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Eleanor Mildred Sidgwick, Country House Science, and Personae for British Women in Science at the turn of the Twentieth Century[1]

Donald L. Opitz
DePaul University

Abstract

Higher education for women in the fields of science and mathematics significantly expanded in the United Kingdom at the end of the nineteenth century and into the twentieth century. A major force in that expansion was Eleanor Mildred Sidgwick (1845–1934), the mathematically talented head of Newnham College, Cambridge, and researcher in experimental physics at the University of Cambridge's Cavendish Laboratory. In this article I examine Sidgwick's role in advancing science education for women, focusing on her construction of a scientific persona for British women that drew upon her evangelical Anglican values of family and domesticity. I argue that Sidgwick's work contributed to an enterprise of 'country house science' in which other members of her extended family were engaged, and that her case contributes to a reorientation of the historiography from a focus on recovery of women's peripheral contributions to the positioning of the work of science education for women more centrally in our narratives about women in science.

Keywords: Eleanor Mildred Sidgwick, Balfours of Whittingehame, Newnham College, scientific personae

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At the annual meeting of the British Association for the Advancement of Science, held in Manchester, England, in 1915, Eleanor Mildred Sidgwick (1845–1934) began her presidential address to the Educational Science Section (L) with an apology 'for my being here at all.' Acknowledging her distinction 'as the first woman who has had the honour of presiding over Section L,' she went on to explain 'it is obviously very fitting that a woman should sometimes do so.' As she elaborated, '[W]omen have the largest share in the work of education […] if we take education in its widest and fullest sense, and include in it what is done in the home as well as in the school, beginning as it must with the earliest infancy.' But in view of the section's typical discussions on education—'that part of it with which the professional educator, the school or college teacher, is concerned'—she expressed an apology 'for the particular woman selected.' She disclaimed having made any contributions to the science of education or its art, underlining, 'I am no educator.'[2]

Contrary to her articulation of a rather common, feminine 'trope of modesty' in the context of a male-dominated, 'professional' sphere, Sigwick was in fact a well-known, major force in 'educational science', particularly on matters regarding female science education.[3] Her self-reflective, publicised words contributed to a broader pattern of autobiographical expression that she exercised across her long career, constituting a form of 'life writing' through which she constructed a scientific persona for women, as I shall explore further in this essay. As the long-time principal of Newnham College, Cambridge, she earned recognition for advancing the higher education of women within a university system that continued to deny conferral of full degrees to women until 1948. Her distinction between 'what is done in the home' and 'the professional educator' acknowledged the outcome of a massive transformation of intellectual life that occurred during her lifetime, and in which her late husband, Henry Sidgwick, was an important agent.[4] Elder sister of the aristocrat Arthur James Balfour (created Earl of Balfour in 1922), she belonged to an older generation of gentlewomen who acquired their education through a private, home-based system that was almost always directed by women.[5] Although university-level courses of study were opened up for women just as Eleanor (or 'Nora,' as she was better known) came of age, rather than enrol she instead took on the management of her family's manor house and, after marriage, the philanthropic and administrative work associated with launching Newnham College. Alongside these claims on her time, she kept up her private study of mathematics.

Sidgwick's contributions in advancing women's higher education and to experimental research in the physical sciences are well-documented.[6] She is particularly noted for her leading role in establishing and expanding Newnham

College, one of the two pioneering women's colleges at Cambridge (the other being Girton College). By virtue of her positions at Newnham, and aristocratic class status, she emerged as one of the most influential advocates for women's education in science and mathematics. As sister-in-law to the physicist, John William Strutt, third Baron Rayleigh, she collaborated with Rayleigh both at his private laboratory and at the Cavendish laboratory in experimental studies ranging from the redetermination of electrical units of measure to the behaviour of fluids and capillary action. She was among the founders of the field of psychical research, in which her own researches and longterm professional service placed the field on a firm scientific basis, in contrast to the more popular movements in spiritualism and theosophy.

Here, I analyse her assumption of a social identity as advocate for women's access to higher education, generally, and the fields of science and mathematics, specifically, and how she leveraged that identity in articulating the possibilities for women thus educated, at the turn of the twentieth century. For this I shall adopt the concept of 'scientific persona' as advanced by Lorraine Daston, Otto Sibum and others, which emphasises the mediation between individual persons and social institutions through constructed social roles, or personae, and which are enmeshed in (and therefore recoverable from) subjects' biographical and autobiographical texts and other publicised commentaries on the social life of science.[7] Life writing provided the means by which Sidgwick created and publicly disseminated a distinctive scientific persona that offered both herself and her audiences an archetype for becoming, and being, a woman of science in an intellectual context dominated by men. As a learned gentlewoman skilled in mathematics and the natural sciences, she participated in those elite settings of science sociability, which in turn provided the material for an entire genre of life-and-letters that constructed scientific personae, for both men and women. The historiography attending to this genre has emphasised the construction of 'separate spheres' (a theme I probe in the next section) with the outcome defining public roles for men of science and, in contrast, companionate, less visible roles for women as (typically) informal assistants or supportive family members (doting wives, sisters, and daughters).[8] Both men and women contributed to the production of life writing works, as authors, amanuenses, editors, contributors (of content), critical reviewers (of both drafts and published works), and publishers. Although the social-material structuring of the labour undergirding this industry falls beyond the scope of my essay, it is important to acknowledge that gendered hierarchies constituted the writing processes and their outcomes, including the personae transcending the writing itself.[9] My emphasis, instead, is to foreground how tropes of evangelical Anglican domesticity and familial duty figured prominently in Sidgwick's life writing

