basic calculations became uncomfortably apparent.

Conclusion

The aim of this chapter was to fill in the missing gaps in William Herschel's education to understand how and why he turned from music to astronomy and where and how he identified the limits to his ambitions. As this chapter shows, William's move from music to astronomy was gradual and cautious. He was motivated by interest in the subject, but also, by an awareness of how this new area of study might change his social position. As a child William was taught to see education as a means of social advancement. As an adult, he developed this further, learning not just how to improve his prospects as a musician, but to remodel himself to the employers of musicians as a fellow philomath as opposed to solely an employee. By sharing leisure interests with members of the nobility and gentry, he was able to raise his apparent social position. Moving up the scientific hierarchy helped to secure that transition as he moved from philomath to member of a provincial philosophical society to fellow of the Royal Society.[145] His discovery of the planet Uranus helped accelerate the process, allowing him to leave music entirely. However, he soon discovered, at least after corresponding with astronomers in France, a new hierarchy to contend with, as he found himself praised primarily as an instrument maker, rather than holding the more desirable status of natural philosopher.

William's transition from music to astronomy, motivated by more than simply a love of astronomy, was slow and cautious. He started out on very general philosophical texts, then on ones that dealt with music, then fluxions then astronomy and instrument making. He never published his treatise on music. He spent years presenting himself as a philosopher only to musicians and music students. Eventually he tried out his knowledge of mathematics to fellow philomaths, only to hide behind his identity as a musician as he did so. Then slowly he became bolder. His family came over and helped him make telescopes. He tested his work against that of a Copley award winner. Still he didn't try to publish his work, though like his treatise

[145] William was elected Fellow of the Royal Society on 6 December 1781.

on music, he wrote up his findings and arguments. Then he met William Watson and the rest of the Bath Philosophical Society and began to learn how to present and write papers. His years of practice paid off, his papers were read at the Royal Society and his discovery of Uranus made him a household name throughout Europe.

The pre-Uranian period of William Herschel's life has been generally dismissed in the secondary literature, as though there were no need to explain why he should make this transition from music to astronomy. The problem with leaving this unexplained is that it makes the whole process appear effortless, as though the study needed amounted to nothing more than the reading of a couple of books. As this chapter shows, there was rather more to it. William spent 20 years reading, practicing, and testing out his abilities in different media and to different audiences and even after all that, he still found there were areas he had yet to perfect.

Chapter Two: The training of Caroline Herschel

In this chapter I give an account of Caroline Herschel's education to establish two points: firstly that astronomy was only one part of her education and must be judged accordingly, and secondly, that Caroline played a far more active role in shaping her own education than has been previously acknowledged. The education that members of her family provided for her, tended to be designed to teach skills that would have immediate application. This I will argue was why astronomy came relatively late in her education. Those lessons meanwhile that Caroline actively sought, were chosen with a longer term view, one based on the ideas which had surrounded her during her upbringing. Education, from Caroline's perspective, should be a means of achieving social mobility, as well as of improving her usefulness to her family. Caroline gradually learned to use her educational opportunities as a means of self-fashioning. In doing so she became the only plausible candidate for the position of William's astronomical assistant by the time he was in a position to appoint one.

The dominant view in the nineteenth and much of the twentieth centuries was that Caroline was a passive recipient of education, driven solely by a desire to please her brother. She became a singer to please her brother and then an astronomer, again for William. In this narrative, her only role was to allow him to shape her in these moulds. For example William's biographer, E. S. Holden described Caroline as 'a perfectly untried girl, of very small accomplishments and outwardly with but little to attract…Her obedience was unquestioning, her reverence amounted almost to adoration'.[146] Similarly in their 1930s book about forgotten women, Helen Ashton and Katharine Davies described her as being 'elevated beyond the common timidity of her mind by the flow of her love for William.'[147]

Michael Hoskin has taken this one step further, asking if she was 'an assistant astronomer, or *merely* a devoted astronomer's assistant?'[148] In asking this question he places value judgements on the different roles each sibling held within the family enterprise. Hoskin's answer to this question was that, 'William had enough curiosity, inventiveness and originality for the two of them. He needed a dedicated, reliable and

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[146] Holden, *Sir William Herschel: His Life and Works*, p. 33.
[147] Ashton and Davies, *I Had a Sister*, p. 157.
[148] My italics Hoskin, *The Herschel Partnership: As Viewed by Caroline*, p. 4.

indefatigable assistant, and it was such an assistant that he collected from the family home in Hanover in 1772.'[149] Their comparative education is given no thought; instead their different activities within the family project are explained in terms of personality and temperament.

The alternative conclusion drawn by writers on Caroline Herschel is that rather than selfless devotion, Caroline's real motivation was independence only disguised as selflessness. Again, like Hoskin these arguments are often tied up with ideas about proper science and whether or not what she did made her an astronomer in her own right or merely an astronomer's assistant. Claire Brock for example argues that Caroline was driven by a desire for independence and paid work and this helped her become a 'practising astronomer in her own right'.[150] Rather than examine the particular role Caroline played, and why she may have ended up with that role, Brock and others like her prefer to mould her into something deemed more respectable.[151]

Having been described for decades as 'devoted', 'selfless' and 'meek', many modern authors have chosen to exaggerate her aspirations for independence as a remedy. However, as Patricia Fara points out, this simply downgrades the actual work Caroline did. Only a very small part of Caroline's work can be made to fit this model, while most has to be understood in terms of her role as part of a larger project, figure-headed by William. While Fara has concentrated on Caroline and how best to understand her work and self-presentation in the context of her time, I look in this chapter, at the years leading up to Caroline's career in astronomy within the more immediate context of her family. In particular I compare Caroline's education - its content, the learning skills it taught and its overall purpose – with that of her brother William. In doing so I hope to complement Fara's work, by providing a richer understanding of how it was that she came to take on her particular role in astronomy and present herself in the way that she did.

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[149] Ibid., p. 153.
[150] Claire Brock, *The Comet Sweeper: Caroline Herschel's Astronomical Ambition* (London: Icon Books, 2007), p. 138.
[151] Others like Brock include for example Gunn, "Caroline Herschel: Female Astronomer."; Hughes, "Caroline Lucretia Herschel – Comet Huntress."

Life in Hanover: 1750-1772

Caroline's childhood education in Hanover consisted of schooling, alongside her brothers at the local Garrison School. In addition it included training from her mother in various domestic skills, and lessons, where she could find them, in a whole host of skills and accomplishments. Much of her education was driven by her parents. However, Caroline made a number of requests ensuring that where possible accomplishments, as well as straightforward domestic skills, were included in her training. In this, I will argue, she was following the family trend of using education as a means of social advancement, learning skills that might facilitate her and her family's social mobility. At the same time, her education was very different from her brothers and not just in its content. Theirs was designed to develop gradually, in time leading them to become expert musicians. Hers in contrast was about learning skills with immediate use and then quickly applying them.

Although in many ways considered a cultural backwater in mid-eighteenth century Europe, Hanover was, like the rest of Germany, far in advance of all other European countries, in its provision of compulsory education for children. Education had been of central concern to Martin Luther and the humanists of the sixteenth century Reformation. This resulted in growing concern about the state of, and access to, education throughout Europe and a steady increase in school provision, led by Germany. A series of decrees, beginning in the seventeenth century and continuing in the eighteenth, set out to establish a system of universal education in a number of German provinces.[152] Contributing to this, toward the end of the eighteenth century, was the establishment by the Prussian military of its own school system, the 'Garrison Schools'. These provided the children of military men of all ranks except the very highest, with lessons in reading, writing, mathematics and religion. For girls in these schools, and the state schools, the emphasis was still very much on learning domestic skills.[153]

The choice of domestic skills taught was determined by class. The schools provided by the state, and intended for the lower classes, taught skills that might enable those girls to find work outside the home, and these included some academic

[152] Rebecca Peterson, *Early Educational Reform in North Germany* (2001).
[153] Peter Petschauer, "Improving Educational Opportunities for Girls in Eighteenth Century Germany," *Eighteenth-century Life* 1976, p. 57.

lessons. Schools favoured by the middle classes on the other hand, tended to focus less on academic training and more on the acquisition of accomplishments. 'Middle-class writers' Peter Petschauer explains, 'generally insisted on maintaining the traditional roles assigned to women, and disapproved of any kind of education that might have led women to seek careers outside the home.'[154] Within this context, Caroline's education was comparable to William's in the sense that it formed one part of their parents' strategy for raising the family's social status. William and his brothers had been taught to play and act like Court musicians. Caroline was encouraged to actively pursue skills that might make her appear, from her education, to be a member of a particular social class.[155]

The social ambitions of this family and of their father Isaac have been discussed in the previous chapter. All the boys were trained, like William, to find positions at Court rather than following exactly their father's career. By and large this strategy was successful: at some point in all their careers, Jacob, Alexander and Dietrich all held posts in the Hanoverian Court Orchestra. Their eldest sister Sophia meanwhile, though making what her father considered to be a bad marriage with a mediocre musician, ensured that her own sons had an education equivalent to her brothers. As adults all four found work as Court musicians in the English Court of George III. The education of the boys, as we have seen in the previous chapter, was very much directed to that end, of allowing each boy to raise his social status and this training for social climbing was mirrored in the education of the girls. Like the boys, their father encouraged them to see their future in an elevated social position and to see education as the key to achieving this.

Caroline's description of an average day at school, followed by knitting lessons and then practice of the skills she had learned in the evening, suggests that education played as important a role in her childhood as it did in that of her brothers:

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[154] Ibid., p. 58.

[155] The term middle class is problematic since the three tiered system did not quite exist at this time. However, I use it here following the definitions Petschauer uses in Ibid., p. 56, namely 'During the eighteenth century, most writers on women customarily divided Germany society into three classes. The lower class included all peasants and serfs, except those at the very top of village society, and all urban workers - manual labourers, servants, artisans, and clerks - who could not afford a middle class lifestyle. The middling orders encompassed all those who lived like burghers - merchants, certain craftsmen, well-to-do servants at courts, the middle ranks of bureaucracy and military, and most of those in academic and artistic circles. Numbered among the upper classes were all those who lived, or aspired to live, nobly - aristocrats of more than strictly local consequence, members of the urban Honoratorien, high level civil servants, wealthy merchants, recognised intellectual leaders and well established artists.'

> I went dayly [sic] with my little brother to School by the Garrison Küster, and when returning from thence at three in the afternoon, I went to another till six where I learned to knit; and from that time on I was fully employed with providing my Brothers with stockings… Besides this my pen was taken frequently in requisition for writing not only my Mothers letters to my Father but to many a poor soldiers Wife in our Nighbourhood [sic] to her Husband in the Camp; for it ought to be remembered that in the beginning of the last century very few women left country schools with having been thaught [sic] to write.[156]

While the boys continued to practice their skills in private, gradually improving until they were sufficiently expert to perform at concerts and auditions, Caroline had to master and apply her skills very quickly. This gave a very different feel to her education. Whereas the boys were developing musical expertise, Caroline was in contrast developing a wide range of skills to a practical though not necessarily expert level.

Caroline's mother, Anna, played an essential role in her early upbringing, teaching her the skills needed to run a home without staff. Anna has been frequently demonised in the secondary literature, often presented as the sole reason for any limitations put on Caroline's education. Indeed much in Caroline's own accounts of her childhood in Hanover describes a clearly pretty bleak existence. However, these accounts indicate that this was the result not just of the domestic workload she shared with Anna, but also the poverty, constant upheaval and threat of war and invasion that they lived through. Most of this was outside her mother's control. The secondary literature has consistently blamed Anna for Caroline's lot: 'Thanks to her mother's opposition overriding the wishes of her father, Caroline was denied any kind of polite education,'[157] writes Anthony Turner in his catalogue on science and music in eighteenth century Bath. Hoskin meanwhile repeats on several occasions the claim that Anna saw Caroline as a source of cheap labour: 'Caroline, whom their mother saw as a permanent source of cheap help in the home, and whose education she sabotaged to prevent her escape'[158]; 'this left her [Caroline] as the sole remaining supply of cheap labour in the home'[159]; 'Her daughter would be a household drudge forever if Anna

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[156] Hoskin, *Caroline Herschel's Autobiographies*, p. 208.
[157] Turner, *Science and Music in Eighteenth Century Bath*, p. 26.
[158] Michael Hoskin, "Alexander Herschel: The Forgotten Partner," *Journal for the History of Astronomy* (2003).
[159] Hoskin, *The Herschel Partnership: As Viewed by Caroline*, p. 10.

had her way.'[160] The suggestion that Anna looked upon Caroline simply as a source of 'cheap labour' is misleading since it implies that Anna was acting out of malice rather than necessity. This effectively trivialises the essential domestic work Anna was carrying out and in doing so denigrates the domestic work in which Caroline was trained. Caroline's education suffered not because Anna was cruel, but because domestic work is time consuming and necessary. Anna needed help, Caroline would be expected one day to run her own home and needed the skills to do it, and the boys were all busy becoming musicians.

Of the few authors who have tried to understand the reasons for Anna's behaviour, Marianne Kirlew writes that Anna 'was a careful and busy wife and mother, but being unable even to write herself, she had little sympathy with [academic] education.'[161] Alice Corkran similarly argues that 'Life to her [Anna], poor woman, was a harassing experience; there were mouths to feed and bodies to clothe, and women had to look after all the necessaries of life.'[162] This understanding of Anna's motivations is certainly borne out in the frequent references given in Caroline's autobiographies to the various domestic tasks she and her mother were working on at any one time. When William left for England, for example, Caroline wrote of her mother's task '[t]o pack a Trunk with Linnen [sic] and necessary Cloathing [sic], of which she must have had but short Notice; for, she was several days and throughout the nights busied with Ironing and drying linen by heated stoves.'[163] Later, referring to the same year she goes on:

> My mother was now enabled to give up more of her time to Nursing and comforting my Sister; besides doing some needle work, with which she was supplied by a Friend who had the commission of furnishing the Army with Tents and Linnen [sic], in which I began to assist after School hours with all my might. And I can say with truth till my fingers were worn to the bones.[164]

The frequent, often incidental references elsewhere in Caroline's autobiographies to evenings spent with her mother knitting, sewing and spinning suggest that the domestic duties in which Caroline was being trained could quite easily fill every waking hour. By dismissing Anna as simply cruel however, authors also dismissed

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[160] Ibid., p. 11.
[161] Kirlew, *Famous Sisters of Great Men*, pp. 62-63.
[162] Cockran, *The Romance of a Woman's Influence*, p. 148.
[163] Hoskin, *Caroline Herschel's Autobiographies*, p. 106.
[164] Ibid., p. 107.

this time-consuming aspect of Caroline's childhood. Hoskin described her as not having as much of the 'musical gene'[165] as her brothers but does not consider that this comparative lack of attainment might be the result of time constraints and a different education. While her brothers had music lessons and hours of practice, Caroline was busy with her lessons and practice in sewing, knitting, spinning, cooking, cleaning and all the other domestic skills she was learning from her mother and outside tutors.

Caroline's father in contrast has often been praised in the secondary literature for his encouragement of his daughter. Unlike Anna it is argued he 'wanted to teach her the violin, but this was possible only when his wife was out of the way or in a particularly indulgent mood'.[166] It is claimed that he 'went to great lengths to provide [all] his children with a decent education.'[167] These comments are however extrapolated from brief references Caroline made in her autobiographies rather than any substantial evidence of his behaviour. Caroline it should be remembered did not see a great deal of her father when she was growing up.[168] He died when she was 16 years old, having been away for long periods. Some of the incidents she describes give an indication of his interests and how he tried to share these with his children. She remembered one evening in 1755 for example, 'I remember his taking me in a clear frosty night in the street to make me acquainted with several of the most beautiful constellations, after we had been gazing at a Comet which was then visible.'[169] This incident shows their father had an interest in astronomy that he would try to share with his children when the opportunity arose. However, neither this, nor any of her other anecdotes related to her father, give any clear indication of his ambitions for her. The hopes he is claimed to have had in the secondary literature come instead from ambiguous comments by Caroline. According to her autobiography around the year 1759 (a year her father was entirely absent) she had 'been struggling throughout her whole life, for acquiring a little knowledge and a few accomplishments; as might have saved her from wasting her time in the performance of such drudgeries and laborious

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[165] Hoskin, *The Herschel Partnership: As Viewed by Caroline*, p. 6.
[166] Ibid., p. 11.
[167] Gunn, "Caroline Herschel: Female Astronomer.", p. 31.
[168] Isaac Herschel meanwhile was away at war for most of 1741 to1745 (during the War of Austrian Succession), 1756 to 1757, April 1757 to April 1760 and December 1760 to Spring 1761 (during the Seven Years' War) returning home only for occasional visits. When he finally did come home to stay in 1761 he was unwell and unable to take much of an active role in his children's upbringing. He died five years later in 1766 when Caroline was 16.
[169] Hoskin, *Caroline Herschel's Autobiographies*, p. 24.

works as her good father never intended to see her grow up for.'[170] This was Caroline's reading of her father's intentions, but how she was to avoid 'drudgeries and laborious works' was not stated.

Following her brothers' example and the ambitions of her father, Caroline actively sought opportunities to learn new domestic skills and accomplishments. In 1764 she described being allowed to attend a seamstress, though only for a couple of months, 'to be taught to make household linen'.[171] She would also take violin lessons from her father whenever the opportunity arose.[172] In 1766 another opportunity to learn a skill came her way, and again she made the most of it:

> I had the pleasure of getting acquainted with a Mad[ame] Karsten whose parents lived under the same roof with us. This young person excelled in almost every article of ornamental and fancy works that could be thought of, and I was very desirous of being instructed in the same, but as I could not be spared from the daily routine of business in our family, her willingness to assist me would have been of little avail, if we had not made use of the expedient of meeting at daybreak, when I was employed to make patterns and samples, and at 7 o'clock we separated to go to our usual occupations.[173]

Where the boys were taught to seek out educational opportunities in order to improve their chances as musicians in a competitive market, Caroline did the same with domestic skills and accomplishments.

As Caroline grew older however there remained the question of her future. Her mother would not be around for ever and her brothers would one day leave to get married. As she wrote about the year 1771:

> I began to feel great anxiety about my future destination; for I saw that all my exertions would not save me from becoming a burden to my brothers, and I had by this time imbibed too much pride for submitting to take a place as ladiesmaid, and for a Governess I was not qualified for want of knowledge in languages. And I never forgot the caution my dear Father gave me against all thoughts of marrying, saying as I was neither handsome nor rich it was not likely that anyone would make an offer, till perhaps when far advanced in life some old man might take me or my good qualities.[174]

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[170] Ibid., p. 29.
[171] Ibid., p. 37.
[172] Ibid., p. 39.
[173] Ibid., p. 39.
[174] Ibid., pp. 46-47.

The pride she describes in not becoming a ladies' maid again suggests that like her brothers, she had been taught to see her future in an elevated social position. Indeed, much of her training up to this date can be compared with that of her brothers. Like them, Caroline received an intensive vocational training from an early age. While the boys were taught how to make a living, she was taught how to run a house. In both cases, where finances allowed, they were encouraged to pursue relevant educational opportunities that might make them better at what they did and better than their parents. Indeed it is not inconceivable to suggest that Caroline's comment about her father's wishes for her – that she should not waste her time on 'drudgeries and laborious work' – was more about a general ethos of education as a means to a better life than a specific judgement about the superiority of academic and musical accomplishments over domestic ones. Less clear is what Caroline's father's long term plans for her were in light of his warnings to her about her marriage prospects. Possibly he had not given the matter much thought. Perhaps he assumed that her brothers, made successful musicians by his training, would provide for her and that she might in exchange keep house for them. Later that same year William arrived in Hanover, having apparently pondered the same question:

> we early in the winter had letters from my brother William informing us of his intention of paying us a visit in the following summer, and at the same time proposed to take me over with him, to make the trial, if by his instruction I might not become a useful singer for his winter concerts and oratorios? And advised my brother Jacob to give me lessons by way of beginning but, that if after a trial of two years we should not find it answer our expectation he would bring me back again.[175]

To alleviate her guilt at leaving, Caroline set to work: 'For my mother and brother D.[ietrich] I knitted as many cotton stockings as were to last two years at least. In this manner I tried to still the compunction I felt at leaving relatives who I feared would lose some of their comforts by my desertion.'[176] While her brother also played his part: 'the anguish at my leaving her [Anna] being somewhat alleviated by my brother's settling a small annuity on her, by which she would be enabled to keep a person for supplying my place.'[177] These comments suggest Caroline was well aware of the important role she played in the running of the family home. On leaving, she worried

[175] Ibid., p. 47.
[176] Ibid., p. 47.
[177] Ibid., p. 117; Hoskin, *The Herschel Partnership: As Viewed by Caroline*, p. 24.

how they would manage without her, and indeed someone was needed to take her place, aware of how useful her education had trained her to become to her family.

Caroline was by this time 22 years old, and had spent her entire life in and around Hanover and her family. She had taken every opportunity she could to learn subjects and skills she considered had the potential to make her more useful in her domestic role within the family and to make that role more interesting. They included a large array of accomplishments acquired as a means of enhancing the family's claims to an elevated social position. As she told her nephew's wife years later:

> Had the knitting with needles been known 40 years sooner, it would have been one of the accomplishments with which I came at the age of 22 in 1772 into England; for there was no kind or ornamental needlework, knotting, plaiting hair, stringing beads &c...&c., of which I did not make samples by way of securing the art.[178]

Caroline's education in this period was formed out of a range of ambitions and compromises. On the one hand her mother needed help feeding, clothing, caring for and cleaning up after her father and four brothers. The family had limited resources and Caroline's academic education, given she had little hope of earning her own living or marrying well, was considered of very low priority in terms of the distribution of those resources. However, her father had aspirations for all his children and encouraged them to see education as a means of fulfilling those ambitions. As part of this family, Caroline grew up sharing this view of education.

Life in Bath: 1772-1781

As we have seen, in 1772 William brought Caroline over to England so she might try making a living as either a music teacher[179] or as a singer in Bath in his concerts and oratorios.[180] Her arrival and that of her brother Alexander a few years earlier marked the beginning, in 1773, of William's telescope building project. For Caroline though, any kind of education in astronomy was still a long way off. As it had been in Hanover, the education provided for her by family members (previously her parents,

[178] Caroline L. Herschel to Margaret Brodie Herschel, 24 September 1838, BL: Eg3762 f32-33.
[179] Hoskin, *Caroline Herschel's Autobiographies*, p. 116.
[180] Ibid., p. 47.

now her brother) was designed with immediate application in mind. With a view to her assisting him in his musical work, Caroline was taught to sing. Just as essential, she was also taught how to present herself both on stage and within the social circles they must enter in order to gain work. William was by this time fully immersed in fashionable society and part of Caroline's gilding was to have her do the same. At the same time she was also taught practical skills including accounting to help her run the house. While in Hanover she had supplemented her home and school education with lessons in middle class accomplishments such as ornamental needlework and knitting to aid the family's project of social advancement. Now in England, she sought to fill the gaps in the education provided by her brother, by requesting lessons in algebra and geometry from him and in cooking from their housekeeper.

Caroline's lessons from her brother began almost as soon as she arrived. Her first lessons were to help her achieve some of the technical skills needed for her new role as singer and English housekeeper:

> I had 2 or 3 lessons every day, and the hours which were not spent at the harpsichord were employed in putting me in the way of managing the family.
>
> On the second morning, when meeting my Brother at breakfast, which was at 7 o'clock or before, (much too early for me, for I would rather remain up all night than be obliged to rise so early an hour) he began immediately to give me a lesson in English and arithmetic, and showing me the way of booking and keeping account of cash received and laid out. The remainder of the forenoon was chiefly spent at the harpsichord; shewing me the way how to practise singing with a gag in my mouth.[181]

As she states, this first intensive six week course was to teach her learning techniques (such as practising singing with a gag in her mouth), as well as the basics needed for singing and managing the family home. After these six weeks, Caroline had to improvise, inventing her own lessons, as the Bath season approached and more and more of William's time was taken up with music lessons and public performances. Using her skills from childhood Caroline took the initiative and looked for ways to improve on the education her brother was providing for her:

> I began to think on how those hours I should now be left to myself might best be spent, in learning what would become necessary to know for a housekeeper

[181]Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 50.

> of our little family. And for this purpose the first hours immediately after breakfast were spent in the kitchen, where Mrs Bulman taught me to make all sorts of puddings and pies, besides many things in the confectionary business, pickling and preserving, &c., &c., a knowledge for which it was not likely I should ever have occasion.[182]

Just as she had as a child, Caroline supplemented the education provided for her by her family by asking those around her with additional skills, to give her lessons. In Hanover these tended to be lessons in accomplishments, filling a void she saw in the education provided for her by her mother and the Garrison school. Here in Bath Caroline was required to learn a whole new set of social and presentational skills. To this end William introduced her to 'two ladies both very great critickers [sic] on singers and musical performers'[183] and arranged for one of them, Mrs Colebrook, to take her to London. They stayed for six weeks where she was taken to the Opera and theatre numerous times, and to auctions and shopping. Although a little overwhelmed by the experience, and glad to be back, she did note in her autobiography that 'to her (Mrs Colebrook) and to the Marchioness of Lothian I am indebted for all I ever saw of the Fashionable world.'[184]

Seeing the fashionable world however was only part of her training. In addition William employed a tutor to provide her with a more structured and formal education in these same presentation skills. 'As I was to take part in the Oratorios, I had for a whole year two lessons a week by Miss Fleming, the celebrated dantzing [sic] Mistress, to drill me for a Gentlewoman'. With the help of these three women – Mrs Colebrook, the Marchioness of Lothian and Miss Fleming – Caroline learned the skills needed to present herself as a performer and a gentlewoman. Mrs Bulman had helped her master English cooking. William had begun to teach her singing and some basic accounting. Next the siblings turned their attention to other areas of mathematics.

After her initial accounting sessions with her brother, Caroline's mathematics lessons evolved into something quite different. These 'Little Lessons for Lina'[185] as

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[182] Ibid., pp. 50-51 quoting Herschel, ed., *Memoir and Correspondence of Caroline Herschel*, p. 32.
[183] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 52.
[184] Ibid., p. 55.
[185] 'Little Lessons for Lina', RAS: WH.7/13. References made in Iliffe and Wilmoth, "Mrs Flamsteed and Caroline Herschel.", p. 258; Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 57; Ogilvie, "Caroline Herschel's Contributions to Science.", pp. 151-3.

they were called, sub-headed 'A little Geometry for Lina', 'A little Algebra for Lina' etc, started with algebra and geometry such as angles in a triangle and z-angles.[186] Both algebra and geometry were considered essential pre-requisites for the study of fluxions (an area of mathematics William was then studying).[187] The lessons also incorporated some of the astronomy William was beginning to study. In one lesson for example, certain trigonometric rules were taught, in the next astronomy related problems were set in which those rules might be used, such as finding the position of specific stars.

It is unclear who initiated these lessons or why, though a number of possible reasons suggest themselves. For William teaching Caroline offered the opportunity to test how well he understood what he had learned so far. This was a style of learning he had been taught at the Garrison School. In addition, having his sister know some of this mathematics would have added to his family's reputation as Bath's mathematical musicians. For Caroline the prospect of learning some of the mathematics William was busily building his reputation on, would have some appeal, in that it would allow her to play a greater role in that part of his life and work.

About a year after Caroline arrived in Bath, in the summer of 1773, William began a new hobby that entirely changed the look of the house and the life of its inhabitants:

> It was to my sorrow I saw almost every room turned into a workshop. A cabinet maker making a tube and stands of all descriptions in a handsome furnished drawing-room. Alex putting up a huge turning machine (which in the Autumn he brought with him from Bristol) in a bedroom for turning patterns, grinding glasses and turning eyepieces &c. .. I was to amuse myself with making the tube of pasteboard against the glasses arrived from London[188]

While initially appalled at what this meant for the house, Caroline would later recognise the educational opportunity offered to her through this new hobby and take advantage of it. At first however her role in instrument making was minimal as her musical and domestic duties took precedence.

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[186] The pairs of identical angles formed when you make a z shape from two parallel lines and a diagonal line are called z angles. Like angles in a triangle, if you are given one angle, you can work out the rest.
[187] 'The only requisite was a knowledge of algebra (but not series) and geometry (with or without trigonometry).' Guicciardini, *The Development of Newtonian Calculus in Britain 1700-1800*, p. 55.
[188] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 65.

Throughout this period both William and Caroline were using education to develop new roles for themselves. While William was gradually becoming more astronomer than musician, Caroline was busy making herself indispensible in every area of William's life. Growing up in Hanover, the only girl in a family of musicians, Caroline saw all the boys taught something considered admirable while she was taught simply what was necessary. Under those circumstances, Caroline may have wished for a bit more involvement in the projects of her brothers. Certainly she seemed keen to jump at any opportunity first her father, then her brothers, offered for learning music. In Bath she was able to develop this from being occasionally allowed to join in, to becoming an essential part of the project. First she became assistant to William the musician, not just as a singer as had been originally suggested, but in all aspects of his life as a musician. Then she began to work her way into his mathematical work. At the same time a good deal of her day was still devoted to the more mundane work of running the house. For that reason she could not move as quickly into this scientific work as perhaps she might have liked.

Telescope training: 1781-1786

In 1781 William Herschel discovered the planet Uranus, and thanks to the work of his supporters in London was given a King's pension. For this he was required to move to a house nearer Windsor and be on call to show the Royal Household the heavens whenever they wished. The pension was generous enough to allow William to take Caroline with him, and so the two of them packed up and moved to Slough. They moved a number of times in the first few years before eventually settling on a property later known as Observatory House.

It was in this period that Caroline's education moved to its next stage. As William's priorities and finances changed so did Caroline's and a new type of training followed, to allow her to fulfil this new role. Music was no longer needed, nor was entertaining in fashionable circles such a priority. Instead the peripheral subjects of mathematics and astronomy were brought to the fore as William developed a new role for his sister. In this Caroline showed a certain amount of foresight having already insisted back in Bath that she should have some preparation in these areas. The scientific projects would still be William's but Caroline would have a role in helping to

make them happen. It was at this point, where financial security allowed them, as a family, more flexibility to create their own individual roles that Caroline began to develop her approach to the family's scientific endeavours. She learned how to write academic papers through making copies for William. She learned the process of making observations, practising when William was away and writing down his observations when he was around.

On arriving in their new home, Caroline stated:

> I found I was to be trained for an assistant Astronomer; and by way of encouragement a Telescope adapted for sweeping …was given to me. I was to sweep for comets… I began Aug 22, 1782… but it was not till the last two months of the same year before I felt the least encouragement for spending the starlight nights on a grass-plot covered by dew or hoar frost without a human being near enough to be within call[189]

Relieved of the burden of having to make a living through music, William had set about devoting all his time to observing, studying and instrument making. Caroline no longer needed to practise or perform music. She had mastered enough of what was needed to carry herself in the social world of Slough and Windsor, and had help with managing the house from their small group of servants. William now decided that she should use this new spare time to join him in his passion for astronomy. In fact sweeping for comets was only one of the many exercises William set her as part of her training as his assistant; in addition she was to look for and so be able to identify and distinguish between:

> Double stars that appear to be one, two or three diameters asunder.
> Clusters of stars such as 5, 6, 7, 8, &c. near together, all within a dozen diameters or so.
> Nebulas.
> Comets.[190]

These were precisely (with the possible exception of comets) what William himself was looking for, implying that from his point of view, the purpose of this exercise was to allow her to take part in his project. An early result of this observing practice was

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[189] Ibid., p. 150.
[190] Hoskin, *The Herschel Partnership: As Viewed by Caroline*, p. 61; RAS: CH.1/1.1 pasted in front; XII, 6.

Caroline's discovery of a number of nebulae, all of which William included in his catalogue with footnote references to credit Caroline as discoverer.

Caroline is often presented as one of the very few women in science in the eighteenth century to be given public credit for her work. Work such as Ashton and Davies' *I had a sister*, Cockran's *The romance of a woman's influence* and more recently, Patricia Fara's *Pandora's Breeches* all cite numerous examples of uncredited women in eighteenth century science.[191] The contexts these works provide suggest that it was William's decision to credit Caroline, rather than the fact of her involvement in his scientific enterprise, that is in need of some explaining. Neither he nor Caroline ever gave a reason, implying that this was not a political stance they were taking. The most plausible answer seems to be the family's background in music. In her work with William singing in his concerts, Caroline naturally got credit, and she would invariably be named in the programme; this was standard practice.[192] Following this through to their astronomical work, Caroline continued to be given credit for her role as discoverer of a number of nebulae.

In instrument making Caroline's approach to education, of effectively picking up all she could to a useable standard when the opportunity arose, showed itself to be a good complement to her brothers' work in terms of helping them to work as a unit. Where each brother learned a specific aspect of instrument making and perfected it so they might be the best in their field, Caroline took the opportunity to learn from both enough to play her own distinct role within the process. As a result she was able to act as translator within the family. William made mirrors and was interested in the final product. Alexander had no interest in astronomy, but was concerned with the mechanics of the designs, the clockwork elements and the detailed metalwork such as the manufacturing of eyepieces. In a letter written by Alexander from Bath to William in 1785 for example he tells him:

> I send you here a description of the manner the Hammer of a Common eight day clock is made to stricke [sic] the Bell, it will perhaps assist you to understand my plan of the Bell machine. I do not wunder[sic] at your not being able to make anything of it, for after I had with a great deal of pains finished it,

[191] Ashton and Davies, *I Had a Sister*; Cockran, *The Romance of a Woman's Influence*; Fara, *Pandora's Breeches: Women, Science and Power in the Enlightenment*.

[192] Caroline is named for example in the poster for a Concert of Music from the Messiah, 1778. The poster belongs to a private collection but is reproduced in Turner, *Science and Music in Eighteenth Century Bath*, p. 62.

> I could hardly understand it myself when I came to read it over, but I think if you was to get Carolina to read it over and see what she can do for she is perhaps better acquainted with my round about way of describing things.[193]

The letter preceding this quote is indeed full of intricate detail about clock design. Alex's faith in Caroline's ability to understand it suggests Caroline's capacity to learn and apply knowledge quickly had found an unexpected outlet. It allowed her to fulfil this often unrecognised role of technical interpreter. In a similar role, she played a part turning William's ideas about how he wanted his telescope mirrors into reality, by supervising the workmen when William was away.

During Caroline's first few years in Slough she began to fashion a scientific role for herself and gained credit for that work. As part of a family of musicians Caroline had received public acknowledgement for the role she performed. When this role changed from singer to observer the public acknowledgement continued. As part of a family of instrument makers meanwhile Caroline was able to make use of her experience of a different style of education from that of her brothers. Though the role of technical interpreter is often overlooked, it was, in the case of this family, essential for the smooth running of their instrument making activities.

Mathematics and theory

Having carved out a role for herself within the family's instrument making project, Caroline then began to take more control over other aspects of her education. In this period she actively pursued an understanding of the mathematics and astronomy her brother was studying. Her 'little lessons for Lina' became answers to her questions to her brother.

From a set of papers which Caroline described to her nephew as containing 'chiefly answers of your fathers to the inquiries I used to make when at breakfast, before we separated, each for our dayly tasks, &c. &c.' a new stage in her mathematical and astronomical education is evident. This was a continuation of the 'little lessons from Lina' she had begun in Bath, but here the phrasing she used to introduce the papers makes it far less ambiguous as to who initiated them. Here

[193] Alexander Herschel to William Herschel, 1785, NMM: MS/79/118.

Caroline was setting the topics covered, selecting areas of mathematics she felt she needed answers to and quizzing her brother. The content however suggests that the questions came out of the broader tasks set for her by her brother. There are for example rules on how to use the astronomical instruments he had given her and then rules and theorems for calculating useful information from her observations.

In the first few pages of this set of papers is a list of algebraic trigonometric relationships as a table, with a column for 'given', the next for 'required' and the third for equations to get from 'given' to 'required'. Next she and her teacher, William, moved on to logarithms. There then follows a number of sections each introducing a particular theorem or rule for her to obey: 'Theorem for determining the field of view by the passage of a star'; 'Rules for making use of the French tables for very small arches and their complements'; 'rules for making use of astronomical instruments' and 'Theorem for calculating the number of stars that have been seen in a sweep'. In each of these early sections it is possible to see a direct correlation between the rules and theorems laid out and the tasks she was assigned in her new role as William's astronomical assistant.[194]

As time went on, their relationship developed into more of a partnership, as William's latest theories began to creep into the lessons. On page 29 for example, Caroline was introduced to 'The 8 classes of Nebulae' and 'The 6 classes of Double Star', classes that William was developing at the time. This suggests he was once again testing out his mastery of an idea through teaching and indicates that her feedback might affect the way these ideas were presented in the final papers. One entry near the end of this set of papers suggests that Caroline was still receiving help from William in mathematics when John, William's son, was at school. Although not dated, the entry is entitled 'Eccentricity of planets and asteroids'[195] dating it to post-1801 (the year the first asteroid was discovered), when John was 9 years. This suggests the process was ongoing but irregular. There were often long gaps of several months between lessons. It also introduces an interesting contrast between William's attitude to Caroline's education and to his son.

John was taught to follow in William's footsteps, but also to learn from his mistakes and perceived failures, so particular attention was paid to areas in which

[194] Set of papers titled 'chiefly answers of your fathers to the inquiries I used to make when at breakfast, before we separated, each for our dayly tasks, &c. &c.', BL: microfilm M/588(5).
[195] Ibid.

William felt he had limited ability. In essence this was the same style of education as William had received; it was teaching expertise. Caroline meanwhile had very different educational needs. Her early training was not in developing narrowly focused expertise in a particular subject but in gaining a wide range of skills each anticipated to have an immediate application. In his reply to a letter from the French mathematician Joseph-Jérôme Lalande, passing on compliments to 'the learned Miss Caroline'[196] from 'Mad. du Piery who is the only female astronomer in France'[197] for example, William wrote:

> on behalf of my sister to give my best wishes to Mad. du Piery and to tell her that she would feel only too happy to be already able to do fluxional calculations, as she hears her fortunate rival can do at present: but following so glorious an example she will constantly beg her brother to teach her that sublime science.[198]

In other words, she actively sought out new skills to learn, and as many as possible, applying them where she could to enhance her role in family projects.

Caroline tried her best to gain an education comparable to that of her brothers; however she did not have the luxury of being able to focus on one single area and so reach a comparable level of expertise. Instead she compensated for this by learning a range of subjects to the level at which they might be applied quickly. This was the style of learning she had been brought up with, and resourcefully she managed to find a way of using this skill to carve out a role for herself within the family enterprise. She could help her brothers communicate, enabling them to collaborate successfully on telescope building. She could also be relied upon by William to turn her hand to any new skill he might need her to master, making her the perfect assistant.

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[196] 'la savante Miss Caroline'.

[197] 'Mad du Piery qui est la seule astronome de France', Joseph-Jérôme Lalande to William Herschel, 26 April 1787, RAS: WH.1/13.L.5.

[198] 'J'avois aussi oublié dans ma dernière (faut de n'avoir pas votre lettre), de vous prier de la part de ma sœur de rendre mille compliments à Mad du Piery; & lui dire qu'elle ne se sentiroit que trop heureuse d'être déjà à portée de faire aussi des calculs fluxionals, comme elle entend que son heureuse rivale les fait a présent: mais qu'en suivant un exemple si glorieux, elle ne cessera pas de prier son frère de lui enseigner cette sublime science.' Ibid.

Comets and catalogues: 1786-1797

Between 1786 and 1797 Caroline Herschel discovered a number of comets and worked on a reorganisation of Flamsteed's star catalogue. Both projects gained her public recognition and praise within the astronomical community. Curiously both have also been used, in the secondary literature, as evidence of her inferiority as an astronomer. In this section I will consider the circumstances leading to her to pursue and gain credit for these works to establish what she saw as the purpose of her education.

Caroline's comet discoveries have been used in much of the secondary literature as evidence of her importance as an astronomer in her own right.[199] In doing so the authors imply that this is what counts. As Patricia Fara points out, 'methodical work lies at the core of scientific progress, yet we still celebrate the unusual, the breakthrough, the single spectacular event.'[200] A project Caroline was working on, over roughly the same time as her comet discoveries, was the production of an 'Index to Flamsteed's observations'. Fara continues that William's reputation was in large part dependent on Caroline's organising ability and meticulous attention to detail of which this was a clear and public example.[201] While a number of authors have highlighted Caroline's comet discoveries, Fara redresses the balance in her work to place more weight on Caroline's cataloguing work. Both her comet discoveries and her cataloguing work help to illustrate the position Caroline saw for herself in the family's astronomical work. This was work led by William but involving the participation of both Caroline and Alexander. Caroline was well aware of the importance not just of William as a figurehead, but of the contributions of all the participants in his instrument making and observing programme. In that sense, both her catalogue and her comet discoveries can be seen in the same context, as ways in which she was able to get her role within this larger project recognised.

Caroline's catalogue came out of her work rearranging Flamsteed's star catalogue into a list of stars by zone (rather than constellation) so that her brother might use it in his zonal sweeps of the sky.[202] This was, as she put it, a project that

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[199] Brock, *The Comet Sweeper: Caroline Herschel's Astronomical Ambition*; Hughes, "Caroline Lucretia Herschel – Comet Huntress."; G. Moore, "Herschel, Caroline – Seeker of Comets," *Electron Power* 33, no. 3 (1987); Gunn, "Caroline Herschel: Female Astronomer."

[200] Fara, *Pandora's Breeches: Women, Science and Power in the Enlightenment*, pp. 151-152

[201] Ibid., Chapter 8 Caroline Herschel/ William Herschel, pp. 145-166.

[202] See Hoskin, *The Herschel Partnership: As Viewed by Caroline*, p. 70; Caroline L. Herschel's MS reworking of Flamsteed's catalogue, RAS: CH.2/1.

would give her something useful to do when William was busy. 'I had always in hand some kind of work with which I could proceed without troubling him with questions, such as the Temporary Index which I begun in June 1787, and some years after, the Index to Flamsteed's observations.'[203] This followed her standard justification for activity. It was work that would make her more useful to her brother. Yet on Maskelyne's suggestion that it should be published, she wrote:

> I thought the pains it had cost me were and would be sufficiently rewarded in the use it had already been, and might be of in future, to my brother. But your having thought it worthy of the press has flattered my vanity not a little. You see, Sir, I do own myself to be vain because I would not wish to be singular, and was there ever a woman without vanity? – or a man either? Only with this difference, that among gentlemen the commodity is generally stiled [sic] ambition.[204]

Though in principle happy to produce her catalogue purely to help her brother in his work she was not averse to having that contribution more widely recognised. In her comet discoveries too, these two motivational strands are evident. On the one hand, her observational work away from her brother allowed her to play a role in his project, sweeping the sky (albeit with a smaller telescope) for objects he might have missed. On the other, when she found something, she was keen to have her name attached to that discovery. In this aim she had the support not only of her brother, but of most, if not all, his peers within the astronomical community.[205]

Caroline discovered her first comet on 1 August 1786, the next in December 1788, two more in 1790, a fifth in December 1791, then in October 1793 she found another (though this it turned out had previously been seen by Messier), another in November 1795 (this was later found to be a reappearance of the comet now known as Encke's) and finally in August 1797 she discovered her eighth and final comet. The details of each discovery have been discussed in detail elsewhere.[206] The timing of these discoveries, as Claire Brock points out, is significant.[207] Almost all occurred when William was away. The discoveries then abruptly stopped in 1797 when she moved out of Observatory House. In addition to Brock's point about spare time, three

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[203] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 171.
[204] September 1798, Ibid., p. 257.
[205] Iliffe and Wilmoth, "Mrs Flamsteed and Caroline Herschel."
[206] Hoskin and Warner, "Caroline Herschel's Comet Sweepers."
[207] Brock, *The Comet Sweeper: Caroline Herschel's Astronomical Ambition*, p. 164.

more essential ingredients were needed to allow these discoveries to take place. Caroline also had in this period easy access to her telescope and her five years of training and practice had given her the technical skills as well as the knowledge of the sky needed to find and recognise these comets. These four factors combined – time freed from helping William, access to her telescope, technical skill and knowledge of the sky – allowed her to make these discoveries.

Once each discovery was made, Caroline or her brother made it known, a paper was read to the Royal Society on her behalf and that was that. Of her second comet, announced to Maskelyne she begs 'the favour of you to take it under your protection.'[208] On the discovery of her fourth she asks Banks to make her discovery more widely known, 'for the sake of astronomy'.[209] In each case she passed on the information to prominent members of the scientific community and left them to deal with the details. This has left certain authors to conclude that she was not a proper astronomer. As Hoskin writes, 'we look in vain in her manuscripts for any hint of interest beyond the mere act of discovery'.[210] In the process, and in a strange inversion of Fara's criticism, this conclusion determines astronomy to be not discovery, or routine observations and organisation, but the calculations and theorising following discoveries. This is despite evidence to suggest William acted in very much the same way with his discovery of Uranus. He, like Caroline, made his discovery known to all relevant parties and then returned to his project of cataloguing the star clusters, nebulae and double stars. This was not uncommon behaviour. Charles Darwin acted in a similar manner when he published *On the Origin of Species* in 1859 and then stood back leaving others to develop and defend it.[211] In doing the same Caroline was simply like her brother and Darwin demonstrating where her main interests lay.

The point here is rather that Caroline, with the support of her brother, was glad to receive recognition for the discoveries she made and for her routine cataloguing. She expected it perhaps more than most of her female peers given her family background in music. However that is not the same as saying, as Brock has argued, that she worked her whole life towards this recognition and more specifically paid work. Given there was no precedent, this would have been an unlikely ambition. Her

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[208] Caroline L. Herschel to Nevil Maskelyne, 22 December 1799, in Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 245.
[209] Caroline L. Herschel to Joseph Banks, 19 April 1790, in Ibid., pp. 249-250.
[210] Hoskin, *The Herschel Partnership: As Viewed by Caroline*, p. 109.
[211] Janet Browne, *Charles Darwin: The Power of Place* (London: Pimlico, 2003).

motivation, as far as can be inferred from the evidence, was to play an integral role within William's astronomical project. Where recognition for some particular piece of work was possible, she was keen to take it. She was ambitious, as she almost tells Maskelyne, in the sense that she actively sought recognition and credit for certain discoveries. At the same time, she was not ambitious for an independent reputation as has sometimes been claimed. She was part of the Herschel family astronomical team, but within that, saw no reason not to announce her specific role and achievements.

Conclusion

Caroline Herschel was a resourceful woman, able to make use of the many educational opportunities that came her way. However, her education was very different from that of her brothers' and this was reflected in the roles she was then able to play. As a child in Hanover her education was focused heavily on the domestic sphere, and on learning a large range of tasks to a level where they might be usefully applied but not beyond. Her brothers in contrast were taught how to perform in the public sphere and to develop their skills to a level of expertise. In Bath a large part of Caroline's education was devoted to catching up, not only with musical and academic lessons, but in learning the presentation skills needed to succeed within the public sphere. This together with limited access to scientific societies and publications, the lack of female role models and prevailing views as to proper roles for women is why her scientific achievements can never sensibly be compared to her brothers.

Caroline's education gave her the ability to learn quickly and to apply what she learned. Her motivation for learning different things to make herself useful was broadly speaking a survival technique, but within that she sought out modes of usefulness that were also interesting and fulfilling. An essential part of this was to play her part in fulfilling the family's aspirations for social mobility. As a child this meant devoting herself to domestic work that might aid her family. It also meant studying accomplishments while at the same time learning nothing that could be interpreted as a commercial skill. As an adult it meant undergoing years of training in how to present herself publicly as a gentlewoman.

Although previous authors have claimed Caroline was motivated by devotion to her brother or an ambition for an independent career I have argued that neither

extreme is strictly true. Instead, following her training, she placed a high value on being part of the family business, not of leading it or working alone but of being part of an interesting family run project. That it was not simply devotion to her brother or an ambition for independence is borne out by her transfer of allegiance to her nephew and her interest in being involved in his projects. As she wrote to her nephew's wife, Margaret just prior to their leaving for South Africa:

> At present my thoughts are wholly fixed on the busy scenes with which you are at present surrounded, and regretting that I am not with you to afford you any assistance, or to take charge of my nephew's workshops, as I used to do of his father's when absent; or that it is not possible to shake off some thirty years from my shoulders that I might accompany you on your voyage.[212]

This was not straight forward devotion to William since her allegiance was easily shifted when the opportunity arose to work with John. In addition to this her choices of which aspects of either William or John's life to be involved in were selective. She did not for example travel with William even before he married; she did not get involved in John's chemistry work; she never mentioned any interest in William's radiant heat experiments. These were not projects with which she wished to be involved. In contrast, she was interested in learning fluxions and complained to her brother when he did not include this in her education.