about what young women could become through their study of science and mathematics.

As I will elaborate, Sidgwick constructed, occupied, and promoted a persona for educated women that embraced an efficient form of gentlewomanly domesticity, one that could only be enhanced by women's scientific and mathematical training. The life writing through which she accomplished this occurs across a range of published and unpublished documents.[10] Here I draw on her autobiographical statements contained in a variety of those texts, including an unpublished memoir about her mother; her letters quoted in published domestic biographies about her and other members of her immediate family; her published essays and speeches expressing her views on education for girls and women; and her contributions to published education reports. These sources are by no means exhaustive (further relevant texts include, for example, letters she wrote to editors of various periodicals), but together they establish a consistent perspective across several decades of her long career.[11] Her articulation of this persona served a dual purpose: to defend the cause of women's higher education against critics who judged it as unbecoming and unhealthful, and amid such criticism to encourage female students' aspirations along rather conventional lines. In this way, Sidgwick took a middle road through the debates concerning the suitability of science as a womanly pursuit. Her case illuminates not only a persona of critical significance to this first wave of feminism in relation to science, but it also adds to an historiography that imbues agency to women in science in the face of barriers that otherwise thwarted their fuller participation on terms equal to men's.

Below, I consider Sidgwick's work in the context of her family's scientific industry. Because I have elsewhere analysed the intermingling of science and domesticity within the lives of her two sisters, Alice Balfour and Evelyn, Lady Rayleigh—the three indeed forming a 'remarkable group of sisters'[12]—here I will focus on Sidgwick to illustrate the central importance of domesticity and familial relations in her own career trajectory and its basis for a scientific persona that she promoted for other women. Her role as a country house manager served as a foundation upon which she developed her public persona, and in this, aristocratic, evangelical-Anglican values, emphasising intellectual and moral development in service to family and society, were paramount. Despite the central roles of home and family in shaping both Sidgwick's life and outlook, her story does not readily conform to the 'separate spheres' mapping of private and public affairs. For this reason, I begin by setting the stage for an interpretation that moves beyond this emphasis in the historiography.

Transcending 'separate spheres'

Stereotypes circulating in nineteenth-century British discourse tended to confine women's contributions in the sciences to the 'amateur' domestic realm, ancillary to the main business of 'professional' science, the occupations of men. The stereotypes employed the more general cultural ideology of 'separate spheres'—the structuring of society into two distinct domains, the private being that of women, the public that of men—a construction that feminist historians, especially those writing on aristocratic women, both contextualised and critiqued.[13] Historians and sociologists of science have interrogated the domestic sphere as a site for science, applying the lenses of both sociology and gender studies. Sociologist Steven Shapin advanced a now classic statement on 'the house of experiment' and its status in seventeenth-century gentlemanly English natural philosophy, inspiring further studies concerned particularly with domestic sites.[14] Serious attention to the gendered dynamics of scientific households flowed from a growing literature on women in science that analysed the 'intimate' and marital contexts of women scientists' work, and then more pointedly their fuller domestic situations.[15] A special issue of *Centaurus* edited by Christine von Oertzen, Maria Rentetzi, and Elizabeth Watkins made an important statement in favour of a gendered analysis of the wider geographies of science 'beyond the academy,' prominently highlighting domestic sites; soon following, a volume of essays under the title *Domesticity in the Making of Modern Science* argued for a perspective of science as inextricably wedded to the domestic realm, spatially and ideologically, in gendered terms.[16]

The Victorian separation of spheres has shaped these historiographies, for better or for worse. Early on, historian Jeanne Peterson cautioned against uncritically reading that ideology into the lived experiences of upper-class scientific gentlewomen like Rose Paget, a Cavendish researcher who married the physicist J. J. Thomson, or her relative, the entomologist Eleanor Ormerod, a single gentlewoman of independent means. Historian K. D. Reynolds similarly challenged the reality of a 'private' and 'public' division of the aristocratic world, where chatelaines fulfilled—through their domestic positions—a range of public duties that exceeded the more circumscribed worlds of middle- and working-class women. Hardly the 'Angels in the House' stereotyped by contemporary writers like poet Coventry Patmore, Victorian gentlewomen realised personae of worth not measured in terms of 'professional' recognition but rather that of family and social status. Further historians echoed this interpretation in their analyses of specific cases, including that of Nora Sidgwick.[17]