Like many women working in science in the eighteenth century, Caroline's role does not fit easily within traditional models of proper science. In a sense Caroline's case forces us to see science, even private amateur science, as a collaborative exercise. What sets her apart from the hundreds of other sisters, wives, daughters and nieces working with eighteenth century gentlemen amateurs, is that she was able to gain credit for much of her work. This I argue was a result of the family's musical background.

It has been acknowledged elsewhere that in this period a woman's role in science was limited to that of assistant or collaborator with a male relative. Caroline's story gives some indication of the agency involved on the part of these women to be considered by said male relative for that role. The Caroline- William story is generally told from the view that William made all the decisions and Caroline was just lucky

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[212] Caroline L. Herschel to Margaret Brodie Herschel, 6 September 1833 from Herschel, ed., *Memoir and Correspondence of Caroline Herschel*, pp. 258-259.

enough to benefit from them. However, as this account of her education shows, Caroline was aware of the skills she would need to have to become indispensible. Caroline saw herself as part of the family business and set out to make herself an essential part of it. In Hanover this meant contributing to the family's ambition for social mobility by learning accomplishments. In England this meant fully immersing herself in William's new social and cultural world. It meant learning all the skills needed for that part and finally taking up mathematics, then instrument making and observing so that she might play a useful role in that enterprise too.

Chapter Three: John Herschel, the astronomer's son

In this chapter I will argue that John Herschel's childhood education was shaped primarily by his father with the intention of overcoming some of the limitations he had experienced in his own education. Specifically, he set out to overcome two main problems: firstly, he did not want John to be seen as an outsider and secondly he did not want him to have any problems understanding Continental mathematics. Having become aware, through his own experience of education, of the hierarchies in the British class structure and in science, he set out to ensure his son might gain a higher position in both than he had managed for himself. After years of inching up the social hierarchy, having to convince others of his ability and credentials at every stage, William chose a wife whose class position was beyond question. Mary's was a family that had settled into their social position generations earlier, a family that could provide his children with the class security he always lacked. For this reason, I argue, William at first looked to his wife's family's experience of education as a guide in selecting schools for their son. At the same time, however, he supplemented this schooling at every stage with tutors in mathematics in order to help John overcome the second limitation William had experienced in his own education. Specifically this was his failure to fully grasp fluxions and Continental analytics.

Within the secondary literature there is little detailed discussion of John's formative years. A number of authors assert that he had 'native ability'[213] and a 'powerful and versatile intellect'[214] and so negate the need to explain any further how he came to do so well at Cambridge. However, there are several others who indicate, without detail, that there was more to it. Buttmann for example describes John as having grown up in an environment with 'all its advantages and unique educational opportunities'[215] though he does not spell out what these were. Similarly, Charles Pritchard described the Herschel household as being 'singularly calculated to nurture into greatness any child born, as John Herschel was, with natural gifts capable of wide

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[213] David Stanley Evans et al., *Herschel at the Cape. Diaries and Correspondence of Sir John Herschel, 1834-1838, South African Biographical & Historical Studies. No. 3* (Cape Town: A. A. Balkema, 1969).
[214] Evans, David, 'Introduction', in Buttmann, *The Shadow of the Telescope: A Biography of John Herschel*, p. xii.
[215] Ibid., p. 8.

development'.[216] In each case, no detail is given as to what it was that was so unique and educationally advantageous about the Herschel family home. It is these details that I intend to identify.

Three authors have looked a little closer at John's childhood for clues to explain his later interests and outlook. Harvey Becher points to Herschel's childhood trip to Paris and to a letter written to Charles Babbage in 1812 where he signed himself 'citizen' as evidence of John's sympathies with the French revolution. He suggests that these sympathies were a product of his background.[217] Philip Enros states that 'Herschel... had been interested in Continental mathematics even before attending Cambridge'. His source for this is a couple of letters between John and his home tutor, Alexander Rogers, though he gives no further comment on why that should have been the case or what this interest comprised.[218] William Ashworth meanwhile points to a summer holiday in which John and his family visited various industrial towns and factories. Through this trip, Ashworth argues, John came to look at the way the mind works (and so how it solves mathematical problems) as being like a factory.[219] In each case, specific episodes are identified as key turning points to explain John's later behaviour and interests.

In this chapter I argue against Becher on his identification of Herschel's 1802 trip to Paris as pivotal. I will elaborate on the Herschel-Rogers relationship identified by Enros and provide a context for the lessons Ashworth points to John having learned on holiday. I will look at the whole of John's childhood, from birth to university, rather than try, as the authors mentioned above have done, to identify a single pivotal moment that drew John to analytical mathematics. In doing so I argue that John's early success at Cambridge, both as a student and as a founder member of the Analytical Society, was the result of years of concentrated study on a clearly focused educational programme designed by his parents. This programme was designed with the view of overcoming shortcomings William identified in his own education.

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[216] Ibid., p. 3 quoting Prichard.
[217] Harvey W. Becher, "Radicals, Whigs and Conservatives: The Middle and Lower Classes in the Analytical Revolution at Cambridge in the Age of Aristocracy," *British Journal for the History of Science* 28 (1995), p. 410.
[218] Philip C Enros, "The Analytical Society (1812-1813): Precursor of the Renewal of Cambridge Mathematics," *Historica Mathematica* 10 (1983), p. 29.
[219] William J. Ashworth, "Memory, Efficiency, and Symbolic Analysis – Charles Babbage, John Herschel, and the Industrial Mind," *ISIS: International Review devoted to the History of Science and its cultural influences* 87, no. 4 (1996), pp. 630-631.

The Herschel household: 'calculated to nurture... greatness'

John was born in 1792 and spent his early years with his mother and her friends and family, most of whom lived locally. This time spent with his mother, her family and local friends gave John a taste of the infancy experienced by his more conventional peers. Just as important, however, was the time he spent surrounded by his father and aunt, their scientific friends, their telescopes and the onsite workmen, which helped to shape how he saw normal adult life. As I argued in chapter two, the Herschels had found that entry into a profession, be it music or astronomy, took more than simply technical skill. When Caroline first came to music she had to learn not just how to sing and read music but how to act, how to hold herself and the terminology to use within her brother's professional musical world. By growing up at Observatory House, with nothing to do in those early years but watch and learn, John was able to observe and copy those around him and learn how men and women of science behaved. A contemporary of John's and later teacher of his sons, Charles Pritchard, said that the Herschel household was 'singularly calculated to nurture into greatness any child born, as John Herschel was, with natural gifts capable of wide development'.[220] In this section I consider what this might have meant in practice. In what sense was this household 'singularly calculated to nurture into greatness' John's natural gifts?

A number of biographical accounts of John have used episodes in his early childhood out of context, as evidence of a supposed natural aptitude in science. Francis Ring, Helen Ashton and Katharine Davies for example all use this quote by Caroline Herschel as evidence of John's innate gift for chemistry[221]:

> John and I to remain the most affectionate friends, and many a half, or whole holy day he was allowed to spend with me and dedicated to making experiments in chemistry where generally all boxes, tops of tea canisters, peper boxes, tea cups &c served for necessary vessels and the sand tub furnished the

[220] Buttmann, *The Shadow of the Telescope: A Biography of John Herschel*, p. 3 quoting Prichard.
[221] Francis J. Ring, "John Herschel and His Heritage" (paper presented at the John Herschel 1792-1871: A Bicentennial Commemoration, Royal Society, London, 1992); Ashton and Davies, *I Had a Sister*; all use the anecdote quoted on the next page about Caroline and chemistry as evidence for his early ability in that science.

> matter to be analized. I only had to take care to exclude water which would have produced havoc on my carpet.[222]

This type of analysis was once common in science biography. Mechanical devices made as children by Issac Newton, Albert Einstein and John's father William have all been cited by their respective biographers as evidence of their natural ability and inclination towards science.[223] This seems a rather simplistic explanation for how skills are learned. Here I want to give a different kind of explanation based on education. John's play in chemistry should be seen within the context of his environment, his other activities and his age at the time. It did not mean he was destined for a future in chemistry, only that he was introduced to the subject at an early age, and later incidents added to his understanding of, and interest in the subject which, cumulatively led to a professional interest.

In these very early years, John was at home with his parents and aunt, where he was informally introduced to some of the scientific interests of his relatives. As Caroline described:

> March 7 1792, my Nephew John FW Herschel was born, and till Oct 1798 not a day was spent without I [sic] had the pleasure of seeing him some part of each day about me, for his Nurse could not please him more than bringing him to aunty! Work-room where I used to entertain him with shewing him the constellations in Fl Atlas of which the Wail was his favourite object, for when the Nurse brought him to me (en cording shrugs) he came with Aunty shew me the Wail [sic]![224]

This quote gives some indication of the way in which the materials, terminology and images associated with astronomy and science found their way into the everyday world in which John grew up. William was taught the violin as soon as he 'was able to hold a small one made on purpose for [him]'[225] and Caroline was taught domestic skills as

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[222] Caroline L. Herschel to John's wife, Margaret Brodie Herschel, 6 September 1833, BL: Eg.3761 f189-190.

[223] See for example stories of Einstein examining a compass aged 5 - H. Gordon Garbedian, *Albert Einstein, Maker of Universes* (London, Toronto, Melbourne & Sydney: Cassell and Company Ltd, 1939), p. 5; Denis Brian, *Einstein: A Life* (New York, Chichester, Brisbane, Toronto, Singapore: John Wiley & Sons, Inc, 1996); stories of Newton making mechanical things at school aged 12 - Augustus de Morgan, *Essays on the Life and Work of Newton* (1846), p. 7; stories of William Herschel's early scientific leanings - Sime, *William Herschel and His Work*, p. 13.

[224] Caroline L. Herschel, *Biographical memorandums of my Nephew J. Herschel to the best of my recollections,* 27 May 1838, original at HRC; BL: microfilm M/588(4).

[225] Armitage, *William Herschel*, p. 18; Macpherson, *Herschel*, p. 8; Dreyer, ed., *The Scientific Papers of Sir William Herschel*, p. xiv.

early as possible so as to be able to apply them. John meanwhile was encouraged to share his relations' scientific passions and so become familiar and at ease with the language and ideas associated with them. Through these sessions with his aunt and her star charts John became familiar with the idea of constellations, with their shapes, their names and their relation to one another. He was made familiar with the night's sky, an essential prerequisite for any kind of astronomical observation.

It is within this context that the quote about chemistry experiments given above should be understood. Once at school, Caroline reports, he would spend holidays with her, 'making experiments in chemistry', but in doing so he was only mimicking the behaviour of those around him. As other children might play mummies and daddies, shops or schools, John played at chemistry. In describing the Herschels' renovation of Observatory House a neighbour, Mrs Papandiek, writes that 'The stable yard was now a pretty garden, on one side of which were buildings for chemistry'.[226] This would have been where the speculum metal was made for the mirrors for William's telescopes. The work that went on in those buildings provided John with a model to copy in his play at chemistry.

From a very early age, the tools, terminology and activities associated with experimental and observational science were all around him. So too were more men than was typical of an eighteenth century experience of childhood. As Michele Cohen observed, the typical eighteenth century experience of childhood was that of being brought up surrounded primarily by women. This she argues was one major reason behind the popularity of the Grand Tour, and to a lesser extent the all male boarding school, which was designed to 'remove the prejudices'[227] of this type of education. John however in addition to his female carers, had workmen to watch and interact with. Like his scientific relatives, these workmen were using tools, in some cases even manipulating the telescopes and other scientific apparatus around the house and grounds adding to his understanding of how adults might typically fill their day.

At the Herschel home, workmen were constantly onsite and John would get to know them and mimic what he saw them doing. When he was about two years old, Caroline described 'listening to his prattle' when 'my attention was drawn to his

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[226] Mrs V. D. Broughton, ed., *C. L. H. Papendiek: Court and Private Life in the Time of Queen Charlotte Being the Journals of Mrs Papendiek, Assistant-Keeper of the Wardrobe and Reader to Her Majesty.*, 2 vols. (London: Bentley & Son, 1887), pp. 251-252.

[227] Michele Cohen, "The Grand Tour: Constructing the English Gentleman in Eighteenth Century France," *History of Education* 21 (1992), p. 242.

hamering [sic]' only to find that he was destroying some building work that was being carried out on the house at Slough. She called over one of the workmen, a man called John Wiltshire, whom she describes as 'a favourite carpenter' adding that 'our John was this man Pet he teached him to handle tools.'[228] On another occasion she was reminded of John 'among your father's carpenters working with little tools of your own'.[229] All of which suggests that his play in chemistry should not be seen in isolation, but alongside other games, such as this play in carpentry, in which his play was similarly based on copying what he saw others do around him.

As a small child, playing in and around Observatory House John found lots of models of adult behaviour to watch and copy. He was introduced to the constellations almost as soon as he could talk, and played at being both a chemist and a carpenter. Science would not appear to him daunting or new when he first encountered it formally because the behaviour and terminology associated with it had already become so familiar. Importantly, science here was associated with activity rather than solely with reading and reasoning.

Mary Baldwin, her family and their education

William came from a culture of aspiration, where education was seen as a means of enabling social mobility. For Mary, as far as it is possible to tell from the limited extant archival material, education was about tradition, conformity and maintaining a social position. Each generation followed the same series of steps, the same schools and colleges, as previous generations and as friends and neighbours. This emphasis on preserving the past, I will argue, comes through not just in her attitude to education, but in her interest in family and ancestors and, as we will see later in this chapter, in her cautious reception of change in the wider world. Nothing has previously been written on Mary or her family background, yet she played an important, if low key role in John's education and did so, at least in part, because of her experience of and received opinions on education.

From the start, there were two competing strands to John Herschel's education. On the one hand, William wanted the content of his son's education to be of an

[228] Caroline L. Herschel to Margaret Brodie Herschel, 6 September 1833, BL: Eg.3761 f189-190.
[229] Caroline L. Herschel to John F. W. Herschel, 11 September 1834, BL: Eg.3762 f4-5.

exceptionally high standard and directed towards certain subjects. On the other, there was an attempt to provide him with a conventional education, similar to that of his peers. It was for this secondary educational aim, I will argue, that the family looked to Mary's family as a guide.

Mary's first husband, John Pitt, had been to Eton and may have followed this with Oxford or Cambridge.[230] Mary's father, Adee Baldwin and his father Thomas Baldwin, owned and rented properties to tenants in the Slough area and these were passed down to Mary as her accounts show.[231] It was relatively common at this time for sons of landowners to be sent away to Oxford or Cambridge to learn how to manage the family estate though whether or not this was the case for the Baldwins is unclear. More distant relations on Mary's grandmother's side were sent away to University and on to vocational training for one of the professions. Mary's great grandfather, Nicholas Adee was a rector; his son, Mary's great uncle, became a lawyer while her second cousin and two of her second cousins twice removed all trained as doctors. For the landowning classes this use of university – to train the eldest son to run the family estate and the younger ones to earn a living in one of the professions – was fairly standard for the seventeenth and eighteenth centuries.[232] In his book on Cambridge mathematics, Andy Warwick points out that it was not until the mid to late nineteenth century that a university education became about learning to do academic research.[233] Given this family background it would seem plausible to suggest that Mary envisaged a similar type of education for her son. That is, to have him attend local schools well established in preparing boys for university and then on to Oxford or Cambridge. Cambridge would undoubtedly already have been William's preferred university because of its reputation for mathematics. However, it seems reasonable to suggest that Mary would have had difficulties about making any definite future plans for her son John following the death of her son from her first marriage, Paul Adee Pitt who died, aged 19.

Paul's death in 1792 only months after John was born coloured all Mary's aspirations for her second son. As she wrote after a visit to the palace with John aged three:

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[230] From personal correspondence with Eton archivist, Mrs. P. Hatfield.
[231] 'Memoranda of the Past '*Particulars relating to my Mother's family' JFWH's notes 1822-1826'*, JHS papers FC A3.
[232] Martha McMackin Garland, Cambridge before Darwin: The Ideal of a Liberal Education, 1800-1860 (Cambridge: Cambridge University Press, 1980).
[233] Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics*, p. 46, p. 270.

> Saturday January 9 – 1796 – My son was introduced to the Queen and princess by Miss Planta – the Princess Elizabeth gave him a china cup and saucer – which she desired him to keep for her sake, which I hope he will live to show to his children's children, for as long as I live, I will take care of it for him – Mary Herschel'[234]

Her hope that 'he will live to show to his children's children' suggests a reluctance to make plans for his future. Paul had attended Eton and so had begun to follow a similar educational path to his ancestors, but died of consumption before he could follow them into land ownership, business or a profession. Though she left no written record spelling out precisely how his death affected her, the memory of his loss is evident in a number of passing references. Her hope that John should 'live to show his children's children' the cup and saucer he received at the palace is one. Another, which suggests John was taught never to forget the brother he never knew, is a picture of Paul Adee in the family archive, accompanied by a note by John's daughter which reads: 'This picture was much cherished by my father, who had indeed no personal recollection of his only brother (there was never a sister) Paul; but who always knew his brother's worth'.[235] Though relatively common in the eighteenth century, the loss of a child, especially one who survived infancy, could be shattering[236]. For Mary, he was her only son from her first marriage. With John Pitt dead, she had no one with whom to share the loss. In addition she had a new baby and by all accounts a rather tense relationship with her new sister-in-law with which to contend. Given the circumstances, it would be hardly surprising if she should be reluctant to make too solid and inflexible a long term plan for her remaining child.

Evidence of Mary's conservatism and interest in tradition and family heritage can be seen in her contribution to the family library. When Mary married William, her library, inherited from her first husband, was brought together with his. In the late nineteenth century a catalogue was created of this combined library.[237] Within it only a few items were specifically listed as belonging to Mary: Henry Pye's *Alfred, an Epic*

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[234] Envelope reads 'Notes by (Mary) Lady Herschel re JFWH's saucer given to him by Princess Elizabeth, 1796', JHS papers FC B4.
[235] Envelope reads 'catalogued by MFH', JHS papers FC B4.
[236] See similar situations within the Paget family in Peterson, *Family, Love, and Work in the Lives of Victorian Gentlewomen*, pp. 115-116
[237] Sydney Ross and Isabella Herschel, eds., *The Catalogue of the Herschel Library: Being a Catalogue of the Books Owned by Sir William Herschel, Kt. And by His Son Sir John F. W. Herschel, Bart.* (New York: 2001).

Poem (1801), Milton's *Paradise Lost* (1746) and *Sermons* by Beilby Porteus as well as a Bible from 1712 inscribed with family entries of births, deaths and marriages with Pitt, Beckwith, and Herschel families all included. Pye was at this time Poet Laureate while Milton's *Paradise Lost* was already considered a classic, so these two might be seen as simply important works to have. Her copy of the Bible, meanwhile, inscribed with family birth, death and marriage dates, suggests she saw family as important. This, coupled with a comment in the family archive by John, in which he describes Nicholas Adee as 'the farthest ancestor my Mother can trace in the female line', indicate that it was not simply living family members or close relatives that she was concerned with, but the longevity of the family name.

The inclusion of Beilby Porteus's sermons gives a slightly different impression of Mary and her views. Porteus was an Anglican reformer, chaplain to George III and an outspoken opponent of slavery. The sermons Mary included in the family library were those on the abolition of slavery. While her poetry choices demonstrate her conservatism, the inclusion of these sermons suggests she saw some areas of the political world in need of reform.

Mary's experience of education up to her marriage to William was fairly traditional for her time and class. For Mary education for boys consisted of attendance at a series of well established and respected institutions. These were schools and universities experienced in preparing their charges with all that they needed for a career in the professions and an easy entry into polite society. For the most part, her extant papers give the impression of a woman concerned with preserving the status quo, of providing her sons with a comparable education to that of previous generations and so preserving the family name. At the same time however, there were certain areas of her family life and the world around her in which she could see room for improvement. The death of her first son made her plans for John that much more flexible since she did not want to make any firm long term plans.

Schools and tutors

In this section I look at the development of John's formal schooling from the age of five. In this period I will argue, William and Mary shared responsibility for their son's education. William looked to Mary as an authority in how to provide a good and

respectable English education for their son. While Mary, drawing on her experience of her first child focused on preparing John for Eton, William ensured his mathematics and science did not fall behind. Their decision to remove John from Eton after only three weeks has previously been attributed solely to Mary's concern over his welfare. Though that was undoubtedly a factor, it does not explain why William was so easily persuaded. In this section I will argue that at the same time that Mary was finding out about fighting among the boys at Eton, William was learning about the curriculum. Neither parent was happy with what they discovered. It was for this combined reason that John changed schools so abruptly.

John began formal schooling at the age of five. He was sent to small local schools, ones with only local reputations and so ones likely to have been chosen by Mary from recommendations by family, friends and neighbours. From very early on the curriculum of each school John attended was kept under close scrutiny by his father and home tutors were employed to cover any perceived shortcomings. This was very much in keeping with William's experience of education. Back in Hanover he had always had his school lessons supplemented first with music lessons from his father and later with language lessons from an outside tutor. Mathematics in John's education was consistently singled out as needing extra attention. The precise type of mathematics that particularly concerned William became apparent as John got older and more specialist tutors were required.

In 1797 John went to his first school. This was run by Mr Atkins and here not only mathematics but writing and geography were seen as a cause for concern. According to Caroline: 'He was at Mr Atkins schul in Slough, come home Sundays and other days to receive instruction of a Mon. (I forgot his name) in Writing, Arithmetic and Geography'.[238] By August 1799, seven year old John had moved to Mr Bull's school in Newbury. At this school he boarded as his short, formal and neatly written letters home to his mother indicate:

> Dear Mamma, I write to inform you I am well & happy & to thank you for the clothes you was so kind as to send me. I should be glad if you would send my cyphering & music books; I dined at Mr Sainsbury's last Sunday. My Master & Miss Bull desire their compts to you & papa to whom pray give my duty I

[238] Caroline L. Herschel, *Biographical memorandums of my Nephew J. Herschel to the best of my recollections,* 27 May 1838, original at HRC; BL: microfilm M/588(4).

remain your dutiful son, JFW Herschel[239]

There is no mention of additional teaching at this second school, though it may simply have been impractical given he was boarding and anyway was there only one year. The following year, in 1800, he enrolled at his half brother's old school, Eton. To mark the occasion, the family had a portrait painted of John in front of the school.[240]

John spent only three weeks at Eton before being removed by his parents and sent to a local boarding school run by Dr Gretton in nearby Hitchin. The portrait commissioned and the fact that John's half brother Paul attended Eton until the age of 18, both make John's sudden departure worthy of further investigation. The standard story, taken from Caroline's memoirs, is that Mary insisted on her son's removal from the school after seeing John fighting.[241] After Paul died Mary was very protective of her only remaining child, so this plausibly was part of the reason. However, at the same time, William had realised just how little mathematics was taught at Eton. According to Caroline, William would in later years complain 'that the young people at Eaton [sic] were kept with learning nothing but Greac and Latin till the age of 18 which he called a waste of many years of the life of a young man.'[242] This was after John had changed schools but gives a good indication of why that move took place.

Eton was known to have provided Oxford and Cambridge in this period with a large number of its pupils. It might then have been William's assumption that Eton would teach a good deal of mathematics as preparation since he knew from his own circle of Cambridge graduates that Cambridge specialised in mathematics.[243] William never discussed his son's education or asked directly for help in shaping that education from his friends so it is difficult to find direct evidence of his reasoning. However, his two greatest champions within the Royal Society, William Watson and Nevil Maskelyne, were both Cambridge graduates. This may have given William the

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[239] John F. W. Herschel to Mary Pitt Herschel, 9 August 1799, in 'Newbury' envelope, JHS papers BFR 4.

[240] Painting of John F. W. Herschel starting Eton, JHS objects GR.

[241] This is the version found in Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 298 and Buttmann, *The Shadow of the Telescope: A Biography of John Herschel*, p. 9.

[242] Caroline L. Herschel to Margaret Brodie Herschel, 2 June 1841, BL: Eg.3762 f78-79.

[243] Isaac Newton studied, taught and lived at Cambridge most of his adult life. Robert Smith, an author William had studied in his own training, had been a graduate of Trinity College, Cambridge and later a Cambridge professor. Similarly William's scientific friends and supporters, William Watson and Nevil Maskelyne were both Cambridge graduates.

impression that a Cambridge education provided a good route to being taken seriously as a man of science.[244]

William's discovery that at Eton boys were taught nothing but Greek and Latin and little mathematics, coupled with Mary's concern for John's welfare, seems to have resulted in John's quick removal from the school. From this point on, William took over the design of his son's education. He no longer looked to his wife and her local and family knowledge of how to train his son for Cambridge and on to a life in science. Instead he began to use his own experience of education and to seek advice from his own tutors.

Improving on William's failings

As discussed in chapter one, by the late eighteenth century, French and English mathematics had become so distinct from one another that few could claim to understand both. At the same time, France and England were mostly at war, making communication between the two countries difficult and politically undesirable. A small number of English men of science continued, where possible, to retain links with their foreign peers and William was among them. In Scotland the links with France were stronger and as a result understanding of French mathematics more commonplace.[245] Through his correspondence with several French philosophers and mathematicians, William became aware of his limited ability to understand French mathematics. Though he seemed unable ever completely to overcome these limits in his own education, he was able to identify where he went wrong. In attempting to save his son reaching similar limits in his understanding, William set about using his contacts in Scotland to introduce John to this alternative type of mathematics at a young age and to learn it alongside English mathematics.

In 1802, when John was 10 years old, the family went on a trip to Paris. During the trip William renewed various acquaintances with prominent men of science. John spent the time sightseeing with his mother and cousin. Harvey Becher

[244] Watson and Maskelyne both grew up in London. While neither went to Eton – going instead to Charterhouse and Westminster respectively – all three schools were and are comparable and Eton was considerably closer to the Herschels.

[245] A. D. D. Craik, "Calculus and Analysis in Early Nineteenth Century Britain: The Work of William Wallace," *Historica Mathematica* 26, no. 3 (1999).

refers to this trip to Paris as evidence of John's associations with France prior to joining the Analytical Society at Cambridge. He gives this alongside other members' French associations, indicating that although it was unusual for English boys to have anything to do with France at this time, a high percentage of this group did. While Becher is right to highlight the Herschel family's links with France and French mathematics, I will argue here that he is wrong to identify this trip as particularly important to John's education. Rather, for John the trip was just a holiday with his parents. Far more important for his education was his father's long running correspondence on French mathematics with philosophers and mathematicians both in France and Scotland. His French correspondents provided him with a well stocked library; his Scottish friends with the recommendation of a tutor.

After his three weeks at Eton, John then aged seven was sent to a new school, run by Dr Gretton in Hitchin at a cost of £33.6.0 a year.[246] Here the curriculum was kept under William's constant scrutiny. As Caroline later remarked, 'Though my poor Brother seemed to have had no hands in the education of his only son; I know (from having been by chance present at many privat [sic] conversation he had with Dr Gretton) that nothing was done without his approbation and advice.'[247] However, even with this degree of control, William saw a need to supplement John's schooling with home tutors. In 1804 Mr Luscombe, a recent Cambridge graduate, was appointed as a home tutor in mathematics. Two years later he was replaced by Alexander Rogers from Scotland. Two years after that Dr Hausman was appointed to help John with his German.

Mr Matthew Henry Thornhill Luscombe, who went on to become principal master at the East India College in Haileybury, arrived when John was 12. Luscombe had been at Cambridge earning his MA when he was appointed by the Herschels and so was plausibly there to supplement John's training for Cambridge. Dr Gretton did have some experience of training boys for Cambridge – John corresponded with a fellow pupil who went up a few years before him[248] – but this was not enough for John's father. Gretton's schooling alone would, very probably, have been enough to get John into Cambridge. However his additional tutoring suggests William wanted John not just to get into Cambridge, but to excel there.

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[246] Slough House Book, 24 May 1804 (goes up to 1815), NMM: HRS/2.
[247] Caroline L. Herschel to Margaret Brodie Herschel, 7 July 1842, BL: Eg.3762 f104-105.
[248] James A. Gordon referred to in Crowe, ed., *A Calendar of the Correspondence of Sir John Herschel*

Luscombe was followed two years later, in 1806 by Alexander Rogers, the tutor who would introduce him to Continental calculus. Though William never discussed his son in correspondence, it seems very likely that Rogers came to the Herschels as mathematics tutor on the recommendation of Patrick Wilson, William's own informal tutor in Scotland.

Patrick Wilson, professor of Astronomy in Glasgow, was one of a number of Scottish academics who criticised English mathematicians for failing to recognise the importance and usefulness of French analytical mathematics.[249] He was also William's first contact with Scotland and its universities when the pair began a long running correspondence in 1783.[250] Three years later William was awarded his first honorary degree by Edinburgh University. In 1792, Glasgow University awarded him his second honorary degree offering William a chance to renew some of those acquaintances. William Herschel and Patrick Wilson's long correspondence contains discussion on both scientific subjects and shared friends. Those friends included people such as the physician James Lind, William's Scottish born neighbour, and James Watt in Birmingham. Herschel and Wilson spent holidays together through which Mary had become good friends with Wilson's sister.[251] As a source of recommendations for John's tutor he was not only someone intellectually respected by William but someone Mary knew and liked. He was also someone William turned to when trying to understand French mathematics himself. 'I wished much to talk over the contents of Lambert's Systeme du Monde with you' William began a letter to Wilson in 1799 ending that perhaps 'you will have no objection to introducing me to your friend the translator of the work in question.'[252] Elsewhere in their correspondence there are references to William calling both on Wilson and on his Scottish colleagues for help in understanding other, mainly French, mathematical texts.[253] In addition, Wilson knew Rogers. When Wilson died in 1807, Rogers wrote sadly to John, 'It grieves me to learn that in Dr Wilson I have lost another friend'[254]. It

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[249] Craik, "Calculus and Analysis in Early Nineteenth Century Britain: The Work of William Wallace."
[250] Patrick Wilson to William Herschel, 10 November 1783, RAS: WH.1/13.W.95.
[251] In 1800 for instance, alongside his sister 'Miss Ramsden, Mrs Nash and all the Miss Adamses' Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, pp. 299-300.
[252] William Herschel to Patrick Wilson, 10 February 1799, RAS: WH.1/1. pp.236-237.
[253] E.g. William Herschel's conversations with Prof. John Robison over the work of Laplace, were discussed in Patrick Wilson to William Herschel, 31 January 1802, RAS: WH.1/13.W.131.
[254] Alexander Rogers to John F. W. Herschel, 10 January 1812, RS: HS 14.396.

seems then highly likely that it was through Wilson that Rogers came to be appointed.[255]

Only one written comment on John's education exists from William. In this, responding to a direct request for information, William wrote that under Rogers, John 'has made great progress in those parts of education which require early application, and I shall be happy to introduce him to you in his present improved state.'[256] The 'parts of education' he was referring to were, on the evidence of John and Alexander Roger's correspondence, likely to have been Continental mathematics. In this correspondence, which the pair took up after Rogers left the family home as tutor in 1807, Rogers directed John to certain books: 'The title of LaCroix's elementary works is, *Cours de mathematiques, a l'usage de l'ecole centrale des quartre nations*, par J F La Crois, 7 vols, Octavo, price £2.2'[257] offering even to lend his own copy. He also gave him advice on the order in which to read the various texts, perhaps as one of William's philosophical gentlemen had done for him back in the 1760s when he was learning about fluxions:

> If you would be pleased to make use of the copy of LaCroix which I have, until you procure one, it is very much at your service, and I dare say would reach you safe. – The Mechanique Celeste which you have received also lies beside me. I struggled thro' the beginning of it; but my progress was so slow & painful, that I have not opened it for sometime. To go through it with anything like pleasure, would, I believe, require an acquaintance, not only with LaCroix's elementary works, but also with the Traité de Calcul différentielle et de calcul integral, which he has published in 3 vols, Quarto. I found the Mechanique Analitique of LaGrange a good deal easier: it is conducted nearly in the same way, and would perhaps be a good preparation for the study of LaPlace's work.[258]

These titles are worth noting because they played a central role in the work of the Analytical Society which John later joined as an undergraduate at Cambridge. In particular it was LaCroix's *Traité de Calcul différentielle et de calcul integral* that the Analytical Society chose to translate in 1816. John was not only learning how to understand this mathematics from Rogers, but also noting how to teach it in that he later followed Rogers' advice on the order in which to study these texts.

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[255] Rogers also refers to having 'one young man studying Dr Hutton's course of mathematics with me', Alexander Rogers to John F. W. Herschel, 5 November 1808, RS: HS 14.390 suggesting yet another mutual contact.
[256] William Herschel to William Watson, 10 December 1808, RAS: WH.1/1.p.274.
[257] Alexander Rogers to John F. W. Herschel, 5 November 1808, RS: HS 14.390.
[258] Alexander Rogers to John F. W. Herschel, 2 January 1809, RS: HS 14.391.

Besides simply recommending titles, Rogers offered an approach of how best to tackle these texts. What provoked John's initial interest is less clear, though easy access to William's well stocked library is likely to have been a factor. This was after all a library, which, thanks to William's network of correspondence in France contained Lalande's *Traité d'Astronomie* (1792 edition), Laplace's *Mécanique Céleste* (1800) and two books by Lagrange that predate John's interest (*Théorie des Fonctions Analytiques*, 1797 and *Résolution des Équations Numériques*,1808).[259] William was aware of his limited ability to understand French analytic mathematics. His appointment of Rogers suggests he did not want the same limits imposed on his son's education. Through Wilson, William found, if not a better understanding of this mathematics for himself, then at least a means of better preparing his son through the appointment of a suitable tutor.

While Continental mathematics was the main area William felt from his own failings needed early attention, it was not the only one. In addition, right at the end of his schooling, John was given lessons in German by a private tutor, Dr Hausmann.[260] There is only one mention of this teacher in the Herschel papers, a line in the household accounts that simply reads for 'teaching my son German'[261]. The timing of this appointment suggests that this may have been a polishing exercise. It was relatively late in his schooling and so unlikely to have been to teach him German from scratch. Although William was brought up speaking German, he never corresponded with any colleagues in the language - even with those who wrote to him in German. Having developed his scientific knowledge and self-presentation in England, William presumably lacked confidence in his ability to write formal or technical German. Rogers had been appointed to develop John's expertise in an area of mathematics in which William had always felt himself at a disadvantage. Hausmann's appointment suggests William also saw an advantage in being able to speak and write better German than he or Caroline could teach.

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[259] Ross and Herschel, eds., *The Catalogue of the Herschel Library: Being a Catalogue of the Books Owned by Sir William Herschel, Kt. And by His Son Sir John F. W. Herschel, Bart.* Also listed in Ross' catalogue are Lacroix's Traité du Calcul Différential et du Calcul Intégral (1810) and Lagrange's Leçon sur le Calcul des Fonctions (1806) but these are both annotated 'JFWH 1812' and 'J FW Herschel, St John's College, 1812' respectively and so presumably belonged to him rather than the family library.

[260] In 1803, John's godfather, General Komazewski told William he was preparing for John 'a long conversation with him in our pure latin' General Komarzewski to William Herschel, Paris, 15 March 1803, RAS: WH.1/13.K28; Following John's German lessons, William's brother Dietrich writes to him in German on the classification of apes. Dietrich Herschel to John F. W. Herschel, 5 January 1810, HRC: folder M0884.

[261] 'Herschel family dates', JHS papers FC A1; see also Slough House Book NMM: HRS/2-3.

Family holidays

When William married Mary, his friend William Watson commented on her good influence in making him take a regular annual holiday's away from his work.[262] This tradition continued after they became parents, so that each year, John had a break from his intensive training, as the family went away somewhere. In these breaks, his mother had her turn to shape her son's outlook. She did this by showing him how to view the various social and environmental changes occurring in the world around him. As discussed earlier in this chapter, Mary's outlook was quite conservative, but tinged with social responsibility. This coloured her views on the rapid changes brought about across the country by industrialisation. While she admired some aspects of this trend, she was appalled by some of the social problems she saw it cause. In this section I will argue that her interpretation of the benefits and costs of industrialisation had some influence on the way John Herschel also saw and understood the modern world.

Ashworth identifies a trip in 1809 as exemplary of John's visits to manufactories and quotes his diary as evidence of his fascination in and admiration for the industrial process.[263] Here I will argue that although he was impressed by the technology on show on these visits, it was through his mother that he came to see also some of the damaging social and environmental consequences of industrialisation.

Every summer William, Mary and John would go away somewhere over the school holidays. Often Mary's niece, Sophia Baldwin, would accompany them while Caroline stayed behind to look after the house. In the early years these were a way for John to see his parents interact with the various men and women of science with whom they were visiting or holidaying. The holidays of 1809, 1810, 1811 and 1812, those immediately preceding and during John's time at Cambridge, were different. They are significant in that they show a conscious effort by John's parents, and his mother in particular, to show him and discuss with him what they saw around them rather than simply who they met. As we shall see, they were about celebrating the advances made

[262] Hoskin, *The Herschel Partnership: As Viewed by Caroline*, p. 95.
[263] Ashworth, "Memory, Efficiency, and Symbolic Analysis – Charles Babbage, John Herschel, and the Industrial Mind."

with technology while at the same time condemning the environmental effects of industrialisation.

In 1809 the family travelled to the Lake District, a fashionable location, recently made so by Wordsworth and other of the Romantic poets. Before he went John was encouraged to read if not Wordsworth then certainly the poetry of Walter Scott. Indeed their choice of site appears to have been inspired by a Scott poem. Mary described in her diary that they stayed in 'a small village under the foot of Helvellyn where we dined at the Nags head a single house. Here my son had the pleasure to ascend that fine mountain which Scott has immortalised in his beautiful poem'.[264] The implication here is that both John and his mother knew the poem, and that she positively encouraged this interest in contemporary poetry.

The Romantic poets, Walter Scott included, shared with Mary mixed feelings about industrialisation. Like the Herschels, the Romantic poets fell between the aristocracy and the middle classes in their allegiances, and more often than not, invested heavily in education and in the use of knowledge as a means of livelihood and status.[265] Richard Holmes in his book, *The Age of Wonder* has commented on certain similarities in outlook between the Romantic poets of the early nineteenth century and the 'romantic scientists'[266] of the same period. Like the poets, Herschel was brought up, through these holidays, to regard the changing face of Britain with both admiration and hostility. In isolation the technology and science that made manufacturing possible was to be admired, yet at the same time the social and environmental impact of the changes were often seen as too high a price to pay.

Before reaching the Lakes, the Herschels stopped in Derby, Manchester and then in Grantham on the way back. At their first stop in Derby they visited silk and cotton mills. John was impressed by the cotton mills, describing the works as 'extremely beautiful, on account of the elegant machinery employed. The impulse is given by a small steam-engine, and thence communicated.'[267] At Manchester Mary presented a different view of industrialisation, writing in her journal 'as to the Town of Manchester I hope never to see it again, the manufactorys are without number, and I

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[264] Mary Pitt Herschel's travel journal 1809, JHS papers ARM referring to the Romantic poet and novelist, Sir Walter Scott and his poem 'Helvellyn' first published in 1806.
[265] For biographical comparisons see Richard Holmes, *The Romantic Poets and Their Circle*, *Insights* (London: National Portrait Gallery Publications, 2005).
[266] Holmes' term – see Richard Holmes, *The Age of Wonder* (London: Harper Press, 2008).
[267] Ashworth, "Memory, Efficiency, and Symbolic Analysis – Charles Babbage, John Herschel, and the Industrial Mind.", p. 630 quoting John Herschel, "Travel diary, 1809-1810," 20-21 July 1809, HRC.

am sure so are the inhabitants, I never saw so many people together in the streets except in Paris'. She was no more impressed by the manufacturers; 'at the top of the rock stands the House of Mr Arkwright who belongs to several of the cotton manufactorys in this neighbourhood. He is said to possess one hundred thousand pounds a year. Too much for any one man'. This disappointment in the social and environmental consequences of industrialisation was echoed by John a few years later in a letter to his friend John Whittaker showing the lesson had sunk in:

> tell me sincerely, do you not perceive in the present situation of our domestic affairs every symptom which has been field forward as the characteristic of decaying greatness... But look at our overgrown metropolis and the hundred tumours of the second magnitude which have arisen in every hint of this diseased & corrupt body each tainting the little circle around it, each daily increasing in extent & foulness – the nation is apoplectic – choked with its own population – overloaded with its useless manufactures & decaying commerce, it stands in need of no simple or common remedy[268]

On the way back from the Lakes they stopped at Grantham and, as Mary recounted in her diary:

> were there more than three hours looking at all the machinery. I wish it was in my power to give the least description of what I saw but that is impossible for to describe the powers of a steam engine requires a more able pen than mine ... There we saw a thrashing machine, on the best construction that can be; it belonged to the master of the Inn. They were thrashing beans, four horses were imployed and they could grind out more corn in one day than could be done by 6 men in a week. It is, I think, a sin that every parish in the Kingdom has not one.[269]

Through these comments Mary attempted to assert a role for herself in John's education after all choices regarding his formal schooling had been taken over by William. In terms of the views expressed, both mother and son seem agreed that the technology was good and interesting, let down however by the people and the effects the factories were having on the local environment.

In 1810 the family had their first holiday since John had started at Cambridge. Travelling north, they went first to visit various sites of industrial interest including Boulton's manufactory in Birmingham. This was the first time John had ever been

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[268] John F. W. Herschel to John Whittaker, 2 July 1813, SJC.4.
[269] Mary Pitt Herschel's travel journal 1809 (entry for 22 August), JHS papers ARM.

there though he had met both Watt and Boulton when they visited his house in Slough. For William this was the first time he had been back since his trip in 1792. Ashworth cites this holiday as evidence of John's experience of and enthusiasm for the industrial process. He argues that John would later apply this understanding of the industrial process to the process of producing mathematics through the analytical method. [270] For this trip John kept his own diary[271], which Ashworth quotes, recording his reactions to the work he saw in both Derby and Birmingham. These mainly positive reactions and the timing of the trip, at the end of John's first year at Cambridge, make the possibility that this trip could have influenced his work at Cambridge plausible. Like Becher's claims about the Paris trip however, the way in which that influence worked may have been more complicated than simply seeing and applying. These were friends of William so Mary was less free to pass judgement. More than that, they were part of this informal group of Francophiles to which William belonged where admiration if not full understanding of French mathematics was as much a part of their cultural outlook as manufacturing and the promise of progress inherent in their technologies.

After the Herschel's brief stay in Birmingham in 1810, the family travelled north to Scotland where they visited Mr Rogers and where John met James Grahame for the first time. Unlike John and his Cambridge friends, Grahame, a law student at Edinburgh University, attended balls and parties and read Jane Austen novels and tried to persuade John to do the same. They became friends for life, never corresponding about mathematics or science - indeed in one letter Grahame comments on his own ignorance of mathematics.[272] Instead, they talked about their lives and loves, their aspirations and their deepest desires. When John passed on a letter of recommendation from Grahame to his future mother-in-law he told her 'I have no secrets, or intentional concealments of any kind from my noble-minded friend – that which I could not communicate to him, I would not harbour in my own bosom.'[273] Through his mother, and now Grahame, John began to glimpse a world beyond isolated, intensive academic study.

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[270] Ashworth, "Memory, Efficiency, and Symbolic Analysis – Charles Babbage, John Herschel, and the Industrial Mind."
[271] John F. W. Herschel, 'Travel Diary, 1809-10', HRC.
[272] James Grahame to John F. W. Herschel, 10 April 1817, RS: HS 8.279.
[273] John Herschel to Emilia Stewart, [4 December 1828], JHS papers HCEJ.

The summers of 1811 and 1812 again took the family to Scotland. All these holidays were a chance for John to take a break from his intensive schooling. They were also a means through which Mary was still able to make an impression on his education after his formal education had come under the close attention of her husband. While William focused on ensuring his son achieved academic success, was able to pass exams and excel in areas he had found limiting, Mary attempted to give this some balance. Through these trips she was able to broaden his outlook, so that he was aware of the changes brought about by industrialisation and how these could have both benefits and problems. She was able to introduce him to contemporary literature and bring it to life – through visiting places mentioned in poems and going to parties with his new friend James Grahame. Through these holidays John was made familiar with the remarkable industrial changes taking place across Britain and he was given an intellectual framework through which to view these changes. He was also introduced to a reaction to these changes taken by a particular group of intellectual poets that his mother had encouraged him to admire.

Cambridge & the Analytical Society

At Cambridge John was able to make use of the intensive training provided by his family and at the same time begin to assert his independence. At first he found himself over prepared for his official studies and so busied himself producing a mathematical paper for publication. Then in his final year he found a peer group when he was invited to join the Analytical Society. John not only joined but became one of the society's most active members demonstrating his mastery of French analytical mathematics. He also graduated as senior wrangler, demonstrating his mastery of English fluxions. Why this was the case has not previously been adequately explained. Here I will argue that he had this success as a student at Cambridge and as a member of the Analytical Society as a direct result of his intensive education, and in particular, his father's concern that John should study all kinds of mathematics. Not only did this period mark the culmination of all that work, but it also marked a turning point as control over the design of John's educational programme transferred from father to son.

While there is considerable literature on the Analytical Society and its achievements, the literature looking at the individuals within the society, their contributions and motives is very limited.[274] Harvey Becher talks about the class backgrounds of society's members to explain their political allegiances but does so only in very broad terms.[275] Enros meanwhile points to certain moments in the earlier lives of some of the society's members where they were introduced to analytical mathematics but gives no context for why the introductions had occurred.[276] Neither explains why these particular individuals should wish, or why they should be equipped, to take part in this society.

In the case of John Herschel, I will argue that his involvement and contribution to the society came out of a childhood filled with intensive mathematical study all directed toward making him a better natural philosopher than his father. To that end, as we have seen, he was not only introduced to, but taught in some detail English fluxions and French analytical mathematics years before he began attending Cambridge. His training in English fluxions meant that he was well prepared for the official syllabus at Cambridge and so had more free time than many of his friends to work on analytics. His training in analytics meant that his starting point in this work was already ahead of most within the society.

When John first went up to Cambridge his parents reacted by taking on the roles they played in withdrawing him from Eton: William looked into the syllabus and teaching while Mary concerned herself with her son's welfare. John's tutor at St John's, Mr Horbuckle, was invited to Slough once before and once during his first

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[274] Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics*; Garland, Cambridge before Darwin: The Ideal of a Liberal Education, 1800-1860; Guicciardini, *The Development of Newtonian Calculus in Britain 1700-1800*; Enros, Philip C, 'Cambridge University and the Adoption of Analytics in Early Nineteenth-Century England' in Herbert Mehrtens, H. J. M. Bos, and Ivo Schneider, *Social History of Nineteenth Century Mathematics* (Boston: Birkhauser, 1981), pp. 135-47; Jonathan Topham, 'A Textbook Revolution', in Marina Frasca-Spada and Nicholas Jardine, *Books and the Sciences in History* (Cambridge: Cambridge University Press, 2000), pp. 317-337; Enros, "The Analytical Society (1812-1813): Precursor of the Renewal of Cambridge Mathematics."; Becher, "Radicals, Whigs and Conservatives: The Middle and Lower Classes in the Analytical Revolution at Cambridge in the Age of Aristocracy."; Ashworth, "Memory, Efficiency, and Symbolic Analysis – Charles Babbage, John Herschel, and the Industrial Mind."; Harvey W. Becher, "William Whewell and Cambridge Mathematics," *Historical Studies in the Physical Sciences* 11 (1980); Philip C. Enros, "Cambridge University and the Adoption of Analytics in Early Nineteenth-Century England," in *Social History of Nineteen Century Mathematics*, ed. Herbert Mehrtens, H. J. M. Bos, and Ivo Schneider (Boston: 1981).

[275] Becher, "Radicals, Whigs and Conservatives: The Middle and Lower Classes in the Analytical Revolution at Cambridge in the Age of Aristocracy."