These scholarly strands collectively reset the problem of reclaiming, re-evaluating,

and 'righting the record' of women's neglected work in science, to one of contextualising women's contributions amid family enterprises and social works of *noblesse oblige*.[18] Even so, sex discrimination predicated on separate-spheres ideology was undeniable, reified in the barriers erected against women's access to professional (paid) opportunities and the eventual disparaging of the entire domestic sphere, defined as feminine.[19] Historian Claire Jones therefore argued that the displacement of the physics laboratory from its domestic realm in the early twentieth century was a symptom of professional men's broader efforts to de-feminise the fields of mathematics and physics.[20] Amid such dynamics, talented British gentlewomen occupied an uneasy place: their privilege afforded them wide latitude to pursue their scientific interests at the same time as it justified their exclusion from the emerging professions. With that context in view, Jones explained the self-effacing career of Nora Sidgwick as an instance of a female mathematician giving up a serious pursuit of mathematics 'in favour of supporting her husband and his work,' in the manner of other angelic, 'selfless heroines' of Victorian literature.[21] In the balance of my essay I suggest an alternative interpretation that restores agency to Sidgwick within the broader geography of science and mathematics, taking into account, as part of that landscape, the contexts of aristocratic public duty and the movement to advance science education for women.

The Balfour dynasty's country house science

Nora Sidgwick grew up within one of the wealthiest British landed families of the nineteenth century. Her father James Maitland Balfour was proprietor of vast estates located in the Scottish Highlands and outside of Edinburgh, Scotland, in the East Lothian district. Balfour inherited his wealth from his father, James Balfour of Balbirnie, who accumulated profits as a clerk of the East India Company and supplier to the Royal Navy in India (conferring on him notoriety as a 'nabob'). The senior James's purchase of the 10,000-acre East Lothian estate, Whittingham (afterwards 'Whittingehame'), erection there of a large neo-Greco mansion, designed by Robert Smirke (afterwards architect of the British Museum), and marriage to Lady Eleanor Maitland, daughter of the eighth Earl of Lauderdale, secured his family's place in aristocratic, country-house society. The younger James inherited a legacy valued at over £300,000 upon his father's death in 1845. Like father, he also married well, to Lady Blanche Gascoyne-Cecil, daughter of the second Marquis of Salisbury and sister of a scientifically talented brother, Robert Gascoyne-Cecil, afterwards third Marquis of Salisbury, the noted Conservative prime minister and proprietor of the famed

palace, Hatfield House, situated in Hertfordshire.[22] Practically always pregnant from 1844 until 1854, Lady Blanche Balfour bore nine children, eight of whom survived childbirth. Nora Balfour's birth in 1845 positioned her as the eldest, but before the youngest, Eustace Balfour, reached his second birthday, their father James Maitland Balfour succumbed to tuberculosis. Lady Balfour thenceforth independently superintended the care of the children and estates.

Extant manuscript and published family reminiscences of various members of the children's generation engaged a fairly common genre of elite, domestic memoir writing that preserved information about the family as well as transmitted values to be inculcated among the younger generations. Sidgwick's own autobiographical recollections are sprinkled among manuscript essays and letters, as well her published speeches, and yet despite their varying audiences and purposes, they articulated remarkably consistent messages about her life experiences and perspectives. In an analysis of the mother-daughter relationship between Lady Balfour and Sidgwick, Janet Oppenheim aptly suggested how Sidgwick's writings, 'disguised as biographical sketches of her mother,' functioned as autobiographical memoirs.[23] More than this, they extended an aristocratic version of the nineteenth-century evangelical-Anglican tradition of domestic biography analysed by Christopher Tolley and relevant to the construction of scientific personae, as I consider further below.[24] Through these filters, then, we can see Sidgwick's representations of her values and ideals, grounded in her own experience and yet serving as exemplars for others.