[276] Enros, "The Analytical Society (1812-1813): Precursor of the Renewal of Cambridge Mathematics."

term.[277] Mary meanwhile stayed in Cambridge near to the college for the whole of his first term to ensure John was safe and well looked after.[278] After this, John and the teaching staff were left alone, suggesting that his parents were satisfied by what they had observed. John was less satisfied by the experience. In 1810, not long after he had started at Cambridge, John wrote to Rogers to complain about his course. Rogers wrote back soberly:

> I am sorry that your present studies are not altogether agreeable, but patience, as you observe, will prove the best remedy. – To retrace the elements of science, after having once made a progress therein, is a drudgery ill suited to the ardour of youth; yet it may be the means of suggesting many ideas that would have been overlooked in a more rapid progress, and the fundamental principles of science will be more deeply impressed upon the mind[279]

Rogers had clearly already taught him all the mathematics he was now learning again in his first year at Cambridge. That he was well prepared, perhaps even over prepared, for the curriculum at Cambridge is evident in the fact that he found his official studies dull and, at least at first, undemanding. While some academically ambitious students were, by 1810, beginning to supplement their lectures and tutorials with additional cramming with private tutors, this does not seem to have been the case for Herschel.[280] However continuing his correspondence with Rogers served a similar purpose. Rogers' unofficial role as supplementary tutor was recognised by the family in the occasional one-off payment they sent him as a fee.[281] This may have contributed to Herschel's interest in pursuing and promoting analytical mathematics, or at the very least kept up his interest, in the years between starting Cambridge and joining the society.

Finding his official studies dull, and supported by his continued contact with Rogers, John busied himself preparing an article on analytics and sending it to Nicholson's Journal. The journal's full title was *A Journal of Natural Philosophy, Chemistry, and the Arts* but was commonly known as Nicholson's Journal after its founder, William Nicholson. This first contribution was a letter (which he signs 'a

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[277] Observatory House Visitors book 1783-1828 (copied), JHS papers BFL 9.
[278] Caroline's diary entry for 17 October 1809 'My Nephew went to Cambridge. His mother and Miss Baldwin remained in lodgings at Cambridge.' Quoted in Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 324.
[279] Alexander Rogers to John F. W. Herschel, 5 March 1810, RS: HS 14.394.
[280] Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics*, chapter 2.
[281] 'Herschel family dates', JHS papers FC A1; see also Slough House Book, NMM: HRS/2-3.

Lover of Modern Analysis') on the derivation, by a new method, of various analytical formulae for the sine and cosine.[282] The journal, very much like the *Ladies Diary* where William first published, was aimed at an interested amateur audience.[283] It is this first move that suggests John was beginning to take steps in his education beyond those directly prescribed by his father. John's next publications were papers presented to the Analytical Society (as William's had been papers presented to the Bath Philosophical Society) and later published as part of the memoirs of the society. Only after that did John prepare papers to be read before the Royal Society and subsequently published in *Philosophical Transactions*.

There are clearly parallels that can be drawn between this sequence and the much slower development of William Herschel's publishing profile. Where William over the course of several years published first in the philomath journal, *The Ladies' Diary*, then presented papers to the Bath Philosophical Society and finally to the Royal Society, John achieved much the same in a matter of months. If John was trying in this period to emulate his father's early career, however, this would explain only part of his attraction to the Analytical Society. Another, he described in hindsight many years later, was the attraction of the forbidden. Reminiscing in 1832 he wrote of himself and his friends:

> Students at our universities, fettered by no prejudices, entangled by no habits, and excited by the ardour and emulation of youth, had heard of the existence of masses of knowledge from which they were debarred by the mere accident of position. They required no more. The prestige which magnifies what is unknown, and the attraction inherent in what is forbidden, coincided in their impulse. The books were procured and read, and produced their natural effects.[284]

French analytical mathematics at Cambridge was attractive because it was forbidden. But equally important in bringing Herschel to the Analytical Society, was that the Society provided him with a sympathetic peer group. As he told his father, he had

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[282] John F. W. Herschel to William Nicholson, 23 March 1812, published in *Journal of Natural Philosophy, Chemistry, and the Arts*, 32 (1812), 13-16 referred to in Crowe, ed., *A Calendar of the Correspondence of Sir John Herschel*, catalogue no. 35.

[283] S. Lilley, "Nicholson's Journal (1797-1813)," *Annals of Science* 6 (1948-50).

[284] Quoted in Enros, "The Analytical Society (1812-1813): Precursor of the Renewal of Cambridge Mathematics.", p. 31. Quoting John Herschel's review of Mrs. Somerville's Mechanism of the heavens, *Quarterly Review*, 47, p. 545.

found persons his own age who shared his own way of thinking.[285] Within this society were like-minded people, people who must have shared some aspect of his unusual upbringing so as to have come across this type of mathematics at all.

The Analytical Society was just one of many student societies to spring up as student numbers rose sharply at Cambridge in the early 1800s, catering for various interests from drinking clubs to Bible reading.[286] The Analytical Society was just one more of these, but one that happened to meet John's interests. It ran from 1812 to 1813 and had as its initial stated aim the distribution of Silvestre Lacroix's textbook, *Traité élémentaire de calcul differential et de calcul integral* (1802), as the Bible Society aimed to distribute the Bible.[287] It was started as a parody of the Bible Society by a recent graduate, Edward Bromhead. Bromhead was inspired by a joke made by Charles Babbage and called together a meeting in May 1812, towards the end of Herschel's third year at Cambridge. To it he invited: 'all those of his acquaintance who were most attached to mathematical subjects'.[288] A number of these – Charles Babbage, George Peacock, John Whittaker and Richard Gwatkin – became Herschel's good friends both at University and in the years that followed, though there is no indication as to whether or not they all knew each other before the meeting.

As the society developed they extended the society's aims to spreading interest in, and knowledge of, French analytic mathematics among their peers by doing and publishing their own research. This in itself was a step away from the ideas with which John had been brought up. This was research not to discover something new or to show off one's own skills and abilities but to initiate change in others through leading by example.

The members of the Cambridge Analytical Society who joined that first meeting, had mostly come to French analytical mathematics before the society formed, though each in a different way. Alexander D'Arblay, son of Fanny Burney and grandson of William's friend Charles Burney, 'attended school in Napoleonic Paris

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[285] This is inferred from the reply he received in which William wrote: 'You say that Cambridge affords you the Society of persons of your own age and of your way of thinking,' William Herschel to John F. W. Herschel, 8 November 1813, Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 349.

[286] Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics*, p. 77.

[287] Enros, "The Analytical Society (1812-1813): Precursor of the Renewal of Cambridge Mathematics.", p. 27 referring to Babbage's comments to Michael Slegg in May 1812.

[288] Ibid., p. 27 quoting Babbage letter from the Buxton collection at Museum of the history of science, Oxford.

before attending Greenwich Academy and matriculating at Cambridge.'[289] Edward Bromhead had previously attended Glasgow University where they were more open to non-Newtonian mathematics and could therefore have come across the subject there. Charles Babbage, the son of a successful banker, had a somewhat fragmented education, frequently moving schools. He spent a good deal of his time in private study, reading whatever came to hand, including Lagrange's *Théorie des fonctions analytiques* (1797), and *Analytical Institutions* (1748). Of the others less is known, though in each case they appear to have been the sons of gentlemen or clergy, to have attended local schools and often to have had a school or private tutor supplementing their mathematical education.[290] John, as we have seen, had an extreme form of this, as his father meticulously shaped his education to ensure his son was master of the subjects in which he felt most aware of his limitations.

As a society the group would meet, draw up constitutions and sets of rules and read papers to one another. Later, after most of the members had graduated, they began publishing. First they published their memoirs and later followed this with a translation of a textbook by Lacroix and an accompanying book of exercises. The society did not last long and its lasting legacy to both Cambridge and English mathematics has been disputed. For John Herschel, as one of its most active members, it created strong friendships, a means of practising, developing and showcasing his understanding of analytical mathematics and a new way of looking at his education. Instead of seeing education, as his father had done, as a means of social advancement, John was introduced to the idea that his knowledge might be used to initiate change in the world around him. Their Lacroix translation and book of exercises were published not just because they thought they were interesting and the society supposed there might be a market for that kind of thing. Their books were published to try to change the way mathematics was done at Cambridge and throughout England.

As the final exams approached, John began to question what it was his education and in particular his time at Cambridge had prepared him for. In this he was not alone. As Andy Warwick points out in *Masters of Theory*, throughout the nineteenth century, many high ranking students found the process of cramming for exams made them hate Cambridge. Senior Wrangler of 1840, Robert Ellis for example,

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[289] Becher, "Radicals, Whigs and Conservatives: The Middle and Lower Classes in the Analytical Revolution at Cambridge in the Age of Aristocracy.", p. 410.
[290] John Venn and J. A. Venn, *Alumni Cantabrigienses* (Cambridge: Cambridge University Press, 1922-1954).

complained in the run up to his final exams of his 'bitter dislike of Cambridge' and its need to replace 'his "freshness and purity of mind" with "vulgar and trivial ambition"'.[291] Likewise William Thomson (later Lord Kelvin) and James Clerk Maxwell expressed similar dissatisfaction with their student experience.

In the summer before his final exams Herschel wrote to his friend and fellow Analytical Society member, John Whittaker: 'I make it a point of consciousness to get drunk every day and live in other respects a singular life…mathematics I have utterly discarded'. Continuing in the same letter to spell out precisely what he had come to think of Cambridge:

> Now my dearly beloved I have written myself sober, so let me give you 1¾ words of advice – Read – Write – Imprison yourself – Speak to no one – Cram – Repeat. Do all this and you will then be fitted for a fellow at a college to spend (or rather lose) an unhappy existence in solitary idleness – To die forgotten and unlamented, to leave your fame to the keeping of your Bedmaker who may perhaps when drunk retell an anecdote of some trivial nature of you, and to be succeeded by someone to whom you were in life an obstacle, in death a cypher – These are thy trophies Cambridge[292]

A few weeks later John advised him to

> leave Cambridge and her mathematics, to shift for themselves, and mix more in the society of females than you seem to do. What signifies the life of men if 'twere no' for the lapses. You are now in your garret pouring over some infernal old cram book, or getting some … by heart for examination – fling them to the devil my beloved… I used to be cramming and cursing old Wood or Newton, or any of those other dull obsolete writers.[293]

John had just spent the summer in Scotland visiting James Grahame where he had mixed 'more in the society of females'. However, like Whittaker, he knew ultimately that he would need to go back to those 'dull obsolete writers' if he were to pass his exams.

At Cambridge, all William's hard work shaping John's education paid off. John graduated in the mathematics tripos top of his class, as senior wrangler. He also, undoubtedly pleasingly for William, found a way of showcasing his knowledge of French analytical mathematics and so left with excellent prospects for a life as a

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[291] Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics*, p. 185.
[292] John F. W. Herschel to John Whittaker, August 1812, SJC.1.
[293] John F. W. Herschel to John Whittaker, undated, SJC.3.

natural philosopher. However, John's interest in French analytics had introduced him to a new set of people, a peer group, to whom he now began to look, instead of to his father, for how he might shape his future. As he told his father not long after graduating, Cambridge had provided him with a set of friends his own age and of his 'own way of thinking'[294]. With them, he despaired at what a Cambridge education had actually left him fit for. Like John Stuart Mill, he had reached a crisis point with his intensive education.

Although Mill did not attend Cambridge, he had, like Herschel, been intensively educated by an ambitious father throughout his childhood. Mill experienced an extreme reaction to this kind of training. He suffered a nervous breakdown in his 20s and subsequently severed all contact with his father.[295] In comparison, John Herschel's reaction was mild. Like Mill he found coming out of this kind of education difficult, not quite knowing what to do next, but unlike Mill, he could immediately see some advantage in the position his education put him in and did not let his remaining doubts affect his relationship with his father unduly. John Herschel's training in analytical mathematics meant that he stood out from the majority of Cambridge students but also gave him common ground with a small subset of students, those with whom his formed the Analytical Society.

Cambridge marked a turning point in how John's education was designed. Up until that point William had decided who his tutors were, which subjects he should study and how his time should be divided up. Once at Cambridge, John began to set his own agenda. First, through his own initiative, he began to test out his understanding of analytics by publishing in Nicholson's Journal, following to some extent the model set by his father. Next, with help from his friends in the Analytical Society, he took a bigger step away from his father's programme. In their project to publish a textbook and book of examples, John had begun to view his education as a means by which he might not only shape his own future, but start to change the position of his subject in the world around him.

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[294] William Herschel to John FW Herschel, 8 November 1813, Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 349.
[295] Mazlish, *James and John Stuart Mill: Father and Son in the Nineteenth Century*.

Conclusion

John Herschel's childhood education when looked at in detail leaves very little mystery as to how he came to be so academically successful at Cambridge and so ahead of his peers in French analytical mathematics. He did so because from a very early age his father ensured he spent almost every waking hour studying, and, more specifically, studying those subjects in which his father felt most disadvantaged – namely English and French mathematics.

The choices William made about John's education suggest he had two main objectives. First that John should have as conventional an experience as possible, provided that this did not compromise his second objective, that he should master both French and English mathematics. This hierarchy of ambitions became particularly apparent over the decision of whether or not John should attend Eton. John was sent to Eton since to do so was to conform to the standards of his family's class and locality. He was then removed partly because the school taught little or no mathematics.

Not all of John's childhood education was so consciously designed. As a toddler he was surrounded by the people, tools and terminology of astronomy, chemistry and mathematics, and he would return to these surroundings every holiday once he began school. This made for an unconventional home life, but also helped to make the tools and the terminology, the idea of research and publication, and the link between abstract mathematics and practical application part of his tacit knowledge. Once at school his leisure hours were crammed with tutoring in mathematics, and later languages. Even on holiday he was expected to learn. Holidays provided John with a glimpse of the wider world and an introduction, primarily through his mother, to a critical interpretation of some of the social and environmental consequences of the industrial revolution.

Once at Cambridge John was able to capitalise on his intensive training, coming top of his class and showcasing his knowledge of French analytical mathematics through the Analytical Society. He also began to question the purpose of his education, indicating to friends that the life of a Cambridge academic was not for him. While his family saw education as a means of entry to Britain's scientific elite or to the professions, John began to see another purpose through his involvement with the Analytical Society. Education could be used to try to change the position of mathematics and science within society.

Having been through this intense education, it is not too surprising that John Herschel did well academically. However, the particular nature of this success, of becoming senior wrangler and an active member the Analytical Society, was a result not only of the intensity of this education but also of its clear direction. John's experience showed that William had successfully worked out where the limits were in his own education and how to overcome them. John's success need not be ascribed simply to native ability, but is better explained historically as the result of a sustained programme of well directed, intense study. This was helped by a family environment that made academic activity familiar and a normal part of adult life. Both of these advantages were due largely to William and Caroline.

Chapter four: John Herschel, from Philosopher to Scientist

In this chapter, I look at the education John Herschel created for himself in the 17 year period immediately following his graduation from Cambridge. Specifically I will look at how this education helped him to do two things: firstly, to establish an identity and reputation in science, one that went beyond being just William Herschel's son; and secondly, to formulate and promote a definition of science, by investigating different sciences and finding common ground between them. This study of John Herschel's development highlights various factors involved in both creating a reputation in science and promoting science to the general public. John Herschel understood and exploited the importance, in reputation building, of meeting and being publically linked with the right people. He was also aware of creating public displays of his proficiency in different scientific areas primarily, though not exclusively, through writing. In promoting science to the public he recognised not only the need to write accessibly, but also to find familiar connections with his audience. Following the example of his mentor, Clarke, he presented science in terms of civility. He also made sure his audience was included in his descriptions of science, providing a role for everyone, not just the scientific elite.

In his paper on Herschel's discovery of 'hypo', a chemical later used in early photography, Sydney Ross describes this period in John Herschel's life as one of 'divided purpose'.[296] Ross's point was to try to explain why Herschel did not follow up this discovery or see earlier how it might be applied to photography. He suggests the reason for this 'divided purpose' was 'a core diffidence and self-distrust'. In this chapter I will argue that first, Herschel's purpose was not divided, but rather non-specialist: the purpose was to find links between the different disciplines. Second, rather than attribute this wide ranging interest to self-distrust, I will suggest that it came from a lack of necessity to specialise. Unlike his father, or most of his peers, John Herschel had the luxury of investigating a range of disciplines to discover precisely what it was he really wanted to do with his life.

In a much earlier paper, Ross suggests that, as a rule, men of science in the nineteenth century opposed the transformation of science into a profession, regarding it

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[296] Sydney Ross, "Herschel and Hypo," in *Nineteenth-Century Attitudes: Men of Science*, ed. Sydney Ross (Dordrecht: Kluwer, 1991), p. 184.

as a downgrading of their art.[297] In this chapter I will suggested that the opposite was true of John Herschel. Ross spoke for those, like Michael Faraday, who had used science to raise their social status and so relied on science remaining primarily the preserve of the leisured classes. John Herschel meanwhile, spoke for those who were already part of this social class. He spoke for those with a university education and a profession who had been pushed out of science by the need to earn a living. For these men, making science a profession would allow them to maintain their social status, earn a much needed income, and devote a much greater portion of their time to science. These men were his friends at Cambridge and for a brief period after graduation, his role models. It was their interests, and the interests of men like them that he had in mind when he argued for the need to have some professional men of science in his *Preliminary Discourse* in 1830.

Herschel's *Preliminary Discourse* helped to secure his status as the exemplary nineteenth century man of science. In the 1830s, artist and critic John Ruskin referred to having 'met the leading scientific men of the day, from [John] Herschel downward.'[298] That is to say he saw Herschel as the top of the British scientific hierarchy, exemplary of what it was to be a scientific man at that time. Similarly Walter Cannon described the definition of a scientist by the mid-nineteenth century as being to '[b]e as much like Herschel as possible'.[299] Michael Crowe has asserted that John Herschel was 'one of the most important science teachers of his age.'[300] Allan Chapman states that 'John Herschel epitomised science and the scientific establishment to the nation at large'.[301] In this chapter I will explore some of the factors involved in enabling him to become this central figure in nineteenth century British science.

John Herschel left university a promising graduate burdened with a great scientific family name. By the 1830s he was one of the most widely known scientific men of his day. His *Preliminary Discourse* is generally considered to be the main reason for this transformation. Steven Ruskin, taking up an argument first put forward

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[297] Ross, "Scientist: The Story of a Word."
[298] Quoted in Crowe, ed., *A Calendar of the Correspondence of Sir John Herschel*, p. 1.
[299] The term scientist was only coined in 1833 - Walter F. Cannon, "John Herschel and the Idea of Science," *Journal of the History of Ideas* 22 (1961); Ross, "Scientist: The Story of a Word.", p. 219.
[300] Michael J. Crowe, "John Herschel: Britain's First Modern Physical Scientist" (paper presented at the John Herschel, 1792-1992: Bicentennial Symposium, Herschel School, Claremont, South Africa, 1994 1992).
[301] Allan Chapman, "An Occupation for an Independent Gentleman: Astronomy in the Life of John Herschel," *Vistas in Astronomy* 36, no. 1 (1993), p. 71.

by Cannon, suggests that it was John's expedition to the Cape a few years later that really made Herschel's name.[302] I will argue in this chapter that in fact it was neither one nor the other single pivotal moment that made his name. Instead his ideas and reputation gradually developed over a number of years, leading first to his *Preliminary Discourse*, whose audience was wide but still limited to those who bought books on science and natural philosophy, and then his Cape voyages which spread his name further through stories in the popular press. As we shall see, although the *Preliminary Discourse* cemented that reputation within certain circles, it had already been developing, gradually, for many years.

The making of a scientific career (1813-1816)

Allan Chapman described John Herschel as the last of the independent gentlemen amateurs.[303] In this section I will argue that while this is what he eventually became, and was precisely the future his father had trained him for, it was not John's original ambition. John wanted to follow his friends and have a career. However, he wanted a career he found intellectually absorbing and that proved difficult to find. Over this three year period between graduation and returning home to live with his parents, John tried out a number of different activities. He toyed with becoming a lawyer, dabbled in chemistry then turned his attention to mineralogy. At each stage, his concept of what he might do with his life, and of how these different scientific disciplines fitted together, developed and changed. Gradually he began to identify common ground between the different sciences and to see himself as a generalist. He began to develop arguments for why the pursuit of science might be beneficial to society and so deserve a professional status akin to those careers he had originally considered pursuing in the church and the law.

The debatable merits of the different professions

John, as we have seen in chapter three, left Cambridge unclear as to what he should do with his life. He had excelled academically, but feared a future at Cambridge which

[302] Steven Ruskin, *John Herschel's Cape voyage: private science, public imagination and the ambitions of Empire,* (Aldershot: Ashgate 2004)
[303] Allan Chapman, *An Occupation for an Independent Gentleman: Astronomy in the Life of John Herschel* (Oxford: Pergamon 1994).

might leave him 'forgotten and unlamented'. While John was agonising over what he should do with his life, William carried on as he always had, attempting to shape his son's future. William saw John's future in science, supported by family money. John meanwhile felt he should earn his own living. In attempting to accommodate John's wishes, William suggested he train for the Church. Explaining further what he hoped to get out of working life, John countered that he might prefer the law. In his discussions with friends and family on the relative merits of these two professions, and in his justifications of why he should find work at all, John began to formulate an idea of what would be desirable in a career.

John graduated on 16 January 1813[304] and was then elected a fellow of St John's College.[305] John's father, William, wrote at this time to ask Sir Joseph Banks to nominate John as a member of the Royal Society:

> You will readily forgive me if I should express a wish to see my Son's name among the list of members of the Royal Society. I can truly say that were he not my son and I knew him as much as I do I should readily sign the usual certificate, and in case of your approbation I am in hopes several of my friends, such as Sir Ch. Blagden, Dr Wollaston, &c., who have already personal knowledge of him, will be so good as to put their names to the required form.[306]

For William, a fellowship of the Royal Society was the next step to his son becoming a member of the scientific elite. John was accepted and became a fellow of the Royal Society aged 21.[307] Besides his father's backing and that of his father's friends, John had written two well received papers on mathematics for the Royal Society. He had also published two (anonymous) articles in *Nicholson's Journal* to merit this fellowship.[308] With the help of his father he had acquired a Cambridge degree,

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[304] From newspaper clippings catalogued together with a much earlier letter from John F. W. Herschel to William Herschel, 5 February 1812 held at HRC: folder L0549.
[305] John Whittaker to John F. W. Herschel, 4 May 1813, RS: HS 18.239.
[306] Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 339.
[307] See the following paper to confirm this is unusually young - Arthur Schuster, "On the Life Statistics of Fellows of the Royal Society," *Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character* 107, no. 743 (1925).
[308] John F. W. Herschel, "On a Remarkable Application of Cotes's Theorem," *Philosophical Transactions of the Royal Society* (1813); John F. W. Herschel, "Consideration of Various Points of Analysis," *Philosophical Transactions of the Royal Society* (1814); John F. W. Herschel, "Analytical Formulae for the Tangent, Cotangent, &c," *A Journal of Natural Philosophy, Chemistry, and the Arts (Nicholson's Journal)* 31 (1812); John F. W. Herschel, "Trigonometrical Formulae for Sines and Cosines," *A Journal of Natural Philosophy, Chemistry, and the Arts (Nicholson's Journal)* 32 (1812).

membership of the Royal Society and a college fellowship to support him over the next five years. He also had the promise of his parents' financial support making him perfectly prepared to begin a life as a man of science in the same vein as his father. John however was less clear about his future.

Following graduation, most of his friends – none of whom, as Harvey Becher has observed, had the financial security of coming from the aristocracy – began training for a profession since few could rely on family money to support them.[309] George Peacock, John Whittaker, Richard Gwatkin, and a little later William Whewell had taken up university fellowships and positions as tutors to support themselves as they trained for the Church. Edward Broomhead and James Grahame had begun training for careers in the law. John decided that he too wanted to study for a profession. He had found friends at Cambridge and it seems he wanted to follow their example of joining a profession and earning an independent living. John's sudden desire to earn a living surprised his father:

> You mention the necessity of a mode of acquiring a living, and that a man should have some ostensible means of getting his bread by the labour of his head or hand, as if you already found yourself in confined circumstances, or had no expectation of assistance from your parents, which you will know is not a just idea of your situation.[310]

To William, John had everything he needed, everything he, William, had felt he lacked – financial security, a place within the scientific elite, and a well structured and diverse mathematical education. But John, I argue here, wanted to be like his friends. Like them, he felt he needed a profession. To Whittaker he admitted reservations about devoting himself full time to analytical mathematics, telling him that while he enjoyed mathematics, 'analysis is not the object of human existence, nor the bond of human society' and he would therefore devote no more than 3 hours a day to it.[311] The rest of the time he would spend engaging in some way with society, though at the time of writing this letter, he had not quite settled on what.

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[309] Becher, "Radicals, Whigs and Conservatives: The Middle and Lower Classes in the Analytical Revolution at Cambridge in the Age of Aristocracy."
[310] William Herschel to John F. W. Herschel, 8 November 1813, Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, p. 349.
[311] John F. W. Herschel to John Whittaker, 20 July 1813, SJC.2.

If John must pursue a profession, his parents told him they would prefer the Church. A clergyman after all would have plenty of spare time, 'without the least derangement of his ostensible means of livelihood'. He would have, William argued,

> time for the attainment of the more elegant branches of literature, for poetry, for music, for drawing, for natural history, for short pleasant excursions or travelling, for being acquainted with the spirit of the laws of his country, for history, for political economy, for mathematics, for astronomy, for metaphysics, and for being an author upon any one subject in which his most advantageous and respectable situation has qualified him to excel.[312]

John need not worry too much about his lack of total belief since even '[t]he most conscientious clergyman may preach a sermon full of sound morality, and no one will require him to enter into theological subtleties.' John however preferred the idea of the law, despite William's assertion that it was 'crooked, tortuous and precarious.' He preferred it because he felt it had 'an unbounded scope for the exercise of the labour of the head', that is, he was interested in what he understood as the intellectual nature of the work itself. This is in contrast to William's concern that any career should be chosen in accordance with how much spare time it allowed for his pursuit of science.[313]

William and John's differing aspirations for John's future also had a political dimension. John once described himself to Whittaker as 'a poor snivelling democratic dog' in an 'aristocratic world'.[314] In a letter to Babbage, as Becher has pointed out, he once signed himself 'citizen' in reference to the revolutionaries in France. These passing comments indicate that in terms of the French Revolution he had greater sympathy for the revolutionaries than for the aristocrats. In that context, the idea of becoming a leisured, genteel man of science, living off family money would have had little appeal against the prospect of earning his own living. William meanwhile kept quiet about his political affiliations. He had friends in post-revolutionary France, but he also relied on the King for his and his sister's income. While he may have had more in common with the revolutionaries than the aristocrats, the British aristocracy had been good to him and he saw no need to support any change of political system.

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[312] William Herschel to John F. W. Herschel, 8 November 1813, Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, pp. 348-350.
[313] William Herschel to John F. W. Herschel, 8 November 1813, Ibid., pp. 348-350.
[314] John F. W. Herschel to John Whittaker, 7 July [possibly 1815 since letter contains references to 'the exploits of the everlasting Wellington'] SJC.9.

John's exchange with his father gives an indication of the differences in how each viewed paid work. For William it was work that provided an income without impinging too much on the work one did for enjoyment. The Church for this reason was preferable to the law. John on the other hand felt he should be able to find financial security and an intellectual challenge in the same career. Given he had grown up with William and Caroline, both of whom received a pension for the work they loved, this was not an unnatural assumption. At this stage, he seems unconcerned about how, if at all, he was to fit mathematics or science into his daily adult life; instead his focus was on a moral, political and social desire to earn his own living and not simply live off inherited wealth.

Law and Chemistry

John entered Lincoln's Inn ready to begin his training as a lawyer in January 1814. While he liked the idea of training for a profession, the reality was not as appealing. Instead of paying attention to his lectures at Lincoln's Inn, he wrote to his friends about the lectures he attended at the Royal Society, in particular those on chemistry. While he wanted a career, he found he liked chemistry much better than the law.

Chemistry in London in 1814 was a popular and fashionable subject thanks in large part to Humphry Davy. His lectures at the Royal Institution drew large crowds, while the published version of these lectures, Davy's *Chemical Philosophy,* was widely read. Over one third of the papers published in the *Philosophical Transactions* in 1814 were on chemistry. For John, it had the added appeal of being a subject in which his best friend, Charles Babbage, had just taken up. As he told John: 'I have been chemicising a good deal and have met with much success in cutting, burning and defacing my own hands. Such things must be endured, I hope you will soon come and assist me'[315]. Inspired, Herschel began to take particular note of the chemistry lectures at the Royal Society as he told Babbage:

> I have a good deal of chemical news for you, the 2nd part of the Phil Trans contains 2 papers by Berzelius & Marcet on the sulphured of carbon {alcohol of sulphur} h/w we were making. They have decomposed it. It consists of sulphur 84.83 carbon 15.17}100 or 2 atoms of sulphur to one of carbon. It contains no hydrogen. It unites with Sir H. Davy's cholorite of azote (azotane), the new detonating substance, with out detonation, & the compound does not

[315] Charles Babbage to John F. W. Herschel, 12 January 1814, RS: HS 2.21.

> detonate – Berzelius says that in the way we proceeded, he has made as much as half a pint in a day[316]

Herschel's letters to Babbage, his most frequent correspondent at this time, make no mention of his legal studies, only mentioning his scientific activities, and regular visits to the Royal Society. 'I was last Thursday at a meeting of the Royal Society where a paper of Davy's was read of a highly curious nature. It seems that a new substance (Ei ode or iode[iodine]) has been discovered by a saltpetre manufacturer…'[317] In this letter he went on to give details on how to recreate the experiment at home. 'I have been again to the RS – Wollaston had some Iode in a glass tube – you may make it by pouring sulphuric acid on the ashes of kelp from which the soda has been exhausted.'[318] While these Royal Society lectures would have occupied only a few hours a week, more time was then given over to following up what was learned through reading old papers and trying out the experiments described and/or demonstrated. By April 1814, his involvement with this new subject was such that his old friend Whittaker could describe him as 'a mineralogist & a chymist, & a 'grand philosopher''.[319]

While John spent little of his time in London studying law, the period was nonetheless an important part of his education. This was his first attempt at teaching himself something new. Chemistry was not only a new subject to him, but also involved a new way of learning, through practical, hands-on experimentation. Experimental work would not have been part of his Cambridge education, nor is there any reference to it in any account of in his pre-university education at school or in his lessons with his private tutors. This was an area of scientific research he and Babbage were teaching themselves through reading and listening to lectures and trying out what was described.

The idea of practical work in science would not have been as unusual to him as for many of his peers because of his unusual family background. His family home and grounds had after all contained astronomical apparatus and a chemistry laboratory. However, this was still a new stage in his education. All his father-led training to date suggests William's wish was for John to become a grand natural philosopher.

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[316] John F. W. Herschel to Charles Babbage, 26 January 1814, RS: HS 2.22.
[317] John F. W. Herschel to Charles Babbage, 26 January 1814, RS: HS 2.22 –N. B. this is Iodine, and the discovery is something he uses as an example in his *Discourse* so obviously made an impression on him.
[318] John F. W. Herschel to Charles Babbage, 26 January 1814, RS: HS 2.22.
[319] John Whittaker to John F. W. Herschel, addressed to St. John's, 18 April 1814, RS: HS18.242.

Whittaker's comments indicate that while this was an aim John could relate to, he was also interested in other things. This dip into experimental chemistry suggests John was not content simply to follow his father's prescribed path, but was actively trying to find his own area of scientific interest and expertise.

While he had not given up the idea of finding paid work, of 'getting his bread by the labour of his head or hand', he had found, just a few months into his studies, that he was ill suited to the law. He much preferred attending scientific lectures at the Royal Society and Royal Institution. He had begun to re-evaluate his aim of finding a professional career that might encapsulate all his interests. Through the scientific lectures he attended while in London, he had discovered a new interest in practical work, in using his head and hands to investigate the world around him through experiment. He had identified the work he enjoyed, but had still to work out how this might help him to earn 'his bread'. This new experimental science was a departure from the astronomy and mathematics he had grown up with, it was a move away from the family specialism. He had begun to expand his understanding of what constituted the sciences.

Mineralogy, Cambridge & Clarke

John officially gave up his legal studies in November 1815, though he had left London, and with it any pretence of attending lectures at Lincoln's Inn, back in the summer of 1814.[320] After a summer at home with his parents, he returned to St John's as a fellow in September 1814 bringing with him all that he had acquired in London. Back in Cambridge, John discovered mineralogy and a mentor, Edward Daniel Clarke. Herschel's relationship with Clarke is entirely absent in the literature on both these figures. Clarke was significant to Herschel's career because he treated him not as his father's son, but as his own student and protégée. He would become still more important when John returned home to work with his father and they exchanged letters. At this stage, however, in 1814 and 1815, they were just getting acquainted. John began attending Clarke's lectures and trying his hand at some mineralogical analyses.

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[320] John F. W. Herschel to Charles Babbage, 10 September 1815, RS: HS 2.39; John F. W. Herschel to Charles Babbage, 11 October 1815, RS: HS 2.42; James Grahame to John F. W. Herschel, 3 November 1815, RS: HS 8.269; John F. W. Herschel to Charles Babbage 6 November 1816, RS: HS 2.44; James Grahame to John F. W. Herschel, 18 September 1814, RS: HS 8.265. All chart John's plans to move to Cambridge and give up law.

John had, it can be inferred from Whittaker's earlier comment[321], already come across some mineralogy in London. In Cambridge he began to take a greater interest. 'I have been attending Clarke's lectures' he told Babbage, '& am becoming half a mineralogist & have been analysing some of his specimens for him'.[322] From Herschel's point of view, mineralogy, at least the type of mineralogy he was interested in, was closely related to chemistry. This was not a sudden change of direction, but rather a development as he moved from looking at the composition of chemicals to that of minerals.

Clarke's lectures had proved immensely popular in the first decade of the nineteenth century resulting in his appointment as the first Professor of Mineralogy in 1807.[323] Brian Dolan has argued that the integration of science into Georgian English education, as Clarke did with mineralogy, depended on being able to present it in terms of the traditional values of English education. It should improve and should reinforce British politeness and civility. In this context civility meant the reproduction of English liberal values through education.[324] Clarke managed to do this at Cambridge by 'incorporating information drawn from the earth sciences into traditional components of gentlemanly education, such as travel and classical studies.'[325] In the lectures John attended, Clarke presented an image of the Earth Sciences that suggested that studying the natural world added to a civilised and cultured understanding of the world around us. John would later extend and promote this idea in his *Preliminary Discourse* by arguing that science as a whole is what makes our society civilised. While John makes no overt reference to the impact these lectures had on his understanding of science and its use to society, I argue that they planted some seeds in his mind that would later be developed through other experiences.

Through Clarke, Herschel not only discovered a new science to practice but a new understanding of what science is and how it relates to society. When he left Cambridge in 1813, he had struggled with the idea that he should earn a living and in some way make a contribution to society. Now returning a couple of years later, he was introduced to science as a means not of personal advancement, as his father saw it,

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[321] 'a mineralogist & a chymist, & a 'grand philosopher', John Whittaker to John F. W. Herschel, 18 April 1814. RS: HS18.242.
[322] John F. W. Herschel to Charles Babbage, 23 March 1815, original at HRC; BL: microfilm M/588(1).
[323] Brian P. Dolan, "Governing Matters: The Values of English Education in the Earth Sciences, 1790-1830" (University of Cambridge, 1995), p. 8 – PhD thesis
[324] Ibid., p. 5
[325] Ibid., p. 6

but as a means of improving, and making more civilised the world around him. This, I argue, was a crucial step in helping John to begin to see how science might become a profession. If science was good for civilised society, then it followed that society should support the existence of professional practitioners and developers of science. I will return to John's relationship with Clarke a little later in this chapter, as it developed in correspondence after John left Cambridge.

Science writing

Between 1813 and 1816 Herschel and Babbage made various attempts to earn a living in science. In doing so they found there were very few opportunities available. By November 1815 John had identified science writing as his best option, allowing him to earn a living, build a reputation and make a case for the importance of science to the wider public.

Herschel and Babbage began their writing careers in the summer of 1813 when they published, at their own expense, their *Memoirs of the Analytical Society*. It had a print-run of 100 copies, while an additional 150 were printed for Herschel and Babbage's own private use, presumably intended as a means of recouping some of their money.[326] After this their careers took slightly different trajectories, though their aims seem to have been similar and they frequently compared notes. Both of them wanted (or needed, though not as desperately as their friends) to earn money, while simultaneously pursuing the subjects they loved. Babbage's job hunting successes and failures, coupled with his own, gave John a better, broader, understanding of his available options than would have been gained on his own experience alone.

In August 1814 Babbage looked into the possibility of becoming an assistant to a local mineralogist.[327] In March 1815 he wrote optimistically to Herschel of the newly vacant post of Professor of Chemistry at Cambridge.[328] Meanwhile Herschel had given up law and was back in Cambridge teaching as a sub-tutor, while attending Clarke's lectures.[329] A few months later, in early 1816, Babbage applied (unsuccessfully) for another professorial position, this time of mathematics at the East India Company College.

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[326] Jonathan Topham, "A Textbook Revolution," in *Books and the Sciences in History*, ed. Marina Frasca-Spada and Nicholas Jardine (Cambridge: 2000), p. 326.
[327] Charles Babbage to John F. W. Herschel, 10 August 1814, RS: HS 2.29.
[328] Charles Babbage to John F. W. Herschel, 23 March 1815, RS: HS 2.38.
[329] Thomas W. Hornbuckle to John F. W. Herschel, 2 May 1815, RS: HS 9.482.

In the midst of this job seeking, in November 1815, Babbage wrote to Herschel telling him he had been offered space in a magazine for reviewing mathematical subjects.[330] He suggested either he or John should write an anonymous work on analysis for the magazine and John was quick to reply that despite having had no time for mathematics recently, he would be happy to do it.[331] Babbage did not see writing as a solution to his employment problems; the immediate return on a single article would not have been enough for the work involved. To become a successful author would take time and involve some insecurity, especially at the start, as contacts and a reputation were built. Babbage had a growing family and felt he needed the security of a salary. John, with less immediate need for money, saw that this might be the very means though which he could earn a living and a reputation in a field he enjoyed.[332] As Topham has observed, when marketed well, there was growing opportunity to make a comfortable living as an author in Britain and especially Cambridge in the early nineteenth century.[333] If John could gain some experience and some contacts writing, he might be able to work towards becoming such an author.

Herschel also heard that Babbage was writing for the *Journal of the Royal Institution*, and stated that he too would like to write articles for an encyclopaedia.[334] They were at this time working together on a translation of Lacroix's *Elementary Treatise on the Differential and Integral Calculus*. This was a textbook aimed at the Cambridge market and initially discussed within the Analytical Society back in their student days. A few days later he told Babbage of his plans to write a book on Newton, suggesting he was now seriously considering a career as a writer.[335]

> I mean to publish, if the university will aid & albeit it I intend also offering to undertake a Cambridge edition of Newton provided I stay in Cambridge which I am not quite decided upon... I hear you have been writing papers for this new journal of the Royal Institution. Who are the editors of it? Will they pay one for writing? Or do you know anybody who will? I should like to get to write articles for some of these encyclopaedias if I could

[330] Charles Babbage to John F. W. Herschel, 13 November 1815, RS: HS 2.47.
[331] John F. W. Herschel to Charles Babbage, 20 November 1815, RS: HS 2.48.
[332] Charles Babbage to John F. W. Herschel, 9 March 1816, RS: HS 2.58.
[333] Topham, "A Textbook Revolution.", p. 332.
[334] John F. W. Herschel to Charles Babbage, 14 July 1816, RS: HS 2.64.
[335] Charles Babbage to John F. W. Herschel, 20 July 1816, RS: HS 2.65.

In summing up his newly formulated career plans he concluded: 'In a word I want to get money and reputation at the same time, and to give up cramming pupils, which is a bore & does one no credit but very much the contrary.'[336]

Herschel's announcement to Babbage in this letter of his writing plans gives an indication of the type of writing he was hoping to turn into a career. He names three possible outlets for his writing – a Cambridge funded book on Newton, papers for the Royal Institution's new journal, and articles for 'some of these' encyclopaedias. All were aimed at roughly the same literate mass market audience, a similar, though slightly broader, audience than the one imagined for their Analytical Society publications. On the one hand, this made commercial sense since if this was to be a source of income then the audience needed to be as large as possible. On the other, it made sense in terms of building a reputation separate to his father's since it would allow him to appeal directly to the public rather than wait for an academic reputation to filter down.

By this date, July 1816, John had only a very limited academic reputation. He had been a fellow of the Royal Society for three years, had published only one paper in the *Philosophical Transactions* in mathematics and the *Memoirs of the Analytical Society* since graduation. At Cambridge he was better known, but again primarily as the son of William Herschel and as a mathematician. His work with Clarke helped, but only within a relatively limited circle.

Between graduating in 1813 and returning home in 1816 Herschel gradually developed an idea of what it was he wanted to do with his life, an idea he modified in the light of experience, encountered ideas and available opportunities. As we have seen, after graduating he wanted to follow his friends and train for a career. On starting his training however he found that he didn't enjoy law, but did very much like experimental chemistry and so began to conclude that his career should in some way involve this science. From chemistry he moved to mineralogy and with it found a mentor in Edward Clarke who helped him to start building a reputation beyond that of the mathematically gifted son of a famous astronomer. At the same time he began to consider how writing might give him the career he wanted. By writing for different audiences he could build a wide reaching reputation, while at the same time promote the subjects he saw as important.

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[336] John F. W. Herschel to Charles Babbage, 14 July 1816, RS: HS 2.64.

Back in Slough (1816-1820)

In October 1816 William asked John to return home to train under him in instrument making and observing and ultimately to help him complete his survey of the northern hemisphere. William had recently been ill, and was by then in his late 70s. John agreed and returned home. Back in Slough, John was reintroduced to astronomy and optics. The move helped him to find connections between these sciences and those he had been studying away from his family in London and Cambridge. The move also allowed him to fulfil a wish he had recently articulated to Babbage, of writing for some of these encyclopaedias.

Back home with his family in Slough between 1816 and 1820 John Herschel began to settle down and clarify his future plans and the image he wanted to present. Having established that writing would best fulfil his desire to get 'money and reputation at the same time' he next set about establishing precisely what it was he was expert in and could therefore write about with authority. Gradually he came to see his strength not in any one subject, but as a generalist, bringing the sciences together. Through his writing and self promotion he then set about making sure everyone else saw him the same way.

His first task on returning home was to begin his training in instrument making and observing. He was sent on errands to get mirrors cast, he was set the task of sketching the different stages involved in telescope building, and together, John and his father rebuilt William's 20ft reflector. [337] Like Caroline, John was given a journal in which to record his 'sweeps'. This was his training as an observer, to systematically 'sweep' every part of the night's sky and so practice the art of observing in the style of his father and aunt.[338] By 1821 his training as an observer was considered sufficiently complete that he was able to collaborate outside the family, on an observing project with his friend James South.

In addition to his new training in astronomy and instrument making, John continued his studies in mineralogy. In place of attending his lectures John began a long and profitable correspondence with his old mineralogy lecturer, Edward Clarke.

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[337] William Herschel to John F. W. Herschel, Slough, 26 May 1817, RAS: WH.1/11.4 (photocopied manuscript); Drawings of the result of experiments on the construction of mirrors (made by John F. W. Herschel, under the supervision of William Herschel), RAS: WH. 5/14.2; Chapman asserts that John's 20ft reflector telescope was built by John under William's supervision in the 1810s. Chapman, *An Occupation for an Independent Gentleman: Astronomy in the Life of John Herschel*, p. 5.

[338] John F. W. Herschel's observing journal No. 1, first entry 12 October 1816, RAS: JH.1/1.

Here, Clarke not only set John the task of 'analysing some of his specimens for him'[339], he also explained to him what he did with the information and specimens, taking him through, step by step, the process of his research:

> The reason why the substance you sent, so particularly interests me is this: that you state its analysis according to Mr Lowry as equal to 999/1000 of carbon. Now I have some reason to suspect that both diamond and charcoal have afforded proof of their metallic nature; and from the appearance of your carbon, I have very little doubt but that I shall be able to return it to you in metallic globules. To do this I shall light up a fire that shall put some more of Mr Harman's boxes to the test. It will be impossible to succeed with tubes that are too capillary.- I have now a screen that protects me; but indeed you were in great danger when you sat by me before the naked blow-pipe; as I then used the identical tube which has caused this last explosion.[340]

Like John's old mathematics tutor Alexander Rogers, Clarke's method of teaching was to use his own experience as an example to John rather than give instructions. This gave John a glimpse of the process involved in working something out that he could then apply to new problems. Clarke also introduced him in scientific gatherings as his research assistant. On one (typical) occasion he wrote to John that '[y]ou will greatly oblige me if you will join the usual congregation of sages and philosophers some Sunday evening at Sir Joseph Banks' - to shew [sic] Sir Joseph and his friends the specimen I gave to you of titanium revived by the gaseous blow-pipe'.[341]

Herschel's relationship with Clarke is comparable, in a number of ways, to Charles Darwin's with his professor, and coincidently Clarke's successor, John Stevens Henslow. In both cases the professors were at the height of their careers running well attended lecture courses but saw in Herschel and Darwin respectively an interest in their subject beyond that of the majority of their students. They were singled out, or perhaps singled themselves out with some well placed requests for help and advice. Certainly Janet Browne has suggested that Darwin was, at the point of meeting Henslow, ready to seek out a mentor.[342] This also seems to be true of Herschel who, having tried out some chemistry based on his reading, attending lectures and practising with Babbage, was ready to take his studies in mineralogy a step further.

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[339] John F. W. Herschel to Charles Babbage, 23 March 1815, RS: HS 2.38.
[340] Edward Daniel Clarke to John F. W. Herschel, Cambridge, 1 December 1816, RS: HS 5.256.
[341] Edward Daniel Clarke to John F. W. Herschel, Cambridge, 12 March 1817, RS: HS 16.258.
[342] Browne, *Charles Darwin: Voyaging*, p. 124.

John's development as a mineralogist was helped not only by his work with Clarke but by Babbage, who had also made the move from chemistry to mineralogy. 'I am at present very much engaged with mineralogy and have not much time to think of abstract truth',[343] Babbage told John in March 1818. The pair passed not only news and papers between them but also specimens:

> I have sent you some word Opal and some noble serpentine and some Obsidian from Iceland, with which I hope you may cut your fingers as much as I have done. We must fag [?] as mineralogy before our Cornish expedition and be able – us – astound the natives by pronouncing sphacro-si-aderite and Ayrophisalite and every other ugly break tbothite – I send also a few fragments of coerit very rare.[344]

With Babbage, Herschel could practice what he had learned, and play around with ideas and ways of presenting ideas without having to worry about impressing anyone.

One result of continuing his work on mineralogy and chemistry while at the same time taking lessons from his father in optics, was that John now began to develop an interest in polarisation. By June 1818 news of this interest had reached Cambridge provoking his friend William Whewell to comment: 'I understand from Peacock that you are ... cross examining every ray that passes within half a mile, & patting the awful question 'polarised or not polarised' to thousands that were never before suspected of any intention but that of moving in a straight line'.[345] By November 1818 John was able to describe 'a very beautiful optical phenomenon in crystals'[346] to Babbage from this work. By 1820 he was publishing papers on it.[347]

Up to this point, although Herschel had been working in a range of sciences – chemistry, mineralogy and now optics – all his published work was in mathematics. He had published two anonymous papers on mathematical problems in *Nicholson's Journal* as an undergraduate.[348] He had published a few papers in the *Philosophical*

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[343] Charles Babbage to John F. W. Herschel, 16 March 1818, RS: HS 2.91.
[344] Charles Babbage to John F. W. Herschel, 16 March 1818, RS: HS 2.91.
[345] William Whewell to John F. W. Herschel, 19 June 1818, RS: HS 18.159.
[346] John F. W. Herschel to Charles Babbage 9 November 1818, RS: HS 2.97.
[347] John F. W. Herschel, "On the Action of Crystallized Bodies on Homogeneous Light, and on the Causes of the Deviation from Newton's Scale in the Tints Which Many of Them Develop on Exposure to a Polarized Ray," *Philosophical Transactions of the Royal Society* (1820); John F. W. Herschel, "On the Action of Crystallized Bodies on Homogeneous Light, and on the Causes of the Deviation from Newton's Scale in the Tints Which Many of Them Develop on Exposure to a Polarized Ray," *Thomson, Ann. Phil.* 1 (1821).
[348] Herschel, "Analytical Formulae for the Tangent, Cotangent, &C."; Herschel, "Trigonometrical Formulae for Sines and Cosines."

Transactions of the Royal Society both before and after graduating.[349] He and Babbage had published their *Memoirs of the Analytical Society* in the summer of 1813. In 1816 they followed this was a translation of Lacroix, a textbook aimed at Cambridge undergraduates, for which they received an advance and a distributer who promised to advertise their work.[350]

Shortly after the Lacroix manuscript was submitted, Herschel was asked if he would edit the papers of William Spence, a Glasgow educated manufacturer who had devoted his leisure time to mathematics.[351] The book was published in 1819.[352] Six months after he had begun work on the Spence papers, in June 1817, David Brewster asked William if John might write some articles for his *Edinburgh Encyclopaedia*. He wrote: '[t]he very able papers which your son Mr Herschel has communicated to the Royal Society have made me anxious for some time to request the favour of his assistance in writing some mathematical articles for the Edinburgh Encyclopaedia'.[353] Two articles eventually followed in this encyclopaedia, one on 'Isoperimetrical Problems' and another on 'Mathematics' though neither were published until 1830.

All of these publications were in mathematics. His Royal Society papers in mathematics earned him the Copley medal in 1821 but it still made him a mathematician rather than a generalist. It gave no reflection of his broad range of interests. Then in 1820 his work in chemistry, mineralogy, optics and those points at which the subjects overlapped, was ready, and he published a series of academic papers in a range of scientific journals both in Britain and abroad. In the *Edinburgh Philosophical Journal* he published papers on a new acid and its chemical properties as well as two essays on the optical properties of various chemical structures.[354] In the

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[349] Herschel, "On a Remarkable Application of Cotes's Theorem."; Herschel, "Consideration of Various Points of Analysis."; John F. W. Herschel, "On the Development of Exponential Functions, Together with Several New Theorems Relating to Finite Differences," *Philosophical Transactions of the Royal Society* (1816).

[350] Topham, "A Textbook Revolution.", pp. 332-333.

[351] John Galt to John F. W. Herschel, 6 December 1816, RS: HS 8.34 – letter doesn't mention why Galt chooses him.

[352] John F. W. Herschel, ed., *Mathematical Essays by the Late William Spence, Esq.* (London: 1819).

[353] David Brewster to William Herschel, 11 June 1817, RS: HS 4.241; John F. W. Herschel to David Brewster, 19 June 1817, RS: HS 20.45.

[354] John F. W. Herschel, "On the Hyposulphurous Acid and Its Compounds," *Edinburgh Philosophical Journal* 1 (1819)*; John F. W. Herschel, "On the Hyposulphurous Acid and Its Compounds," Annal. De Chimie 16 (1820); John F. W. Herschel, "On the Hyposulphurous Acid and Its Compounds," Annales generales des sciences physiques 3 (1820); John F. W. Herschel, "On the Hyposulphurous Acid and Its Compounds," Trommsdorff, N. Journ. d. Pharm. V, no. St. 2 (1821)*; John F. W. Herschel, "Additional Facts Relative to the Hyposulphurous Acid," *Edinburgh Philosophical Journal* 1 (1819); John F. W. Herschel, "On the Application of a New Mode of Analysis to the Theory and Summation of Certain Extensive Classes of Series," *Edinburgh Philosophical Journal* 2 (1820); John F. W. Herschel, "On the

Philosophical Transactions he presented a paper on the optics of crystals.[355] Alongside these he also published papers in the *Philosophical Transactions* on the separation of metals as well as others, presumably the result of work with his father, on compound lenses and astronomical observations.[356]

Even before these publications came out news of his work with Clarke in mineralogy, and with his father in astronomy and optics, had spread to Cambridge. There, his new working relationship with his father gave his name weight in the field of astronomy so he was now asked to contribute to plans for a proposed observatory.[357] Similarly, his association with Clarke and his work in mineralogy prompted both Thomas Catton and Miles Bland to suggest John might apply for the post of Woodwardian Professorship in Geology.[358] Having become more settled in his current situation, however, John did not apply for the job. Similarly when Peacock sent him a list of forthcoming professorships at Cambridge he did not apply for any of these. Instead he preferred to continue to work at home on telescope building and astronomy, on his experiments in chemistry, mineralogy and optics, and on his writing.

By the end of 1818 Herschel had established himself as an experimenter and man of science almost exclusively through networking. His publications outside of mathematics did not materialise until 1820. When he did eventually publish, his papers showed the connections he was building between the different sciences. They did not show the development of any specific new specialism to replace his reputation

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Optical Phenomena Exhibited by Mother of Pearl, Depending on Internal Structure," *Edinburgh Philosophical Journal* 2 (1820); John F. W. Herschel, "Some Additional Facts Relating to the Habitudes of the Hyposulphurous Acid and Its Union with Metallic Oxides," *Edinburgh Philosophical Journal* II (1820); John F. W. Herschel, "The Refractive Power of Hyposulphite of Soda and Silver, and of Nitrite of Lead," *Edinburgh Philosophical Journal* 2 (1820).

[355] Herschel, "On the Action of Crystallized Bodies on Homogeneous Light, and on the Causes of the Deviation from Newton's Scale in the Tints Which Many of Them Develop on Exposure to a Polarized Ray."; Herschel, "On the Action of Crystallized Bodies on Homogeneous Light, and on the Causes of the Deviation from Newton's Scale in the Tints Which Many of Them Develop on Exposure to a Polarized Ray."

[356] John F. W. Herschel, "On the Aberrations of Compound Lenses and Object-Glasses," *Philosophical Transactions of the Royal Society* (1821); John F. W. Herschel, "On the Separation of Iron from Other Metals," *Philosophical Transactions of the Royal Society* (1821); Herschel, "On the Separation of Iron from Other Metals."; John F. W. Herschel, "On the Separation of Iron from Other Metals," *Annal. De Chimie* 20 (1822); John F. W. Herschel, "On the Separation of Iron from Other Metals," *Thomson, Ann. Phil.* 1 (1821); John F. W. Herschel, "On the Separation of Iron from Other Metals," *Jahrbuch fur Chemie und Physik* 32, no. 2 (1821); John F. W. Herschel, "On a New Method of Computing Occulations of the Fixed Stars," *Memoirs of the Astronomical Society* 1 (1822); John F. W. Herschel, "Subsidiary Tables for Facilitating the Computation of Annual Tables of the Apparent Places of Forty-Six Principal Fixed Stars; to Which Is Prefixed a Statement of the Formulae Employed, and the Elements Adopted in Their Construction," *Memoirs of the Astronomical Society* 1 (1822).

[357] George Peacock to John F. W. Herschel, 10 December 1817, RS: HS 13.256.

[358] Thomas Catton to John F. W. Herschel, 9 March 1818, RS: HS 5.221; Miles Bland to John F. W. Herschel, 10 March 1818, RS: HS 4.153.

in mathematics, instead, they show him becoming a generalist. Job offers now came to him, including commissions for articles and various professorships suggested by friends. He could work confidently in a range of sciences, not just astronomy and mathematics but in chemistry and mineralogy as well as a number of areas in which these different disciplines overlapped.

The subjects to which John was attracted were not as disparate as has previously been assumed. Sydney Ross asserted this period in John Herschel's life was one of 'divided purpose'.[359] However, this detailed study of the way in which his interests developed and the work that came out of these overlapping studies suggests the subjects were all linked. In both chemistry and mineralogy his main area of interest was in analysing specimens to find out the sample composition. When he then began to work on optics, he found ways of bringing these different subjects together, looking at the effects of different mineralogical samples on light through the study of polarisation. Far from dividing his purpose, he was seeking out coherence using the various techniques he came across in the different sciences he studied, to investigate properties in some cases of the same samples. In identifying similarities between these different scientific subject areas he was creating a basis from which he would later create a new definition for 'science' as a coherent whole.

Grand Tours (1819-1826)

In this section I will show how John's travels in Europe helped him to develop an independent identity, distinct from that of his father's son. He visited important people, created collaboration opportunities where he could, and he wrote this up at home ensuring his name was linked with important international names in science. He avoided visiting astronomers early on his career, visiting instead men with expertise in sciences not shared by his father. In this way he was able to develop his projected image as a man of science.

In 1819, at the age of 27, Herschel set off with Babbage for Paris. John had been abroad only once before, with his parents to Paris in 1802. This began a series of trips abroad as John copied a trend set by many of his friends. The European Grand

[359] Ross, "Herschel and Hypo.", p. 184.

Tour was still a popular part of a gentleman's education in the early nineteenth century. Herschel and his friends were not quite in the same class as those who could afford to spend several years abroad studying art and culture with their tutors. However, they were able to afford the occasional short holiday. Unlike the Grand Tours of the aristocracy, those carried out by Herschel and his friends had a decidedly scientific edge. Herschel used his to great effect, taking the opportunity to introduce himself to various Continental scientific luminaries. He also, where possible, created situations where he was able to collaborate with them on some piece of experimental science. He took apparatus with him to carry out experiments in new environments and did some sightseeing. These trips expanded the scope of his image creating project, presenting him as an internationally renowned gentleman of science. His Continental collaborators do not seem to have been particularly interested or involved in working with him. He chased them for information and then wrote up the work alone rather than in collaboration with them, but that did not stop him using their names as a way of building his reputation at home.

By 1819 a number of John's friends were or had recently been travelling on the Continent. His mentor, Edward Daniel Clarke, had built his reputation and an impressive mineralogy collection through his travels. In 1816 John's friend George Peacock did some travelling around Italy.[360] In May 1818 John's school friend James Gordon had written with news of his own travels. Then in January 1819 John followed the trend and started to talk of his own travel plans. In taking these trips, John was not only following the example of his friends, he was also tapping into a contemporary trend for this type of educational, contact building fieldwork based travelling.

John's tours shared similarities with the England-based geological tours which Sheldon Rothblatt and Crosbie Smith have described in their separate works on the life of Cambridge undergraduates in the first half of the nineteenth century.[361] These geological trips and reading and travelling parties from Cambridge to the Lake District were, as Rothblatt points out, 'one of the principal ways in which the late Georgian

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[360] George Peacock to John F. W. Herschel, 6 August 1816, RS: HS 13.245.

[361] Sheldon Rothblatt, "The Student Sub-Culture and the Examination System in Early Nineteenth Century Oxbridge," in *The University in Society*, ed. Lawrence Stone (Princeton University Press, 1974); Crosbie Smith, "Geologists and Mathematicians," in *Wranglers and Physicists: Studies on Cambridge Physics in the Nineteenth Century*, ed. Peter. M. Harman (Manchester: 1985).

and early Victorian intelligensia met and formed.'[362] On one level, these trips were networking opportunities. They were also, in some cases, opportunities to try out scientific ideas in the field. In this sense, Herschel's trips were especially similar to those of Sedgwick as described by Smith. Adam Sedgwick was then professor of geology at Cambridge. He made a number of geological expeditions to the Lakes in the early 1820s, to the Isle of Wight, to the Welsh and Scottish coasts and, in 1829, accompanied by Roderick Murchison, to Germany, Austria and Switzerland.[363] Sedgwick's principal aim during these excursions was to follow the course of geological strata, to collect specimens for display in Cambridge, and above all, in the case of his expeditions to Wales with Charles Darwin, to determine the geological structure of Wales.' Sedgwick was taking these trips after becoming professor of geology, and therefore had prescribed for him certain boundaries to the subjects he might reasonably pursue. John meanwhile, had a much broader set of scientific interests. In this period he seemed actively to have been looking for opportunities to develop new areas of research, to expand his definition of what constituted science. His move to London gave him the chance to learn chemistry; his move to Cambridge brought him to mineralogy. These trips abroad allowed him to develop new scientific interests, among them, how barometric measurements might be used as a means of calculating the height of mountains.

In January 1819 Herschel and Babbage travelled to Paris, introduced themselves to, among others, Jean-Baptiste Biot, stayed for three weeks, and then came home. Biot was famous for his work on polarisation, an area of research Herschel was at that time pursuing. When they came home Herschel wrote to Biot who replied with information that John was able to work into an article he was writing on polarisation.[364] In this way John was able to get his work read by an influential figure abroad, and to include his name and corrections in the final publication. This gave his work an edge over his English contemporaries as well as developing his reputation overseas. Herschel's work with Clarke had allowed him to distance himself from his father in one field. Through collaborating with Biot, he seems to have been trying to attempt something similar in another field. By aligning his work in

[362] Rothblatt, "The Student Sub-Culture and the Examination System in Early Nineteenth Century Oxbridge.", p. 296. Trips to the Lake District were described by Smith, "Geologists and Mathematicians.", p. 51.
[363] Smith, "Geologists and Mathematicians.", p. 51.
[364] Jean-Baptiste Biot to John F. W. Herschel, 2 May 1819, RS: HS 4.84; John F. W. Herschel to David Brewster, 15 May 1819, RS: HS 20.70.

polarisation with the world expert, Biot, he was able to distract attention away from his status as William Herschel's son.

Fresh from this first independent trip to Paris, John joined a group of mainly amateur astronomers in 1820 to form the Astronomical (later Royal Astronomical) Society. This would later give him an opening to talk about astronomy and to visit overseas astronomers and observatories on his own terms, without having to introduce himself first and foremost as the son of William Herschel. It was a society which, as William Ashworth has argued, was established 'to enable data to be collected quickly and accurately compared… to act as repositories for the collection of facts, efficient processing and for facilitating the flow of information.'[365] Amateur fact gatherers all over the world, it was proposed, would be encouraged to accumulate data then send it back to a number of London based institutions including the Royal Observatory, Greenwich and the Astronomical Society. At these institutions the data would 'be reduced, classified and interpreted by "intellectually" competent men of science such as Airy and Herschel'.[366] This distinction, between 'amateur fact gatherers'[367] and intellectually competent men of science, Ashworth argues, was part of the society's strategy for convincing government of the need for scientific advisors to the Government and through this gaining public money for scientific projects.[368] In order for some people to be paid for their work in science, there needed to be some criteria to explain why they and not others were chosen. It was a distinction that Herschel would return to in his *Preliminary Discourse.*

In August 1821 Herschel and Babbage set off again, this time to the Alps, travelling through France, Italy, Germany and Switzerland. They took with them apparatus in order to try out some experiments in the field. They took barometric readings at key geological sites, at the top of Mont Blanc, at the Mar de Glace glacier and at the top of Monte Rosa.[369] Once again John quickly followed up his contacts. A few days after returning home he wrote to Professor Pietro Configliachi for barometer readings from the bottom of Monte Rosa so he could compare these with his readings

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[365]William J. Ashworth, "The Calculating Eye: Baily, Herschel, Babbage and the Business of Astronomy," *British Journal for the History of Science* 27 (1994), p. 411.
[366]William J. Ashworth, "John Herschel, George Airy, and the Roaming Eye of the State," *History of Science* 36, no. 2, 112 (1998), p. 163.
[367]Ibid., p. 162.
[368]Ibid., p. 156.
[369] John F. W. Herschel to Mary Pitt Herschel, 15 August 1821, HRC: folder L0515.3; John F. W. Herschel to Mary Pitt Herschel, 15 September 1821, HRC: folder L0515.4.

from the top of the mountain.[370] He and Babbage then immediately wrote up their findings in a paper published both in the *Edinburgh Philosophical Journal* and in the German journal *Notizen aus dem Gebiete der Natur- und Heilkunde (Notes from the field of science and medicine)*.[371]

Pietro Configliachi was Professor of Physics at the University of Pavia. He had been a student of and successor to Alessandro Volta. This incorporation of first Biot's and then Configliachi's help into John's academic published work suggests an attempt to align himself with these professional men of European science. Attending Joseph Banks' party as Clarke's research assistant had helped John to make a name for himself distinct from that of William Herschel's son within the British scientific community. Similarly, publishing a paper, naming Configliachi as his collaborator, in a German journal, helped present him to a European audience without unnecessary comparison to his father.

This was the last trip Herschel took with Babbage. The following year Herschel travelled to France and Belgium, sightseeing with James Grahame, a trip that caused him to be absent from his father's death.[372] Two years later, in 1824, John had run out of available travelling companions as all his friends began settling down, and he was left travelling with his servant, James Child. Herschel and Child travelled through France and various Italian and German states. For the first time, he visited observatories abroad at Paris, Turin and Palermo. Following his father's death and his new role within the Royal Astronomical Society, John could afford to show a more open interest in astronomy than on previous expeditions, without fear of immediate comparison with his father. He also met a large number of important chemists, mathematicians and astronomers and carried out experiments.[373] These experiments

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[370] John F. W. Herschel to Pietro Configliachi, 21 September 1821, Wellcome Trust 65659.

[371] John F. W. Herschel and Charles Babbage, "Barometrical Observations Made at the Fall of Staubbach," *Edinburgh Philosophical Journal* 6 (1821). Also published the same paper in *Notizen aus dem Gebiete der Natur- und Heilkunde.*

[372] Specifically Richard Jones to John F. W. Herschel, 3 September 1822, HRC: folder M0305; Lubbock, *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, pp. 361-2.

[373] Chemists, mathematicians and astronomers include D. F. J. Arago in Paris (ref in John F. W. Herschel to Mary Pitt Herschel, 7 April 1824, HRC: folder L0517.5; also mentioned in John F. W. Herschel to Charles Babbage, 11 April 1824, RS: HS 2.194); Geovanni Plana in Turin; Franz Xaver von Zach in Genoa; Giovanni Battista Amici in Modena (ref in John F. W. Herschel to Mary Pitt Herschel, 26 April 1824, HRC: folder L0517.5; also mentioned in John F. W. Herschel to Charles Babbage, 9 May 1824, RS: HS 2.195 & 20.180); Giuseppe Piazzi and Niccolo Cacciatore in Palermo (ref in John F. W. Herschel to Mary Pitt Herschel, 20 June 1824, HRC: folder L0517.13); Joseph von Fraunhofer in Munich (ref in John F. W. Herschel to Mary Pitt Herschel, 20 September 1824, HRC: folder L0517.24); Bernard von Lindenau and Johann Franz Encke in Gotha; Karl Ludwig Harding and Johann Friedrich

were similar to those carried out on earlier trips, and involved taking barometric measurements from the tops of mountains.[374] Unlike previous trips he did not write these up into academic papers. However, they are worth noting here because on this trip, thanks to James Child, we get a glimpse of what was practically involved in John's enthusiasm for carrying out these mountain top observations.

Child according to his contract or 'agreement' was employed:

> To groom Mr Herschel's horse – to keep the Carriage clean – to assist the footman in blacking shoes, cleaning knives & brushing clothes – to assist in waiting when required – to attend Mr Herschel at the telescopes when observing and work the machinery – to sweep and keep the telescopes free from weeds & dirt – to go on errands & messages when required on foot or on horseback – to exercise the horses at proper times – lastly – to be sober orderly and quiet in the family - not to object to do anything not unreasonable although not expressly mentioned here – and not to absent himself, and especially not at night without leave.[375]

His contract was not specific to this expedition and indeed his job extended to act as John's assistant at home as much as abroad. In a letter home to a fellow servant, Harriet Singer, Child describes a few days of their travels in Italy. Each morning he would wake his 'master' at 3 or 5am. They would then climb a mountain or visit some ruins, often, as he describes here, with Child carrying the apparatus while Herschel went on ahead:

> We have been up the mountain fiesly (Fiesde) 3 miles from Florence. I called my master up at 5 in the morning to go to feisly. We went out along [sic] while, the mountain is so very high up. And when we came to the top there is a church witch [sic] I was surprised to see, we sat down and rested a few minuets [sic] and then my master went 3 miles up to A place called pratolins to the grand Duke's statue, I went with my master to carry his instruments the day Being so hot I was very tired, when I got there master had sat down and taken a drawing from the statue.[376]

Blumenbach in Gottingen (ref in John F. W. Herschel to Charles Babbage, 3 October 1824, RS: HS 2.199 and John F. W. Herschel to James Grahame, 25 October 1824, RS: HS 8.320 & RS: HS 20.187).

[374] Ref to experiments at the top of the mountain Fiesde and Mount Etna in John F. W. Herschel to Caroline L. Herschel, 2 July 1824, HRC: folder L0569.1 & in Herschel, ed., *Memoir and Correspondence of Caroline Herschel*, pp. 172-4 also mentioned in John F. W. Herschel to Charles Babbage, 4 July 1824, RS: HS 2.197 & 20.181.

[375] Agreement with James Child, 25 September 1823 in 'Memoranda of the Past 'Particulars relating to my Mother's family' JFWH's notes 1822-1826', JHS papers FC A3.

[376] Letter from James Child to fellow servant at Slough, Mrs. Harriet Singer, 11 May 1824, JHS papers BFR 4.

While Child struggled in the heat to carry John's apparatus up the mountain, John went on ahead, seemingly oblivious to his servant's work. He was then distracted entirely from the experiment they were presumably there to carry out, by the chance to sketch a statue.

The outing Child describes, coupled with the fact that John did not publish any results from this trip, suggests a rather casual attitude to in-the-field experimental work on John's part. While he was quick to follow up contacts and publish work that involved some level of collaboration, he was less bothered about carrying out any independent research. Like the Cambridge trips described by Rothblatt and Crosbie, John's trips abroad seem to have been about contact building first, and fieldwork only when it supported that first aim.

Defining a career in science

In 1826, following the last of his independent grand tours, Herschel turned down his old tutor Hornbuckle's suggestion that he should apply for the Lucasian professorship of mathematics. The post was taken up by George Biddell Airy and then, two years later, when Airy became Astronomer Royal, by John's old friend, Charles Babbage. Thirteen years after graduating, John had worked out what he wanted to do and how he wanted science to be viewed and valued by society, and he was beginning to establish how he might realise these goals. Over the next few years, culminating in his 1830 publication, *A Preliminary Discourse on the Study of Natural Philosophy*, John began to clarify and promote his ideas on science, what it was and how it should be done.

John could afford to turn down the position offered by Hornbuckle because he had family money to support him. His stated reason was that 'I shall do more for science as an independent amateur than as a Professor of any particular branch or department of it.'[377] In one sense this was simply a polite way of rejecting the life of a Cambridge professor, one he had been insistent, almost from the start, was not for him. In another, however, it shows his growing interest in science as a whole and his rejection of compartmentalising his different interests as 'any particular branch or department of it'. While in 1813 he had rejected his father's ambition that he should

[377] John F. W. Herschel to Thomas W. Hornbuckle, 13 October 1826, RS: HS 9.487.

become a gentleman amateur living off inherited wealth, by 1826 he had come to appreciate some of the advantages of that arrangement.

By 1827 John had a clear idea of who he saw as the right people to become paid men of science. At the time, Davies Gilbert, president of the Royal Society, was in the unenviable position of trying to find writers for the *Bridgewater Treatises,* a 'work on the Power, Wisdom and Goodness of God, as manifest in the Creation; illustrating such work by all reasonable arguments'. In explaining why he did not want to write for this work himself, John spelled out to Gilbert precisely who he thought would most benefit from such a commission:

> such persons (men, for example, such as Ritchie, who I mention as a specimen of the class I allude to) who live, or rather starve on their science…Such men, who deserve all the encouragement, but who receive none, in the ordinary course of events, in this country, are the people who every lover of science would wish might receive at least the benefit of windfalls such as these.[378]

William Ritchie was rector of the Tain Royal Academy, a school in the Scottish Highlands where he taught mathematics and natural philosophy. He was also a graduate of Edinburgh University.[379]

Ritchie was precisely the type of man of science Herschel was thinking of when he argued for greater public support for science. He was a graduate, he had trained for the Church and was now, nominally, involved in the scientific world as a teacher but was hoping for something else. Paid scientific work, John argued, was for men such as Ritchie, or like many of his friends at university. These were men who wanted to work in science, but could not afford to do so as amateurs; men who had the option of a profession, but would have preferred something else. This was not an exercise in finding a means through which people such as his father could use science to move their way up the social hierarchy, rather it was to provide those already able to go to university, and who were also interested in science, with an alternative to a career in law or the Church.

In his essay on the origin of the word scientist, Sydney Ross argues that one of the problems many contemporary practitioners of science had with the word 'scientist'

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[378] John F. W. Herschel to Davies Gilbert, 1 July 1830 quoted in W. H. Brock, "The Selection of the Authors of the Bridgewater Treatises," *Notes and Records of the Royal Society* 21 (1966), p. 167.
[379] John F. W. Herschel to William Ritchie, 27 January 1825, RS: HS 14.347.

was that '[t]o them the word *scientist* implied making a business of science; it degraded their labours of love to a drudgery for profits or salary'. It turned it into a profession so that by the end of the nineteenth century, 'science was now presented merely as another alternative profession; and the word *scientist* carried no less desirable connotations than did *physician, lawyer,* or *clergyman'*.[380] While the transformation of science from amateur activity to profession might have been seen as a problem by some, others, I argue here, such as Herschel, welcomed the change.

Herschel could rely on family money, but most of his friends had to work and fit science and mathematics into their spare time. This was not because they wanted to, but because they had no choice. Herschel's desire to have people such as Ritchie receive 'encouragement' and the 'benefit of windfalls' suggests that on behalf of his friends, including Ritchie, he wanted this change in status for his discipline. In 1813 he and his friends had been looking for professions to train for and hoped they might be intellectually stimulating. Most had ended up in the Church or law. Those who could, like Herschel and Babbage, had fallen back on family money to support their scientific work. Some of their friends had been forced, through financial necessity, to give up science entirely.

The transformation of science into a comparable profession to the law or the Church would, for these individuals, have been a welcome change. Ross uses testimony from men working in science under the existing system, to support his claim that the change in status of science was unwelcome.[381] Herschel was looking at the problem from the view of those pushed out of science.

In 1828, Herschel was given the opportunity to write an encyclopaedia article – an article that became a book, *A Preliminary Discourse on the Study of Natural Philosophy* - setting out a definition of science, and why society needed it and should value its practitioners. In it he brought together years of experience to support his central argument: that society needed science to make life more comfortable, more civilised and to bring out the best in humanity.

Throughout the first half of the nineteenth century, the terms 'science' and 'natural philosophy' were, to a large extent, used interchangeably to mean the study of nature. Herschel's book, *A Preliminary Discourse on the Study of Natural Philosophy*, played a significant part in developing a new definition of science. In it, science, in

[380] Ross, "Scientist: The Story of a Word.", p. 66.
[381] Ibid.

contrast to philosophy, was presented as a process from which tangible benefits could be derived.[382] Central to his argument was the ultra-utilitarian assertion that pure science can in principle always benefit society: 'any accession to our knowledge of nature is sure, sooner or later, to make itself felt in some practical application'.[383] Beyond its practical benefits, science was also important because of its ability to bring out the best in mankind. '[M]an' he states, ' is constituted a speculative being; he contemplates the world, and the objects around him, not with a passive, indifferent gaze, as a set of phenomena in which he has no further interest than as they affect his immediate situation, and can be rendered subservient to his comfort, but as a system disposed with order and design.'[384] Science could have tangible utilitarian benefits, but it could also enrich lives, bring out the best in humanity, provide evidence of a creator and render society civilised.

In *A Preliminary Discourse*, Herschel returned to those early chemistry experiments he had watched at the Royal Society. One, which he had tried to copy at home, involved the creation of a new substance, iodine. He used this example to demonstrate the way in which science, industry and society are all interlinked and interdependent:

> Thus (to give an instance), a soap-manufacturer remarks that the residuum of his ley, when exhausted of the alkali for which he employs it, produces a corrosion of his copper boiler for which he cannot account. He puts it into the hands of a scientific chemist for analysis, and the result is the discovery of one of the singular and important chemical elements, iodine.[385]

He also drew on ideas he had first encountered through the Royal Astronomical Society. In their scheme, 'intellectually competent' men analysed and interpreted data collected by 'fact-gathering amateurs'. Following this organisation of science, he argued in his *Preliminary Discourse* that some science was 'highly desirable in general education, if not indispensably necessary'[386] while the creation of new knowledge:

> requires in many cases a degree of knowledge of mathematics and geometry altogether unattainable by the generality of mankind, who have not the leisure,

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[382] Ibid., p. 69.
[383] John F. W. Herschel, *A Preliminary Discourse on the Study of Natural Philosophy* (University of Chicago Press, 1830; reprint, 1987), p. 51.
[384] Ibid., pp. 3-4.
[385] Ibid., p. 50.
[386] Ibid., p. 22.

> even if they all had the capacity, to enter into such enquiries, some of which are indeed of that degree of difficulty that they can be only successfully prosecuted by persons who devote to them their whole attention, and make them the serious business of their lives.[387]

This assertion, that progress in science can only be made by those able to devote their whole attention to science and make it the 'business of their lives' implies he felt science should be turned into a profession, at least for a small, most competent few.

He used examples from chemistry, mineralogy, astronomy and even law to make his case for the usefulness of science to society. He also drew on his experience in trying for many years to write for a wide range of audiences. Herschel had been commissioned to write this article for the *Cabinet Cyclopaedia* by its editor and proprietor, Dionysius Lardner. Lardner had told him in his initial request that his 'chief difficulty in Science is to find profound men who like yourself are able and willing to write a popular work.'[388] The unusualness of this combination of skills – of adequate subject knowledge combined with the ability to write for a popular audience – has been commented on not only by Lardner but by their contemporary and fellow popular science writer, Richard Procter.[389]

Herschel had this combination of skills, in large part because of the way he had managed his writing career. His family wealth allowed him to indulge his research interests and publish the results in academic journals at his leisure. At the same time, however, he was keen to keep up at least a pretence of earning a living, and did so, as he told Babbage he would, by writing. His mathematical textbooks written with Babbage were followed by encyclopaedia articles first for the *Edinburgh Encyclopaedia*, then *Metropolitana Encyclopaedia* and finally Lardner's *Cabinet Cyclopaedia*.[390] While his popular writing was not particularly prolific, he was interested in taking the opportunities offered, which was not the case for most 'profound men' of his generation.

Having tried and failed to find paid work in science, Herschel eventually settled into his role as independent gentleman amateur but he remained aware that

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[387] Ibid., p. 25.
[388] Richard Yeo, "A Preliminary Discourse on the Study of Natural-Philosophy – Herschel, J. F. W.," *Studies in the History and Philosophy of Science* 20, no. 4 (1989), p. 544. Quoting Dionysius Lardner's letter to John F. W. Herschel, 18 July 1828, RS.
[389] Marvin P Bolt, "John Herschel's Natural Philosophy: On the Knowing of Nature and the Nature of Knowing in Early Nineteenth Century Britain" (PhD Thesis: University of Notre Dame, 1998), p. 3 of his Chapter 7: Concluding comments.
[390] John F. W. Herschel's bibliography, RS.

though desirable, this was not an option for most of his contemporaries. Devoting oneself to scientific research was a luxury few could afford in early nineteenth century Britain and that was a situation Herschel saw a possibility of rectifying. Through the process of finding exactly what he wanted to do, while at the same time, trying to help his less wealthy friends find satisfying work, he began to define an idealised career in science. As an argument for society's support of this type of career, and of science in general, he also set about creating a definition of science that emphasised its many uses to society. Society needs science, he argued, not only for its many utilitarian benefits, but also for its civilising role. For science to progress, reasoned 'persons' were needed, who might make the mathematical sciences 'the serious business of their lives'.[391] He was arguing, in other words, for science to be made a professional career.

Conclusion

John Herschel did not graduate from Cambridge and simply fall straight into the role of celebrity, science teacher or role model. Instead he continued his education, taking over its management from his father and directing it toward new areas of science. He carved out a distinct identity for himself, separate from that of his father, by pursuing a range of different sciences and then bringing coherence to these seemingly disparate activities. He secured this reputation by writing for a range of audiences on all aspects of modern science. In his frustrations over failing to find interesting work for himself and his friends, he began to see a campaigning role for his writing. Where his father had used education to change his own personal position in society, John used it to argue for a change in the position of science within society.

Over the course of nearly 20 years, Herschel developed a specialist interest in science, not in any particular science, but in science as a whole. While his research interests appear at first glance to jump around, there was, in fact, a certain unity to his project. As I have already noted, Sydney Ross has described this period of John's life as 'a period of divided purpose'.[392] He was, Ross goes on:

[391] Herschel, *Preliminary Discourse*, p. 25.
[392] Ross, "Herschel and Hypo.", p. 184.

> making trials of various career fields: he began and then abandoned the study of law; after a brilliant start he had lost interest in mathematics; nor did he continue with chemistry after this single preoccupation until, twenty years later, stimulated by the invention of photography, he took it up again for a short time.

Ross puts this down to 'self distrust' and 'internal disquiet', however, by looking at what precisely he got out of the different disciplines he dabbled in, alternative conclusions can be drawn. From mathematics at Cambridge he moved to law in London, where he found chemistry. He then moved back to Cambridge, discovering mineralogy on the way, and a connection between chemistry and mineralogy that he was curious to explore. Where in chemistry he had worked mainly on teaching himself how to do experiments and specifically at how to work out the chemical composition of various samples, he now moved on to mineralogy. In this new subject he was able to build on his experience, and this time, work out through experiment the composition of mineral samples. It was the connections between the different disciplines that seem to have attracted him. In both chemistry and mineralogy he carried out experiments to analyse the chemical composition of his samples. When he then began studying optics, he added new techniques from this subject to his studies. He began studying the optical properties of some of his specimens, looking for example at the polarising effects some of these samples had on light.

At the same time as he was increasing his knowledge of different branches of science and of experimental practice, he was also discovering different views on how science and society should interrelate. From his mentor Clarke, and then a little later from his involvement with the Royal Astronomical Society, he began to develop arguments for science as an essential driver, not just for utilitarian improvements to society, but for the creation and survival of true civilisation. He began to consider how in practice science might be organised to make the best of available resources. Using the hierarchy proposed by the Royal Astronomical Society, he came up with a division of labour that allowed, and even encouraged, mass involvement in science while still retaining prestige for a small minority of experts.

While the ideas in his book and the examples used to illustrate those ideas came from his years of independent study, his authority was still to some degree the result of his inherited family name. He was able to talk with authority on a range of scientific subjects because of his years of self-training. He nevertheless, remained a Herschel. The various professorships that were offered to him after he moved to

Slough confirm this, especially as they came after he had published very little. By 1830 this was beginning to change, thanks in part to his work with his mentor Edward Clarke and his collaborations with men of science abroad. The publication of *Preliminary Discourse* and its subsequent wide circulation completed that process, providing John Herschel with a reputation as an exemplary man of science, distinct from that of his father.

In 1834 William Whewell proposed the name 'scientist' to describe people who did science in the same way that the word artist had long been used to describe those who created art. The need for this new name came about thanks to the work of Herschel and people like him, who were busy redefining the term 'science'. Sydney Ross makes the point that the new term was bound up in the idea of professionalization, that like dentist and podiatrist, the new name suggested a career choice rather than an amateur interest. This he claims was one of the main reasons it took so long to be adopted, since this, he assumes, was undesirable to those then occupied in science.[393] The years following graduation, in which Herschel tried to find a profession that suited him, suggest that for him, this turn of affairs was precisely what he would have wanted.

[393] Ross, "Scientist: The Story of a Word.", p. 66.

Chapter five:

Margaret Brodie Stewart, an evangelical view of science

John Herschel married Margaret Brodie Stewart in 1828. In 1834 they went to South Africa, taking their children with them. They returned in 1838 having provided advice to administrators on setting up a new system of education in the colony. I will argue later in this thesis that this advice had important implications for how their own children were educated. In this chapter I will consider the first 10 years of the Herschels' marriage, between 1828 and 1838, to see how, as a couple, they created their new vision of the purpose of education. I will argue that the stimulus for Margaret's unusually academic and scientific education came from her family's evangelical beliefs. She saw education as a means of becoming a better Christian and saw a duty in sharing that education with others. After their marriage, Margaret gradually became more interested in academic education for its own sake, while John increasingly made reference to the importance of religious education.

This chapter is, in part, an attempt to return Margaret to the family narrative. The literature on John Herschel after his marriage often makes only a cursory reference to her presence, sometimes none at all. Margaret was not a scientific companion and collaborator for John as Caroline had been for William and as a result her contribution has been overlooked in the literature on this family, and on scientific wives in general. John and Margaret's marriage was not a scientific partnership such as those described by Pnina G. Abir-am and Dorinda Outram.[394] Margaret never was, nor aspired to be, John's partner in science. Margaret was the mother of twelve children, born over a period of 25 years, who were mostly taught at home. As Abir-am and Outram's book readily admits, this level of domestic responsibility would have left very little room for significant contributions to science.[395] Yet it was a partnership in the sense that both John and Margaret worked together to decide and make happen what they wanted for John's career, for their domestic life and for their children. Despite having little direct involvement in his work, Margaret nonetheless played an important role in altering the

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[394] Pnina G. Abir-Am and Dorinda Outram, *Uneasy Careers and Intimate Lives: Women in Science, 1789-1979* (New Brunswick: Rutgers University Press, 1987).

[395] Marilyn Bailey Ogilvie, "Marital Collaboration: an approach to science", in Ibid., pp. 104-125, p. 105.

way John viewed the world around him. This I demonstrate here with particular reference to his changing attitudes to education during his time in South Africa.

William Ashworth has described John Herschel's involvement in reforming the system of education in South Africa as 'part of an imperial mission'.[396] While this explains the bigger picture, it does not explain the more specific details of his choices and the advice he gave. Elizabeth Green Musselman meanwhile, has argued that John's time in South Africa changed the way in which he saw his astronomical work and that this change came about because of the way he began to view education.[397] While there, he came to believe more and more in the civilising affects of education as the solution to the country's political unrest. He saw the problem in terms of a division between civilised settled farmers and more primitive hunters, and the solution in terms of educating the hunters to be more like the farmers. This understanding of the political situation around him, Musselman argues, had a direct effect on the way he viewed and talked about his work. During his time in South Africa his language changed. Where once he had talked of hunting data, gradually this was replaced by references to harvesting results.

Neither Ashworth nor Musselman assign any role to Margaret in their South African narratives. In this chapter I will argue that John's changing opinion on education during his time in South Africa, is only properly explained when Margaret is returned to the story. Margaret actively encouraged John to take an interest in and form an opinion on the role education played in the transformation of South Africa while they were there. Margaret took John to see local missionaries at work and invited the missions' converts to their house, and in this way John saw the transformation of these tribal hunters through education. She was also researching and planning the education of their own children and the results of this informed the advice John gave on an ideal system of education.

The purpose of this chapter, then, is not simply to see how Margaret's attitudes might have made an impact on John's work; rather it is to determine the kind of scientific wife she was and how as a team the Herschels developed a new vision of education which then informed the way they brought up and educated their own

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[396] Ashworth, "John Herschel, George Airy, and the Roaming Eye of the State.", p. 152.
[397] Elizabeth Green Musselman, "Swords into Ploughshares: John Herschel's Progressive View of Astronomical & Imperial Governance," *British Journal for the History of Science* 31, no. 111, 4 (1998).

children. Jeanne Peterson, in her pioneering study of women within an intellectual family has suggested that for many Victorian marriages:

> wives were assistants, colleagues, and partners in the work that men did. Their husbands took the public credit for the tasks performed – these were not 'dual careers', nor was there any ideology of equality. These were 'single-career families', but both husband and wife partook of that single career.[398]

Barbara Caine, in her study of the Strachey family makes a similar point, describing these women as 'companionate wives'.[399] In this chapter I will argue that in some ways this description describes the Herschel marriage very well. Both husband and wife were working together, in different roles, towards the same end. However, their joint project was not restricted to John's professional role and reputation, but included also the creation of a particular kind of family life. It was by working out what they both considered desirable in John's public role and in their family life, that John and Margaret created a design for an idealised system of education.

Evangelical: Growing up a Stewart

Margaret Brodie Stewart met John Herschel when she was 18 years old. She was already well educated and that education included the study of some mathematics and science. She was not the daughter of a man of science, but of an evangelical clergyman within the Scottish Church. For Margaret's family, mathematics and science offered an engaging way of understanding the world created by their God. As I show here, she was given a liberal education, of which mathematics and science played one part. This education was designed with the overarching aim of making her a good Protestant with a close connection and appreciation for her Maker and Redeemer.

In Margaret's family the girls were taught science as part of their religious education. Little of her academic education was designed to have any direct application (unlike Caroline's education in the Herschel family). Her father, grandfathers, older brother and older half brother were all ministers within the Church

[398] Peterson, *Family, Love, and Work in the Lives of Victorian Gentlewomen*, p. 166.
[399] Barbara Caine, *Bombay to Bloomsbury: A Biography of the Strachey Family* (Oxford: Oxford University Press, 2005).

of Scotland. The Scottish church in the early nineteenth century was broadly divided into conservative moderates and left wing evangelicals. Much later, in 1843, the latter branch would leave the main church to set up their own church called the Free Church of Scotland or Free Presbyterians. This split followed a parting of views sometimes referred to by historians as the 'Disruption'.[400] The Stewarts were part of this evangelical wing of the Scottish church.

Although the Stewarts were evangelicals, they were also academic and free thinking in the sense that they did not always follow strictly the doctrine of their church. Margaret's father, Alexander Stewart, was originally trained as a moderate clergyman but moved away from mainstream views and practices early on in his career. This conversion came about, according to Charles Simeon, following a visit from Simeon and James Haldane, and certainly Haldane remained a family friend for many years.[401] Alexander Stewart won various academic awards including a degree awarded him in 1819 by the University of Aberdeen for his work as a Gaelic scholar. He was evangelical, but sufficiently unorthodox in his beliefs that evangelicals would occasionally disassociate themselves from some of his writings. Referring to a book Alexander wrote on faith, *The Free Presbyterian*, Rev Donald Beaton suggested the views expressed should properly be described as Sandemanian.[402]

While there were many different branches of nineteenth century evangelicalism certain central ideas remained true to all. Boyd Hilton sums up the collective beliefs of all the various different types of evangelical:

> All [are] in a state of natural depravity, weighed down by original sin, and life is, effectively an 'arena of moral trial', an ethical obstacle course on which men are tempted, tested, and ultimately sorted into saints and sinners in readiness for the Day of Judgement... The organ of redemption is the individual conscience... Justification comes through faith in that Atonement and through faith alone, for though good works, sanctification, and holiness are important, they cannot precede faith.[403]

These views on sin, faith and a personal journey of redemption played an important part in Margaret's childhood education. But so too did her family's interest in

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[400] Stewart J. Brown and Michael Fry, eds., *Scotland in the Age of the Distruption* (1993).
[401] Rev Donald Beaton, *Some Noted Ministers of the Northern Highlands* (Free Presbyterian Publications, 1985), p. 179
[402] Ibid., p. 184
[403] Boyd Hilton, *The Age of Atonement: The Influence of Evangelicalism on Social and Economic Thought, 1785-1865* (Clarendon Press, 1991), p. 8

rationality, intellect and independent thinking. Her lessons from her father included logic and the analysis of religious texts, according to a reminiscence by her daughter, Constance. Talking of her own education, Constance commented that her 'mother, having herself been taught by her father, a Scotch Doctor of Divinity, laid great stress on the importance of logic and I had to make a very close analysis of Butler's argument to please her.'[404] Margaret's father also taught her Latin, as she reminded her mother in a letter home from South Africa when she had begun to think about how to teach her own children:

> I have had Willys Latin lessons all to myself since Papa went away and how it sends me back to old times ... and how Papa used to put his finger on his mouth and try not to take it off all the time I was saying a long verb.[405]

Alexander died in 1821, when Margaret was 10 years old, leaving her education to the rest of the family. By 1827, the date of her earliest surviving correspondence, Margaret's brother, Charles Calder Stewart, had taken charge of her education. By this time the family were living in Edinburgh and Charles, then aged 23, was in Perth and in the process of training to become a minister. The letters he sent home to his sisters contained lessons. A major theme of the letters was religion.

In one letter he began by recapping on earlier lessons. He told her that we must approach religion as 'rational & immortal beings' and give 'sober & serious attention & that judgement which you so well exercise on other matters - to a few things regarding eternal truth'.[406] From there, he launched into a more general argument about the perils of unbelief:

> Unbelief is an unpardonable sin, other sins may be forgiven but this never will, because it dishonours God, it calls him a Liar, it tramples & despises mercy, & you cannot please God in any way so long as you refuse to believe that Christ's salvation is true & complete, & doubt God's power & willingness to save you by it.[407]

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[404] Anon, "Sir William Herschel's Biographer - Lady Constance Lubbock.", p. 8. This refers to Bishop Joseph Butler, *Analogy of Religion* (1736). See http://www.iep.utm.edu/butler/. For the influence in Scottish universities see Ernest Campbell Mossner, *Bishop Butler and the Age of Reason* (New York: Macmillan, 1936).

[405] Margaret Brodie Herschel to Emilia Stewart, February 1841, JHS papers FC A3.

[406] Charles Stewart to Margaret Brodie Stewart (soon to be Herschel), 9 February 1827, JHS papers BFR 7.

[407] Ibid.

In the rest of the letter he returned to his specific concerns about his sister:

> My dear Margaret, I do wish to guard you against the error I fell into. I wanted to believe "that I was believing" & I succeeded for a long time in believing this lie, but a prayerless ungodly life, has shamed me I was deceiving myself. How easy is it to deceive ourselves. But now Margaret, every day I believe & see myself the blackest sinner out of Hell & I believe God's word is true, when he says Christ came to save such as me. Don't be trying to find out whither you are believing, your conduct will soon shew, but look at Christ think & pray over what a saviour God has done for such as you & me - till your heart is broken by a sense of his love.[408]

Finally he signed off: 'Do write to me soon Margaret & tell me what prevents you embracing Christ he deserves your whole love & words cannot tell how happy you would be; do tell me your mind freely, I would feign remove your scruples.'[409]

This concern, according to Boyd Hilton, was typical among evangelicals who,

> anxious to redeem mankind, often fretted more over sinful insouciance than over outright wickedness... Since it is not sinful activity but lack of faith for which men are condemned to Hell, an apparently innocent life is often more dangerous spiritually than a career of heinous crime.[410]

Obvious sinful activity could be atoned for; a less obvious lack of faith might go unredeemed and so send you to Hell. From her brother's comments, Margaret seems at this point to have been questioning whether or not she believed and saw herself as in some way prevented from embracing Christ. However, this kind of doubt was not unusual in nineteenth century evangelicals. Charles told her that he was once in that position too. Similarly, Hilton suggests that this type of uncertainty was common among evangelicals since faith could not be proved, or even quantified in the way good works could. This, he suggests, left many evangelicals publically stating their belief while often internally doubting that conviction.[411] Charles' concern and Margaret's voiced reservations demonstrate their conformity to the standard evangelical way of thinking. However, this dialogue also shows the encouragement that she was given for expressing her opinions and for truly understanding and absorbing what was taught.

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[408] Ibid.
[409] Ibid.
[410] Hilton, *The Age of Atonement: The Influence of Evangelicalism on Social and Economic Thought, 1785-1865*, p. 13.
[411] Ibid., p. 18.

While Christian belief was of central importance in this family, some of the words and phrases they used suggest they also prized logic and rationality. Hilton warns against dismissing all evangelicals as anti-intellectual or irrational and that would certainly seem a wise precaution in the case of the Stewarts. In describing her lessons with her father, Margaret told her daughter that he always 'laid great stress on the importance of logic'.[412] Similarly, when discussing belief, Charles told his sister that they needed to approach the subject as 'rational & immortal beings' and give 'sober & serious attention & that judgement which you so well exercise on other matters'.[413] Other lessons described by the family indicate that this emphasis on logical and rational thinking spilled over into academic subjects.