Thus, in writing about her mother's widowhood, Sidgwick recollected, 'Between children and business, then, my mother must have had her hands very full in 1856 and afterwards, especially as she was very conscientious and as far as possible always attended to things in much detail herself.'[25] Her mother in fact did benefit from paid and volunteer help, especially that of Miss Emily Faithfull, a family friend from the Hatfield parish. Even so, the point Sidgwick emphasises here is how Lady Balfour took an unusual interest and active role in raising her children and cultivating their interests, consistent with principles of evangelical-Anglican Christianity that she fervently endorsed (to be explained further below).[26] Consistent with this, the eldest son and heir, Arthur Balfour, similarly observed, 'I was fortunate in being born with the germs of many tastes; I was still more fortunate in the wise way in which they were encouraged by my mother. The home influences were thus unusually propitious.'[27]

As such comments implied, the Balfours recognised the central position of their home life within their lives. Arthur Balfour's sister-in-law Lady Frances Balfour (wife of Eustace Balfour and daughter of the eighth Duke of Argyll) similarly emphasised,

'Home was the place where we lived, and which contained all our known world.'[28] Although such autobiographical depictions are known to be romanticised,[29] the authentic importance of country houses and landed, aristocratic society in undergirding the Balfour family's various pursuits cannot be overstated. As with other scientific country houses—Charles Darwin's Down House perhaps best known—Whittingehame House belonged to a broad network of prominent domestic sites where serious intellectual and experimental activities took place.[30] In the case of the Balfours and their relatives, evangelical Anglican principles guided their conduct of home, intellectual, and public affairs. The legacy of their version of 'country house science' can be observed in new academic institutes established during the professionalisation of the sciences, which carried forward programmes of research intended to serve the public good—a particularly apt example being Cambridge's Whittingehame Lodge, site of the university's new Department of Genetics from 1913 onwards.[31] For the Balfour women, the country houses gave form and function to their lives, charging them with stewardship over the very foundation upon which 'the parish […] the county and the nation […] all those Institutions are built.'[32]

Strong, aristocratic matrons who oversaw domestic affairs of landed estates were not uncommon, but Lady Balfour's early widowhood and evangelical piety distinguished hers. Biblical teachings provided the frame for her motherhood and household management. She 'as a young woman had strongly evangelical views,' and as such was caught up in the aristocratic strand of the wider Evangelical Revival.[33] At the heart of her evangelicalism lay an emphasis on ascetic domestic economy and direct involvement in supervising a home education for her children that emphasised piety, atonement, and self-discipline. To guide their moral development, she regularly engaged the children in prayer and bible readings, to which 'she attached more importance […] than to church services.' Nora recalled being delegated a reader 'as the eldest of the family,' at least until she dwelt too often on the 'doctrine of hell.'[34] The family did attend services, too, both of the Churches of Scotland (Presbyterian) and of England (Anglican), lending a fairly 'broad church' outlook to their religious orientation.

Central to the Balfour family's evangelicalism was the cultivation of the mind and senses so that God's immanence and design in nature could be well observed, understood, and appreciated.[35] A loose form of natural theology intermixed with a strong sense of aristocratic duty in Lady Balfour's superintendence of her children's lessons, ensuring they were rich in science and yet explicitly concerned with promoting the public good. 'Life, position, wealth, opportunities,' recollected Sidgwick, 'were given us to use to the best of our ability for the benefit of others—of

the world in general. The principle applied in little things as well as big.'[36] Lady Balfour's provision of tutors, books, and scientific instruments engaged her children in studies of natural history, chemistry, and spectroscopy which, in turn, inspired the Balfours' later noteworthy contributions to the sciences—through research, philanthropy, and civic engagement. A collaborative industry in collecting, identifying, studying, describing, and illustrating natural history specimens, propelled Alice Balfour's entomological studies and Francis ('Frank') Balfour's noted biological career. Whereas the former's contributions promoted local civic science through donations to museum and school collections and the development of a field naturalists' society, the latter's resulted in a new academic department of morphology, a legacy of students, and a school of research ultimately feeding into Mendelian genetics.[37] Arthur Balfour's writings on science and religion showed the most explicit, and controversially conservative, application of the family's domestic, theistic framework for understanding nature. Through his books he defended a basis for Christian faith in opposition to the rise of scientific naturalism and its agnostic proponents.[38]

Part and parcel of her evangelical austerity, Lady Balfour emphasised plainness, economy, and utility in her example and teachings. In dress 'she disliked anything extravagant in appearance, or unnecessarily expensive.'[39] To provide a lesson in economy during the Lancashire cotton famine, between 1862 and 1863 she dismissed the domestic staff, guided the children in running the household, and donated the savings to rural families in distress.[40] Then, with the family quarantined at the house during an outbreak of diphtheria in early 1864, she set the children on producing an estate newspaper that both promoted and reported their scientific learnings. This exercise in utility established a holiday occupation in the ensuing years, engaging the family in a process of inscribing knowledge not unlike more formal, periodical publication in the sciences.[41]

The extant manuscript issues of their paper, the 'Whittinghame Advertiser,' provide an unusually rich window into the youthful ensemble's domestic scientific industry. Co-edited by Arthur and Nora Balfour, the paper included a wide range of writings and illustrations contributed by all eight children. Detailed reports of their activities highlighted out-of-doors adventures like bird-shooting and seaside dredging as well as indoor occupations like attending a botany class and hosting a 'magic lantern' show for the village schoolchildren. Coloured sketches of birds, landscapes, and a spectral analysis accompanied expository descriptions based on direct observations and readings from their house's library. Specimens collected in and beyond the estate stocked a private museum and aquarium kept at the house.