This was an academic family. Margaret's father Alexander had won prizes for mathematics at university and was described in later life as a Gaelic scholar.[414] Her brother, Charles Calder Stewart, studied at the universities of Aberdeen and Edinburgh and was at the time of his correspondence with Margaret, session-clerk of Perth[415]. Duncan, their eldest brother, was a trained surgeon who had recently and successfully petitioned the board of directors of the East India Company and was now in India.[416]

This was an intelligent, religious family whose members saw religion as their vocation, and saw academic study as a means of better understanding and so becoming closer to God. Not only did they use terms that might suggest an appreciation for rational and logical thinking, they also included astronomy and mathematics in their childhood lessons. One book that Charles mentions in his lesson letters to his sisters is John Bird's *The Juvenile Observatory* of 1824, a book written as a children's introduction to astronomy from a religious perspective.[417]

According to Aileen Fyfe, it was not until the 1840s that 'the sciences were regarded as eminently worthy of study' by evangelicals. Her study concerns the use of science in evangelical publications aimed at the working classes. Among University educated evangelicals themselves however, the situation seems to have been rather

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[412] Extract from account written by Constance Lubbock for her children, 1939 reproduced in an article, Anon, "Sir William Herschel's Biographer - Lady Constance Lubbock." (original at home of Mrs Diana M Ladas).

[413] Charles Stewart to Margaret Brodie Stewart (soon to be Herschel), 9 February 1827, JHS papers BFR 7.

[414] Beaton, *Some Noted Ministers of the Northern Highlands*, p. 183.

[415] Scanned book extract – no source given - from genealogy website: http://freepages.genealogy.rootsweb.ancestry.com/~rykbrown/stewart_of_invernahyle.htm

[416] Duncan Stewart's East India Company papers, BL (India Office): L/MIL/9/376 f.123.

[417] Charles Stewart to Emilia Stewart, 16 May 1827, last part of letter is to Margaret, JHS papers BFR 7.

different. The Stewarts clearly thought the sciences a subject worthy of study, as did a number of their friends and contemporaries within the Scottish Church. Thomas Chalmers, the Scottish evangelical responsible for leading the revolt against the established church in the 1843 Disruption, was one. He was also a friend of Margaret's half brother, Alexander, and had been since they met in Glasgow when Alexander was a student there around 1820.[418] Like the Stewarts, Chalmers saw value in the study of mathematics and the sciences. He had been professor of mathematics at the University of St Andrews and in 1817 wrote a book on astronomy - *A series of discourses on the Christian revelation viewed in connection with the modern astronomy*. This book, aimed at an adult evangelical audience, set out to marry astronomy and Christianity. In it he argued that since God created all, a study of astronomy could be understood as a study of God's work and so an appropriate activity for a Christian. Another Scottish evangelical, Thomas Dick, followed suit, writing *The Christian Philosopher or the connexion of science and philosophy with religion* in 1823 for roughly the same audience.[419] The following year Bird brought out *The Juvenile Observatory*.

John Bird's astronomy book was aimed at children. It reads as an exercise in reconciling astronomy and religion. The book is primarily about teaching the mathematical techniques needed for scientific subjects. He stated in his introduction that the work came out of lectures on astronomy, 'as they have been delivered before the public schools, and other scientific institutions'.[420] He tells the reader he has

> occasionally introduced passages out of the Sacred Scriptures, where I have found them to accord with the subject; for I felt it my duty to mingle the Work throughout with such things as would give it a moral and religious tendency, and to lead the youthful mind along the path of Science by short easy stages, that as they go along, they may have time to pause, and wonder at the vast displays of wisdom and goodness that they will discovered in the Creation of Heaven and Earth.[421]

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[418] Beaton, *Some Noted Ministers of the Northern Highlands*, p. 234.
[419] William J. Astore, *Observing God: Thomas Dick, Evangelicalism, and Popular Science in Victorian Britain and America* (Aldershot: Ashgate, 2001).
[420] John Bird, *The Juvenile Observatory: In Which the Power and Wisdom of God, in the Works of Creation, Are Displayed in a Course of Astronomical Lectures, for the Instruction of Youth; as Delivered before the Principal Public Schools, &c. &c.* (London & Eton: E. Williams, 1824), Preface.
[421] Ibid., Preface.

However, in the main body of the text, the links between the science and religion are less intertwined. Instead the format is to have a religious statement nominally about the scientific subject, followed by very practical information about experiments and mathematical exercises to try at home. For example, when talking about the Moon he introduces the subject with a biblical reference:

> The first account we have of the Moon, is in the sacred Scriptures (Gen. I. ver. 16), where she is called "a lesser light to rule the night"; and I will endeavour to prove to you that the Moon could not have been more advantageously situated, to answer the purpose for which she was intended.[422]

This statement is immediately followed by a description of an experiment to try at home with a globe and an explanation for how this can be used to find the length of day or night for any latitude. This experiment is followed with other examples to try at home. He then concludes the section with a return to religion.

> Here again we have a display of Wisdom and Goodness of the unfathomable and Omnipotent Jehovah, who has made these tremendous objects subservient to the accommodation of his creatures, in furnishing us with light, alleviating the terror and inconvenience which accompany darkness, answering that end for which she was created - to be "a lesser light to rule the night".[423]

Similarly, his section on the construction of maps begins with a statement about the connection between geography and 'Sacred history' but is then followed by several pages of the practical geometry needed to construct maps.[424] This includes meridians of longitude, parallels of latitude, secants, tangents, chords and the use of compasses. This was the section Charles asked Margaret to copy out for him, with illustrations, while he was away in Perth, suggesting he was trying to construct a map, using Bird's instructions,` in his spare time.[425]

This use of the science Charles was taught as a child represents a key difference between the Herschels and Stewarts in how they saw science education and its purpose. The Herschels were taught science in order to become practitioners. The Stewarts were taught science to give them a better understanding of the world around

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[422] Ibid., p. 44.
[423] Ibid., p. 58.
[424] Ibid., p. 85.
[425] Charles Stewart to Emilia Stewart, 16 May 1827, last part of letter is to Margaret, JHS papers BFR 7.

them, as a form of natural theology and to give them wholesome activities for their leisure time as adults.

Many of the tasks in Bird's book are essentially practical. Bird sets mathematical problems for the reader to solve. In his section on the use of globes for example he asks:

> Problem II. When it is 10 o'clock in the morning in London, what is the time in Port Jackson?
> Problem III. To ascertain what time the Sun will rise and set at any time or place. - What time will the Sun rise and set at London on the 21st of March?[426]
> Problem VI. To tell on what point of the compass any place is situated with regard to London; and its distance in English, or Geographical miles.[427]
> Problem XI. To Find the Right Ascension and Declination of the Sun, Moon, Planets or Stars.[428]

These problems are strikingly similar to those Charles set for his sisters. Following the lead set by Bird, Charles first drew his sisters' attention to a biblical star, 'I look at them [the stars] sometimes to remind me of Isabella & you all & to remind me of the "Star of Bethlehem".' Before setting some more practical examples for them to solve in mathematical astronomy:

> What is the Sun's declination & to what place will he be vertical on the 15th of March? What is the Suns altitude & azimuth on the same day at Hastings, at 10 o'clock in the morning & at 3 in the afternoon? & When does the sunrise & set on that day with you. What is the Sun's latitude on that day & what his longitude. Tell me the missing culminatory & settings of Regulus, Virgo & Aldebaron at Edinburgh on March 20th.[429]

These would then have been solved using the mathematics Margaret was learning and writing out in her 1827 lesson book. Here she wrote out rules for dealing with various problems in trigonometry, such as the trigonometry of a circle, an ellipse and techniques for finding chords, sines, tangents and secants. She would then run through various problems (often with an astronomical theme), using these skills. Each had a worked solution to find, for example: 'The latitude & difference of long of two places having given to find their distance on the chord & sines', or, 'to find the distance

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[426] Bird, *The Juvenile Observatory*, p. 93.
[427] Ibid., p. 96.
[428] Ibid., p. 100.
[429] Charles Stewart to Margaret Brodie Stewart (soon to be Herschel), 9 February 1827, JHS papers BFR 7.

between London & Rome, the difference of latitude & longitude being given' or she would be asked to 'find the distance between two stars; their right ascensions & declinations - or their latitude & longitude given'.[430]

This method of learning, and the particular problems set, is reminiscent of William's 'little lessons for Lina', albeit on a more limited scale. Like Caroline, Margaret was set problems on latitude and longitude, and on right ascension and declination, to help her understand these astronomical concepts and what they meant mathematically. The difference is in the broader purpose of education. Caroline initiated her lessons and did so as a means of better understanding the technical elements of astronomy, thus enabling her to participate in her brother's work. Margaret meanwhile was set these problems by her brother as part of her basic academic education. They were not set with any specific application in mind but rather to give her a richer understanding of the world and so, if the line of reasoning set in their books was followed to the letter, to help her appreciation of God's work.

As evangelicals within the Church of Scotland, Margaret and her family saw the study of scriptures and personal belief as centrally important to their understanding of the world. They were academic evangelicals who, like Thomas Chalmers and the Anglican John Bird, were interested in current scientific ideas and keen to draw out links between this interest and their religious understanding of the world. They seem to have made little distinction between the sexes in the non-vocational education given to this generation, providing Margaret with a scientific education comparable to that of her brothers. They learned from the same books and were all encouraged to ask questions.

The Stewart family not only valued science education, they also saw a point in teaching it to their daughters. Margaret was brought up to see education as valuable in itself for the enrichment it gave to one's character and soul. Mathematics and certain sciences were included because they were seen as a means of better understanding God's creation. These were not subjects commonly taught to girls in the early nineteenth century as many historians of female education in this period have observed.[431] However, these were the subjects the Stewarts discussed in family correspondence. Other subjects appear to have been taught: later in life Margaret

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[430] Margaret Brodie Stewart's *Lesson Book* 1827, JHS papers TGR LT.
[431] Kathryn Hughes, *The Victorian Governess* (London: 1993).; Sara Delamont, *Knowledgeable Women: Structuralism and the Reproduction of Elites* (London: Routledge, 1989).

refers to childhood French lessons, and she goes on to give her children lessons in literature and music, so these lessons must have taken place, but these are likely to have been taught much earlier. What is interesting about the subjects Margaret discusses with her brother in this relatively late stage of her home education is that they were all taught with the same justification. Astronomy, mathematics and religion were all taught as a means of better understanding God and so becoming a better Christian.

A wife and mother

In this section I look at the first few years of John and Margaret's marriage in terms of how they began to shape their roles. I argue that Margaret and to a lesser extent John had a huge amount to learn in these first few years. Margaret needed to get to know, and to know how to be around, John's circle of friends and acquaintances, many of whom were important men and women of science. She also very soon had to learn to look after a baby. The research she did to learn these skills, I argue here, helped to inform her developing view on the purpose of education. Female education in the nineteenth century is often discussed in terms of its supposed primary purpose of teaching women to become good wives and mothers.[432] However, Margaret's experience, and the research she carried out in her early years of marriage, suggests that she did not feel very well prepared.

Margaret met John in 1828. They were introduced by James Grahame, and John soon became a frequent visitor to the Stewart family home. John proposed in early December 1828. Just before he proposed, he asked James Grahame to write a letter supporting his case to Margaret's mother. James did as requested and wrote vaguely about John's integrity and sincerity. On the question of religion, he stated 'I believe he is a Christian'. However, he also hinted that there was room for improvement in that area suggesting that 'with an elegant & Christian wife, that man would be perfection.'[433] John wrote about how much he loved and admired Margaret and how unsure he was that she reciprocated his affection. More revealing, he also

[432] Jordan, ""Making Good Wives and Mothers"? The Transformation of Middle-Class Girls' Education in Nineteenth-Century Britain."
[433] James Grahame to [Emilia?] Stewart, 29 November 1828, JHS papers HCEJ.

wrote about how much he wanted to be part of a family like the Stewarts. First, he described his own family:

> I stand almost alone in the world hardly any man had fewer family ties except my mother, two first cousins (the young lady you have seen, and her brother, whose habits & way of life differ so extremely from my own that I see but little of him though I regard him highly) are my only near English relatives.

He then contrasted this with what he saw as Margaret's upbringing suggesting she had been 'nurtured in the sunshine of the warmest, tenderest affection'. This was his ideal family, he told her, and he attributed this, at least in part, to their strong religious conviction.

> Were I to choose a family I would look to your fireside, where peace and purity, and innocence seem to have fixed their home. Such a circle I never entered. Surely God is among you. I say not this with reference to any particular religious tenets – but where I see such motives producing such results I cannot refuse to acknowledge their origin nor help wishing that in future your path might be my path and your ways my ways.[434]

Even if we allow for the possibility that John was exaggerating his interest in religion for the sake of winning over his potential mother-in-law, this letter gives some sense of John's desires for married life. He wanted to create the kind of family he felt he had missed out on. He was not looking to recreate a scientific partnership like that of his father and aunt; instead, he wanted someone able to create a happy family home. Of Margaret's aspirations for marriage we know much less; we don't know why, but we know that she accepted. They were married on 3 March 1829, four days before John's 37th birthday.

Margaret's first few months of marriage were occupied with getting to know John's circle of friends and acquaintances and their relation to his work. Mary Somerville soon became a frequent visitor as John was helping her complete her book *Mechanisms of the Heavens*. Mary often asked after Margaret in her correspondence with John. She showed particular concern for her wellbeing when Margaret was pregnant and in the few months after she first became a mother. The relationship between Mary Somerville and Margaret Herschel may perhaps have been helped by

[434] John Herschel to Emilia Stewart, [4 December 1828], JHS papers HCEJ.

some common ground in their upbringing. Both were brought up for some time in Canongate by clergymen from the Church of Scotland.[435]

During these first few months of marriage Margaret also met the Katers and the Dunlops while staying in London[436], and paid a visit to Charles Babbage's mother.[437] At the end of May they travelled abroad, accompanied some of the way by Margaret's brother, John. Travelling through France and Belgium they did some sight-seeing. They also visited John's friends, among them the astronomer and mathematician Adolphe Quetelet[438] and geologist J. J. Nöggerath[439]. Within a year of marriage Margaret had become immersed in this new world of science – all personal friends of her new husband – and, by their first year anniversary, she had become a mother. In preparation for the arrival of their first child, Margaret moved out of their home in Slough, while John supervised renovations on the house.[440] They also began their research as John ordered Michael Underwood's childcare manual, *Treatise on the Diseases of Children.*[441]

The first of their 12 children was a girl, Caroline Emily Mary Herschel (Carry) born 31 March 1830. Her birth was announced immediately to both Mary Somerville[442] and Emilia Stewart,[443] who returned their congratulations. Her name, to please and honour relatives, was made up of John's aunt's, Margaret's mother's and John's mother's names respectively. Her birth was also announced to Eneas Mackintosh, a London-based East India Company merchant and friend of Margaret's family. He wrote back to tell them he would be pleased to act as the child's sponsor, that is, to be her godfather.[444] Eneas Mackintosh is an elusive figure. Papers within the East India Company records refer to him as a merchant in Bishopsgate, London. Letters within the Herschel collection refer to his help in getting East India Company positions for various members of the Stewart and later Herschel families. But

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[435] Dorothy McMillan, ed., *Queen of Science: Personal Recollections of Mary Somerville* (Edinburgh: Canongate, 2001).
[436] John F. W. Herschel to Mary Pitt Herschel, 14 May 1829, HRC: folder L0521.3.
[437] Margaret Brodie Herschel to John F. W. Herschel, 15 May 1829, HRC: folder L0521.4.
[438] John F. W. Herschel to Mary Pitt Herschel, 7 June 1829, HRC: folder L0512.7.
[439] John F. W. Herschel to Mary Pitt Herschel, 15 June 1829, HRC: folder L0521.8.
[440] Series of letters between John F. W. Herschel and Margaret Brodie Herschel, December 1829, JHS.HCEJ.504a-e; JHS.HCEJ.507.
[441] John F. W. Herschel to Mr Roberts, undated [1830?], Yale University.
[442] John F. W. Herschel to Mary Somerville, 31 March 1831, RS: HS 16.334.
[443] John F. W. Herschel to Emilia Stewart, 31 March 1831, JHS.HCEJ.507.
[444] Eneas Mackintosh to John F. W. Herschel, 14 April 1831, RS: HS 12.20.

precisely who he was within the East India Company and how he came to have this close relationship with the Stewart family, is not clear.

A few months after Caroline was born, John and Margaret, partly through choice, part through necessity, began sharing their workloads with one another. John began to share his thoughts on work with his wife, describing his plan to write a discourse on science.[445] At the same time, Margaret was forced to bring John into sharing her domestic work with him. In August 1830, when Carry was only five months old, Margaret had to leave John and the nurse to look after their baby while she went to be with her dying sister, Isabella. While she was away John wrote her letters:

> Baby does not miss you a bit. She lay very still till three this morning when I fed her she took it very well and went to sleep again till seven when she again waked and I fed her again, after which she let up a great long squall, but when nurse took her she stilled and has been uncommonly good all day, Mamma called and saw her, and nurse and Wood reported that she has been as cheerful and laughing when out of my sight as possible.[446]

The letter suggests that rather than relying on a wet nurse, John was left to bottle feed the baby in Margaret's absence. This choice of how to feed their baby is supported by studies of contemporary trends. Wet nursing had started to go out of fashion in Britain towards the end of the eighteenth century in response to medical concerns about the transmission of disease. At the same time, it was becoming increasingly acceptable for middle and upper class women to breastfeed.[447] Parenting manuals in the late eighteenth and early nineteenth centuries - including Underwood's *Treatise,* the book John had recently ordered - were keen to promote breastfeeding, however most conceded that in certain circumstances it might be acceptable to 'handfeed' or bottle feed as this was still preferable to using a wet nurse.[448] Since babies of this period were not generally weaned until around ten months[449], it would seem that at least on this night in August 1830, Carry was hand fed by her father. This episode shows John was keen to be a good father, happy to suffer broken nights' sleep to help his wife look after his daughter. It also demonstrates that as a couple the Herschels were aware of

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[445] John F. W. Herschel to Margaret Brodie Herschel, 23 July 1830 , JHS.HCEJ.513.
[446] John F. W. Herschel to Margaret Brodie Herschel (copied by Isabella), August 1830, BL: microfilm M/588(1).
[447] Valerie A. Fildes, *Breasts, Bottles and Babies: A History of Infant Feeding* (Edinburgh: Edinburgh University Press, 1986), p. 99, p. 106.
[448] Ibid., p. 300.
[449] Ibid., p. 353.

contemporary trends. They were reading up on the latest parenting advice and acting on the recommendations.

While Margaret learned how to fulfil her various roles as wife and mother, John was on hand to help out. This gives an insight early on into how the couple were beginning to work as a team. On the one hand, he had begun to write to her with news of his latest planned publication, on the other, she was able to call on him to look after their new baby while she went home to be with her dying sister. He was also involved in tracking down relevant literature and, preparing their home for the new arrival, showing that they shared responsibility for both the public and private work of this family.

Margaret's sister, Isabella, died in November 1830, and soon after Margaret returned home to John and their baby. A few months later, in January 1831, John began to talk tentatively about the family spending some time in South Africa. Responding to an invitation from Margaret's brother James Calder Stewart, John wrote that the invitation reminded him of an old desire he once had to study the southern skies and that he was now considering the Cape of Good Hope.[450]

While John began investigating the possibility of taking the family to South Africa, Margaret, following a visit from John's friend Maria Edgeworth, began to get to know some of his learned lady friends and to investigate what was involved in becoming a scientific lady.[451] She began to quiz John's aunt, Caroline, on how she became an astronomer and, as later correspondence suggests, she began to take an interest in Edgeworth's work on education. When they first met, in 1831, Edgeworth had described Margaret as 'a delightful person, with so much simplicity, and so much sense, so fit to sympathise with him in all things intellectual and moral, and making all her guests comfortable and happy without apparent effort'.[452] Margaret had already become friends with Mary Somerville, who, because of John's involvement in her book, had been a frequent visitor at their home in the first few months of marriage. In May, Margaret began her correspondence with John's aunt, Caroline.

Caroline was at first apprehensive in relation to what she perceived to be her better educated new niece, asking her in one of her first letters not to

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[450] John F. W. Herschel to James Calder Stewart, 11 January 1831, HRC: folder L0412.
[451] Maria Edgeworth to Margaret Brodie Herschel, 13 April 1831, RS: HS 7.27.
[452] Augustus J. C. Hare, ed., *The Life and Letters of Maria Edgeworth* (London: E. Arnold, 1894), p. 179-180, Letter to Maria Edgeworth's sister Harriet, Mrs R Butler, 29 March 1831.

> …rise in judgement against my perhaps bad grammar, bad spelling &c &c' for the very last I must feel myself walking on uncertain grounds, having been obliged to learn too much without any one thing thoroughly – for my dear Brother Wm H was my only teacher and we begun generally with what we should have ended… Sometime hence you will see a book in which I transcribed such lessons which my brother was obliged to give me at such times when I was to set about some calculations of which I knew not much about[453]

She soon settled down, however, responding to Margaret's questions about her training and life as an astronomer. Her interest was such that Caroline cites her as the inspiration behind her second autobiography. As she states at the beginning of her notebook:

> In consequence of the desire or let me rather say the encouragement of my dear and excellent Niece Lad[y] Herschel has after reading the account I gave of my life - given me, I shall endeavour to recall to my mind some of the occurrences which happened to me and those I was connected with during the 50 years I lived in England.[454]

However, before Margaret could properly put any of this advice into practice and start to construct her own education she had first to take care of her new babies. In June 1831 their second child, Isabella, was born, followed in January 1833 by their first son, William James. Then there were the preparations for their imminent journey to South Africa. In planning the trip, John had described it as a 'pure family party of pleasure'; if the Cape did not work out, they could always go and visit Margaret's relatives in India.[455]

During these first five years of marriage, John and Margaret began to lay the groundwork for their successful partnership. Both appear to have looked at what the other did as important and necessary and set about ensuring they could help out where needed. John did his research into childcare and used this to help Margaret look after their first child. Meanwhile Margaret got to know John's friends and relations and was soon asking their advice on how to become a scientific lady. Margaret's research, on both childcare and on the training of some of John's female peers, suggests that she, with John's support, was interested in studying and developing her role as wife and mother. Not content with simply relying on her childhood education, Margaret instead

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[453] Caroline L. Herschel to Margaret Brodie Herschel, Hannover, 14 May 1831, BL: Eg.3761 f136-137.
[454] Notebook 'Autobiography begun in 1840', BL: microfilm M/588 (4).
[455] John F. W. Herschel to M. Perrey, 16 March 1833, RS: HS 25.3.12.

in these early years of marriage seems to have been looking for ways to educate herself to better fulfil her new role as wife and mother.

South Africa and the missionaries

The family, consisting of John, Margaret, three year old Carry, two year old Bella and William aged not quite one, set sail for South Africa in November 1833. They would stay until 1838 while John carried out his survey of nebulae, star clusters and double stars of the southern hemisphere. During this time, he and Margaret began to consider the question of education for their own children. Looking around them, they also began to consider more broadly the purpose education should serve in society. While in South Africa, John was asked to advise on a national system of education at the Cape and his replies provide a rare insight into the couple's developing ideas. Margaret introduced him to the educational ideals she was brought up with by showing him the work of local missionaries, who like her family, were motivated in all their actions by religion. She also began research into how best to educate their own children and got John involved in some aspects of that education. Margaret herself began to take lessons in becoming a scientific lady. All this, I will argue in this section, fed back into John's public discussions as to the purpose of education.

As noted above, at the beginning of their South African stay, John was asked to suggest a design for a national system of education. The initial request was given by Rev. Dr J Adamson, a Presbyterian minister at the Cape, a financial supporter of missionary work and a key player in the foundation of the South African College. In his reply, John stated that the primary aim of such a system of education must be to help people make sensible choices about their country:

> in a country where free institutions prevail and public opinion is of consequence - every man is to a certain extent a Legislator - and for this his education (especially when the Govt. of the country lends its aid and sanction to it) ought at least so far to prepare him as to place him on his guard against those obvious & popular fallacies which lie across the threshold of this as well as of every other subject with which human reason has anything to do.[456]

[456] W. T. Ferguson and R. F. M. Immelman, *Sir John Herschel and Education at the Cape, 1834-1840* (Cape Town: Oxford University Press, 1961), p. 41, quoting John F. W. Herschel to Rev Dr. J. Adamson, 21 November 1835.

John then listed the subjects that would need covering to meet this end. These included:

> Languages – Latin, German, some Greek and French.
> History - ancient and modern European
> Natural History
> Geography
> Physical Sciences including Mechanics. Astronomy. Chemistry. Optics
> Useful Arts {Engineering. Agriculture & Horticulture. Draftsmanship (Extra)
> Social Relations {Ethics. Jurisprudence. Political Economy
> Mathematics {Arithmetic. Algebra & Analysis. Geometry. Applications.
> Inductive Philosophy[457]

There is no indication in John and Rev.Adamson's correspondence that either supposed this education would be useful only to white children. Indeed the South African College School, which Adamson had helped found, originally took both black and white. However, neither saw any value in teaching any local languages, history or culture. Education was about teaching European, and more specifically, British shared culture and values.

John included classics in his definition of an ideal education, in the sense that he recommended teaching ancient languages and ancient history. At the same time, weight was also given to modern European languages, history and a good deal to mathematics and the sciences. There is no literature, or art or music on his list, there is no religion, but there is plenty of science. In Britain at the time, it was rare for schools to teach much science.[458] However, John had advocated a few years earlier, in his *Preliminary Discourse,* its inclusion in general education. In this sense, his list can be seen as an attempt to put his argument into practice. The education he outlined in this letter was not a training for anything specific but rather an idealised general education, where science played a role equal to more traditional subjects such as Latin and ancient history. However, this was not his final word on how a general education should look. Later he would begin to consider with Margaret the purpose of education in more detail, and in that context give a slightly different emphasis on content.

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[457] Ibid., p. 50.
[458] Delamont, *Knowledgeable Women: Structuralism and the Reproduction of Elites*, chapter 5, especially p. 105 where she states science was not introduced into most school curricula until after the Clarendon Commissions of the 1850s.

Shortly before they left England, Margaret had begun teaching their eldest daughter, proudly telling her mother: 'Carry is learning her letters very fast.' [459] Once in South Africa, she began to appoint new staff to look after their children. A new baby was due – Margaret Louisa, their fourth child, born in September 1834 – so she needed a nurse to look after her. 'I have engaged a monthly nurse an elderly English woman' she told her mother, 'I only hope she will treat my black women with kindness, for I still like them very much'.[460] A couple of weeks after Louisa's birth, Margaret reported again to her mother:

> I have been also fortunate in getting a nice white girl like Sarah to attend Carry & Bella, so that in proof of the assertion (rather in contradiction that white & black – slave & free would not mess together, the three women in my nursery now eating at one table are white, free half coloured, & a coloured slave.'[461]

Margaret's letters home suggest a keen interest in trying to understand and interpret this new world of colour and slavery in terms of her religious training. She appointed black and white staff, she also employed someone who must have been an ex-slave, and as her comments above suggest, was curious as to how they would all interact. Very early on in their stay, Margaret found a friend in a local missionary, Dr Philip, to help her in this understanding. 'It is impossible not to feel interested in the affairs of the native Hottentots & the Slaves,' Margaret wrote home, 'while that good man Dr Philip (I can't tell you how we love and admire him) takes their part so warmly'.[462]

Dr John Philip was a missionary appointed Superintendent of the London Missionary Society's stations in South Africa. He was also a minister at the Union Chapel in Cape Town.[463] The London Missionary Society was founded in 1795, originally as simply the Missionary Society then becoming the LMS in 1818. It was a non-denominational society co-ordinating the work of the missions of various churches – including the Church of Scotland - throughout the world. It was set up to 'spread the knowledge of Christ among Heathen and other unenlightened nations'.[464] Margaret was delighted with what she saw as their good work introducing South Africa's

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[459] Warner, ed., *Lady Herschel: Letters from the Cape 1834-1838*, p. 21 Margaret Brodie Herschel to Emilia Stewart, 12 December 1833.
[460] Ibid., p42 Margaret Brodie Herschel to Emilia Stewart, 11 July 1834.
[461] Ibid., pp. 49-50 Margaret Brodie Herschel to Emilia Stewart, 26 September 1834 – two weeks earlier announces birth of Margaret Louisa.
[462] Ibid., p. 42, Margaret Brodie Herschel to Emilia Stewart, 11 July 1834.
[463] Footnote in Ibid., p. 28.
[464] See Mundus: Gateway to Missionary Collections in the United Kingdom –www.mundus.ac.uk

different ethnic groups to European values and Christianity. By April 1835 Margaret had managed to convert one of her black servants to Christianity:

> Every Sunday they [the Herschel children] learn something by heart - & the one who dresses me while Carry reads, takes in with avidity all she hears on Sunday morning when I take her especially into our Bible lessons. She expresses a great wish to be baptized – for many here live & die without any religious instruction.[465]

John's awareness or opinion about this work is not mentioned anywhere in either his or her papers. However, Margaret did make sure he knew about the missionaries and their work. In June 1835 she invited one of the missionaries' converts to the house to talk to them both. From him they learned with pride and admiration that 'Adam Kok's tribe are brought to a very advanced state of civilisation by the Missionaries, for they clothe in the English fashion & have built many brick Houses for themselves.'[466] The family's prints and drawings collection suggests this interest in the missionaries' work went further than this one visit. In the collection are prints showing a missionary preaching and one of a class room of black South Africans in European dress.[467]



'Education in the early days at the Cape' by Charles Davidson Bell, NMM: PAH6033

[465] Warner, ed., *Lady Herschel: Letters from the Cape 1834-1838*, p. 69 Margaret Brodie Herschel to Emilia Stewart, 11 April 1835.
[466] Ibid., pp. 75-76 Margaret Brodie Herschel to Duncan Stewart, 6 June 1835.
[467] National Maritime Museum prints and drawings collection: PAH6029, Rev. Mr Moffat preaching to the Bechuana and PAH6033, Education in the early days at the Cape.

The emphasis of the missionaries' work, at least that reported by Margaret, was on education, on teaching the indigenous black South Africans to become more like European Christians. Generally part of this education involved teaching hunter-gathers to become settled farmers.

While Margaret wrote to her own family about the work of the missionaries, to John's aunt she stuck rather more rigidly to her children's academic progress. In return, Caroline sent back advice. By September 1834, Margaret had started Carry on learning numbers as well as the letters she had begun to teach back in England. Caroline pleaded with John to make sure she did this properly: 'I beg you will look to it that she [Carry] learns to make her figures as you find them in your Father's MSS such as he taught me to make … The daughter of a mathematician must write plain figures'.[468] While Caroline never voiced an opinion of what John and Margaret should be training their children to become, she clearly had opinions on certain standards that must be maintained.

As their children grew older, Margaret began to consider when best to begin a more formal, structured education. Corresponding with Mary Maclear, the wife of Thomas Maclear, John's friend and fellow astronomer at the Cape, she discussed when best to start languages. 'What you say to your Caroline beginning French in this way along with Mary?' Margaret asked Mary in one letter. Thomas and Mary Maclear became close friends of the Herschels during their stay. They had children of a similar age, and, it would seem from Margaret's subsequent comments, had had similar experiences of education themselves as children. Margaret went on in the same letter to tell Mary about an improved method of teaching French she would like to try out on her eldest, Carry.

> Miss Crybbace told me that her eldest pupil 6½ years old could read French quite as easily as English, having learnt it in this way, & as you were thinking rightly that some improvement was indeed needed in the act of learning languages, & I am inclined to add that as any change from the old style, is synonymous with improvement, it is not improbable that both the Carrys may escape the horrors of French grammar which so sorely puzzled their poor Mothers, & your Mary. My Carry has taken to it very kindly reading a lesson

[468] Caroline L. Herschel to John F. W. Herschel, Hanover, 11 September 1834, BL: Eg.3762 f4-5.

each day, & the little bodies will have to tell each other of the pretty words in the new Black Book when they meet.[469]

Margaret's comments to Mary suggest this letter followed a discussion where both agreed their daughters should become fluent in French, while at the same time discovering they were both taught the subject badly in the 'old style', as children. It suggests that at this stage, Margaret was looking at her children's education in terms of her own, with the assumption that while the basic structure and intent might stay the same, some of the details might be improved.

By the end of 1835 Margaret had four children to look after and educate. She had staff to help with their care, and now considered it time to employ staff to help with their education. Kathryn Hughes, in her study of the Victorian Governess, states that in upper middle class homes, different governesses were often employed to teach different age groups.[470] Writing to her mother in December 1835, Margaret told of her plan to employ her nurse's 16 year old daughter 'who has been educated for a nursery governess'. Her job would be to teach Carry 'sewing & Multiplication Tables' for two hours a day until February and then 'all that I do now with them' after that.[471] According to Hughes, nursery governesses were generally employed in upper middle class homes to teach reading and writing to boys and girls from the ages of four to eight so it might be assumed that the remaining lessons after February would be in these areas.[472]

In this same letter to her mother, Margaret sketched out a rough timetable for their daily routine, giving an idea of how their time as a family was spent and how education played a part in that. From nine until two the girls had their lessons, which for Carry included learning chords and scales on the piano. At two, Carry and Bella dined with their parents – the younger ones presumably eating in the nursery with their nurses. Then 'afterwards until sunset' they had 'an abundance of occupation in walking, drawing, calling & superintending the garden improvements'. This was followed by tea.

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[469] Warner, ed., *Lady Herschel: Letters from the Cape 1834-1838*, p. 69 Margaret Brodie Herschel to Mary Maclear, undated.
[470] Hughes, *The Victorian Governess*, pp. 60-62
[471] Warner, ed., *Lady Herschel: Letters from the Cape 1834-1838*, p. 87 Margaret Brodie Herschel to Emilia Stewart, 15 December 1835.
[472] Hughes, *The Victorian Governess*, p. 60.

> After tea there is singing & arranging French sentences with a box of letters till bed time at 8 o'clock, & then comes the only hours I have to read or write, learn German or copy for Herschel.[473]

This daily timetable shows how even at this very young age, education and educational activities were regarded as the best way to fill their day. Between nine in the morning and eight at night, the girls were given lessons in music, mathematics, French and sewing, reading, writing and drawing. They were also taken out for walks and encouraged to tend their garden, which other, slightly later, sources suggest were also made into educational activities. In October 1836 for example, Margaret describes to John's aunt Caroline how John would take the girls out on bulb-gathering walks. On these walks 'his two little girls, (who knew the botanical names of all the flowers) [would] fly about like pointer fairies to discover the flowers for him while he follows with trowel and basket.'[474] There is no mention of playtime in this schedule, though some lessons were given more structure than others.

Besides telling us about the education of their children, this letter also shows Margaret returning to her own studies. As we saw in the first section, Margaret had been taking lessons from her brother in religion, mathematics and astronomy, up until her marriage to John. After she got married, she began a less formal training, to become a scientific wife and mother as she began to hear about John's work and to learn from books and first-hand experience about motherhood. With several nurses and a governess to help look after her soon to be five children (their fifth, Alexander, was born in February 1836), Margaret could now begin to find time for her own education. At first this was for a few hours in the evening, after the children had gone to bed, where she might 'read or write, learn German or copy for Herschel'. Later she began to make time in the mornings too:

> for instance I am just now learning Algebra from him [John Herschel], & reading every morning at Breakfast some pages of a MS Vol on the subject

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[473] Warner, ed., *Lady Herschel: Letters from the Cape 1834-1838*, p. 87 Margaret Brodie Herschel to Emilia Stewart, 15 December 1835.

[474] J. P. Rourke, "John Herschel and the Cape Flora, 1834-1839" (paper presented at the John Herschel, 1792-1992: Bicentennial Symposium, Herschel School, Claremont, South Africa, 1992), p. 73 quoting Margaret Brodie Herschel to Caroline L. Herschel, 3 October 1836. Letter also quoted in Evans et al., *Herschel at the Cape. Diaries and Correspondence of Sir John Herschel, 1834-1838*.

> which I dare say he will publish some day, having first tried its effect on learners of the lowest capacity.[475]

Adopting a routine similar to that of his father and aunt, John began to give Margaret his own version of William's 'little lessons for Lina.' Like Caroline's, the lessons would help his pupil become a better companion with whom he might discuss his work. However, unlike Caroline there is no hint that Margaret was being trained for a specific role in John's scientific project. She had her own role, caring for and educating their ever growing family, yet it was still of benefit to them both for Margaret to know something of John's world, just as it was the other way around.

John's role in the early up-bringing of his children is hinted at from time to time, leaving the impression that he was often around but not necessarily involved in many of the decisions. Margaret comments to John's cousin, Mary Baldwin, for example, that 'William [then aged three] had taken to saying 'cometa', Latin for comet every time his father was around 'with great importance'.[476] This suggests he was there to be impressed by his children, but was not the one as yet doing any of the teaching. Similarly, Margaret's comment to John's aunt about his bulb hunting expeditions with his daughters indicates he was there to do his bit, but that central control for their children's education was nonetheless Margaret's domain.

Margaret took her role seriously as educator of her children and did her research. As we have seen, she discussed their progress and her plans for them with family and friends such as Mary Maclear. She also read the latest childcare manuals for inspiration and ideas which she then incorporated into her children's regime. In August 1836 she was sent a book she refers to as 'Coomb's *Physical Education*' by John's cousin, Mary Baldwin:

> It has so far converted me to the Romping System & my little subjects are so obedient in that way, requiring only half a day's instruction to become perfect (which is more than can be said for any other accomplishment) that the noise in the house has become unbearable ever since & I can quiet our anxious heart by the assurance that their lungs are all day long in full play, & that it is only while you are at a great distance from the cry of "Whoop for Carry", "I am a Tiger & you are a Lion" and "Get on Horse, run faster" &c &c that you could expect any quiet from such an assurance.[477]

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[475] Warner, ed., *Lady Herschel: Letters from the Cape 1834-1838*, p. 100 Margaret Brodie Herschel to Dr James Stewart, 20 April 1836.
[476] Ibid., p. 120 Margaret Brodie Herschel to Mary Baldwin, 15 August 1836.
[477] Ibid., p. 120 Margaret Brodie Herschel to Mary Baldwin, 15 August 1836.

While in December 1835 she had described a rather quiet and orderly daily routine, a few months later, as a result of reading this book, she had been converted to the 'romping system' and was encouraging her children to run around screaming for the good of their lungs.

The book to which she appears to be referring was an advance copy of Samuel Smiles' 1838 publication, *Physical Education*, based on Andrew Coombe's research and specifically on his book *Physiology applied to Health*. It is possible Margaret simply got mixed up with the titles and is referring to the Coombe's original – though a coincidence she should choose that title. Certainly Smiles' book is very similar to the book Margaret describes. In one section for example, he told his reader

> A healthy child cannot be still for a moment. He will romp, and frisk, and leap about to his heart's delight … [T]his propensity to muscular activity is so powerful that it is impossible to restrain it; it is highly improper indeed to attempt to do so, since it is wisely implanted in the young by nature for the purpose of calling into action their limbs and the healthy play of their lungs, so that in romping they only obey the powerful natural instinct given them for the very purpose ... Akin to the physical effects of crying are those of shouting and roaring, that children so love to indulge in, and from precisely the same reason. They exercise the lungs; and when muscular exercise and shouting are combined, the pleasure of children seems to reach its acme… It is this shouting and bellowing, as well as in the muscular exercise, that a great source of the pleasure of their exercise lies. Stop the noise, and you stop the play; for there is no fun in silence, and as little physical enjoyment.[478]

Smiles' comments on 'romping' and 'roaring' and the health benefits of noise and physical exercise suggest this was the book Margaret was referring to in her letter to Mary Baldwin.

Smiles' book is filled with advice on the practicalities of looking after children, from what to feed them, what to expect and look out for with regard to teething, to how best to cloth them and how to manage their sleep. The vast majority of the book however is concerned with encouraging parents to value fresh air and exercise. It warns against losing sight of physical education once academic education begins[479] and offers gardening, botanizing and dancing as all excellent forms of exercise for the

[478] Samuel Smiles, *Physical Education* (Edinburgh: 1838), pp. 94-97.
[479] Ibid., pp. 157-8.

'advanced youth'[480]. Botanizing was particularly recommended for 'early awakening a taste for the beauties of nature'.[481] All these points of advice seem to have been taken up by the Herschels.

Another book that informed Margaret's approach to the education of her young children was *Practical Education* by her friend Maria Edgeworth. Margaret referred to it as a book she had already been using for some time in a letter she wrote to Edgeworth in the 1840s suggesting she first encountered it in South Africa.[482]

Practical Education ran into several editions and took as its starting point Rousseau's *Emile* and its ideal of leaving children between 2 and 12 to learn through experiment with their natural surroundings rather than academic training. It was written by Maria and her father, Richard Lovell Edgeworth, and based on his experiments in education tried out on his 22 children.[483] Between them, Maria and her father describe the types of toys children should be encouraged to play with, the stories they should hear and read, and how best to teach different subjects. On natural history, they wrote that it was 'a study particularly suited to children: it cultivates their talents for observation, applies to objects within their reach, and to objects which are every day interesting to them.'[484]

Both books – Coombe's (or perhaps Smiles') and Edgeworth's - promote a similar approach to education. Both have Rousseau at their core and start from the assumption that children are naturally curious about the world around them and that the purpose of education is to encourage and not stifle that natural curiosity. Margaret seemed to have been very taken with them both, though not to the exclusion of all other influences. She encouraged educational play and excursions but also insisted they learned their Bible.

Towards the end of their stay, and following the births of two more sons, Alexander Stewart in 1836 and John in 1837, Margaret began to worry about her husband. She told her brother that:

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[480] Ibid., p. 159.
[481] Ibid., p. 170.
[482] John F. W. Herschel to Maria Edgeworth 11 April 1841, JHS papers BFR 5.
[483] Tony Lyons, *The Education Work of Richard Lovell Edgeworth, Irish Educator and Inventor, 1744-1817* (New York: Edwin Mellen Press, 2003), p. 8.
[484] Maria Edgeworth and Richard Lovell Edgeworth, *Practical Education*, 2 vols. (London: 1798), p. 338.

> we must have our Herschel a decided & recognised Christian … Probably (& I know it) he has read more controversial works, & the writing of the Fathers than we have, but he confesses, that he was not accustomed to watch the life of a humble & sincere Christian living & rejoicing in their God.[485]

In South Africa Margaret had introduced her husband to Christianity not through set lessons or texts, but by showing him how to live as a Christian. She showed him through her own conduct and through the work of the missionaries the good works that could result from a Christian education. While she doubted whether or not he had become a decided and recognised Christian himself, his recommendations regarding a new system of education in South Africa suggest she had managed to convince him of the value of a Christian education.

By the time the Herschels left South Africa in 1838 Margaret had finally found the time to return to her education. She had begun to study some algebra and German as well as a range of contemporary literature on the upbringing and education of children. Through this she had begun to consider how best to educate their growing family. At the same time, she had got to know the local missionaries and their work, and introduced them to her husband. Through his encounters with the missionaries and in simply seeing Margaret at home with their children and servants, John had begun to see religion as Margaret did. He began to see it as an admirable way of life that had, at its heart, the improvement of self and others. When asked to advise on a new system of education at the Cape as they prepared to leave, John drew on these experiences and he and his wife's shared concern about their own children's education. In 1838, John presented his new, revised definition of the purpose of education.

> Reading, writing & arithmetic - the perusal of the Scriptures as the foundation of moral instruction and the formation of orderly & moral habits by conformity to a well regulated distribution of time, occupation & amusement - must form essential features in every plan of education[486]

A month later in a memorandum to Lord Glenelg, Secretary of State for the colonies in the British Government he gave a more detailed outline of what he saw to be the purpose of education. He wrote:

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[485] Warner, ed., *Lady Herschel: Letters from the Cape 1834-1838*, pp. 132-133, Margaret Brodie Herschel to John Stewart, 4 May 1837.
[486] Ferguson and Immelman, *Sir John Herschel and Education at the Cape, 1834-1840*, p. 16, quoting John F. W. Herschel to Bell, 17 February 1838.

> The business of education, in its various stages, from the lowest to the highest, is: -
> 1st. To form in the individual advantageous personal habits.
> 2nd. To store his mind with useful knowledge, and practical maxims available for the demands of active life.
> 3rd. To enlarge the powers and capacities of his mind, and to elevate his propensities, by familiarising him with trains of connected and serious thought and with high examples of moral and intellectual conduct.
> 4th. To form good citizens and men, by instructing them in the relations of civil and social life; and so fit them for a higher state of existence, by teaching them those which connect them with their Maker and Redeemer.
> Such are the objects which ought to constitute the chief scope of a sound educational system, whether public or private.[487]

The most striking new addition to this definition of education's primary purpose is the introduction of religion. Not only has a 'perusal of the Scriptures' become in this new draft an essential element of any educational course, it has also become its highest aim that it should teach connections between pupils and 'their Maker and Redeemer'. His last statement is also revealing. Whereas previously he had talked generally of 'every man' as the recipient of this education, here he states that these are the essential components and aims of any system of education 'whether public or private'. This, when coupled with the timing of his comments, suggests that the education of his own children was included in this definition.

Margaret had arrived in South Africa ready to teach her children more or less as she had been taught herself. Her comments to Mary Maclear suggest she was open to minor improvements – a different style of teaching French might for example get better results – but her expectation was that there were standard subjects to be tackled at set ages. During their time in South Africa, she returned to her own education and she began to dip into contemporary literature on childcare and education. Following this study she quickly adopted a number of the recommendations given in the child focused, experience and experiment led teaching models proposed by Smiles and Edgeworth. Education was made fun, and science was taught, where possible, as an activity. Her reading played some part in this, but so too did the experience of returning to her own education.

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[487] Ibid., p. 28, quoting a Memorandum by John F. W. Herschel to Lord Glenelg, Secretary of State for the colonies in the British Government, 6 March 1838.

As she wrote to Maria Edgeworth in 1841, a few years after the family returned to England, she by now understood enough of her husband's work to follow the basic thread, but could still see room for improvement:

> in the abundance of your charity pray come and infuse some of your own clear sighted and right thinking metaphysics into Herschel and Mr Whewell who are just now deep in profound dissensions on these subjects, and sadly want some fresh ideas on cause & effect - My poor brains are quite addled with it all, but there is enough of wickedness left in me to desire to see the gentlemen floored by a women, for we claim you, however nearly you may be allied in intellect to the other sex[488]

Not long after this letter was written, John and Margaret called on several intellectually accomplished women to act as godmothers to their daughters. Maria Edgeworth became godmother to their eighth child Amelia, born in 1841; the photographer Julia Margaret Cameron became godmother to their ninth, Julia Mary in 1842 and Mary Somerville to their tenth, Matilda Rose in 1844.[489] In thanking Maria Edgeworth for performing this duty, Margaret hinted at why these important and successful women had been chosen. She told her 'I only pity my poor little girl on the high nature of the hopes & expectations which may be formed of her'[490] suggesting that these women were chosen with the hope that their daughters might follow their example. Margaret's education had been able to take her so far, it had given her a better start in mathematics and the sciences than many of her female contemporaries but she could see room for improvement. She saw in John's female friends such as Maria Edgeworth and Mary Somerville, women who could hold their own in any intellectual debate, women who could 'see the gentlemen floored'. By turning to these women to act as godmothers and by seeking their advice on education, Margaret seems to be suggesting she wanted her daughters to have an academic education to match theirs.

Conclusion

In this chapter I have argued that Margaret Brodie Herschel was brought up an evangelical Christian, taught to see science education as a means of better

[488] Margaret Brodie Herschel to Maria Edgeworth, April 1841, JHS papers BFR 5.
[489] McMillan, ed., *Queen of Science: Personal Recollections of Mary Somerville*, p. 22.
[490] Margaret Brodie Herschel to Maria Edgeworth, 15 April 1841, JHS papers BFR 5.

understanding God's work. Then, through her marriage to John and entry into his circle of friends, she discovered women like Maria Edgeworth, Caroline Herschel and Mary Somerville. These were all women who had used science education as a means of placing themselves on a more equal footing with their male contemporaries. After meeting them she began to change her views on the purpose of education.

Margaret may once have wanted to become John's scientific companion, but as their family grew, the possibility of this became less and less likely. Instead she turned her attention to her daughters, using the knowledge she had gained from John's friends on how to become a scientific lady to teach them. She asked these women about their lives, admired their ability to win intellectual debates with men, and called on them to act as godmothers to her daughters thus providing them with their own role models. When they were very young, she had her sons and daughters taught the same, introducing new methods of teaching – such as Smiles' 'Romping system' – for all the children, as she discovered them. In the next chapter we will see what effect her aspirations for her daughters had on the education they received later on, and if she continued to provide them with the same education as their brothers.

In South Africa, when Margaret wasn't busy planning, researching or carrying out the teaching of her children, she was attempting to convert John to Christianity. She introduced him to missionaries, had one of their servants baptised and told her mother of her intention to make John a good Christian. While her letter to her mother indicates that she was not yet convinced she had managed to convert him, the development of his advice on the new South African system of education suggests she had brought him round at least to the importance of religious education for others. John we find in this chapter was happy to be changed by marriage. He chose a wife whose family life he admired and wished to emulate. He ordered a childcare manual when they were expecting their first child and happily took responsibility for the baby when Margaret had to go away. He helped out with lessons – something Caroline commented his own father had never done – and he met Margaret's missionary friends while they were in South Africa. His advice on a new system of education at the Cape, given towards the end of their stay, suggests he had been discussing the question with Margaret since the recommendations show evidence of her involvement. In his 1834 statement John described a list of subjects that he felt would best help prepare a typical countryman of South Africa to become a law abiding citizen, able to make informed choices. His 1838 statement in contrast was far more ambitious and shows evidence of

Margaret's involvement in its inclusion of so many of her concerns. Herschel's new system of education concerned all education, whether public or private, and so was applicable to their own children as much as the people of South Africa. It was religiously motivated, aiming as its highest ideal to connect the student with their Maker and Redeemer and it was concerned with intellectual self improvement as a means of ensuring high moral conduct.

Chapter six: Making 'active useful Herschels of some sort'

In this chapter I look at the education of the third generation of Herschels in terms of their parents' aims and ambitions for them. By third generation I am referring to John and Margaret's twelve children:

Caroline Emily Mary (1830-1909)
Isabella (1831-1893)
William James (1833-1917)
Margaret Louisa (1834-1861)
Alexander Stewart (1836-1907)
John (1837-1921)
Maria Sophia (1839-1929)
Amelia (1841-1926)
Julia Mary (1842-1933)
Matilda Rose (1844-1914)
Francisca (1846-1932)
Constance Anne (1855-1939)

Of these children, only their middle son and their youngest daughter were sent to Cambridge. Their two other sons were sent to pursue careers in India. Their other daughters either remained at home, looking after the historical collection of family papers, instruments and letters, or married men with some involvement with the running of state and empire. Within the secondary literature on this and similar families there is an assumption that careers in India and non-scientific marriages were not the desired outcomes for the children of a successful nineteenth-century man of science. By examining in detail the education provided for this generation of Herschels, I question this assumption. In this chapter I argue that John and Margaret shared similar ambitions for their children with many of their scientific contemporaries and that these ambitions were broader than simply wanting their children to become men of science and scientific wives.

This generation – the sons and daughters of successful men of science, born in the middle of the nineteenth century - has either been ignored or apologised for in the literature on scientific families.[491] This is especially true of those who were sent to India. Hector MacPherson mentions this generation when talking about the Herschel

[491] Macpherson, *Herschel*, p. 69; Moore, "On the Education of Darwin's Sons."; Hyman, *Charles Babbage: Pioneer of the Computer*.

family as a whole but only to pick out any work they did in astronomy. Anything else is simply ignored. In the Darwin family, Charles Darwin's youngest son, Leonard went to Woolwich to train for a career in India while his brothers studied at Cambridge. James Moore suggested this was because Leonard thought himself 'the stupidest member of his family.'[492] Similarly according to Anthony Hyman, Babbage's youngest son Henry Prevost joined the Bengal Army because he was bored: 'Left behind in England while the other two brothers were abroad, he decided to enter the Indian Service and started on a military career.'[493] In each case, careers in India are treated as anomalies to be ignored or explained away in terms of the boy's choice rather than their parents. However, as I will show in this chapter, India was a popular choice among the scientific parents of this generation and, as we shall see, the reasons for this are revealing in terms of how this group saw and valued education.

The daughters of scientific men have received even less attention in the secondary literature than the sons. Janet Browne asserts that Leonard Horner's daughters were educated with a view to their growing up to marry members of the intelligentsia.[494] She also states in contrast that Charles Darwin did not place much importance on the education of his daughters.[495] Men of science, it is implicitly assumed, wanted their sons to go to Cambridge and become great men of science as their fathers had. It is likewise assumed that if they taught their daughters science, it was in order that they should they marry great men of science, join them in their work and educate their children to a suitable standard. As we saw in the last chapter, female education in the nineteenth century was often justified in terms of its ability to train women to become good wives and mothers. From this Browne concludes in the case of the Horner family that a scientific education must have been designed to produce scientific wives. No conclusions have ever been suggested for why the Herschel family provided a scientific education for this generation of girls. In this chapter I argue that for the Herschel daughters, a scientific education was primarily provided to prove these girls were as capable as any boy. At the same time, their education was not limited to science, or to this single aim.

I shall argue in this chapter that for families like the Herschels, training an entire generation to pursue careers and marriages in science was unrealistic and

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[492] Moore, "On the Education of Darwin's Sons.", p. 64.
[493] Hyman, *Charles Babbage: Pioneer of the Computer*, p. 200.
[494] Browne, *Charles Darwin: Voyaging*, p. 357.
[495] Ibid., p. 534.

expensive. Instead, families like the Herschels made strategic choices. Science education for the Herschels was not just about preparation for the right career or marriage. Instead it was about passing on an intellectual heritage. I shall argue that science education was designed to help them enjoy and participate in science as adults but was not necessarily designed as any kind of vocational training. Despite John's identity as a scientific man, I argue here that the aspirations he shared with his wife for their children went beyond science. While they wanted science to play some part in their children's adult lives, they also wanted them to do something useful and to be happy, comfortable and financially secure. Their choices show they did not believe science alone was necessarily the best means of achieving those goals.

Establishing differences with the past (1830s & 1840s)

In the 1830s and 1840s John and Margaret began to set out what it was they were trying to achieve, through education, for their children. They were offered advice and help from relatives on both sides, only some of which they took. They also, as we began to see in the previous chapter, started to read contemporary literature on childrearing and education. The secondary literature on this generation implies that there would have been no question as to their ambitions for their children; they must have been training them to become men of science and scientific wives. However, in this section I will show that this was not the case. At this stage the Herschels had not decided, or at least were in the process of deciding, what they wanted for their children's futures.

On their return to England from South Africa in 1838, the Herschels found a new, larger home in Hawkhurst in Kent, which they called Collingwood. It was chosen because the grounds would allow 'our little ones to run wild'[496]. Almost immediately they were met with advice from well meaning relatives. Caroline assumed they would be looking for schools similar to John's old school, Dr Gretton's, and directed them to a couple of school masters she had heard about.[497] However, John and Margaret showed no signs of following up this advice. Instead they educated

[496] Margaret Brodie Herschel to Maria Edgeworth, 15 December 1838, JHS papers BFR 5.
[497] Caroline L. Herschel to John F. W. Herschel, 26 August 1839, BL: Eg.3762 f42-43.

the boys at home alongside the girls, and appointed a new governess to help them. All the children, Margaret told her brother Charles in 1840, were:

> getting on admirably with their lessons under their excellent German governess & as Willie [then aged 7] is working hard at German I have deferred his Latin & Greek for a little while - Ancient history, & natural history are their favourite studies and Caroline [aged 10] shews a good deal of talent for music.[498]

While the boys and girls were taught together, Caroline advised 'caution', warning that the girls might be 'safest rather to conceal some than showing too much approbation of their abilities'[499] if they were to find husbands. John and Margaret did not take this advice and no more seems to have been given. Instead Caroline took to complimenting them on the improvements they made to William's teaching method. In particular, she applauded John for 'giving up so much of his valuable time to his dear sons'.[500]

Like John's aunt, Caroline, Margaret's relatives also offered advice and help in bringing up their children. In the summer of 1843 John received a surprise letter informing him that Eneas Mackintosh had arranged for his eldest son, William, then aged just ten, to join the East India Company. Eneas Mackintosh was a friend of Margaret's family, her guardian at the time of her marriage and had helped her brother find a position within the Company. The letter offered to find William a writership in India, that is, position within the Indian civil service. This was a very generous offer. Only around 40 writerships were given each year, each a gift from one of the Company's directors, and each one estimated to be worth around £3,500.[501]

> Peter Stewart [Margaret's brother] has informed me of your most kind and friendly views regarding the appointment of one son Wm to a writership in India when of a proper age. Though I ought not to be surprised at any instance of generous and disinterested friendship… by Eneas Mackintosh, … this has come upon me in a way so unlooked for and at the same time so considerate in itself and so delicate in the manner of its proposal that I am quite at a loss how to convey to you the impression it has … on both Margt and myself.[502]

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[498] Margaret Brodie Herschel to Charles Stewart, 28 January 1840, JHS papers BFR 7.
[499] Caroline L. Herschel to Margaret Brodie Herschel, 5 April 1840, BL: Eg.3762 f55-56.
[500] Caroline L. Herschel to Margaret Brodie Herschel, 7 July 1842, BL: Eg.3762 f104-105.
[501] Cyril Henry Philips, *The East India Company 1784-1834* (2006), p. 15.
[502] John F. W. Herschel to Eneas Mackintosh, 19 August 1843, draft at HRC; BL:M/588(1).

While the letter indicates considerable surprise on John's part, there is no indication here or elsewhere that he considered, even for a moment, turning it down. Writing to her friend Maria Edgeworth, whom we met in the last chapter, Margaret indicates that this opportunity fit well with her ambitions for her children. She wrote, since 'it has been determined that our Eldest boy is to follow the same path in India - we have two more to turn into active useful Herschels of some right sort in England'.[503] John took longer to come round, but by 1846 was able to justify his acceptance of Mackintosh's offer in terms of the good it would do:

> Independent of the advantageous position in which an appointment of this nature places a young man, there is something in the nature of the [Indian Civil] Service itself which falls in with all my ideas of what is most desirable and best calculated to call into action all the powers of the individual. Assuredly there is no government on Earth which not only so well rewards its servants, but also knows how to apply their abilities, each in the most available manner and according to what they are best fitted for. And then on the other hand there is no government on earth which is so thoroughly well served, and in whose maintenance and well working the civilisation of mankind has so deep a stake.[504]

After careful consideration, John had concluded that the Service would achieve what he had decided was the purpose of his children's education – that it would 'call into action all the powers of the individual'.

Once the future career of their eldest son was determined, the Herschels set about finding a school to prepare him for his new college and turned to their friend Maria Edgeworth, recently made godmother to their eighth and newest child, Amelia. One of Edgeworth's many brothers was about to start at Dr Pritchard's Clapham Grammar School and she recommended the school to the Herschels.[505] This was a school that taught science for the enrichment of the boys' adult lives rather than necessarily as preparation for their future careers. The boys at Pritchard's school were taught to:

> draw with reasonable skill a good diagram of a condensing steam engine; a chart of contemporaneous history, ancient and modern, from memory; and a genealogy of the dynasties which have occupied the throne of England, etc. Every boy in the school, with the exception of the youngest, was expected to

[503] Margaret Brodie Herschel to Maria Edgeworth, 16 November [1843], JHS papers BFR 5.
[504] John F. W. Herschel to Julia Margaret Cameron, 15 (or 18) August 1846, Getty Centre.
[505] Reference to Edgeworth recommending the school in Margaret Brodie Herschel to Maria Edgeworth, 24 August [1846], JHS papers BFR 5.

> attend the weekly lectures on chemistry, and some other branches of natural philosophy, and subsequently to draw from memory the various apparatus employed in the illustrations.[506]

This meant that all Pritchard's pupils left well prepared to spend their leisure time studying nature, which he states was the primary purpose of the education he provided:

> my great aim to establish a habit of thinking; ...to provide resources for the leisure hours of after life, by removing those rudimentary difficulties which invariably beset the commencement of the study of Nature in its several aspects or departments.[507]

They were also well prepared for taking the entrance exams for Oxford or Cambridge, or for one of the two East India Company training colleges, Haileybury or Addiscombe. As Pritchard later boasted:

> To the school now flocked ever increasing numbers: they consisted very much of the younger sons in families where the elder brothers were sent to more expensive schools, such as Eton, Harrow and Rugby. Another important element was derived from the sons of men at the head of the several branches of science and of the liberal professions. The names of Airy, Darwin, Gassiot, Grove (Sir W.), Hamilton (Sir W.), Herschel, Maurice, etc., became familiar in the roll-call, and, in due time, we could number among the Old Boys a senior Wrangler, and many other men distinguished at both the universities, and especially some who eventually attained to rare distinction in the army. Nor were we less advantageously known at Haileybury and Addiscombe. Twice we furnished the head students of these colleges.[508]

This was an education for the rising middle and professional classes rather than the aristocracy. It was also for those who valued science. The impressive roll call of Pritchard's school came about partly through recommendations, since many scientific men of this generation shared the same aspirations for their sons and compared notes on how these aspirations might be achieved. Richard Owens and Thomas Maclear both asked Herschel for school recommendations for their sons and, as we have seen, the Herschels looked to Maria Edgeworth for guidance when doing the same.[509] However, it was also the result of active campaigning on Pritchard's part. For

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[506] Ada Pritchard, *The Life and Work of Professor Pritchard* (1897), p. 57.
[507] Ibid., p. 56.
[508] Ibid., p. 56.
[509] Herschel was asked his recommendations for schools for the children of other scientific men – see Richard Owen to John F. W. Herschel, 22 December 1853, RS: HS 13.195; John Hawkins to John F. W. Herschel, 29 July 1860, RS: HS 10.171 (asks on behalf of Thomas Maclear).

example, he wooed the astronomer William Hamilton, with the offer of reduced rates and the prospect of his son becoming friends with the young Herschel.[510]

By the end of the 1840s, John and Margaret were beginning to form a picture of the future prospects for their sons, thanks to the intervention of Eneas Mackintosh and the discovery of Dr Pritchard's school. Mackintosh had found William a career. Pritchard's school meanwhile provided a framework whereby boys from families like the Herschels could be trained for suitable careers in the Professions or in India while still cultivating an interest in science. The purpose of the girls' education was less clear.

As a guide to their daughters' education the Herschels had the conventions of their class and the writings of Maria Edgeworth. Maria Edgeworth, as we saw in the previous chapter, wrote about education and about the way children learn, in a way that chimed with the Herschels' experience and ideals. While, I will argue, the Herschels stuck to convention in the basic structure of the education they provided for their daughters, it was Edgeworth they turned to for the details.

When they first arrived back in England, the Herschels appointed a German woman, Madam Amelia Gerlach, as governess.[511] A few years later, in 1844, Madam Gerlach left and was replaced by Miss Agar, who was later joined by Miss Rufenacht.[512] The appointment of two governesses simultaneously may have been because they now had children of many different ages. According to Kathryn Hughes' study of the Victorian Governess, it was common in upper middle class homes to appoint different governesses for different age groups. Nursery governesses taught boys and girls reading and writing from aged four to eight. A preparatory governess was then appointed for girls aged between eight and twelve. She might typically teach 'the basics of English grammar, history, "use of globes", French, perhaps Italian or German, piano, singing, drawing' and whatever else she might know well.[513] The teaching of arithmetic remained weak until the end of the century and science was almost unknown in most homes. Latin was taught only if the governess was the daughter of a clergyman or if the child's father took on the responsibility.

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[510] Robert Perceval Graves, *Life of Sir William Rowan Hamilton*, 3 vols., vol. 2 (Dublin: Dublin Univ Press, 1885), p. 524.
[511] Margaret Brodie Herschel to Maria Edgeworth, 15 April 1841, JHS papers BFR 5.
[512] 'Papa came home from Slough, he left Madame not very well at Mrs Masons', 9 January 1844, Margaret Louisa Herschel's diary, JHS papers ARM.
[513] Hughes, *The Victorian Governess*, pp. 60-61.

According to Jeanne Peterson, governesses were employed by these upper middle class families to help with the education of their daughters but not to carry out all the teaching. Mothers, she notes, would often take on substantial parts of the teaching, as would older sisters as the families grew up. Fathers might be brought in to teach their favourite subjects, while outside tutors were employed for specific subjects.[514]

The Herschel experience, described in nine-year old Margaret Louisa's diary for the year 1844, appears similar, in its basic set up, to the typical home Hughes and Peterson describe. In terms of teachers, the governesses took some of the lessons: Miss Agar taught them elementary mathematics (the older, more advanced children were taught by their father) and took them for walks; Miss Rufenacht taught geography, German, French and natural history. Other subjects were taught by their parents, including music, religion and literature from their mother, Latin and advanced mathematics from their father. In addition they spent most evenings translating between English, French, German and Italian or occasionally reading plays with their mother. Sometimes they would play games such as dominoes or chess. On one occasion Louisa complained about having to play cricket with her brother William, back from Clapham for the holidays. An outside tutor was brought in for dancing and painting. In the summer they did gardening and periodically they were taken to see lectures and shown experiments by their father.[515]

The detail Louisa describes of what they were taught and how, shows an attempt to follow the advice of Maria Edgeworth. Edgeworth asserts 'that we should associate pleasure with whatever we wish that our pupils should pursue, and pain with whatever we wish they should avoid'.[516] Elsewhere she states that 'Natural history is a study particularly suited to children: it cultivates their talents for observation, applies to objects within their reach, and to objects which are every day interesting to them.'[517] She defends the teaching of accomplishments on the grounds that they act as 'resources against ennui, as they afford continual amusement and innocent occupation. This is ostensibly their chief praise; it deserves to be considered with respect.'[518] She

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[514] Peterson, *Family, Love, and Work in the Lives of Victorian Gentlewomen*, pp. 36-37.
[515] Margaret Louisa Herschel's diary, JHS papers ARM.
[516] Edgeworth and Edgeworth, *Practical Education*, p. 713.
[517] Ibid., p. 338.
[518] Ibid., p. 522. *Practical Education* goes into several later editions: 42 editions had been published between 1798 and 2003.

concludes, however, that the study of nature would serve the same purpose, and had the additional advantage of making your girls stand out in the marriage market.

Following this advice, the Herschels taught accomplishments and science. They taught science both as a treat, and as an activity to engage their children's powers of observation. Where science was mentioned in these early years, it was always with reference to experiment rather than any kind of text based study and scientific outings were presented as treats. An astronomy based outing, for example, was presented as a prize, for good behaviour: 'Papa promised us if we were good, that he would bring us to see a solar microscope at Highgate and the dissolving Venus.'[519] Elsewhere, science lessons with their father were sporadic and based on experiment and observation:

> Papa shewed us an experiment with phosphorus on a piece of wire and put in a large mug of water he then put a bottle over the phosphorus and immediately the phosphorus began to fill the bottle with a kind of smoke. But papa said it was a very fine powder which looked like smoke.[520]

Certain other aspects of the education Louisa describes resonate with the typical middle class experience described by Hughes and Peterson: they had daily practice for languages and music, their father taught them Latin and they had outside tutors for painting and dancing. However, there was also a strong emphasis on mathematics and to a lesser extent science both of which were very badly taught, if taught at all, in most middle class Victorian homes. For these lessons the Herschels could not turn to the typical experience of their peers. Nor could they look to their own childhood experience, since there is little to suggest either John or Margaret were taught any kind of experimental science as children. Instead they had to turn to their own enthusiasm, and to Edgeworth for the particulars on what aspects of and approaches to science might best engage their children.

Towards the end of the 1840s John and Margaret returned to the problem of their sons' futures. The choice of Dr Pritchard's school had provided some sense of direction, effectively spelling out their possible career options. As the decade wore on, John learned more about the details of the careers available in India. In doing so, I will argue, he began to develop an understanding of what he wanted for his sons. I

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[519] 29 February 1844, Margaret Louisa Herschel's diary, JHS papers ARM.
[520] 29 June 1844, Margaret Louisa Herschel's diary, JHS papers ARM.

will show that he saw their professional and financial security as his primary concern. However, within those parameters, he was also keen for them to have some opportunity to pursue science.

In 1849, Eneas Mackintosh offered his help and contacts once again, offering to find a place for John and Margaret's youngest son, John, at Haileybury, the same Indian civil service training college his brother William would soon be attending. This time John (snr) turned him down, suggesting the place might be more helpful to his nephew, Duncan Stewart's son.[521] As an alternative, John suggested the Royal Military Academy at Woolwich. As a compromise, Mackintosh offered to procure him a place at the East India Company's military academy at Addiscombe.[522]

Haileybury was the East India Company's training college for the Indian Civil Service. The college's stated aims were that 'young men, before their departure, should be imbued with reverence and love for Religion, the Constitution, and Laws of their own country'. This was to fortify them for 'many years of life among people in every way dissimilar to their own'.[523] In practice this meant they were taught European history,[524] Indian languages and no science. [525]

Woolwich was the British Army's training college for commissioned officers of the Royal Artillery and Royal Engineers. The army's infantry and cavalry were trained at Sandhurst. At Woolwich, the emphasis was on mathematics and science as preparation for careers as army engineers, dealing with fortifications, building bridges and railways, laying telegraph cable and so on, which were then almost guaranteed.[526]

The Military Academy at Addiscombe, was another East India Company training college. Like Haileybury, it was established at the beginning of the nineteenth century and initially took only those nominated by members of the Company, though this rule was later relaxed. Unlike Haileybury there was a strong emphasis on mathematics and science in order to train future engineers. While Addiscombe's primary aim was to train boys suitable for infantry and cavalry in India, a small (but

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[521] John F. W. Herschel to Eneas Mackintosh, 13 July 1849, HRC: folder L0239.
[522] John F. W. Herschel to James Calder Stewart, 4 March 1849, HRC: folder L0433.
[523] Anthony Farrington, *The Records of the East India College, Haileybury, and Other Institutions, India Office Library and Records* (London: H.M.S.O., 1976), p. 7.
[524] History paper for Haileybury, December1852 for third and fourth terms - general history questions – From envelope labelled 'WJH Official Appointments also Haileybury Exams Reports' JHS papers TEU.
[525] From envelope labelled 'WJH Official Appointments also Haileybury Exams Reports' JHS papers TEU.
[526] MOD information sheet on The History of RMA Sandhurst: http://www.army.mod.uk/documents/general/history_of_rmas.pdf

steadily increasing) number of students were trained as engineers and artillery. At Addiscombe, they were taught a range of subjects considered relevant to their future careers,

> The cadets were instructed in the 'sciences of mathematics, fortifications, Natural Philosophy, and Chemistry; the Hindustani, Latin, and French languages; in the art of Civil, Military, and Lithographic Drawing and Surveying; and in the Construction of the several gun-carriages and mortar-beds used in the Artillery service, from the most approved models.[527]

Indian languages were less important than at Haileybury, since the men would be expected to spend the majority of their time commanding forces composed mainly of 'sepoys' (Indian troops) in English. The syllabus was instead heavily scientific, with particular emphasis on the use of precision instruments for surveying. Out in India, those good enough to join the Bengal Engineers would find themselves building canals and bridges, telegraphs and railways, or as was the case for John Herschel (jnr), carrying out large scale surveys.

Undated, though clearly related to his discussions with Mackintosh, is Richard Jones' reply to John's letter asking for advice on the different Indian training colleges. Though John's original request no longer exists, some of its content can be inferred from Jones' reply. John wanted information on Addiscombe and on his son's chances of training there to become an engineer. Richard Jones was John's old friend from Cambridge. He was also professor of economics and history at Haileybury. Since both Haileybury and Addiscombe were East India Company colleges, he was assumed to know a little of what to expect. Jones consulted Addiscombe's Engineering Officer, Robert Dawson,[528] who advised sending him to the government run Woolwich Academy instead.

> On your point Woolwich has the advantage ... at Addiscombe he may only get an infantry commission – we will do Johnny the justice to suppose that this evil chance will not weigh much in his case... there have been great opportunities in both services – the mortality has been great in India during Dawson's

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[527] J. M. Bourne, "The East India Company's Military Seminary, Addiscombe, 1809-1858," *Society for Army Historical Research Journal* 57 (1979), p. 208 - quoted from East India Company, *Rules and Regulations for the Good Government of the Military Seminary, Established by the East-India Company for the Appropriate Education of Young Men Intended for Their Military Service in India* (London: East India Company, 1825), pp. 7-8.

[528] His identity is inferred from the details and dates implied by this letter, and information in the DNB entry for Robert Dawson (1771-1860).

> experience & he thinks that you in little exertion on your part would while you live do more for him in the English than the Indian service finally Dawson himself if he had the choice would send his boy to Woolwich.[529]

Dawson and Jones recommended Woolwich since the chance of joining the artillery or engineers was much greater than at Addiscombe and because it was safer.

While Mackintosh's first offer was accepted unquestioningly, by 1849 John knew more both about what was available and what he wanted for his children. While he had retrospectively justified the choice of Haileybury as being for William's own good, by 1849 he knew enough about careers in India to know a more scientific career was possible. While he accepted that the East India Company was a good opportunity, his correspondence with Richard Jones indicates that he saw engineering as a more desirable career for his youngest than following his brother into the civil service. Moore concluded that when Leonard Darwin went to Woolwich to become an engineer, it was because he thought himself the stupidest, implying this was not a high aspiration for the son of a successful man of science.[530] John Herschel seems to have thought differently.

This dilemma faced by the Herschels, of what kinds of careers they should prepare their sons for in the absence of much paid work in science, was faced by other scientific families too. Thomas Maclear spelled this out in a letter to John in 1850.

> With such a family as mine bless them, we have been obliged to study a very systematic plan of economy to make both ends meet the future prospects of the Boy...The medical profession is by far the most lucrative for a man of good education & fair talent: but the cost of the education from first to last including all fees, is little short of 800£. ... Like most boys the Army & Navy would appear to have the greater attraction for them: & as the second (Jack) appears to be cut out for the latter service I applied two months back to Sir Fr Beaufort & Captain Charles Eden for their interest to obtain a Cadetship. The boy is approaching the medium age for entering that service[531]

For the eldest he had thought of India, though without the Herschels' contacts he could not send him to an East India Company college. After all, he concluded, India 'presents the best field for talent, industry & honourable conduct'. Although it took him by surprise, Mackintosh's offer put the Herschels in rather a comfortable position.

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[529] Richard Jones to John F. W. Herschel, undated, RS: HS.10.408.
[530] Moore, "On the Education of Darwin's Sons.", p. 64.
[531] Thomas Maclear to John F. W. Herschel, 17 November 1850, RS: HS 12.150.

As John got better acquainted with the system, he worked out that Addiscombe would train his son for a potentially more scientific career than the civil service college at Haileybury. By 1849 John had realised that there were more opportunities to make a professional life scientific than he had previously been aware. His suggestion that Woolwich or Addiscombe, with a view to becoming an engineer, would be preferable to Haileybury and a career as a civil servant shows he wanted to make his son's career as scientific as possible. A career as a military engineer would have been more dangerous than that of a civil servant, but its scientific content appears, in John's mind at least, to have balanced that out.

By the end of the 1840s, John and Margaret's choices indicate that at this stage, their primary aim was to give their children secure futures and realistic ambitions. They were not trained, as John had been, to become natural philosophers. There was no paid work in that field, and John and Margaret could not afford to support all their children as adults, as John's parents had supported him. However, this generation was taught to see science as a part of their adult lives, as a recreational activity at the very least.

Marriages, colleges and schoolrooms (1850s)

In this section I will consider how John and Margaret's ambitions for their children progressed throughout the 1850s. During this period, their eldest children began to marry, start work and leave home. They had achieved the secure futures their parents had hoped for, but those futures lacked a place for science. For the younger children, I will argue, science, and even the possibility of a scientific career, was now given increasing prominence in their education.

In April 1852 the Herschels' eldest daughter Caroline rejected her first marriage proposal. The proposal was from the young and wealthy but otherwise unknown, William Peareth. Margaret's approval of this decision was expressed first to Caroline's sister Bella: 'Of course his great inferiority in talent (though we need not say so) - & his extreme youth (not yet 21) were sufficient objections in Carry's eyes & would be in ours'.[532] Then to John:

[532] Margaret Brodie Herschel to Isabella Herschel, 25 April 1852, JHS papers BFR 6.

> In short he is every boy & would never be the man suited to our glorious Carry. I was glad to hear at last from him however, that his uncle... took exactly the same view as I did - that it seldom did well, that the wife should be the superior of the two (& they all acknowledge Carry's pre-eminence) & that he too thought WP much too young to marry[533]

Margaret's comments give an insight into her aspirations for her daughters. Back in the 1840s, Margaret had told Maria Edgeworth of her ambition to see the gentlemen 'floored' by a lady. The education of her daughters, up to this point, implies that she saw no reason to hold back their education or hide (as Caroline had advised) their intelligence for the sake of finding a husband. However, she still worried that her daughters might not be happy marrying an intellectual inferior. In this context, it would seem their education was designed in part to ensure they married within the intellectual elite.

A few months later Caroline married Alexander Hamilton Gordon, a Scottish soldier, and the son of the Tory Prime Minister, the 4th Earl of Aberdeen, George Hamilton Gordon, a distant relative of Margaret's.[534] John expressed some regret at this marriage, suggesting he had higher or at least different aspirations for his eldest daughter, though he did not then spell out what they might have been.[535] Gordon was not a scientific man, so it is plausible that he may have been concerned that her marriage would give her no obvious outlet for her scientific education. Whether Alexander Hamilton Gordon was considered to be her intellectual equal or not is not documented.

As Caroline was getting married, William was preparing to leave for India. Again, John expressed concern about his child's lack of opportunity for using science. John wrote to William, urging him to keep up his interest in science.[536] After that he intervened only to try to ensure William's safety and social position. He requested a change in assignment from Madras to Bombay,[537] and asked friends to send him letters of introduction so William would have contacts when he arrived.[538] John and

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[533] Margaret Brodie Herschel to John F. W. Herschel, undated, JHS papers BFR 6.
[534] Charles Mosley, ed., *Burke's Peerage and Baronetage*, 106 ed., 2 vols. (Crans, Switzerland: Burke's Peerage (Genealogical Books) Ltd, 1999), p. 10.
[535] John F. W. Herschel to Margaret Brodie Herschel, 25 August 1852, HRC: folder L0543.14.
[536] John F. W. Herschel to William J. Herschel, 20 [?] 1852, JHS 5.34.
[537] John F. W. Herschel to Margaret Brodie Herschel, 5 January 1851, HRC: folder L0542.1.
[538] Charles Hay Cameron to John F. W. Herschel, 10 January 1853, RS: HS 5.147; Edward Ryan to John F. W. Herschel, 17 January 1852, RS: HS 14.462.

Margaret's eldest son and daughter were safe and financially secure, but neither had any obvious outlet for science besides its pursuit as a leisure activity.

While two of John and Margaret's oldest children were leaving home and finding limited use in adult life for their scientific training, Bella, their second oldest, was at home using hers to teach her siblings. In February 1854 the family's governess of 10 years, Miss Rufenacht, left. Bella, now aged 22, stepped in to act as tutor. Margaret wrote to John: 'Bella is everything in the house just now, Housekeeper, Secretary, Tutor, Hostess & Student - I can only call her incomparable.'[539] Bella took the children on expeditions to learn botany: 'The children had their botany lesson al fresco yesterday in the pass of Thermopylo. Alick accompanying them as souffleur to Mrs C & brought home armfuls of grasses which Amelia has even dragged Emily in to examining.'[540] She had them studying their finds and sent them out, with their mother's support, to look for more:

> Fancy [Francisca, eleventh child, then aged 8] is busy looking at mosses through her microscope & has found some wonderful little seed vessels "just like dust" she says & Mamma had promised 3 pence to the first of us that finds a primrose but we have not got any further than a little wee bud which Rosy [Matilda Rose, tenth child, then aged 10] found today.[541]

Margaret's use of prize money for specimens found shows she was watching the teaching methods at Clapham. There, as Pritchard says, half-holidays were offered as prizes for specimens found on country walks.[542]

Bella also encouraged the children to think about the scientific properties of the everyday objects they saw around them, just as Edgeworth recommended.[543] When she thought her own knowledge lacking, she turned to her father. At this time, John was away in London working as Master of the Mint. However, this did not stop his involvement in his children's education; it just meant questions now needed to be asked in writing. 'I want to know all about air!' Bella wrote on one typical occasion:

> & about water & steam & heat, & weight, & pressure, & resistance & attraction &c &c &c &c ... There's a modest little want for you! The immediate reason, is that

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[539] Margaret Brodie Herschel to John F. W. Herschel, 9 February [1854?], JHS papers BFR 6.
[540] Isabella Herschel to Margaret Louisa Herschel, c.1854, JHS papers BFR 6.
[541] Maria Sophia Herschel to John F. W. Herschel 4 March [1854], JHS papers BFR 6.
[542] Pritchard, *The Life and Work of Professor Pritchard*, p. 59.
[543] Edgeworth and Edgeworth, *Practical Education*, e.g. with respect to teaching chemistry on p. 429.

> one day in talking to the school-children I plunged into the subject of clouds & dew & then found that I could tell them a great deal that they could quite understand about the atmosphere, the properties of air, & of water - with ample references of course to tea-kettles, roasted chestnuts &c. - but still I feel on rather unsafe ground about it all[544]

While her initial request for help was so she might teach better, she quickly went on to admit it was also to satisfy her own intellectual curiosity. Having identified a book in their library that might answer her question (a book by her father), she warns:

> I don't promise that I will stop at the "useful" though I suppose I must at the intelligible - for I confess to the selfish desire of knowing its contents for myself, as well as for the benefit of the children.[545]

Bella's confession to her 'selfish desire' implies she thought he might approve of her seeking scientific knowledge purely out of interest.

Around the time Bella was acting as family governess, a local woman, Miss Cornwallis, began to become a regular visitor. Miss Caroline Francis Cornwallis was a highly educated woman, a keen promoter of education for all, including women and the lower classes. She wrote a series of books introducing complex subjects to the lay reader. She was also a committed Christian and wrote a book on the decline of Christianity. When her friend Miss Lipscomb died, she took care of her (Miss Lipscombe's) daughter, who took both surnames, Lipscombe and Cornwallis, and later married John Herschel (jnr).[546] Miss Cornwallis first appears in the Herschel family correspondence in 1853 when she helped to nurse Amelia after some kind of accident.[547] After that she became a regular visitor, entertaining the girls with her outspokenness: 'Miss Cornwallis came here to lunch too to incense us & be incensed herself at the profound ignorance of the upper classes!'[548] In doing so, she provided the girls with a new model of how an intelligent, well educated woman might behave.

The Herschel girls had grown up surrounded by a number of different models of female adulthood. They knew a number of scientific wives, mainly as mothers to their friends and as godmothers to their siblings. They also knew a number of highly

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[544] Isabella Herschel to John F. W. Herschel, undated [1854?], JHS papers BFR 6.
[545] Ibid.
[546] Madeline Barber, *Scholar Daughter of the Rectory* (Oxford: 2007); M. C. Power, ed., *Selections from the Letters of Caroline Frances Cornwallis* (1864).
[547] John F. W. Herschel to Miss Cornwallis, 17 January 1853, RS: HS 23.128 (copy).
[548] Margaret Louisa Herschel to John F. W. Herschel, undated [1854?], JHS papers BFR 6.

respected female intellectuals, both married and unmarried such as Mary Somerville and Maria Edgeworth. Miss Cornwallis represented something slightly different. Miss Cornwallis was a campaigner.

Margaret had reservations about Miss Cornwallis. Shortly after their new governess, Miss Karth, was appointed, Miss Cornwallis gave a public lecture. 'The girls & Miss Karth have gone to hear Miss Cornwallis make an unnecessary fool of herself in giving a lecture to the Public at Goudhunt', Margaret wrote to John,

> If it had been to a set in her own barn or within some home walls, or if it had been to save her ancestors from being made asses of or to make profession of her faith faith[sic]! I would do it myself - but in cold blood, to instruct the poor people in these horrible cruelties I could not lend my bonnet still less my countenance to the transaction. I feel I am bold enough - no woman should be bolder.[549]

Margaret's comments demonstrate the complexity of her position on appropriate female public speaking. She states she would have approved had the lecture been at home, or in defence of her family name or her faith. However, any other subject or arena was inappropriately bold for a woman speaker. Here Cornwallis was talking about the wrong subject, to the wrong audience. Like her comments on Carry's marriage, this outburst shows the point at which her ambition and her social conditioning collide. On the one hand, she looked at women like Caroline Herschel, Mary Somerville and Maria Edgeworth as inspirational role models for the kind of educated woman she hoped her daughters might one day become. On the other, she had very strict views on how that education might be used. That said, she did not impose this view on her children, instead willingly allowing them to attend the lecture.

With one daughter married, one at home teaching the younger ones and two sons destined for lives in India, John now set about arranging a career for his middle son. In October 1854 John wrote to his friend William Whewell, Master of Trinity College, Cambridge, expressing his hope that Alexander might enter Trinity in October 1855.[550] Whewell found him a place and in February 1855, Alexander began studying at Clapham for his entrance exams. He and Wilfrid Airy, the son of the Astronomer Royal George Biddell Airy, helped each other work:

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[549] Margaret Brodie Herschel to John F. W. Herschel, 25 April [1854?], JHS papers BFR 6.
[550] John F. W. Herschel to William Whewell, 28 October 1854, RS: HS 23.149 (copy).

> [Wilfrid] Airy is working manfully & is of great use to me in one way - ever since Perry went up to college I have had no one to work mathematics with & to keep ahead of but now that Airy has got into the integral calculus... & works at it faster than Mr P can spare time to explain difficulties he comes to me to get things expounded & this said expounding keeps me well up. In back work & moreover makes it much clearer in my own head as well as in his.[551]

The boys expected to go to Cambridge were kept on at Clapham to prepare, sitting an intensive course of study designed to get them through their exams:

> All here is now in full swing as if it had been going on for a month at least both as regards work & everything else - mathematical hours are from 11 $^1/_2$ till 1 $^1/_2$ & from 2 till 5 - classics are 4 hours a day besides play hour which are easier spent in work[552]

While John had used his contacts to ensure his son got into Cambridge, he did not then make any attempt to find him a coach. The practice of employing an external 'coach' or tutor to ensure exam success at Cambridge was well established by 1855.[553] Few if any students left as senior wranglers without spending some time with a coach. John, who had spent considerable time over past five years on various parliamentary commissions examining the current state of teaching at Cambridge, would not have been unaware of this.

The committees were set up to enquire into 'the state, discipline, studies and revenue of our University of Cambridge' and this included finding out and evaluating the merits of what was taught and how.[554] Herschel and his fellow committee members discussed the current situation with regard to professorships, private tuition and subjects offered by the University for Examination. They interviewed members of the colleges about precisely what took place –

> What is the mode of instruction pursued within your college? What amount of oral examination is given at the college lectures?... What are the elementary treatise on subjects of mathematics given or applied which have during the last years been published by members of the University not being fellows of the college chiefly for the use of students and of them what are read in the University?[555]

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[551] Alexander S. Herschel to John F. W. Herschel, 4 March 1855, JHS papers BFR 6.
[552] Alexander S. Herschel to John F. W. Herschel, 6 February 1855, JHS papers BFR 6.
[553] Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics*.
[554] Papers relating to the Cambridge Commission, BL: microfilm M/588(7)
[555] Ibid.

They also presented recommendations: 'The system of teaching the physical science should not remain barren of application'. '[T]he importance of experimental and illustrative lectures' should not be underestimated. While John made no attempt to appoint a coach for Alexander he did encourage him to carry out his own experiments in his rooms at least as late as October 1854.[556] In other words, he followed his own recommendations. When Alexander graduated 20th Wrangler, his father found him his first job, working in the observatory and laboratory of his old school.[557]

John's intervention in Alexander's education, especially in light of his involvement with Cambridge teaching at the time, shows he had no particular desire to see him graduate, as he had done, as senior wrangler. He did not employ a coach and at the same time, encouraged interests outside the curriculum. Becoming a high wrangler would have opened up the possibility of a fellowship and the chance to train for the Church. However, this does not seem to have been John's ambition for his son. Instead, he wanted Alexander to graduate from Cambridge but at the same time, to keep up his interest in experimental science. John may also have been trying to protect his son from the experience of competing to become a high wrangler. John, as we saw in chapter three, hated cramming for exams, and as Andy Warwick points out in *Masters of Theory*, he was not alone. Many aspirant high wranglers ended up hating Cambridge and even making themselves ill trying to aim so high.[558] Instead, John allowed Alexander to study at his own pace, and on graduating, found him a perfectly acceptable first job, working in the lab at his old school, Clapham Grammar.

The Herschel children had been brought up to see opportunities for scientific activity everywhere. This could make them seem rather odd even to children of other men of science, who had not experienced the same kind of education. As Margaret Louisa reported to her father on one visit to the Lubbocks' home at High Elms:

> Alick is trying to get on with the boys here, but they have very little in common, and if this is the ordinary run of boys they must be a very stupid race: how they would stare at Alicks little chromatrope or Nap the genii bottle down

[556] Alexander S. Herschel to John F. W. Herschel, 10 October 1854, JHS papers BFR 6; Alexander S. Herschel to John F. W. Herschel, 15 October 1854, JHS papers BFR 6.
[557] Charles Pritchard to John F. W. Herschel, 23 November 1859, JHS papers BFR 4.
[558] Warwick, *Masters of Theory: Cambridge and the Rise of Mathematical Physics*, see chapter four.

> tight under stopper, or rather at the possibility of finding anything fascinating in such amusements.[559]

For the Herschel children, education and upbringing had taught them to view science as fun, an entertaining way to spend their free time, but this was not a view shared by all their contemporaries. As they grew up and found spouses and careers, their parents became increasingly concerned about the role science might play in their adult lives. While the priority for the eldest children had been to ensure their financial security and status, the younger ones were increasingly encouraged to be involved in science as much as possible.

Perfecting the syllabus and repairing mistakes (1860s)

By the 1860s most of the Herschel children had finished or were finishing their education. The exception was Constance, the youngest, born in 1855, who instead benefited from the years of refinement that had gone into the family's home syllabus. For the rest, John and Margaret continued to play a role, approving or disapproving of marriages, and recommending their sons for particular pieces of work. From these interventions, I will argue, it would seem that John and Margaret wanted to give their sons the opportunity to make names for themselves in science, while also earning a reasonable living. They wanted their daughters meanwhile to grow up well educated and marry someone intelligent, respectable and high ranking.

In 1861 John Lee offered to nominate 24 year old John Herschel (jnr) to become a Fellow of the Royal Astronomical Society. John (snr) replied that while he was grateful for his support, he had advised his son not to apply until he had made some significant contribution to astronomy.[560] Having appropriate letters after his name was not John's main ambition for his son, rather he wanted him to make his name through his work. Aware of the way in which the scientific world was evolving – where military men overseas were increasingly used to accumulated scientific data - John (snr) used his contacts to help John (jnr) get work on scientific projects in India. In 1866, when Edward Sabine was looking for someone to do meteorological

[559] Margaret Louisa Herschel to John F. W. Herschel, undated, JHS papers BFR 6.
[560] John F. W. Herschel to John Lee, 10 December 1861, HRC: folder L0223.

experiments in India in 1866 John (snr) suggested his son.[561] A few years later, when George Gabriel Stokes was looking for someone to observe the 1868 eclipse from India for the Royal Society again John proposed his youngest son.[562] While rejecting help in getting his son nominated a Fellow of the Royal Astronomical Society, John was happy to use his contacts to help his son make his name in science.

For Alexander, John investigated employment opportunities, asking around about the Royal School of Mines before Alexander moved there in 1861. He read through Alexander's scientific papers for him before he submitted them. In one letter, for example, John wrote giving his comments on each line of Alexander's paper. 'I don't like mixed metaphors' he told him at one point. 'I don't understand what meaning is intended to be conveyed by "as the brightest stars are"'[563] he wrote a little further on. In effect, John taught him how to write a publishable scientific paper.

In 1862 John encouraged Alexander to apply for the professorship of Mechanical and Experimental Physics at Anderson University, Glasgow.[564] He then wrote to his friend Augustus de Morgan for more information about the institution[565] before asking William Whewell to recommend Alexander for the post.[566] Alexander took up the post in 1866. John meanwhile confided to a number of friends his hope that Alexander would 'one day' be a physics professor at a 'considerable institution'.[567]

Anderson University (now the University of Strathclyde) was set up in 1796 following the wishes expressed in the will of John Anderson, former professor of natural philosophy at the University of Glasgow. His aim had been to establish a second university in Glasgow, one dedicated to useful knowledge and scientific research. John's definition of a 'considerable institution' is never stated. However, there were still not a huge number to choose from by 1866 and his assertion that Alexander was not yet at one implies he hoped his son might end up at one of the more ancient, long established universities.

Like Darwin, John Herschel, 'worked quietly to promote his sons' careers'.[568]

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[561] John F. W. Herschel to Edward Sabine, 4 September 1866, RS: HS 24.166 (copy).
[562] George Gabriel Stokes to John F. W. Herschel, 17 May 1867, HRC: folder M0506.
[563] John F. W. Herschel to Alexander S. Herschel, 19 April 1861, JHS papers TET.
[564] John F. W. Herschel to Alexander S. Herschel, 5 March 1862, JHS 1.105.
[565] John F. W. Herschel to Augustus de Morgan, 11 March 1862, Wellcome Trust 45498.44.
[566] John F. W. Herschel to William Whewell, 10 April 1862, RS: HS 23.366 (copy).
[567] John F. W. Herschel to John Tyndall, 28 May 1866, RS: HS 24.157.
[568] Browne, *Charles Darwin: The Power of Place*, p. 434.

In doing so, he was able to modify his ambitions in the light of experience. William had been given a secure and prestigious, though unscientific post in the East India Company. This opportunity had been modified for John (jnr), who, though still with the East India Company had been allowed to become an engineer. In this post John (snr) had then been able to provide him with the means to make his name in science. Alexander meanwhile, was helped in establishing his own scientific career within a university.

While John (snr) was helping his two younger sons create scientific careers for themselves, Constance was beginning her home-schooling. By the time she was ready to begin her education, the Herschels had some 25 years of experience in planning and designing lessons and she was the beneficiary. As an adult she wrote a description of this schooling:

> My sisters' governess, Miss Karth, who was a French Alsatian, taught me French and German from the moment I could speak, so that when she left Collingwood, I being then not quite eight years old, could read both languages easily and chatter nursery French. Thereafter my father undertook to teach me Latin and Mathematics, while my mother and sisters divided the other subjects between them.[569]

Like her sisters, there was a strong emphasis on modern European languages in her curriculum. Her father taught her Latin at 8 o'clock in the morning, while he was still in bed and mathematics every other day at 12. Like her sisters, she was taught religion and literature by her mother. At 8.30 every morning she would read to her mother from the Bible and then read her some poetry. After that she had breakfast and some time free 'to run about in the garden, to feed my rabbits or to watch the coachman grooming the horses.' Then, at 10.30 she came in for lessons:

> One of each of my three sisters (who were still at home) took the morning lesson for two days in the week. Isabella[570] taught me geography, Julia[571] history and literature and Rose[572] drawing. At 12 o'clock I went either to my father for Mathematics or to read aloud to my mother in the drawing room till lunchtime, 1 o'clock. The books she chose were very various; sometimes

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[569] From an account written of her childhood and education c.1939. Full version is with descendant Mrs Diana M Ladas. Extract reproduced in Anon, "Sir William Herschel's Biographer - Lady Constance Lubbock.".
[570] The second child, 24 years older than Constance.
[571] The eighth child, 13 years older than Constance.
[572] Matilda Rose, their ninth child, 11 years older than Constance.

> travels, Eustace's Italy or even guidebooks to Paris or Rome, or more serious subjects such as Butler's Analogy of Natural and Revealed Religion. ... The afternoon lessons were not so strictly adhered to as the morning ones; the general rule was for an hour's reading aloud of a French or German book.[573]

The routine she describes appears much more structured that the one Margaret Louisa described in her 1844 diary. Modern European languages, Latin, religion and mathematics again played a central role. There is no mention of any science lessons such as those described in the family's 1850s correspondence when Bella was their principal teacher. This could mean the lessons had stopped, or, just as likely, that they continued as they had in the 1840s and 1850s, as impromptu outings and treats.