Although the scope and depth of the children's educational pursuits conveyed a seriousness of effort in 'scientific expeditions' and 'deep scientific research,' the children explained their goals with humorous wit that showed their awareness of a call to civic duty beyond the confines of their private sphere. As Arthur Balfour editorialised: 'It is our intention to chronicle, and hand down to our admiring posterity the doings of a small section of her Majesty's subjects, of that Family, in short, which may be described the most intelligent portion of the most civilised nation that has ever existed.'[42]

Industrious domestic imagery dominates the family's writings—for example, Arthur Balfour's characterisation of Whittingehame House as a 'Temple of Research' in the late 1870s and his niece Eve Balfour's report of the estate as a 'Mothing' field in 1914.[43] Such portrayals constructed the homestead as a symbolic anchor within a wider sea of knowledge-making that included distant rural, urban, academic, and colonial settings. Yet further 'truth-spots' emerged as the home-schooling of the boys gave way to secondary education at public boarding schools like Eton and Harrow and then to university studies.[44] With the exception of Cecil, in regular succession the Balfour brothers followed in their fathers' footsteps and matriculated at Trinity College, Cambridge: Arthur in 1866, Frank in 1870, Gerald in 1871, and Eustace in 1873. Meanwhile, the three sisters engaged in a form of finishing school that included housekeeping lessons at home and travel and study abroad, for example Alice's tour in Italy (accompanied by Emily Faithfull), where she took lessons in artists' studios. Letters exchanged between the siblings transcended these spatial separations and instructed each other in their respective scholastic endeavours—the letter-writing itself constituting one characteristic form of familial intellectual activity.[45]

Arthur Balfour composed much of his first book, *A Defence of Philosophic Doubt* (1879), during a period largely spent 'in country houses visiting my friends,' thus widening the geography of philosophising beyond his Whittingehame study.[46] Similarly, Frank Balfour spent his formative years as a naturalist collecting and cataloguing specimens on the estate. Then, on the commencement of his university studies, he spent most of the next dozen years engaged in experimental research primarily in laboratories at Cambridge—an illustrious career cut short upon his accidental death while mountaineering in 1882.[47] His intermittent (holiday) visits to Whittingehame included time spent working on his monographs—with sister Alice drawing many of the figures—and leading family collecting jaunts; even so, marine and academic laboratories generally superseded the country house as his primary research sites.[48] Alice Balfour, who among the siblings ended up spending the most time at Whittingehame, preoccupied with managing its domestic affairs, also bug-

hunted and botanised in distant places while on tours of North America, Ireland, and southern Africa.[49] Séances at Arthur's London townhouse, No. 4 Carlton Gardens, and a range of country houses, stimulated his circle's scientific study of paranormal phenomena and their involvement in the founding of the Society for Psychical Research (SPR) in 1882—an initiative in which Nora and Henry Sidgwick assumed leading roles.[50]

In considering these instances of individual and collaborative work at broadly distributed sites, it becomes clear that the foundation of the family's scientific productivity, including Nora Sidgwick's education work, was a rather consistent 'familial organization' (to borrow a phrase from Marsha Richmond) that structured the work and domestic routines wherever they were happening.[51] Arthur Balfour credited his family accordingly: 'Then there was the family life at Whittingehame, Strathconan, and London, resting on that solid basis of seven brothers and sisters, to whom I was bound by ties of the most intimate affection.'[52] This domestic, familial context is fundamental in explaining not only the Balfours' industry of works but also their representations of that industry publicly.

A country house persona for women in science

A decisive gender-based distinction in the siblings' upbringing was the brothers' formal secondary and higher education in parallel to the girls' home-based lessons in manners and household management, quite typical for Victorian aristocrats.[53] But atypical for a gentleman's last will and testament, and in line with Lady Balfour's wishes, James Maitland Balfour left each of his daughters with healthy inheritances upon which they could draw incomes, irrespective of their marital status, plus an extra annuity to the estate in support of any unmarried daughter—thus ensuring the sustenance of the daughters even if they did not marry. In line with this, Lady Balfour 'was anxious that we girls should not regard marriage as the only desirable prospect in life,' Nora Sidgwick explained. 'She wanted us to look forward to useful lives whether we married or not.'[54] The financial incentive indeed enabled each of the three sisters to pursue her independent artistic and intellectual interests—Evelyn in singing and piano-playing, Alice in watercolour painting, and Nora in mathematics. But their mother's evangelicalism oriented those pursuits in terms of their utility to society. Nora Sidgwick's development of a gentlewomanly occupation devoted to advancing the higher education of women epitomises this orientation, and in the remainder of this article I will analyse how her development of a persona in this area blended intellectualism and domesticity as she worked on educational reforms.