While science lessons received no mention in this period, mathematics in contrast was discussed at length. John clearly relished the amount of time he was able to devote to his daughter's lessons, relating with pride, every small step in her progress. At seven she was mastering addition:

> By the bye in 2 lessons she [Conny] has learnt addition perfectly & can do such sums as this (I copy from her book-of-letter-scrap)
>
> 98531
> 17766
> 62501
> 10002
> 188800
>
> And she says "I do like it so give me another" – "now I'll find you a hard one" – "Oh never mind, I like the hard ones best".[574]

By the time Constance was twelve John had started to teach her algebra, while continuing with her Latin and poetry, and again wrote to tell Margaret of her achievements.[575] John appears simply to marvel at his daughter's ability to learn things and to enjoy learning. There is no indication in these letters or elsewhere of any particular ambition they might have had for her.

Her sisters, were at this time, choosing to marry or to stay at home. Caroline had been married for years, Isabella had stayed at home. The next youngest, Margaret Louisa had married Reginald Dyke Marshall in 1858. Though little is known about this man, the family correspondence implies her parents were happy enough with the match. Maria Sophia married Henry Hardcastle in 1865, just two years after her

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[573] Anon, "Sir William Herschel's Biographer - Lady Constance Lubbock."
[574] John F. W. Herschel to Margaret Brodie Herschel, 12 February 1862, JHS papers BFR 4.
[575] John F. W. Herschel to Margaret Brodie Herschel, 23 May 1867, JHS papers BFR 4.

brother William had married Henry's aunt, Emma Haldane Hardcastle. On the Hardcastle family, Margaret told John approvingly:

> Emma's Father Mr Hardcastle was well known to & greatly respected by the Airys who were somehow neighbours near London & they almost introduced them to us when the ladies came to Highgate - Mr Hardcastle was a wealthy _ & especially addicted to sending Bibles among the heathens[576]

The letter is dated 1864, after William's marriage but before Maria Sophia's and was written in response to John's query about the family. This shows that either he hadn't been paying attention in 1863, or, he was more concerned that his daughters should marry well than his sons. In contrast, Margaret's lengthy response indicates she had already done her research, and this research showed the family was rich and evangelical. Elsewhere in the letter she mentions the family's links to the Haldanes 'whose family were so much known by my dear Father in Scotland' and 'that it was Mr Eneas Mackintosh who principally introduced the ladies to us'. She does not mention anything scientific about the family beyond their association with the Airy family.

When it came to their daughters' futures, John and Margaret were concerned that they should marry high ranking men of status. They approved of religious families, though were accepting of others. The men themselves had to be intelligent, or as Margaret put it, should not be their daughters' intellectual inferiors. No particular preference was declared for scientific men. In this context, the girls' academic training could be seen, in part, as a means of ensuring their husbands met certain intellectual standards. Margaret's objections were presented in terms of happiness, that she could not imagine her daughters would be happy married to their intellectual inferiors. At the same time, she saw no argument for under-educating her daughters to provide them with a greater pool of intellectually superior future husbands to choose from. By avoiding their intellectual inferiors, Margaret was attempting to ensure her daughters were not bored, and were marrying men from families with a similar interest in and enthusiasm for education.

While the eldest girls were marrying appropriate men, the boys were beginning their careers. As they did, their father was able to see the opportunities available to men of science in the modern world. With this knowledge, he was able to refine the

[576] Margaret Brodie Herschel to John Herschel, 1864, JHS papers TET 15.

details of his ambitions for them. The way in which he intervened in their careers, demonstrates his ambitions for them were that they should be able to interweave science as much as possible into their professional lives. He wanted them to be able to make names for themselves in science, but ideally through work resulting from, or related to, their professional lives rather than as amateurs. As we have seen in previous chapters, John was interested in popularising science and embedding science within British culture. Part of that project involved campaigning for more jobs in science. Through his sons, he was able to build on this project, turning existing careers into scientific ones.

Independent lives and parental pride (1870s & 1880s)

On 11 May 1871, John died peacefully in his sleep aged 79. As Margaret wrote: 'our beloved Herschel has fallen asleep - and so greatly that I only knew it by the ceasing of the pulse of the dear hand I held in mind & the simple cessation of breathing, with scarcely a gasp to tell which was the last.'[577] For his youngest daughter, Constance, John's death meant not only the loss of her father, but potentially the loss of her education since he was, and had been for some time, one of her main teachers. Unhappy with the thought that her daughter's education might suffer, Margaret made arrangements for her to go to Girton, the newly opened ladies college at the University of Cambridge. Constance described her preparation for Girton in her adult reminiscences: 'in order to prepare for college, I went to live with my sister in London and to attend lectures at University College, Gower Street.'[578] In October 1874 she began her studies in Physiology, Comparative Anatomy and Chemistry.

Margaret's pride in her daughter's place at Cambridge is evident in the reply she received from Maria Edgeworth's sister, Lucy Robinson, wife of the Astronomer at Armagh Observatory. She told her 'We are very much obliged by your mentioning that your daughter Constance is at Cambridge. For we rejoice to think of her enjoying to retrace the footsteps of her father and of the intense pleasure it must be to you.'[579] Constance took the examination for the Natural Science Tripos in December 1878 for

[577] Margaret Brodie Herschel to unnamed friend, 11 May 1871, JHS papers BFR 4.
[578] Anon, " Portrait: A Note by Lady Lubbock to Her Children," *Newsletter of the Japan Herschel Society* 1993-1994.
[579] Lucy Robinson to Margaret Brodie Herschel, 18 December 1874, JHS papers BFR 5.

which she received the equivalent of a second class degree. She stayed on as science mistress until she married childhood friend and neighbour, Neville Lubbock, in 1881.[580]

Anna Lloyd, one of the first women to attend Girton in 1869, was made to leave by her family who regarded Girton as 'a life "merely of self-indulgence and self-satisfaction, distracting her from the plain duties that lay before her".'[581] Given the evidence of this family and their attitudes to the girls' education, and in particular Bella's earlier comments on her desire to follow up a question for her own interest, this would seem to be precisely what Girton had to recommend it. It was not useful or vocational education, it was self indulgent and distracting. Its purpose, as Emily Davies described, was to provide women with the same educational opportunities as men. In both cases, as she saw it, the purpose of education was bring out the best in an individual so they might excel at whatever they did in later life, marriage and parenting included.[582]

Roy Macleod and Russell Moseley conclude from their study of the women attending Cambridge in the late nineteenth century that 'there is little archival material from which one can infer their motivations or expectations.'[583] As we have seen here, in the case of Constance Herschel, her mother, if not Constance herself, was motivated to send her to Girton because it offered the same education as that given to boys. It allowed her to follow in her father's footsteps and prove girls could do just as well academically as boys when given the opportunity.

Up until his death John continued to help his three sons in their scientific careers. In March Airy wrote to him about an eclipse coming up in December 1871 that would be visible from India and asked if his John might be available to make observations.[584] He was, and those observations led to John (Jnr)'s election as Fellow of the Royal Society, making him the first of this generation of Herschels to receive that honour. However, by the 1870s the boys had begun relying less on their father's intervention, and more on one another to help them in their scientific work. While still

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[580]Anon, " Portrait: A Note by Lady Lubbock to Her Children."
[581]M. C. Bradbrook, *'That Infidel Place': A Short History of Girton College, 1869-1969*, Rev. ed. (Cambridge: Girton College, 1984).
[582] Emily Davies, *The Higher Education of Women* (London and Ronceverte: The Hambledon Press, 1866).
[583] Roy M. MacLeod and Russell Moseley, "Fathers and Daughters: Reflections on Women, Science and Victorian Cambridge," *History of Education* 8 (1979), p. 326.
[584] George Biddell Airy to John F. W. Herschel, 13 March 1871, RGO 6.134.127.

a professor in Glasgow, Alexander corresponded with his brothers on his and their work. He was sent a specimen for his meteor work from William and his wife Emma in India[585]:

> [T]hank you and Emma for the 'omanological specimen' which is really a pattern meteorite as even the postman admitted as it arrived here free of charge except the 'annas' postage on the outside. I have found the description of the meteor from Emma's history of it in her letter to mama... I can thank you and Mr Burnmand too much for the most precious present of that famous meteorite! It has a choice place at present in the glass case with my smaller ones[586]

Alexander was also sent information by his brother John to help him give a lecture at the Royal Institution.[587] He sent William books on the Sun and spectroscopy to help him carry out work that interested him.[588]

In 1871 Alexander moved to the newly established College of Physical Science at Newcastle. The new college was set up in Newcastle as part of Durham University. It was one of a number of new institutions in the north, designed to provide a useful education for engineers and miners employed or seeking employment in local industry. It was to provide 'that kind of education which everyone recognised the necessity of, in order to fit for undertaking the responsible duties of managers of collieries, iron works, or chemical works.'[589] He remained at Durham as Professor of Physics until he retired in 1886.

This may not have been what John meant by a 'considerable institution'. For the majority of students, the education provided by the college was vocational rather than academic, providing a ready workforce for the local industries which in turn provided substantial subsidies for the college. Alexander however remained there for 15 years and in that time built up the new department to such a degree that they named the new laboratories after him when he left. In part his decision to stay there may have

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[585] It is possible William, as a magistrate, was involved in the recording of meteorite falls in India which may explain how he was able to access this sample for his brother Savithiri Preetha Nair, "Science and the Politics of Colonial Collecting: The Case of Indian Meteorites, 1856-70," *British Journal for the History of Science* 39, no. 1 (2006).
[586] Alexander S. Herschel to William J. Herschel, 2 June 1870, JHS papers TET.
[587] Alexander S. Herschel to William J. Herschel, 3 November 1872, JHS papers TET.
[588] Alexander S. Herschel to William J. Herschel, 3 November 1871, JHS papers TET.
[589] College of Physical Science minute book 1871-1886, Registrar's office, University of Newcastle Archives.

been a pragmatic recognition of the limits of his academic abilities. However, in doing so, he was also becoming a 'useful' Herschel, as his mother had wished. The college, unlike the ancient universities, had as its principal aim to help local people and local industries better themselves. By staying, he was helping these people. He was also teaching science to the masses, and building up one of a number of institutions of science, making the country more scientifically literate just as his father would have wanted.

While Constance was at Girton, her sisters were finding other ways to indulge their interest in science. Much to her mother's despair, Julia decided to marry Jack Maclear. Margaret's objection was in part based on his attitude to money. She encouraged Julia to put off marrying him until he had accumulated what she considered to be a reasonable 'nest egg'. She complained to John that Maclear did not seem interested in becoming richer. Julia's attraction to Maclear was in part, so her mother told her brother, because: '[S]he is intensely interested in all the scientific results of this "Challenger" cruise & is wonderfully neat handed in collections &c &c so that he has indeed got a treasure'.[590] Her mother saw this is as a failing, regarding Jack Maclear as Julia's intellectual inferior. As Margaret told John (jnr), '[Jack's] intellectual capacity is, I imagine bounded by his professional acquirements & the scientific branch in which, it is generally admitted, he is a careful observer'.[591] In other words, Jack would do better out of the marriage than her daughter. After initially listening to her mother's reservations (Julia broke off the engagement in 1877 and travelled to India to visit her sister and two brothers), Julia married Maclear in 1878.

Jack Maclear was the son of the Royal Astronomer at the Cape, Thomas Maclear and his wife Mary both of whom were close friends of the Herschels when they were in South Africa. Like Julia's brother, John, Jack Maclear found his way into a scientific career through the military and parental influence. He joined the Royal Navy as a cadet in 1851 (aged 13) and worked his way up the ranks to become commander of Sir George Nares' 'Challenger' expedition in 1872. The expedition was a scientific round the world trip aimed at exploring the ocean's depths. Margaret's reaction to Julia's choice of husband gives an indication of her ambitions for her daughters and her attitude to science. According to Margaret, Julia's education would have made her an asset to her husband's work and in exchange, Julia should

[590] Margaret Brodie Herschel to John Herschel (jnr), 1 June 1876, JHS papers TEU.
[591] Ibid.

expect to be financially well looked after by her husband. For Margaret, this latter part of the exchange was crucial, but Julia and Jack do not seem to have agreed. Whether or not Julia did go on to help Maclear with his work is unclear. She is not cited in any of his subsequent published material.

Aside from helping her daughters choose husbands, Margaret also seems to have agreed with Emily Davies that a good academic education was the best way to prepare middle class women for any future role they might have. When updating John (jnr) on Constance's progress in 1881, Margaret proudly related 'I rejoice that my Conny is among those [women at Girton] who proved the power & the needs of women to do something else than lie fallow.'[592] As we saw in the last chapter, Margaret told Maria Edgeworth that she would like to see the men floored by a woman. This, combined with her praise of Girton shows that a major purpose she saw for educating her daughters was to prove they were just as capable as the boys. This was a view shared by Davies but opposed by many others.[593] While their levels of education had some impact in determining who they might marry, its main purpose was to bring out the best in them, just as Davies stated it should be.

Margaret's ambitions for her sons were in many ways quite similar. Their early education was designed to be a grounding on which later vocational training could build. However, when it came to her ambitions for their careers, these seem to have changed as she came increasingly to value science and the Herschel legacy. In the 1840s she expressed a hope that all her sons might become 'useful' Herschels. By the 1880s, she expressed a rather different desire. After receiving a recent biography of their grandfather (Holden's 1881) she wrote to Alick:

> If you all three were rolled into one, I suppose you would be equal to some of your ancestors - at present I am ready to maintain that none of you disgrace your parentage - & I am very proud of that. John says that your name has a very long tail already on the Royal Soc panels, so that I may count on your dear Father having two sons FRSoc'[594]

Preceding these comments, she told him the book 'is delightful & I cannot help feeling how much more precious such an inheritance "which no man can take from you" is

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[592] Margaret Brodie Herschel to Alexander S. Herschel, March 1881, JHS papers TET.
[593] Some campaigners agreed with Davies, others felt women should have a different education to boys as preparation for different adult lives. Delamont, *Knowledgeable Women: Structuralism and the Reproduction of Elites*.
[594] Margaret Brodie Herschel to Alexander S. Herschel, undated, JHS papers TET 9.

than Landlordism.' In other words, scientific greatness was their unique inheritance, and she hoped her children would look up to, admire and aspire to emulate the work of their ancestors. While her initial ambition for her sons was to see them in secure, and 'useful' positions, forty years later she expressed a hope to see them also make names for themselves in science.

By the end of the 1870s both William and John had returned home from India. John returned to some experiments he had begun back in the 1850s with his father, and to publish his work in a series of papers.[595] William moved to Oxford and began studying for a degree in Theology. Constance meanwhile used her position at Cambridge to try to help her siblings play a part in contemporary science, just as her father and brothers had done before her. 'Would you like to do something for the achievement of science?' she asked her sister Matilda Rose, who was still out in India. Conny went on:

> There is a gentleman here (a Mr Gwatkin – such a nice man!) who is collecting snails tongues to classify them. He has got almost all possible British ones but he is very anxious to get some out landish ones. If you ever come across any shell beasts land, freshwater or marine which look odd it really would be a good act to put them in a bottle of spirits – mind it is the tongue he wants not the shell (though that is important too to know the beast by) so empty shells are no good & the creature must be enspirited while fresh. Do go in for snails – it will be a novel occupation I am sure, and among Indian univalves there is an unexplored field open to you.[596]

The Mr Gwatkin referred to here was Henry Melvill Gwatkin, a theologian and natural historian, and the son of John's old college friend and fellow founder member of the Analytical Society, Richard Gwatkin. Whether or not Matilda followed up this suggestion is not known. However, it would be fair to surmise that although they did

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[595] John F. W. Herschel to John Herschel (jnr), 18 August 1857, JHS 5.6; John Herschel, "On the Figure of the Earth," *Nature* 20 (1879); John Herschel, "Note on the Difference of Variation of Gravity at Revel and St Petersburg; and on Grischow's Pendulum Observations at Other Stations.," *Monthly Notices of the Royal Astronomical Society* 40 (1880); John Herschel, "On the Employment of the Pendulum for Determining the Figure of the Earth," *Nature* 21 (1880); John Herschel, "Wire Torsion," *Nature* 22 (1880).; John Herschel, "On the Determination of the Acceleration of Gravity for Tokio [Sic], Japan," *Philosophical Magazine* 9 (1880); John Herschel, "Note on the Length of the Pendulum Observed by De L'isle De La Croyère at Archangel in 1728," *Monthly Notices of the Royal Astronomical Society* 41 (1881); John Herschel, "On a Simplified Form of the Torsion-Gravimeters of Broun and Babinet," *Royal Society Proceedings* 1881; John Herschel, "On Gravimeters, with Special Reference to the Torsion-Gravimeter Designed by the Late J. Allan Broun, Frs," *Royal Society Proceedings* 1881; John Herschel, "Pendulum Observations in London," *Nature* 25 (1882).

[596] Constance Herschel to Matilda Rose Herschel, 3 February 1881, Archives of Diana Ladas (photocopies with Lubbock descendants).

not publish, some of the women in this generation maintained an interest in science into their adult lives.

Constance, like her brother Alexander, made the beginnings of a career in science when she stayed on to run the laboratory at Girton. In 1881 she married Neville Lubbock, son of John Lubbock and childhood neighbour of the Herschels and Darwins. After this she became interested in her husband's work, but returned to the subject of science and her family in later life. In the 1930s she wrote a privately printed biography of her father, and a much cited account of her grandfather and great aunt: *The Herschel Chronicles*. Some of her sisters too, continued to pursue science as a hobby. Francisca, one of the two women from this generation credited with organising the family archive, was awarded one of the first full fellowships given to women by the Royal Astronomical Society in 1916.

Conclusion

While historians have inferred that eminent scientific men in the nineteenth century simply wanted their sons to follow them into science and their daughters to marry other men of science, the Herschel story shows this was not always the case. The Herschel example shows that the ambitions for this generation could be a lot more complicated, driven by a desire to make them not just scientific but also financially secure, happy and useful.

In the childhood education of the generation of Herschels discussed in this chapter, science was initially treated not as part of their vocational training to help them find work and husbands, but as an enjoyable accomplishment. Just as they were taught music and art without any view to becoming or marrying musicians or artists, they were taught science primarily, at first, to enrich their adult lives. However when they became adults, the objectives began to change. Their father, John Herschel had long campaigned for science to feature more heavily in Britain's professional landscape. As his sons began to look for and enter into careers of their own, he began to see in practical terms how this might be achieved. Whereas in earlier decades he had argued rhetorically for science to become a profession, faced with his sons career options he began to take a more pragmatic approach. Instead of hoping to create new jobs, he began to see how existing jobs could be made more like his ideal. Alexander

was helped and encouraged to carry out research while also fulfilling his primary duty at Durham, teaching the workers in local industry. John, the engineer, meanwhile was sent all kinds of additional projects, via his father's scientific friends, to add to his official surveying duties with the Bengal Engineers. The girls of this generation, meanwhile, encouraged by friends and family, though less systematically than their brothers, found various ways of applying their childhood training in science to projects in adult life.

The Herschels taught their children academic subjects and accomplishments with the aim of giving them the opportunities and resources needed to enjoy and pursue science if they wished, as adults. As they became adults, they and their parents tried to find ways of weaving science into their professional and married lives, but financial security came first. Their aim was not to ensure they became great or eminent men and women of science, but to allow that to become an option. There were few opportunities to make careers in science in the 1850s and 1860s when the Herschel boys were completing their education and John and Margaret were pragmatic enough not to train their sons for careers that did not exist. Instead they chose respectable positions appropriate to their class, building scientific work into this as the opportunities arose.

Other families made similarly pragmatic decisions based on their financial circumstances. The Darwin family was one of the richer, more financially secure scientific families in the mid-nineteenth century. As a result, most of their sons went to Cambridge, but their daughters received a relatively unscientific education. As Janet Browne put it, Darwin was very relaxed about his daughters' education. 'Henrietta and Elizabeth were not taught any science or mathematics, for example, beyond some rudimentary botany; their lessons were principally geography, music, singing, and languages....Of course, the question of education was different for sons.'[597] Henrietta married the penniless Richard Litchfield with her parents support while Elizabeth never married.[598] Unlike the Herschels there was no need for them to marry money since there was enough family money to support them all.

Comparison with the Lubbock family raises different issues. John Lubbock, like Herschel, was a scientific man, a fellow of the Royal Society and on occasion its Vice-President and a fellow of the Royal Astronomical Society. But he was also a

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[597] Browne, *Charles Darwin: Voyaging*, pp. 534-535.
[598] Browne, *Charles Darwin: The Power of Place*, p. 356.

banker and a barrister. He came from a banking family and had gone to Eton and on to Cambridge. He occasionally lamented the lack of interest Eton showed in science. On one occasion for example he wrote to Louisa Herschel about his two teenage sons, complaining about a summer assignment they had been given:

> Beaumont and Monty have an ode to Athena as their holiday task & are to put that 'her glory will never fade ages cannot' which is as true a statement they had before viz that 'The sun & the Moon are planets' But they do not care for modern history or astronomy at Eton." [599]

He nonetheless continued to send his sons there regarding this as the best route to a reliable and lucrative career. While he encouraged friendships between his children and those of his scientific neighbours, the Herschels and the Darwins, he did not make science any part of their formal education. For Lubbock, science was interesting but not necessarily something he felt his sons needed to learn. Unlike Herschel he seems to have regarded it as his own hobby, quite separate from any ambition he might have for his children.

The Maclear family offers a final comparison. Here, as we have seen, financial considerations played a part not only in forcing the selection of certain careers, but in ruling out most schools and colleges. While other families could afford to send at least one son to Cambridge, in the hope that it might lead to a scientific career, the Maclears simply could not afford the fees. Nonetheless, like the Herschels, they found ways within existing career structures to create a scientific career for one of their sons (Jack) once his financial security had been established.

The Herschel family fell between these extremes. They were rich enough to send one son to Cambridge and had the contacts to send two more to East India Company colleges. While the highest ten wranglers at Cambridge were given fellowships that might finance their further vocational training for the Church, law or medicine, lower ranking graduates were not. These graduates still needed to train for their future careers, but this training had to be paid for by their parents, on top of their already expensive Cambridge education. While the mathematical education offered at Cambridge may have been attractive to many men of science for their sons, for most of these men, it came with an element of risk. Their sons needed at some point to be trained to earn a living.

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[599] John Lubbock to Isabella Herschel, 14 December 1855, JHS papers BFR 6.

While a degree might help to find work in science, in the 1850s when the Herschel boys were of university age, it was still statistically unlikely. It was not until 1870s and 1880s, when William, Alexander and John were all reaching the ends of their careers that jobs in science requiring university degrees began to emerge. A safer option was to find a respectable and financially secure position that in some way lent itself to becoming more scientific, then use family knowledge and contacts to alter that career accordingly.

The daughters within this generation of Herschels were taught science and mathematics primarily as a means of proving themselves as capable as any boy. The chance of sending the youngest to Cambridge to study for the new Natural Sciences Tripos, to compete alongside boys in the same exams was an unexpected treat, one their mother relished. Like the boys, the girls' science education was designed to equip them with the tools needed to pursue any scientific opportunity that came their way. At the same time, like the boys, they were also encouraged to pursue financial security, and for girls this meant making good marriages. While the boys' careers were steered smoothly by their parents, ensuring a financially secure position was gained and then moulded to become more scientific, their girls encountered more conflict. Julia's marriage to the scientific Jack Maclear was disapproved of on the grounds that he might not provide her with adequate financial stability. Similarly other daughters were encouraged to reject any man, however rich, on the grounds of intellectual inferiority.

Contrary to the assumptions made in all current secondary sources, these children of a nineteenth century man of science were not brought up to become great men or women of science. They were not trained to become men of science or scientific wives. Instead, John and Margaret Herschel sought a place for their children within the upper middle classes. Science for the Herschels was their route to that social position and security.

Conclusion

This dissertation has addressed a number of overlapping questions. It has dealt with the relationship between parents' aspirations for their children and the education they provide. It has concerned the motivations that directed three generations of the Herschel family to study science, and the role of self-presentation in determining scientific success. But it has also been about the hierarchy of scientific roles, and has demonstrated that great scientific men do not necessarily wish their sons and daughters to follow in their footsteps. As we have seen, there were many reasons - including financial necessity, available opportunity and domestic responsibilities – why some members of the Herschel family were encouraged to become scientific assistants, educators and engineers. Others were keen to become natural philosophers and scientists, and were encouraged to do so. I have argued that their success in these various ambitions cannot be explained simply by native ability or genetics. I have suggested instead, that parental ambition, education and the wish to exploit the social possibilities of the time, were also very important factors.

In the following sections I return to the main issues I raised in my introduction, showing how they have been addressed in the previous chapters.

1: Herschel scholarship to date

As I observed in the introduction, the literature to date on the Herschels has followed broad trends within the history of science. A good deal has been written on William, Caroline and John while a few other pieces exist on Margaret, and on John and Margaret's children. In each case the Herschels have been studied as individuals, or in the case of William and Caroline, as a pair, with little consideration of their early years and of the role the family might have played in this formative period of their lives. Nothing to date has considered the whole Herschel family together and how the generations interacted. The fact that they all came from a scientific family has often been asserted as significant without requiring further explanation. By concentrating, in this thesis, on the planning and very early education of each of the Herschels, the role of the family in shaping these individuals comes to the fore. Becoming a great man or

woman of science in this family was achieved when the right combination of educational strategies and ambition were passed on, and when these coincided with opportunity. I have also argued that achieving this kind of success was not always the aim of the education provided for each member of this family.

John and his children were all brought up surrounded by the tools, people and language of science. In this respect, both of these generations were better placed to become successful in science than either William or Caroline. However, while a number of John's children made some contributions to science, and lived moderately scientific lives, they are generally regarded in the secondary literature as being less successful than their father, grandfather or great aunt. The difference between these generations I have argued, and the key to their various successes, lay in the ambitions of their parents. In each generation, education was started very early and was directed by the parents towards achieving certain goals. As the children grew up, each then reinvented both the goals and themselves in light of new opportunities. Indeed, a key part of this family's success was the ability of each individual to re-think the relationship they wanted between their family and science. The elite education that William was able to give John, and that John in turn was able to provide for his children, played an essential role in this by instilling in them the kind of self-confidence and self-reliance that allowed them to make the most of their opportunities.

William and Caroline had socially ambitious parents who passed on, along with their didactic skills, the idea that education should be used as a means of raising one's social status. William's early education was directed toward his becoming a society musician. His father taught him how to learn music; he also introduced and supported an interest in additional subjects that might make William appear more cultured and therefore marketable as a society musician. These subjects included astronomy and natural philosophy. William developed this scientific interest into a professional hobby, initially to impress musical clients and to give himself the edge in a saturated market. Gradually he reinvented himself as a natural philosopher as opportunities arose.

John's parents were socially and scientifically ambitious for their son. They wanted him to have the social skills to fit in with his class, but also, and more importantly, wanted him to have the mathematical skills to raise his position within the scientific hierarchy. John's childhood education had been directed toward his becoming a very successful mathematician or mathematically trained natural

philosopher. He benefited from this intensive academic education in that it allowed him to become senior wrangler, an Analytical Society member and a successful author. In particular I have considered John's correspondence with his home tutor and William's correspondence with French and Scottish mathematicians that led, directly and indirectly, to that tutor's appointment. In doing so I have shown how John came to excel both in Newtonian and continental calculus, and, therefore, how he came to be senior wrangler and a key member of the Cambridge Analytical Society.

Following graduation, John reinvented himself, rejecting the parental ambitions that had shaped much of his early upbringing. He did not want to live off family money or concentrate solely on mathematics. He wanted to work to make his own living. Having found that training to become a lawyer was not to his liking, he turned to the growing field of experimental science. Despite the lack of professional opportunities, he gradually fashioned himself as an experimenter and as a general science writer. This period of John's life, in which he tried several fields of study, without making any outstanding contribution to any, was a period described by Ross as one of 'divided purpose'. However, as I showed in chapter four, there was a pattern underlying these various activities. His changing interests came about through his encounters with available opportunities and his ability to see links between them. He then managed to weave these different experiences together to form the coherent description of science he would outline in his *Discourse*.

By deploying previously unused correspondence regarding his marriage, I have shown how and why John rejected his parents' model for his future. In this correspondence we find he deliberately chose a wife who might help him create the kind of home life for his children he felt he had missed out on for himself. Margaret married into the Herschel family bringing with her a strong belief in the superiority of her own upbringing, especially her attitudes regarding education and religion. Mine is the first study of Margaret's early life and, as I have shown, it had important repercussions for how her children were raised, and how John came to view education. While she was brought up to see a religiously driven liberal education as the ideal, she like the rest of the Herschel family moderated this inherited model in light of experience. As she got to know John's circle of friends and relations, and as she began to read up on current thinking on education and childcare, she began to view science as an increasingly important component of an ideal education.

John and Margaret's children were brought up with less specific goals than previous generations. They were not trained to become musicians or grand amateur natural philosophers or evangelists. Their training has not been previously studied in detail by historians, and, as we have seen, was more pragmatic than that of their parents. They were trained to recognise how science might play a significant role in their adult lives, but were also educated to take up established and respectable positions within the upper middle classes. This was not a rejection of science, or of education, but of the pressurised, intense and narrowly directed training to which John felt he had been subjected. For this generation, their home life was less vocationally driven than William or Caroline's, happier and less pressured than John's, and more scientific than Margaret's. This much less narrowly focused parental ambition makes it much harder to establish how this generation reacted against their parents' goals and reinvented themselves.

All of the Herschels emerge from my analysis as different characters to those depicted in existing literature on the family. William, when understood within the context of his family life, appears more ambitious, and more aware of social and scientific hierarchies than previous studies have suggested. Caroline becomes a far more active participant in her own education. The young John is transformed from being naturally gifted, to being partially the product of his father's ambition, and partly that of intense mathematical coaching. On my showing, his time after university becomes far more coherent, showing clear directions of self development rather than being simply divided in purpose. Margaret becomes more than a decorative and good natured companion to John. While Margaret and John's children all come across as able students fulfilling particular, pragmatically chosen paths selected by their parents, they also play a role in shaping their own futures. In each case my account of individual Herschels is built on previously unused archive material, the context of family ambition, education and personal choice.

2: Intellectual families

The Herschels were a high-achieving family for more than a century. As I stated in the introduction, this type of family has attracted two types of treatment in the secondary literature. The first considers them as a rare genetic anomaly, the second as an

example of a broadly defined intellectual class. Neither of these approaches explains why or how the Herschels first turned to science, nor why in later generations this family and several like them, moved away from pursuing such high profile scientific careers.

I have argued that a major motivating force for the first generation to join the scientific community was social mobility. Natural philosophy offered a way of making William the musician stand out in a saturated market. In this respect the Herschel family is unique, since no other notable scientific family seems to have started out as musicians. However, the reason natural philosophy and then astronomy was chosen by William as the means of improving his standing was in part because of the high social status enjoyed by the sciences at the time. This is something others, ambitious members of local philosophical societies perhaps, may plausibly have noticed and capitalised upon with varying degrees of success.

In training John to follow in his footsteps, William was consciously creating a scientific dynasty. The work that went into creating this education was at least as important as mathematical ability, however it was acquired. An equally capable mathematician might well have followed a quite different career path had his father had different ambitions for him. There is also little sense that William was tapping into a broadly defined intellectual class as a means of learning how to design his son's education. As I have shown, he looked to his wife's family, that is to the traditions of a landowning professional class, for guidance to begin with, but soon rejected their values in favour of an education that was similar to, but more mathematical than his own. Others in the same era experienced a similar kind of intensive childhood training, John Stuart Mill being the most famous example. Harvey Becher has suggested John's fellow Analytical Society members also shared some aspects of his education in order to have been in a position to be invited to join that Society.[600] This study of John's family background and education thus offers fresh light on that shared experience.

The intensity of John's education was largely a function of his father's social ambition. William hoped his son would maintain and increase the social status he had achieved, and would be spared some of his own struggle. This could equally be applied to other families who rose in social position only to become uncertain of how

[600] Becher, "Radicals, Whigs and Conservatives: The Middle and Lower Classes in the Analytical Revolution at Cambridge in the Age of Aristocracy.", p. 407, p. 410.

to maintain their new status. The shared training in Continental mathematics meanwhile can be understood in terms of timing. John and his fellow Analytical Society members grew up in a period when England and France were at war. Many scientific individuals, especially those from the rising intellectual and industrial classes, were nevertheless sympathetic to revolutionary politics, and to the outstanding French achievements in celestial mechanics. In this respect, William's interest in training his son in this particular field can be seen as a reflection of his time and class. At the same time, William had personal reasons for wanting his son to master Continental mathematics, having tried and failed to do so himself.

Only in the training of the third generation is there a clear sense of the family sharing common values and behaviours with other scientific families such as the Darwins. In this context I have argued that the Herschels are best seen as part of a Cambridge network of families. By looking at previously untapped sources, I have shown these families consciously turning themselves into scientific families or dynasties. There was nothing mysterious in the fact that so many of these families chose to send their sons to India as often as they sent them to Cambridge, or why they so often sent their sons to Clapham Grammar School. These apparent coincidences happened because as well as discussing scientific ideas and planning the organisation of science within society, these men and women of science also discussed their children. Their correspondence contains comments on their aspirations and worries about their children. They regularly compared notes, tried to justify their decisions and recommended schools to one another. They were also very often in similar financial positions, and this again determined the options they had available for their children.

The Herschels were a scientific dynasty in the sense that science formed part of their social currency. While in the first two generations the Herschels' pursuit of science was a response to some of the same external pressures experienced by other families and individuals it was only in the third that these similarities can properly be described as a trend. Only then is there a coherent set of ideals about education and its relationship to science that is shared between these families and, as we saw, this is also the point at which the individuals within the family ceased to be regarded as exceptional. They had become part of a broader upper middle class elite.

3: Women and the dominant story of science

As I suggested in my introduction, a major advantage of studying a whole family is that equal weight can be given to the quieter voices in the history of science as to the big names. In particular I have looked at the women within the family who in the secondary literature are either invisible or portrayed as downtrodden victims of others' ambitions. By looking at the Herschel women in terms of their training, its purpose and evolution, I have shown that in all cases the women had far more agency in determining the direction of their education than has previously been thought. I have also shown that they saw themselves, and were seen by others, as equal, though not identical, partners in their relationships. Their roles were different, and this was generally understood, but they were nonetheless regarded as of equal importance.

As a child, Caroline was taught to assist, to learn skills that made her useful to others and she brought this approach to education with her when she came to live with William in England. Domestic work was always her responsibility, and this in itself was important in freeing William's time and energy for astronomy. This area of responsibility was part of what made her an equal partner. Her education in astronomy came relatively late in the astronomical career of her brother, and so inevitably she had some catching up to do. When she did turn her attention to astronomy, the role she played within William's work was considered by both siblings to be necessary and one few others would be able to perform. Though she presented herself as subservient and her work unimportant in comparison with her brother's, this, as Fara has pointed out, was simply a fashionable style of self-presentation for women. As I have shown, just like William, Caroline was brought up to be aware of the importance of self-presentation.

A generation later, Margaret, like Caroline, made her domestic responsibilities her priority. With 12 children, she had little time to spend learning much science, and for this reason she, and women like her, have been almost invisible in the history of science. She was not an assistant or scientific companion to her husband, but I have argued she was an equal partner within this single career marriage. She did her bit keeping together the kinds of social networks Jeanne Peterson points to as typical woman's work within intellectual families.[601] She also took charge of running the

[601] Peterson, *Family, Love, and Work in the Lives of Victorian Gentlewomen.*

home and bringing up their children. She did not have the time to become the kind of scientific collaborator that tends to attract scholarly attention, but this is precisely what makes her so interesting. Her life's work was to create a happy family home and to raise her children as Christians with an interest in science.

Margaret made an early decision that her daughters would be raised to be as academically capable as any man. She was interested in science and pleased to marry into a scientific family (at least she claimed Caroline as a childhood icon and corresponded with her enthusiastically about her life) but her main role within this partnership was not in scientific research. Instead, her role was to take charge of their home and family. Her role in John's professional life, I argued, came out of this domestic role. Through her studies in childcare and education, and her practical work in implementing what she had learned, she was able to inform John's public views on education and its purpose.

Margaret lived in a time when big families were common. Of her peers, Emma Darwin had ten children, Richarda Airy had nine, and Mary Maclear had eleven. None of these wives are considered scientific companions by historians of nineteenth century science. This study of Margaret Herschel shows that while she did not directly help John in his scientific work, she was not intellectually idle. Her religious background and later studies in education informed John's thinking and behaviour both in the public sphere and in the choices they made together about their children. Indeed it is in understanding the careers and marriages of Margaret and John's children than Margaret's contribution becomes vital.

John and Margaret's nine daughters were all brought up to see themselves, and to be seen by others, as intellectually equal to men. They were trained to be equal partners in that sense. This meant that in contrast to previous generations, they openly pursued their studies with a view to satisfying their intellectual curiosity rather than as a means of making themselves more useful to others. This is borne out in Bella's comments on her research for teaching her siblings, and in the decision to send Constance to Cambridge. However, the options available to this generation as adults were not so very different from previous generations. Their opportunities to play some role within the public sphere were still dependent on and obscured by the work of their male relatives. They could marry and help their husband in his career, or they could make their name, as many of them did, through researching and ordering their family's history. Nevertheless they made the best of the opportunities presented to them.

Francisca became one of the first women to be elected a full (as opposed to honorary) fellow of the Royal Astronomical Society for her work on the family archive. Constance helped her husband and his career and after he died wrote *The Herschel Chronicles,* an account of the life and work of her grandfather and great aunt.

In each of these generations, the Herschel women were making the best of their situation and were helped along the way by sympathetic relatives. Although all had to rely on a male relative for their education, none were simply passive recipients of this education. They asked questions, read books and offered help where they saw an interesting opportunity. They were equal in the sense that they made an equal contribution, and that their contribution was equally valued, though in most cases they did less science and more domestic work than their male companions.

Section 4: Biography

As I stated in the introduction, my aim in this thesis was to use the tools of biography to understand the Herschel family over three generations. I focused on the choices made by each generation. Since my work has been about a whole family, the choices I considered have included not just those made by each individual about their own lives, but also the choices they made on behalf of other family members. This approach has meant that the Herschels can be seen not just as dopes of genetics and the broad social and political environment in which they lived, but as active agents shaping their own lives. They made choices and those choices reveal their ambitions for themselves and their children and how they tried to realise those ambitions.

For Caroline, my emphasis on choice has made her agency, rarely acknowledged in the secondary literature on the Herschels, more visible. I showed in chapter two, for example, that, as a child, Caroline chose to learn a range of decorative skills, following the family's desire to appear, from their education, as middle class. As an adult, William chose to teach her skills that would make her useful. Caroline to some extent chose how to use and develop these skills and did so with a view to becoming indispensible.

William's choices about his son's education reveal that he wanted him to master mathematics above all else, regarding this as the key driver of social mobility. He wanted him to fit easily within the upper middle classes the family had now joined,

but when forced to chose, as he was when he discovered Eton did not teach mathematics, William chose mathematics. John's choices indicate that he took a long time to work out what he wanted to do and how he wanted education to help him. Eventually he settled on science writing, and general expertise in science. He then chose a wife, Margaret, primarily, so he claimed in his letter to his prospective mother-in-law, for what she could offer in terms of creating a different, happier, home life to the one with which he had grown up.

The choices made by Margaret's family for her childhood education were, as I showed in chapter five, all driven by religious belief and a conviction that academic education was an excellent means of learning to appreciate God's work. Many of the decisions made about the education of John and Margaret's children were made by Margaret as part of her responsibilities within their single career marriage. However, her choices were not made in isolation but with help from her family, John and John's friends, and the latest childcare and education literature.

In this thesis I have presented considerable archival evidence to show in detail and for the first time, how the formative education of a new generation within a scientific dynasty actually works. This process was not trivial, though it is invariably overlooked in studies of individuals and families, but required a huge amount of planning, research and hard work. There was monitoring, strategy, timetabling, the hiring of governesses and tutors, school selection, and the discussion of pedagogical theory and practice with tutors and social peers. All of this was a necessary part of shaping the next generation and so continuing the scientific dynasty.

The choices made about this third generation of Herschels reveal a marked shift in the ambitions of the family. Whereas Isaac and William had both wanted their sons to follow in their footsteps but to be better equipped and rise higher than they had, John wanted something else for his sons. Having achieved the high social and scientific position to which his own father and grandfather had aspired, John wanted his sons to have happier, more secure and less pressured lives. The story is slightly different for the daughters. Margaret's ambition, revealed through the choices she made and justified for her daughters, was that they should become more scientific than their mother.

5: Liberal education and the professionalization of science

In the introduction I suggested that while during the nineteenth century science became increasingly 'professionalised' and science education progressively more technical and vocational, the opposite was true of the Herschels and families like them. As the Herschels' rose up Britain's social hierarchy, the need to prove themselves intellectually diminished. In the first generation, science education had given them access to and eventual acceptance by an elevated social class. This new social position in turn gave the family greater access to elite forms of education, allowing William to send his son to the best schools and on to Cambridge. For William, a technical if not vocational education for his son was regarded as a necessary means of securing the family's new found social and scientific status. By the third generation, science had become part of the family's cultural currency. It was no longer needed for attaining or retaining the family's social position, but was instead useful for securing another kind of status. Social status and financial stability were secured through careers and husbands. Science was then added or encouraged as a means of gaining personal reputation in the form of publications, awards and fellowships.

Science education had different purposes for different generations within this family. For William, science education had been a means of allowing him to stand out in a saturated music market, and only luck made it into a career. For John's children, science education was again a means of allowing them to stand out in their various careers and in the marriage market. Only in John's case, was there a concerted effort to train a Herschel exclusively and intensively for a life dedicated solely to mathematics and astronomy and this was only made possible by the fact that William was already a world famous astronomer who assumed his son would not need to earn a living.

In my introduction, I pointed out that one major omission in the secondary literature on schools, universities and colleges in the nineteenth century is that none explain why parents chose particular institutions for their children. In this thesis I have explained why the Herschels chose their various institutions of education. In each case, the schools and colleges were chosen because they matched the educational aims of the parents. John's schools were chosen for how much mathematics and science they taught, and how much control his father might have over the curriculum. Tutors similarly were chosen to fit the programme of study William had designed for his son.

William sent John to Cambridge, because it was an elite institution and would thereby give his son a social advantage. It also by then had a reputation for mathematics, which William saw as key to being taken seriously as a natural philosopher.

For John and Margaret's sons (the girls were all taught at home), the school chosen was selected because it presented science education primarily as a source of recreation, as one part of their broad, liberal education. Their institutions of higher education – Haileybury, Addiscombe and Cambridge – meanwhile were all chosen for broadly professional reasons. The East India colleges were directly vocational, training boys to enter careers within the Indian civil service and military. Cambridge too in this context was chosen with the aim of preparing Alexander for a career in academia. The case was different for their daughter, Constance. In her case, her mother chose Cambridge to ensure that she did not miss out completing her education after her father died. It was also chosen because it provided girls with a very similar education to boys, thereby proving they could be just as intellectually competent.

In conclusion, and in answer to the original questions I posed in my abstract, the scientific men and women within the Herschel family did not always want their children to follow in their footsteps. In each case, the parents saw failures in their own upbringing that they hoped to rectify for their children. Isaac wanted his sons to become more successful musicians than himself. William wanted John to surpass him in mathematics. John wanted his children to have a less pressured but nonetheless scientific and directed childhood, while Margaret, mostly happy with her own experience, increasingly wanted her children to become more scientific and so honour the family name. By the standards of the late eighteenth and early nineteenth centuries they were an unusual family. While there are a few examples of other families that share some common ground with the Herschels, the numbers and similarities are too few to be considered a trend. By the mid-nineteenth century, however, the Herschels could be described as typical of a certain type of upper middle class, scientific family, a type that had consciously developed by comparing notes and following the advice of families they saw as being similar to themselves. By this generation, the Herschels and families like them had achieved distinction through science, and sought to promote science as a key part of Victorian culture. They did not need to earn a living through science, but helped to invent a world in which some could in the next generation.

By studying one of these families over three generations, my study has thrown new and important light not just on the Herschels, but on the development of science and scientific dynasties in the eighteenth and nineteenth centuries.