Even while colleges and universities opened their doors to female students, Sidgwick advanced her mathematical skill independently. She read trigonometry with her brother Arthur to help him prepare for the Cambridge previous examination ('Little-go'), a prerequisite to his final examination, the Moral Sciences Tripos, that if passed qualified him for the bachelor's degree.[55] After Evelyn's marriage in 1871 to John Strutt (afterwards third Baron Rayleigh), Nora (then in her 20s) studied calculus with her new brother-in-law and assisted him in private laboratory experiments. These intermittent opportunities arose during extended visits that allowed for concentrated periods of study. During her tour of the Nile with the Strutts on a *dahabieh* (Egyptian sailing house boat)—a rather standard excursion among the Victorian elite—over several months in 1872 and 1873, Nora practiced calculus daily as John worked at writing a monograph on acoustics.[56] Shortly afterwards, she engaged a noted mathematics coach, Norman Macleod Ferrers (afterwards Master of Gonville and Caius College), to prepare for the Higher Local Examinations, a qualification for admission to the new Cambridge women's colleges, Girton and Newnham. In Ferrers's opinion, had she sat for the Mathematical Tripos (officially opened to women in 1881), she would have achieved high marks.[57] But her marriage at the age of 31, in 1876, to Henry Sidgwick, the prime mover behind the opening and advancement of Newnham College, redirected her energies toward assisting in this educational project. The couple's 'academic partnership' defied the helpmeet stereotype, however, as Nora forged an independent identity in the educational sphere.[58] A mutually supportive marriage sustained their shared interests and yet independent contributions in the fields of women's higher education and psychical research, and Nora was thus emboldened to carry forward her projects independently into widowhood, following Henry's death in 1900.[59] Although their marriage produced no children, the couple's attention to nieces and nephews, and to the students at Newnham College, mimicked parental roles. Nora's assumption of responsibilities at Newnham increased during the course of their marriage and well into her widowhood: she became the college's treasurer in 1878 and principal in 1892, a post she continued to hold until 1911. She stayed on as treasurer until 1919.

Interwoven with such occupations were Nora's preoccupations with managing household affairs—first those of her brother Arthur, who inherited his family's estates upon reaching his twenty-first birthday in 1869, and then, upon her marriage, those of her own at Hillside, the house she and Henry Sidgwick occupied in Cambridge. Shortly before marriage, she transferred her role as chatelaine of Whittingehame House to her unmarried sister, Alice. Nora reported in 1875: 'I am instructing her in the art of housekeeping—but this is only a small portion of the talking.'[60] During their

marriage, Henry's observations of Nora's activities confirmed an interweaving of her occupations; in a letter to his mother in 1876: 'Nora is doing mathematics in the intervals of time which she can spare from the melancholy contemplation of our DRAWING-ROOM CURTAINS […]. I wish you could see my study, which I consider to be really Nora's great success. It is only 13 feet by 15, and her practised eye perceived that it was necessary to waste no space on bookcases'—an oblique acknowledgement of her practise of economy.[61]

This skill in household management transferred well to Nora's work at Newnham, substantiating one way by which aristocratic domestic economy served larger society; as Oppenheim judged, she 'adapt[ed] her childhood lessons in housekeeping to a slightly larger scale of operations.'[62] That included such work as the keeping of accounts, supervising curriculum, teaching and tutoring students, managing staff, practicing philanthropy, and hosting elite, academic garden parties. Solidifying the adaptations from one country house to another, the Queen Anne style of Newnham's buildings, designed by Henry Sigwick's Trinity College friend, Basil Champneys, created an educational atmosphere becoming of a country house. Champneys held that 'English domestic architecture of the eighteenth century' was 'universally adaptable,' and with the Queen Anne style he challenged the Gothic Revival championed by John Ruskin and his school. Newnham's buildings therefore displayed features present in Champney's design for his own country house, Manor Farm.[63] Confirming the 'country' element, a Newnham student wrote home in 1876: 'You talk about enjoying the country; it is just like country here. We are completely private in our garden, and quite surrounded with the country sights and sounds.'[64]

Nevertheless, Nora Sidgwick's person, and the persona she assumed and performed, transcended the mundaneness of rural domesticity, owing in large part to her practise of science. After his appointment as professor of experimental physics at Cambridge in 1879, Rayleigh called upon his sister-in-law to help in his research at the Cavendish Laboratory. 'I helped him, as a sort of private assistant in his work from the first,' Sidgwick later recollected. 'His room was on the first floor, and we did the experiments on jets and other things. Later on, for the electrical experiments we worked downstairs.'[65] The scope of her contributions earned her recognition as co-authorship in the relevant publications, in turn influential in establishing international standards for electrical units of measure.[66] Outside of physics she applied her 'scientific habit of mind' in investigative work for the SPR, resulting in 'masterpieces of clear statement, sound reasoning, and balanced judgment,' according to noted moral philosopher Charlie Dunbar Broad.[67] In addition to her investigations and reports, she served as a longstanding councilmember and president of the society—

the latter role held from 1908 through 1909, and again, honorarily, in 1932.

Arguably most impactful among Sidgwick's works, however, was her advocacy to open scientific fields to women. Her example influenced Rayleigh's decision to admit the women students of Girton and Newnham to the laboratory in 1882—the context for Rose Paget and J. J. Thomson's betrothal.[68] At Newnham Sidgwick oversaw science curriculum and instruction: the hiring of lecturers and demonstrators, the building of laboratory facilities, the securing of laboratory instruments, and the administration of science scholarships (see Figure 1). Prior to the opening of the first college laboratory she lent her bathtub at Hillside for demonstrations, with 'much attendant splashing,' and in 1888 she taught experimental physics, 'rather a serious undertaking.'[69] She chaired the committee that planned the acquisition, outfitting, and staffing of the Balfour Laboratory for women biology students, and she generously donated significant funds to the project.[70] Despite her heavy responsibilities, Sidgwick carved out time to individually tutor students struggling with mathematics.[71] She tirelessly defended women's pursuit of higher education; for instance, she issued a forceful, evidence-based disproof of the antagonistic myth that women's intellectual exertions weakened their physical health and capacity for bearing children.[72]

In her public statements—which characteristically drew upon autobiographical reflections—Sidgwick promoted mathematical and scientific study for women of all classes as a pursuit beneficial to their lives, emphasising this whether women's goals involved marriage and housework or employment in the widening sphere of women's work. In this sense she took a rather moderate approach in advocating for women's higher education, emphasising both its principled, intrinsic value as well as its usefulness. About her own pursuit of mathematics she once defended in characteristically economic terms, 'I might some day want to cut an equilateral triangle out of some valuable material, and then the first proposition of Euclid would enable me to do so without waste.'[73] She recognised that women's study of mathematics needed no special justification, yet she carried forward her mother's evangelical emphasis on the development of one's intellect for social good: '[G]eometry interested me and […] I wanted to know more […]. My mother could have added that it was at any rate good training for the mind, which would help in any work.'[74] Sidgwick generalised this to emphasise the potential of scientific training for positioning women's traditional occupations in the advancement of English society as a whole: 'With practical training […] based on a good University education in say, science, a woman, married or unmarried, would find many spheres of usefulness open to her, for it is, I think, generally admitted that there is considerable room for improvement in the average English housekeeping in all classes both as to

efficiency and economy.'[75]

Figure 1. *The Newnham College teaching staff, posing in a garden at Cambridge, 1896*, Newnham College Archives, PH/6/1/4. Mentioned in this article: Nora Sidgwick, principal (seated centre); Ida Freund, chemistry lecturer (seated third from left); and Philippa Fawcett, mathematics lecturer (seated far right). Reproduced by permission of the Principal and Fellows, Newnham College, Cambridge.

Her emphasis on the compatibility between science and domesticity persisted, even as debates ensued over the value of 'domestic science' as a new school subject for girls and young women. Characteristic of her rhetorical strategy, she would underline the intrinsic value of learning—'knowledge must be pursued for its own sake if the utmost profit is to be obtained from its pursuit'—and then follow with an indicator of applicability: 'By all means let girls study science because, among other things, a scientific habit of mind is of immense value in domestic life.'[76] In her contribution to a government report on the mathematics education of girls and women, she clarified that utility need not compromise the rigor of instruction: 'it is highly desirable that women with mathematical ability […] be encouraged to study the subject for its own

sake, and not with limits prescribed by the utility of Mathematics for something else,' and moreover that 'there is no need to consider the case of women separately from that of men.'[77] Although she admonished against the teaching of science or mathematics as 'the handmaid' of cookery, hygiene, and social work, she avoided the more militant tone of contemporaries like her Newnham colleague, Ida Freund, Britain's first female chemistry lecturer. Freund vehemently argued against the vogue toward adopting 'domestic science' as a substitute for educating girls in science: '[A] large number of experienced women science-teachers, among whom not a few can claim first-hand experience of household work and household management […] deny the possibility that "science can be directly and adequately taught in the kitchen".'[78] Sidgwick's approach, somewhat more nuanced, defended and promoted gains for women's higher education, yet without threatening the domestic social order that had conferred exceptional privilege upon her own person.