Bibliography

Archive material:

BL British Library

Caroline L. Herschel to John F. W. Herschel, 8 May 1827, BL: Eg.3761 f64

Caroline L. Herschel to Margaret Brodie Herschel, 14 May 1831, BL: Eg.3761 f136-137

Caroline L. Herschel to Margaret Brodie Herschel, 6 September 1833, BL: Eg.3761 f189-190

Caroline L. Herschel to John F. W. Herschel, 11 September 1834, BL: Eg.3762 f4-5

Caroline L. Herschel to Margaret Brodie Herschel, 24 September 1838, BL: Eg3762 f32-33

Caroline L. Herschel to John F. W. Herschel, 26 August 1839, BL: Eg.3762 f42-43

Caroline L. Herschel to Margaret Brodie Herschel, 5 April 1840, BL: Eg.3762 f55-56

Caroline L. Herschel to Margaret Brodie Herschel, 2 June 1841, BL: Eg.3762 f78-79

Caroline L. Herschel to Margaret Brodie Herschel, 7 July 1842, BL: Eg.3762 f104-105

John F. W. Herschel to Charles Babbage, 23 March 1815, original at HRC; BL microfilm M/588(1)

John F. W. Herschel to Margaret Brodie Herschel (copied by Isabella), August 1830, BL: microfilm M/588(1)

John F. W. Herschel to Eneas Mackintosh, 19 August 1843, draft at HRC; BL: microfilm M/588(1)

Caroline L. Herschel, *Biographical memorandums of my Nephew J. Herschel to the best of my recollections*, 27 May 1838, original at HRC; BL: microfilm M/588(4)

Notebook 'Autobiography begun in 1840', BL: microfilm M/588 (4)

Set of papers titled 'chiefly answers of your fathers to the inquiries I used to make when at breakfast, before we separated, each for our dayly tasks, &c. &c.', BL: microfilm M/588(5)

Papers relating to the Cambridge Commission, BL microfilm: M/588(7)

William Herschel to Charles Hutton, 1784, original at Harvard; BL microfilm M/541

Duncan Stewart's East India Company papers, BL (India Office): L/MIL/9/376 f.123

Edinburgh Special Collections, University of Edinburgh

William Herschel, *Theory of Music*, Edinburgh: Ms. No. Dk.2.35, Book C

Getty Centre

John F. W. Herschel to Julia Margaret Cameron, 15 (or 18) August 1846, Getty Centre

HRC Herschel collection at Harry Ransom Centre, University of Texas

John F. W. Herschel 'Travel Diary, 1809-10', HRC

John F. W. Herschel to John Lee, 10 December 1861, HRC: folder L0223

John F. W. Herschel to Eneas Mackintosh, 13 July 1849, HRC: folder L0239

John F. W. Herschel to James Calder Stewart, 11 January 1831, HRC: folder L0412

John F. W. Herschel to James Calder Stewart, 4 March 1849, HRC: folder L0433

John F. W. Herschel to Mary Pitt Herschel, 7 June 1829, Aix-la-Chapelle. HRC: folder L0512.7

John F. W. Herschel to Mary Pitt Herschel, 15 June 1829, Remagan. HRC: folder L0512.8

John F. W. Herschel to Mary Pitt Herschel, 15 August 1821, HRC: folder L0515.3

John F. W. Herschel to Mary Pitt Herschel, 15 September 1821, HRC: folder L0515.4

John F. W. Herschel to Mary Pitt Herschel, 7 April 1824, HRC: folder L0517.5

John F. W. Herschel to Mary Pitt Herschel, 26 April 1824, HRC: folder L0517.7

John F. W. Herschel to Mary Pitt Herschel, 20 June 1824, HRC: folder L0517.13

John F. W. Herschel to Mary Pitt Herschel, 20 September 1824, HRC: folder L0517.24

John F. W. Herschel to Mary Pitt Herschel, 14 May 1829, HRC: folder L0521.3

Margaret Brodie Herschel to Mary Pitt Herschel, 15 May 1829, HRC: folder L0521.4

John F. W. Herschel to Margaret Brodie Herschel, 5 January 1851, HRC: folder L0542.1

John F. W. Herschel to Margaret Brodie Herschel, 25 August 1852, HRC: folder L0543.14

From newspaper clippings catalogued together with a much earlier letter from John F. W. Herschel to William Herschel, 5 February 1812 held at HRC: folder L0549

John F. W. Herschel to Caroline L. Herschel, 2 July 1824, HRC: folder L0569.1

Richard Jones to John F. W. Herschel, 3 September 1822, HRC: folder M0305

George Gabriel Stokes to John F. W. Herschel, 17 May 1867, HRC: folder M0506

Dietrich Herschel to John F. W. Herschel, 5 January 1810, HRC: folder M0884

JHS John Herschel-Shorland's private collection

'Herschel family dates', JHS papers FC A1

'Memoranda of the Past '*Particulars relating to my Mother's family' JFWH's notes 1822-1826'*, JHS papers FC A3

Agreement with James Child, 25 September 1823 in 'Memoranda of the Past 'Particulars relating to my Mother's family' JFWH's notes 1822-1826', JHS papers FC A3

Margaret Brodie Herschel to Emilia Stewart, February 1841, JHS papers FC A3

William Herschel to Jacob Herschel, 12 April 1761: JHS papers FC B3

Envelope reads 'Notes by (Mary) Lady Herschel re JFWH's saucer given to him by Princess Elizabeth, 1796', JHS papers FC B4

Envelope reads 'catalogued by MFH', JHS papers FC B4

Anecdotes of John F. W. Herschel as noted down by James Stewart, September 1833, JHS papers ARM

Mary Pitt Herschel's travel journal 1809, JHS papers ARM

Margaret Louisa Herschel's 1844 diary, JHS papers ARM

John F. W. Herschel to Mary Pitt Herschel, 9 August 1799, in 'Newbury' envelope, JHS papers BFR 4

James Child to Mrs. Harriet Singer, 11 May 1824, JHS papers BFR 4

Charles Pritchard to John F. W. Herschel, 23 November 1859, JHS papers BFR 4

John F. W. Herschel to Margaret Brodie Herschel, 12 February 1862, JHS papers BFR 4

John F. W. Herschel to Margaret Brodie Herschel, 23 May 1867, JHS papers BFR 4

Margaret Brodie Herschel to unnamed friend, 11 May 1871, JHS papers BFR 4

Margaret Brodie Herschel to Maria Edgeworth, 15 December 1838, JHS papers BFR 5

John F. W. Herschel to Maria Edgeworth 11 April 1841, JHS papers BFR 5

Margaret Brodie Herschel to Maria Edgeworth, April 1841, JHS papers BFR 5

Margaret Brodie Herschel to Maria Edgeworth, 15 April 1841, JHS papers BFR 5

Margaret Brodie Herschel to Maria Edgeworth, 16 November [1843], JHS papers BFR 5

Margaret Brodie Herschel to Maria Edgeworth, 24 August [1846], JHS papers BFR 5

Lucy Robinson to Margaret Brodie Herschel, 18 December 1874, JHS papers BFR 5

Margaret Brodie Herschel to John F. W. Herschel, undated, JHS papers BFR 6

Margaret Louisa Herschel to John F. W. Herschel, undated, JHS papers BFR 6

Margaret Brodie Herschel to Isabella Herschel, 25 April 1852, JHS papers BFR 6

Alexander S. Herschel to John F. W. Herschel, 10 October 1854, JHS papers BFR 6

Alexander S. Herschel to John F. W. Herschel, 15 October 1854, JHS papers BFR 6

Isabella Herschel to Margaret Louisa Herschel, c.1854, JHS papers BFR 6

Isabella Herschel to John F. W. Herschel, undated [1854?], JHS papers BFR 6

Margaret Louisa Herschel to John F. W. Herschel, undated [1854?], JHS papers BFR 6

Margaret Brodie Herschel to John F. W. Herschel, 9 February [1854?], JHS papers BFR 6

Maria Sophia Herschel to John F. W. Herschel 4 March [1854], JHS papers BFR 6

Margaret Brodie Herschel to John F. W. Herschel, 25 April [1854?], JHS papers BFR 6

Alexander Herschel to John F. W. Herschel, 6 February 1855, JHS papers BFR 6

Alexander Herschel to John F. W. Herschel, 4 March 1855, JHS papers BFR 6

John Lubbock to Isabella Herschel, 14 December 1855, JHS papers BFR 6

Charles Stewart to Margaret Brodie Stewart (soon to be Herschel), 9 February 1827, JHS papers BFR 7

Charles Stewart to Emilia Stewart, 16 May 1827, bottom of letter is to Margaret, JHS papers BFR 7

Margaret Brodie Herschel to Charles Stewart, 28 January 1840, JHS papers BFR 7

Painting of John F. W. Herschel starting Eton, JHS objects GR

Observatory House Visitors book 1783-1828 (copied), JHS papers BFL 9

Margaret Brodie Stewart's *Lesson Book* 1827, JHS papers TGR LT

John F. W. Herschel to Alexander S. Herschel, 19 April 1861, JHS papers TET

Alexander S. Herschel to William J. Herschel, 2 June 1870, JHS papers TET

Alexander S. Herschel to William J. Herschel, 3 November 1871, JHS papers TET

Alexander S. Herschel to William J. Herschel, 3 November 1872, JHS papers TET

Margaret Brodie Herschel to Alexander S. Herschel, March 1881, JHS papers TET

Margaret Brodie Herschel to Alexander S. Herschel, undated, JHS papers TET 9

Margaret Brodie Herschel to John Herschel (jnr), 1864, JHS papers TET 15

Margaret Brodie Herschel to John Herschel (jnr), 1 June 1876, JHS papers TEU

'WJH Official Appointments also Haileybury Exams Reports' JHS papers TEU

Series of letters between John F. W. Herschel and Margaret Brodie Herschel, December 1829, JHS.HCEJ.504a-e; JHS.HCEJ.507

John F. W. Herschel to Margaret Brodie Herschel, 23 July 1830, JHS.HCEJ.513

John F. W. Herschel to Alexander S. Herschel, 5 March 1862, JHS 1.105

John F. W. Herschel to William J. Herschel, 20 [?] 1852, JHS 5.34

John F. W. Herschel to John Herschel (jnr), 18 August 1857, JHS 5.6

NMM National Maritime Museum

Alexander Herschel to William Herschel, Bath, 1785, NMM: MS/79/118

Slough House Book, 24 May 1804 (goes up to 1815), NMM: HRS/2

Slough House Book NMM: HRS/2-3

Private collection at the Lubbock home

Constance Herschel to Matilda Rose Herschel, 3 February 1881, Archives of Diana Ladas (photocopies with Lubbock descendants)

Extract from account written by Constance Lubbock for her children, 1939 reproduced in an article, [5] Archives of Diana Ladas (photocopies with Lubbock descendants)

RAS Royal Astronomical Society

Caroline L. Herschel's first book of observations, RAS: CH.1/1.1 pasted in front; XII, 6

Caroline L. Herschel's MS reworking of Flamsteed's catalogue, RAS: CH.2/1

John F. W. Herschel's observing journal No. 1, first entry 12 October 1816, RAS: JH.1/1

William Herschel to Joseph-Jérôme Lalande, 5 September 1782, RAS: WH. 1/1 pp. 57-58

William Herschel to Joseph-Jérôme Lalande, 17 October 1788, RAS: WH. 1/1 p. 168

William Herschel to Patrick Wilson, 10 February 1799, RAS: WH.1/1. pp. 236-237

William Herschel to William Watson, 10 December 1808, RAS: WH.1/1.p. 274

William Herschel to Alexander Herschel, 10 March 1785, RAS: WH.1/9.2

William Herschel to John F. W. Herschel, 26 May 1817, RAS: WH.1/11.4 (photocopied ms)

General Komarzewski to William Herschel, Paris, 15 March 1803, RAS: WH.1/13.K28

Joseph-Jérôme Lalande to William Herschel, Paris, 1 May 1782, RAS: WH. 1/13.L.1
Joseph-Jérôme Lalande to William Herschel, 26 April 1787, RAS: WH.1/13.L.5
Joseph-Jérôme Lalande to William Herschel, 9 September 1788, RAS: WH. 1/13.L.12
Joseph-Jérôme Lalande to William Herschel, 2 October 1788, RAS: WH. 1/13.L.13
Ozias Linley to William Herschel, Oxford, 22 June 1787, RAS: WH.1/13.L.53
Patrick Wilson to William Herschel, 10 November 1783, RAS: WH.1/13.W.95
Patrick Wilson to William Herschel, 31 January 1802, RAS: WH.1/13.W.131
William Herschel's observing notebook, RAS: WH.2/1.1
'Memorandums from which an historical account of my life may be drawn', RAS: WH.7/8
'Little Lessons for Lina', RAS: WH.7/13
Drawings of the result of experiments on the construction of mirrors (made by John F. W. Herschel, under the supervision of William Herschel), RAS: WH. 5/14.2

RGO Royal Greenwich Observatory archive at Cambridge University Library

George Biddell Airy to John F. W. Herschel, 13 March 1871, RGO 6.134.127

RS Royal Society

Charles Babbage to John F. W. Herschel, 12 January 1814, RS: HS 2.21
John F. W. Herschel to Charles Babbage, 26 January 1814, RS: HS 2.22
Charles Babbage to John F. W. Herschel, 10 August 1814, RS: HS 2.29
Charles Babbage to John F. W. Herschel, 23 March 1815, RS: HS 2.38
John F. W. Herschel to Charles Babbage, 10 September 1815, RS: HS 2.39
John F. W. Herschel to Charles Babbage, 11 October 1815, RS: HS 2.42
John F. W. Herschel to Charles Babbage 6 November 1816, RS: HS 2.44
Charles Babbage to John F. W. Herschel, 13 November 1815, RS: HS 2.47
John F. W. Herschel to Charles Babbage, 20 November 1815, RS: HS 2.48
Charles Babbage to John F. W. Herschel, 9 March 1816, RS: HS 2.58
John F. W. Herschel to Charles Babbage, 14 July 1816, RS: HS 2.64
Charles Babbage to John F. W. Herschel, 20 July 1816, RS: HS 2.65
Charles Babbage to John F. W. Herschel, 16 March 1818, RS: HS 2.91
John F. W. Herschel to Charles Babbage 9 November 1818, RS: HS 2.97
John F. W. Herschel to Charles Babbage, 11 April 1824, RS: HS 2.194
John F. W. Herschel to Charles Babbage, 9 May 1824, RS: HS 2.195

John F. W. Herschel to Charles Babbage, 4 July 1824, RS: HS 2.197

John F. W. Herschel to Charles Babbage, 3 October 1824, RS: HS 2.199

Miles Bland to John F. W. Herschel, 10 March 1818, RS: HS 4.153

David Brewster to William Herschel, 11 June 1817, RS: HS 4.241

Charles Hay Cameron to John F. W. Herschel, 10 January 1853, RS: HS 5.147

Thomas Catton to John F. W. Herschel, 9 March 1818, RS: HS 5.221

Edward Daniel Clarke to John F. W. Herschel, 1 December 1816, RS: HS 5.256

Maria Edgeworth to Margaret Brodie Herschel, 13 April 1831, RS: HS 7.27

John Galt to John F. W. Herschel, 6 December 1816, RS: HS 8.34

James Grahame to John F. W. Herschel, 18 September 1814, RS: HS 8.265

James Grahame to John F. W. Herschel, 3 November 1815, RS: HS 8.269

James Grahame to John F. W. Herschel, 10 April 1817, RS: HS 8.279

John F. W. Herschel to James Grahame, 25 October 1824, RS: HS 8.320

Thomas W. Hornbuckle to John F. W. Herschel, 2 May 1815, RS: HS 9.482

John F. W. Herschel to Thomas W. Hornbuckle, 13 October 1826, RS: HS 9.487

John Hawkins to John F. W. Herschel, 29 July 1860, RS: HS 10.171

Richard Jones to John F. W. Herschel, undated, RS: HS.10.408

Eneas Mackintosh to John F. W. Herschel, 14 April 1831, RS: HS 12.20

Thomas Maclear to John F. W. Herschel, 17 November 1850, RS: HS 12.150

Richard Owen to John F. W. Herschel, 22 December 1853, RS: HS 13.195

George Peacock to John F. W. Herschel, 6 August 1816, RS: HS 13.245

George Peacock to John F. W. Herschel, 10 December 1817, RS: HS 13.256

John F. W. Herschel to William Ritchie, 27 January 1825, RS: HS 14.347

Alexander Rogers to John F. W. Herschel, 5 November 1808, RS: HS 14.390

Alexander Rogers to John F. W. Herschel, 2 January 1809, RS: HS 14.391

Alexander Rogers to John F. W. Herschel, 5 March 1810, RS: HS 14.394

Alexander Rogers to John F. W. Herschel, 10 January 1812, RS: HS 14.396

Edward Ryan to John F. W. Herschel, 17 January 1852, RS: HS 14.462

Edward Daniel Clarke to John F. W. Herschel, 12 March 1817, RS: HS 16.258

John F. W. Herschel to Mary Somerville, 31 March 1831, RS: HS 16.334

William Whewell to John F. W. Herschel, 19 June 1818, RS: HS 18.159

John Whittaker to John F. W. Herschel, 4 May 1813, RS: HS 18.239

John Whittaker to John F. W. Herschel, 18 April 1814, RS: HS18.242

John F. W. Herschel to David Brewster, 19 June 1817, RS: HS 20.45

John F. W. Herschel to Miss Cornwallis, 17 January 1853, RS: HS 23.128 (copy)

John F. W. Herschel to William Whewell, 28 October 1854, RS: HS 23.149 (copy)

John F. W. Herschel to William Whewell, 10 April 1862, RS: HS 23.366 (copy)

John F. W. Herschel to John Tyndall, 28 May 1866, RS: HS 24.157

John F. W. Herschel to Edward Sabine, 4 September 1866, RS: HS 24.166 (copy)

John F. W. Herschel to M. Perrey, 16 March 1833, RS: HS 25.3.12

SJC St John's College, Cambridge

John F. W. Herschel to John Whittaker, Slough, August 1812, SJC.1

John F. W. Herschel to John Whittaker, 20 July 1813, SJC.2

John F. W. Herschel to John Whittaker, undated, SJC.3

John F. W. Herschel to John Whittaker, Slough, 2 July 1813, SJC.4

John F. W. Herschel to John Whittaker, Sat 7 July [possibly 1815 since letter contains references to 'the exploits of the everlasting Wellington'] SJC.9

University of Newcastle

College of Physical Science minute book 1871-1886, Registrar's office, University of Newcastle Archives

Wellcome Trust

John F. W. Herschel to Pietro Configliachi, 21 September 1821, Wellcome Trust 65659

John F. W. Herschel to Augustus de Morgan, 11 March 1862, Wellcome Trust 45498.44

Yale University

John F. W. Herschel to Mr Roberts, undated [1830?], Yale University

Web material

The Department of Musical Instruments pages on 'Military Music in American and European traditions', at the Metropolitan Museum of Art:
http://www.metmuseum.org/toah/hd/ammu/hd_ammu.htm
Internet encyclopaedia of Philosophy entry for Bishop Joseph Butler:
http://www.iep.utm.edu/butler/
Genealogy webpages on the Stewart family including unreferenced scans from a published book:
http://freepages.genealogy.rootsweb.ancestry.com/~rykbrown/stewart_of_invernahyle.htm
MOD information sheet on The History of RMA Sandhurst:
http://www.army.mod.uk/documents/general/history_of_rmas.pdf

Published material

Abir-Am, P. G. and Outram, D. *Uneasy Careers and Intimate Lives: Women in Science, 1789-1979*, New Brunswick, 1987.

Annan, N. G. 'The Intellectual Aristocracy', in *Studies in Social History. A Tribute to G. M. Trevelyan* (ed. John Harold Plumb), 1955.

Anon. 'The Hon. Caroline Lady Hamilton Gordon', *Bulletin of the William Herschel Society* (1993), 42, p. 8.

——— ' Portrait: A Note by Lady Lubbock to Her Children', in *Newsletter of the Japan Herschel Society*, 1993-1994.

——— 'Sir William Herschel's Biographer - Lady Constance Lubbock', *Bulletin of the William Herschel Society* (1994), 45, pp. 7-8.

Armitage, A. *William Herschel*, London, 1962.

Ashbrook, J. 'Herschel's 'Large 20-Foot' Telescope', in *Sky and Telescope*, 1977, pp. 174-5.

Ashton, H. and Davies, K. *I Had a Sister*, London, 1937.

Ashworth, W. J. 'The Calculating Eye: Baily, Herschel, Babbage and the Business of Astronomy', *British Journal for the History of Science* (1994), 27, pp. 409-41.

——— 'John Herschel, George Airy, and the Roaming Eye of the State', *History of Science* (1998), 36, pp. 151-78.

——— 'Memory, Efficiency, and Symbolic Analysis – Charles Babbage, John Herschel, and the Industrial Mind', *ISIS: International Review devoted to the History of Science and its cultural influences* (1996), 87, pp. 629-53.

Astore, W. J. *Observing God: Thomas Dick, Evangelicalism, and Popular Science in Victorian Britain and America*, Aldershot, 2001.

Ball, R. S. *Great Astronomers*, London, 1895, pp. 246-71.

Barber, M. *Scholar Daughter of the Rectory*, Oxford, 2007.

Barr, E. S. 'The Infrared Pioneers – 1. Sir William Herschel', *Infrared Physics* (1961), 1, pp. 1-4.

Beaton, R. D. *Some Noted Ministers of the Northern Highlands*, 1985.

Becher, H. W. 'Radicals, Whigs and Conservatives: The Middle and Lower Classes in the Analytical Revolution at Cambridge in the Age of Aristocracy', *British Journal for the History of Science* (1995), 28, pp. 405-26.

——— 'William Whewell and Cambridge Mathematics', *Historical Studies in the Physical Sciences* (1980), 11, pp. 1-48.

Beech, M. 'The Herschel-Denning Correspondence, 1871-1900', *Vistas in Astronomy* (1991), 34, pp. 425-47.

Bennett, J. A. 'The Discovery of Uranus', in *Sky and Telescope*, 1981, pp. 188-91.

——— "on the Power of Penetrating Space': The Telescopes of William Herschel', *Journal for the History of Astronomy* (1976), 7, pp. 75-108.

——— 'William Herschel's Large Twenty-Foot Telescope', *Quarterly Journal of the Royal Astronomical Society* (1976), 17, pp. 303-5.

Bird, J. *The Juvenile Observatory: In Which the Power and Wisdom of God, in the Works of Creation, Are Displayed in a Course of Astronomical Lectures, for the Instruction of Youth; as Delivered before the Principal Public Schools, &C. &C.*, London/ Eton, 1824.

Bolt, M. P. 'John Herschel's Natural Philosophy: On the Knowing of Nature and the Nature of Knowing in Early Nineteenth Century Britain', (PhD Thesis) 1998.

Bourne, J. M. 'The East India Company's Military Seminary, Addiscombe, 1809-1858', *Society for Army Historical Research Journal* (1979), 57, pp. 206-22.

Bradbrook, M. C. *'That Infidel Place': A Short History of Girton College, 1869-1969*, Rev. ed. edn, Cambridge, 1984.

Brian, D. *Einstein: A Life*, New York, Chichester, Brisbane, Toronto, Singapore, 1996.

Brock, C. *The Comet Sweeper: Caroline Herschel's Astronomical Ambition*, London, 2007.

Brock, W. H. 'The Selection of the Authors of the Bridgewater Treatises', *Notes and Records of the Royal Society* (1966), 21, pp. 162-79.

Broughton, M. V. D. ed. *C. L. H. Papendiek: Court and Private Life in the Time of Queen Charlotte Being the Journals of Mrs Papendiek, Assistant-Keeper of the Wardrobe and Reader to Her Majesty.*, 2 vols., London, 1887.

Brown, S. J. and Fry, M. eds., *Scotland in the Age of the Distruption*, 1993.

Browne, J. *Charles Darwin: The Power of Place*, London, 2003.

——— *Charles Darwin: Voyaging*, London, 1995.

——— 'Presidential Address: Commemorating Darwin', *British Journal for the History of Science* (2005), 38, pp. 251-74.

Butler, B. J. *Analogy of Religion*, 1736.

Buttmann, G. *The Shadow of the Telescope: A Biography of John Herschel*, New York, 1970.

Caine, B. *Bombay to Bloomsbury: A Biography of the Strachey Family*, Oxford, 2005.

——— *Destined to Be Wives*, Oxford, 1986.

Calvert, H. R. 'The Presentation of Caroline Herschel's Telescope to the Society by Sir John Herschel', *Quarterly Journal of the Royal Astronomical Society* (1970), 11, pp. 105-8.

Cannon, S. F. 'Chapter 2: The Cambridge Network', in *Science in Culture: The Early Victorian Period*, New York, 1978.

Cannon, W. F. 'John Herschel and the Idea of Science', *Journal of the History of Ideas* (1961), 22.

Chapman, A. *An Occupation for an Independent Gentleman: Astronomy in the Life of John Herschel* Oxford, 1994.

——— 'An Occupation for an Independent Gentleman: Astronomy in the Life of John Herschel', *Vistas in Astronomy* (1993), 36, pp. 71-116.

Clark, R. W. *The Huxleys*, London, 1968.

Clerke, A. M. *The Herschels and Modern Astronomy*, London, 1895.

Cockran, A. *The Romance of a Woman's Influence*, London, 1906, pp. 141-84.

Cohen, M. 'The Grand Tour: Constructing the English Gentleman in Eighteenth Century France', *History of Education* (1992), 21, pp. 241-57.

E. I. Company, *Rules and Regulations for the Good Government of the Military Seminary, Established by the East-India Company for the Appropriate Education of Young Men Intended for Their Military Service in India*, London, 1825.

Cornell, E. S. 'The Radiant Heat Spectrum from Herschel to Melloni – 1. The Work of Herschel and His Contemporaries', *Annals of Science* (1938), 3, pp. 119-37.

Craik, A. D. D. 'Calculus and Analysis in Early Nineteenth Century Britain: The Work of William Wallace', *Historica Mathematica* (1999), 26, pp. 239-67.

Croarken, M. 'Astronomical Labourers: Maskelyne's Assistants at the Royal Observatory, Greenwich 1765-1811', *IEEE Annals of the History of Computing* (2003), 25, pp. 48-61.

Crowe, M. J. 'The John Herschel Correspondence Project', in *John Herschel, 1792-1992: Bicentennial Symposium* (ed. Brian Warner), Herschel School, Claremont, South Africa, 1992.

——— 'John Herschel: Britain's First Modern Physical Scientist', in *John Herschel, 1792-1992: Bicentennial Symposium* (ed. Brian Warner), Herschel School, Claremont, South Africa, 1992, pp. 57-69.

——— ed. *A Calendar of the Correspondence of Sir John Herschel*, Cambridge, 1998.

Davies, E. *The Higher Education of Women*, London and Ronceverte, 1866.

Delamont, S. *Knowledgeable Women: Structuralism and the Reproduction of Elites*, London, 1989.

Desmond, A. and Moore, J. R. *Darwin*, London, 1992.

Dolan, B. P. 'Governing Matters: The Values of English Education in the Earth Sciences, 1790-1830', (PhD Thesis) 1995.

Dreyer, J. L. E. ed. *The Scientific Papers of Sir William Herschel*, 2 vols., London, 1912.

Edgeworth, M. and Edgeworth, R. L. *Practical Education*, 2 vols., London, 1798.

Ehrlich, C. *The Music Profession in Britain since the Eighteenth Century: A Social History*, Oxford, 1985.

Emerson, W. *The Elements of Optics*, London, 1768.

——— *The Elements of Trigonometry. Containing the Properties, Relations, and Calculations of Sines, Tangents, Secants, &C. The Doctrine of the Sphere, and the Principles of Plain and Spherical Trigonometry. All Plainly and Clearly Demonstrated*, London, 1749.

Emerson, W. and Smeaton, G. A. *The Principles of Mechanics; Explaining and Demonstrating the General Laws of Motion, the Laws of Gravity, Motion of Descending Bodies ... Strength and Stress of Timber, Hydrostatics, and Construction of Machines.*, London, 1754.

Enros, P. C. 'The Analytical Society (1812-1813): Precursor of the Renewal of Cambridge Mathematics', *Historica Mathematica* (1983), 10, pp. 24-47.

——— 'Cambridge University and the Adoption of Analytics in Early Nineteenth-Century England', in *Social History of Nineteen Century Mathematics* (eds. Herbert Mehrtens, H. J. M. Bos and Ivo Schneider), Boston, 1981, pp. 135-47.

Evans, D. S., Evans, B. H., Deeming, T. J. and Goldfarb, S. *Herschel at the Cape. Diaries and Correspondence of Sir John Herschel, 1834-1838*, Cape Town, 1969.

Fara, P. *Pandora's Breeches: Women, Science and Power in the Enlightenment*, London, 2004.

Farrington, A. *The Records of the East India College, Haileybury, and Other Institutions*, London, 1976.

Ferguson, J. *Astronomy Explained Upon Sir Isaac Newton's Principles and Made Easy to Those Who Have Not Studied Mathematics*, London, 1756.

Ferguson, W. T. and Immelman, R. F. M. *Sir John Herschel and Education at the Cape, 1834-1840*, Cape Town, 1961.

Fildes, V. A. *Breasts, Bottles and Babies: A History of Infant Feeding*, Edinburgh, 1986.

Fiske, R. and Johnstone, H. D. *Blackwell History of Music in Britain, Eighteenth Century*, 6 vols., Vol. 4, Oxford, 1988-1995.

Frasca-Spada, M. and Jardine, N. *Books and the Sciences in History*, Cambridge, 2000.

Galton, F. *Hereditary Genius*, London, 1869.

Garbedian, H. G. *Albert Einstein, Maker of Universes*, London, Toronto, Melbourne & Sydney, 1939.

Garland, M. M. *Cambridge before Darwin: The Ideal of a Liberal Education, 1800-1860*, Cambridge, 1980.

Geiringer, K. and Geiringer, I. *The Bach Family: Seven Generations of Creative Genius*, London, 1954.

Gingerich, O. 'Herschel, 1784 Autobiography', in *Sky and Telescope*, 1984, pp. 317-9.

Graves, R. P. *Life of Sir William Rowan Hamilton*, 3 vols., Vol. 2, Dublin, 1885.

Guicciardini, N. *The Development of Newtonian Calculus in Britain 1700-1800*, Cambridge, 1989.

Gunn, A. 'Caroline Herschel: Female Astronomer', in *Astronomy Now*, 2000, pp. 31-62.

H, T. H. 'Professor A. S. Herschel, 1836-1907 – an Obituary', *Proceedings of Royal Society* (1907-08), A80 19-22.

Hans, N. *New Trends in Education in the Eighteenth Century*, London, 1951.

Hardcastle, M. F. 'Obituary of Francisca Herschel', in *Monthly Notices of the Royal Astronomical Society*, 1933, pp. 228-9.

Hare, A. J. C. ed. *The Life and Letters of Maria Edgeworth*, London, 1894.

Herschel, J. 'Note on the Difference of Variation of Gravity at Revel and St Petersburg; and on Grischow's Pendulum Observations at Other Stations.' *Monthly Notices of the Royal Astronomical Society* (1880), 40, pp. 2-5.

——— 'Note on the Length of the Pendulum Observed by De L'isle De La Croyère at Archangel in 1728', *Monthly Notices of the Royal Astronomical Society* (1881), 41, pp. 79-82.

——— 'On a Simplified Form of the Torsion-Gravimeters of Broun and Babinet', in *Royal Society Proceedings*, 1881, pp. 141-6.

——— 'On Gravimeters, with Special Reference to the Torsion-Gravimeter Designed by the Late J. Allan Broun, Frs', in *Royal Society Proceedings*, 1881, pp. 317-20; 507-40.

——— 'On the Determination of the Acceleration of Gravity for Tokio [Sic], Japan', *Philosophical Magazine* (1880), 9, pp. 446-8.

——— 'On the Employment of the Pendulum for Determining the Figure of the Earth', *Nature* (1880), 21, pp. 599-602.

——— 'On the Figure of the Earth', *Nature* (1879), 20, pp. 33-5.

——— 'Pendulum Observations in London', *Nature* (1882), 25, pp. 196-7.

——— 'Wire Torsion', *Nature* (1880), 22, pp. 557-8.

Herschel, J. F. W. 'Additional Facts Relative to the Hyposulphurous Acid', *Edinburgh Philosophical Journal* (1819), 1, pp. 396-400.

——— 'Analytical Formulae for the Tangent, Cotangent, &C', *A Journal of Natural Philosophy, Chemistry, and the Arts (Nicholson's Journal)* (1812), 31, p. 133.

——— 'Consideration of Various Points of Analysis', *Philosophical Transactions of the Royal Society* (1814), pp. 440-68.

——— 'On a New Method of Computing Occulations of the Fixed Stars', *Memoirs of the Astronomical Society* (1822), 1, pp. 325-8.

——— 'On a Remarkable Application of Cotes's Theorem', *Philosophical Transactions of the Royal Society* (1813), pp. 8-26.

——— 'On the Aberrations of Compound Lenses and Object-Glasses', *Philosophical Transactions of the Royal Society* (1821), pp. 222-67.

——— 'On the Action of Crystallized Bodies on Homogeneous Light, and on the Causes of the Deviation from Newton's Scale in the Tints Which Many of Them Develop on Exposure to a Polarized Ray', *Philosophical Transactions of the Royal Society* (1820), pp. 45-100.

——— 'On the Action of Crystallized Bodies on Homogeneous Light, and on the Causes of the Deviation from Newton's Scale in the Tints Which Many of

Them Develop on Exposure to a Polarized Ray', *Thomson, Ann. Phil.* (1821), 1, pp. 115-32, 60-81.

——— 'On the Application of a New Mode of Analysis to the Theory and Summation of Certain Extensive Classes of Series', *Edinburgh Philosophical Journal* (1820), 2, pp. 23-33.

——— 'On the Development of Exponential Functions, Together with Several New Theorems Relating to Finite Differences', *Philosophical Transactions of the Royal Society* (1816), pp. 25-45.

——— 'On the Hyposulphurous Acid and Its Compounds', *Annales generales des sciences physiques* (1820), 3, pp. 305-6.

——— 'On the Hyposulphurous Acid and Its Compounds', *Annal. De Chimie* (1820), 16, pp. 353-63.

——— 'On the Hyposulphurous Acid and Its Compounds', *Edinburgh Philosophical Journal* (1819), 1, pp. 8-29.

——— 'On the Hyposulphurous Acid and Its Compounds', *Trommsdorff, N. Journ. d. Pharm.* (1821), V, 308-21.

——— 'On the Optical Phenomena Exhibited by Mother of Pearl, Depending on Internal Structure', *Edinburgh Philosophical Journal* (1820), 2, pp. 114-21.

——— 'On the Separation of Iron from Other Metals', *Jahrbuch fur Chemie und Physik* (1821), 32, pp. 452-3.

——— 'On the Separation of Iron from Other Metals', *Philosophical Transactions of the Royal Society* (1821), 293-9.

——— 'On the Separation of Iron from Other Metals', *Annal. De Chimie* (1822), 20, pp. 306.

——— 'On the Separation of Iron from Other Metals', *Thomson, Ann. Phil.* (1821), 1, pp. 389-90.

——— *A Preliminary Discourse on the Study of Natural Philosophy*, 1830.

——— 'The Refractive Power of Hyposulphite of Soda and Silver, and of Nitrite of Lead', *Edinburgh Philosophical Journal* (1820), 2, p. 184.

——— 'Some Additional Facts Relating to the Habitudes of the Hyposulphurous Acid and Its Union with Metallic Oxides', *Edinburgh Philosophical Journal* (1820), II, 154-6.

——— 'Subsidiary Tables for Facilitating the Computation of Annual Tables of the Apparent Places of Forty-Six Principal Fixed Stars; to Which Is Prefixed

a Statement of the Formulae Employed, and the Elements Adopted in Their Construction', *Memoirs of the Astronomical Society* (1822), 1, pp. 421-96.

——— 'Trigonometrical Formulae for Sines and Cosines', *A Journal of Natural Philosophy, Chemistry, and the Arts (Nicholson's Journal)* (1812), 32, p. 13.

——— ed. *Mathematical Essays by the Late William Spence, Esq.*, London, 1819.

Herschel, J. F. W. and Babbage, C. 'Barometrical Observations Made at the Fall of Staubbach', *Edinburgh Philosophical Journal* (1821), 6, pp. 224-7.

Herschel, M. J. ed. *Memoir and Correspondence of Caroline Herschel*, London, 1876.

Herschel, W. 'The Same [Solution To ...] by Mr. Wm. Herschel', in *The Ladies' Diary*, 1780, pp. 46-7.

Hilton, B. *The Age of Atonement: The Influence of Evangelicalism on Social and Economic Thought, 1785-1865*, 1991.

Holden, E. S. *Sir William Herschel: His Life and Works*, New York, 1881.

Hollis, P. H. 'Herschel, Alexander Stewart (1836-1907)', in *Dictionary of National Biography (Second Supplement, 1901-11)*, London, 1911, pp. 257-8.

Holmes, R. *The Age of Wonder*, London, 2008.

——— *The Romantic Poets and Their Circle*, London, 2005.

Hoskin, M. 'Alexander Herschel: The Forgotten Partner', *Journal for the History of Astronomy* (2003).

——— 'Astronomical Correspondence of William Ronan Hamilton', *Journal for the History of Astronomy* (1984), 15, pp. 69-73.

——— *Caroline Herschel's Autobiographies*, Cambridge, 2003.

——— 'The Elder Herschel', *History of Science* (1963), 2, pp.145-8.

——— 'The English Background to the Cosmology of Wright and Herschel', in *Cosmology, History and Theology* (eds. Wolfgang Yourgrau and Allen D. Breck), New York, 1977, pp. 219-321.

——— *The Herschel Partnership: As Viewed by Caroline*, Cambridge, 2003.

——— 'Herschel, John and Astronomy – a Bicentennial Appraisal', in *John Herschel, 1792-1992: Bicentennial Symposium* (ed. Brian Warner), Herschel School, Claremont, South Africa, 1992.

——— 'Herschel, William and the Construction of the Heavens', *Proceedings of the American Philosophical Society* (1989), 133, pp. 427-33.

——— 'Herschel's Determination of the Solar Apex', *Journal for the History of Astronomy* (1980), 11, pp. 153-63.

——— 'Herschel's Dilemma', in *The Listener*, 1963.

——— 'John Herschel's Cosmology', *Journal for the History of Astronomy* (1987), 18, pp. 1-34.

——— 'William Herschel and Sidereal Astronomy', in *Endeavour*, 1964, pp. 18-21.

——— *William Herschel and the Construction of the Heavens*, London, 1963.

——— *William Herschel: Pioneer of Sidereal Astronomy*, London, 1959.

——— 'William Herschel's Early Investigations of Nebulae: A Reassessment', *Journal for the History of Astronomy* (1979), 10, pp. 165-76.

Hoskin, M. and Warner, B. 'Caroline Herschel's Comet Sweepers', *Journal for the History of Astronomy* (1981), 12, pp. 27-34.

Howe, M. J. A. *Genius Explained*, Cambridge, 1999.

Howse, D. *Nevil Maskelyne: The Seaman's Astronomer*, Cambridge, 1989.

Hughes, D. W. 'Caroline Lucretia Herschel – Comet Huntress', *Journal for the British Astronomical Association* (1999), 109, pp. 78-85.

Hughes, K. *The Victorian Governess*, London, 1993.

Hunter, L. and Hutton, S. *Women, Science and Medicine, 1500-1700: Mothers and Sisters of the Royal Society*, Stroud, 1997.

Hyman, A. *Charles Babbage: Pioneer of the Computer*, Oxford, 1982.

Iliffe, R. 'Isaac Newton Lucatello Professor of Mathematics', in *Science Incarnate: Historical Embodiments of Natural Knowledge* (eds. C. Lawrence and S. Shapin), Chicago, 1998.

Iliffe, R. and Wilmoth, F. 'Mrs Flamsteed and Caroline Herschel', in *Women, Science and Medicine* (eds. Lynette Hunter and Sarah Hutton), 1997.

Jones, R. V. 'Through Music to the Stars: William Herschel, 1738-1822', *Notes and Records of the Royal Society* (1978), 33, pp. 37-56.

Jordan, E. '"Making Good Wives and Mothers"? The Transformation of Middle-Class Girls' Education in Nineteenth-Century Britain', *History of Education Quarterly* (1991), 3, pp. 439-62.

King-Hele, D. G. 'John Herschel 1792-1871: A Bicentennial Commemoration. Proceedings of a Royal Society Meeting Held on 13 May 1992', London, 1992.

King, H. C. 'Sir William Herschel and the Discovery of Radiant Heat', in *Journal of the British Astronomical Association*, 1955, pp. 298-304.

M. Kirlew, M. *Famous Sisters of Great Men*, London, 1905, pp. 61-102.

Lalande, J.-J. *L'astronomie*, 1792.

Lane, J. F. *Pierre Bourdieu: A Critical Introduction*, London, Sterling, Virginia, 2000.

Lilley, S. 'Nicholson's Journal (1797-1813)', *Annals of Science* (1948-50), 6, pp. 78-101.

Locke, J. *An Essay Concerning Human Understanding. In Four Books ... A New Edition Corrected*, 3 vols., Glasgow, 1759.

Lovell, D. J. 'Herschel's Dilemma in the Interpretation of Thermal Radiation', in *ISIS: International Review devoted to the History of Science and its cultural influences*, 1968, pp. 46-60.

Lubbock, C. A. *The Herschel Chronicle: The Life-Story of William Herschel and His Sister Caroline Herschel*, Cambridge, 1933.

Lyons, T. *The Education Work of Richard Lovell Edgeworth, Irish Educator and Inventor, 1744-1817*, New York, 2003.

Macfarlane, A. *Lecture on Ten British Physicists of the Nineteenth Century*, New York, 1919.

Maclaurin, C. *Treatise of Fluxions*, 1742.

MacLeod, R. M. and Moseley, R. 'Fathers and Daughters: Reflections on Women, Science and Victorian Cambridge', *History of Education* (1979), 8, p. 333.

Macpherson, H. *Herschel*, London, 1919.

Mazlish, B. *James and John Stuart Mill: Father and Son in the Nineteenth Century*, London, 1975.

McMillan, D. ed. *Queen of Science: Personal Recollections of Mary Somerville*, Edinburgh, 2001.

Mehrtens, H., Bos, H. J. M. and Schneider, I. *Social History of Nineteenth Century Mathematics*, Boston, 1981.

Mill, J. S. *Autobiography*, London, 1873.

Millar, M. and Millar, I. 'Birth of Caroline Herschel – March 16th, 1750', in *History Today*, 2000, pp. 52-3.

Millman, P. M. 'The Herschel Dynasty - Part 3: Alexander Stewart Herschel', *Journal of the Royal Astronomical Society of Canada* (1980), 74, pp. 279-90.

——— 'The Herschel Dynasty – Part 1: William Herschel', *Journal of the Royal Astronomical Society of Canada* (1980), 74, pp. 134-46.

——— 'The Herschel Dynasty – Part 2: John Herschel', *Journal of the Royal Astronomical Society of Canada* (1980), 74, pp. 203-15.

Monk, R. *Bertrand Russell: The Spirit of Solitude*, London, 1996.

Moore, G. 'Herschel, Caroline – Seeker of Comets', *Electron Power* (1987), 33, pp. 176-9.

Moore, J. R. 'On the Education of Darwin's Sons', *Notes and Records of the Royal Society* (1977), 32, pp. 51-70.

Moore, P. *Alexander Herschel, the Meteor Man*, Bath, 1993.

——— *William Herschel: Astronomer and Musician of 19 New King Street, Bath*, Sidcup, 1981.

Morgan, A. d. *Essays on the Life and Work of Newton*, 1846.

Morrell, J. and Thackray, A. *Gentlemen of Science: Early Years of the British Association for the Advancement of Science*, Oxford, 1981.

Mosley, C. ed. *Burke's Peerage and Baronetage*, 106 edn, 2 vols., Crans, Switzerland, 1999.

Mossner, E. C. *Bishop Butler and the Age of Reason*, New York, 1936.

Musselman, E. G. 'Swords into Ploughshares: John Herschel's Progressive View of Astronomical & Imperial Governance', *British Journal for the History of Science* (1998), 31, pp. 419-35.

Nair, S. P. 'Science and the Politics of Colonial Collecting: The Case of Indian Meteorites, 1856-70', *British Journal for the History of Science* (2006), 39, pp.97-119.

Newhall, B. 'Sir J. F. W. Herschel', *The Complete Photographer* (1943), 5, pp. 1963-5.

Nightingale, H. C. 'Alexander Stewart Herschel', *Bulletin of the William Herschel Society* (1992), 37, pp. 6-7.

——— 'Distinguished Members of the Herschel Family', *Bulletin of the William Herschel Society* (1992), 38, pp. 7-8.

——— 'Distinguished Members of the Herschel Family - 3 - Colonel John Herschel F.R.S., F.R.A.S.' *Bulletin of the William Herschel Society* (1992), 39, pp. 3-4.

Ogilvie, M. B. 'Caroline Herschel's Contributions to Science', *Annals of Science* (1975), 32, pp. 149-61.

Panter, J. R. 'Sir John F. W. Herschel and Scientific Thought in Early Nineteenth Century Britain', 1977.

Pedersen, O. 'The 'Philomaths' of Eighteenth Century England', in *Centaurus*, 1963, pp. 238-62.

M. J. Peterson, *Family, Love, and Work in the Lives of Victorian Gentlewomen*, Bloomington, 1989.

Peterson, R. *Early Educational Reform in North Germany*, 2001.

Petschauer, P. 'Improving Educational Opportunities for Girls in Eighteenth Century Germany', in *Eighteenth-century Life*, 1976, pp. 56-62.

Philips, C. H. *The East India Company 1784-1834*, 2006.

Power, M. C. ed. *Selections from the Letters of Caroline Frances Cornwallis*, 1864.

Pritchard, A. *The Life and Work of Professor Pritchard*, 1897.

Rienitz, J. 'William Herschel's Mirror Test and Its Consequences', *Bulletin of the Scientific Instrument Society* (1985), p. 5.

Ring, F. J. 'John Herschel and His Heritage', in *John Herschel 1792-1871: A Bicentennial Commemoration* (ed. Desmond G. King-Hele), Royal Society, London, 1992, pp. 3-15.

Ross, S. 'Herschel and Hypo', in *Nineteenth-Century Attitudes: Men of Science* (ed. Sydney Ross), Dordrecht, 1991, pp. 173-93.

——— 'Scientist: The Story of a Word', *Annals of Science* (1962), 18, pp. 65-85.

Ross, S. and Herschel, I. eds., *The Catalogue of the Herschel Library: Being a Catalogue of the Books Owned by Sir William Herschel, Kt. And by His Son Sir John F. W. Herschel, Bart.*, New York, 2001.

Rothblatt, S. 'The Student Sub-Culture and the Examination System in Early Nineteenth Century Oxbridge', in *The University in Society* (ed. Lawrence Stone), 1974, pp. 247-303.

Rourke, J. P. 'John Herschel and the Cape Flora, 1834-1839', in *John Herschel, 1792-1992: Bicentennial Symposium* (ed. Brian Warner), Herschel School, Claremont, South Africa, 1992.

Ruskin, S. *John Herschel's Cape voyage: private science, public imagination and the ambitions of Empire,* (Aldershot: Ashgate 2004)

Schaffer, S. 'The Great Laboratories of the Universe: William Herschel on Matter Theory and Planetary Life', *Journal for the History of Astronomy* (1980), 11, pp. 81-111.

——— 'Herschel in Bedlam: Natural History and Stellar Astronomy', *British Journal for the History of Science* (1980), 13, pp. 211-39.

——— 'Uranus and the Establishment of Herschel's Astronomy', *Journal for the History of Astronomy* (1981), 12, pp. 11-26.

Schuster, A. 'On the Life Statistics of Fellows of the Royal Society', *Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character* (1925), 107, pp. 368-76.

Shorland, E. 'Sir William James Herschel and the Birth of Fingerprint Identification', in *Library Chronicle of the University of Texas at Austin*, 1980.

Sime, J. *William Herschel and His Work*, Edinburgh & New York, 1900.

Simpson, T. *The Doctrine and Application of Fluxions, Containing a Number of New Improvements to the Theory and the Solution of a Variety of Problems in the Mathematicks*, London, 1750.

Skidelsky, R. J. A. *John Maynard Keynes: A Biography. Hopes Betrayed 1883-1920*, Vol. 1, London, 1983.

Smiles, S. *Physical Education*, Edinburgh, 1838.

——— *Self-Help*, 1859.

Smith, C. 'Geologists and Mathematicians', in *Wranglers and Physicists: Studies on Cambridge Physics in the Nineteenth Century* (ed. Peter. M. Harman), Manchester, 1985, pp. 49-83.

Smith, R. *A Compleat System of Opticks in Four Books, Viz. A Popular, a Mathematical, a Mechanical, and a Philosophical Treatise: To Which Are Added Remarks Upon the Whole*, 1738.

——— *Harmonics, or the Philosophy of Musical Sounds*, Cambridge, 1749.

Söderqvist, T. 'Existential Projects and Existential Choices in Science: Science Biography as an Edifying Genre', in *Telling Lives in Science: Essays on*

Scientific Biography (eds. Michael Shortland and Richard Yeo), Cambridge, 1996.

Steavenson, W. H. 'Catalogue of Instruments Made and (or) Used by Sir William Herschel, as Preserved at Slough and Examined There in 1924, May and June', in *Transactions of the Optical Society*, 1925, pp. 221-38.

——— 'A Peep into Herschel's Workshop', in *Transactions of the Optical Society*, 1925, pp. 210-20.

Stewart, L. *Rise of Public Science: Rhetoric, Technology and Natural Philosophy in Newtonian Britain*, Cambridge, 1992.

Stott. C. 'The Herschel House in Bath', in *Sky and Telescope*, 1981, pp. 192-4.

Symonds, A. S. 'Herschel's Retirement Years', in *Fingerprint Whorld*, 1990.

Tabor, M. *Pioneer Women* 1933, pp. 5-33.

Topham, J. 'A Textbook Revolution', in *Books and the Sciences in History* (eds. Marina Frasca-Spada and Nicholas Jardine), Cambridge, 2000, pp. 317-37.

Turner, A. *Science and Music in Eighteenth Century Bath*, 1977.

Turner, A. 'Portraits of William Herschel', *Vistas in Astronomy* (1988), 32, pp. 69-94.

Venn, J. and Venn, J. A. *Alumni Cantabrigienses*, Cambridge, 1922-1954.

Walters. A. N. 'Conversation Pieces: Science and Politeness in Eighteenth-Century England', *History of Science* (1997), 35, pp. 121-54.

Warner, B. 'Herschel, John, 1792-1871', *South African Journal of Science* (1992), 88, pp. 458-61.

——— 'Herschel, William, 1738-1822', *Transactions of the Royal Society of South Africa* (1989), 47, pp. 145-58.

——— 'Herscheliana', *Vistas in Astronomy* (1987), 30, pp. 85-96.

——— 'Introduction', in *John Herschel, 1792-1992: Bicentennial Symposium* (ed. Brian Warner), Herschel School, Claremont, South Africa, 1992, pp. 1-4.

——— 'John Herschel at the Cape of Good Hope', in *John Herschel, 1792-1992: Bicentennial Symposium* (ed. Brian Warner), Herschel School, Claremont, South Africa, 1992, pp. 19-55.

——— 'The Years at the Cape of Good Hope', in *John Herschel (1792-1871): A Bicentennial Commemoration* (ed. D. G. King-Hele), Royal Society, London, 1992, pp. 51-67.

——— ed. *Lady Herschel: Letters from the Cape 1834-1838*, Cape Town, 1991.

Warner, B. and Rourke, J. P. *Flora Herscheliana: Sir John and Lady Herschel at the Cape 1834 to 1838*, Houghton, South Africa, 1998.

Warner, B. and Warner, N. eds., *Maclear and Herschel: Letters & Diaries at the Cape of Good Hope 1834-1838*, Cape Town, 1984.

Warwick, A. *Masters of Theory: Cambridge and the Rise of Mathematical Physics*, Chicago & London, 2003.

Winchester, S. *The Map That Changed the World*, 2001.

Yeo, R. 'A Preliminary Discourse on the Study of Natural-Philosophy – Herschel, J. F. W.' *Studies in the History and Philosophy of Science* (1989), 20, pp. 541-52.