Conclusion: Beyond 'female subcultures'

Among the noted beneficiaries of Nora Sidgwick's efforts at Cambridge and the broader field of women's higher education, a range of 'firsts' can be cited. Newnhamite Philippa Garrett Fawcett famously placed 'above the Senior Wrangler' in the Mathematical Tripos examination in 1890, the first woman to achieve this top ranking in the lists of examination scores during a time when women could be examined but not submit their scores to qualify for degrees. Following her studies, Fawcett stayed on at Cambridge first as a researcher at the Cavendish Laboratory and then as a lecturer at Newnham for the next decade.[79] Another luminary, Marjory Stephenson, entered in 1903 to read for the Natural Sciences Tripos in chemistry, physiology, and zoology, inaugurating an illustrious career as a biochemist. She held several appointments at Cambridge, ultimately reader in chemical microbiology, and in 1945 she won election as one of the first two women fellows of the Royal Society of London (the other being the crystallographer Kathleen Lonsdale).[80] One of Newnham's most famous scientific alumna, crystallographer Rosalind Franklin (co-discoverer of the structure of DNA), entered in 1938, a couple of years after Sidgwick's death. Like so many before her, Franklin's ability to flourish relied upon the conducive environment for women in science that Sidgwick so tirelessly cultivated.[81]

Marsha Richmond and others have noted that methodologically historians would do well to 'revise the means by which the scientific accomplishments of women have traditionally been measured' and attend to 'female subcultures'—'the social systems women created apart from as well as in connection with the male-dominated scientific

community'—to more fully capture the range of women's experiences in science.[82] As I have analysed here in the case of Nora Sidgwick, I would add to this historiographical lesson, in line with the theme of our special issue, the importance of personae for women in science that the architects of those subcultures created and promoted. Sidgwick's experience and the autobiographical narratives based upon it served to advance the cause of women in science, distinctively. As a gentlewoman raised within a Victorian aristocratic family who collaborated in the study of nature in line with evangelical-Anglican principles, Sidgwick recognised the importance of duty to both household and civic society. Accordingly, she forged a persona that pushed the boundaries for women's scientific pursuits even while admitting the value of those pursuits for fairly conventional, practical ends. Her case instantiates a broader pattern of 'country house science' as practised and promoted by women of privilege for women of all classes; in this, science, family, and domesticity comingled for the benefit, not liability, of women's advancement in science and mathematics.

The manner by which the Balfour 'remarkable group of sisters' positioned the aristocratic household as the foundation of civil society shows how their valuation of domestic roles transcended professional attainments, echoing the case of the gentlewomen of the Paget circle.[83] So, in promoting women's scientific pursuits during a period often characterised as the 'first wave' of modern feminism, the Balfour women emphasised the value of those pursuits not simply for contributing to the advance of knowledge but, more broadly, for contributing to the welfare of society. As Alice Balfour endorsed of women in horticulture, in a letter to the London *Times*, aristocratic domesticity combined with science for the benefit of a larger social good: 'This is a branch of work which we record with extreme satisfaction, for every woman [so] trained […] plays no small part in developing permanent resources now lying fallow and in basing our colonial Empire on that excellent foundation, the thriving English country home.'[84]

According to the journalist who dubbed the Balfour women a 'remarkable group of sisters,' Nora Sidgwick held special distinction as being particularly 'intellectual.'[85] Another journalist who crowned her 'Queen of Teachers,' reminiscent of Mary Somerville's popularisation as 'queen of science,' portrayed Sidgwick as studious at the expense of social interests: 'as a girl [she] would often give up a ball or party in order to spend more time at her desk.'[86] These were images of female intellect clothed in domesticated imagery, exposing the tensions posed by gentlewomen aspiring to transcend stereotypes and occupy personae more typical for scholarly gentlemen. Although tropes of domesticity offered rhetorical justifications for the cause of women in higher education and the professions, among those aristocratic women with the

means, the domestic landscape represented more than rhetorical terms: it was a physical, discursive, religious, and social space ('all our known world') within which they constructed and exercised personae at once domestic, intellectual, and public. As such, these women thus contributed integrally (not peripherally) to aristocratic systems of knowledge production, and to the professional and civic worlds erected upon them.

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About the Author

Donald L. Opitz is an historian of science whose research focuses on women, sexuality, and gender in science, especially in the context of the British Empire in the nineteenth century. His recent work analyses women's scientific pursuits in

agriculture and horticulture. He is an editor of the volumes, *Domesticity in the Making of Modern Science* (Palgrave Macmillan, 2016) and *For Better or For Worse? Collaborative Couples in the Sciences* (Birkhäuser, 2012). In progress is a forthcoming set of volumes, for which he serves as a general editor: *Gender, Colonialism and Science: A Cross-Cultural Compendium of Primary Sources* (Routledge). He is an Associate Professor in the School of Continuing and Professional Studies at DePaul University.

Notes

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