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Celebration of the centenary of the first female Fellows: introduction

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Abstract: The Geological Society of London was founded in 1807. In May 1919, the first female Fellows were elected to the Society, 112 years after its foundation. This Special Publication celebrates this centenary. A total of 18 papers have been gathered to highlight recent research, carried out by 24 authors. The publication also builds on stories introduced in a previous Special Publication of the Geological Society, *The Role of Women in the History of Geology*, edited by Burek and Higgs in 2007, the first book to deal solely with this topic, and in an article by Burek, 'The first female Fellows and the status of women in the Geological Society of London', in 2009. It fills in some of the gaps in knowledge with detail that has only recently been uncovered, leading to more in-depth analysis and reporting. The current publication includes more examples from the twentieth century, and a small number into the present century, allowing some trends to be identified. The collective work is finding connections previously undocumented and in danger of being lost forever owing to the age of the interviewees. The same work also identifies several common challenges that female geoscientists faced, which are still evident in the current investigations. By building on what went before, filling gaps in knowledge and enriching the histories, interesting nuanced insights have emerged.

The Geological Society of London was founded in 1807. At the time, membership was restricted to men, many of whom became well-known names in the history of the geological sciences. On the 21 May 1919 the first female Fellows were elected to the Society, 112 years after its foundation. This Special Publication celebrates the centenary of that important event. It builds on a previous Special Publication of the Geological Society, *The Role of Women in the History of Geology* (Burek and Higgs 2007*a*), which was the first book to deal solely with the role that women played in the history and development of the geological sciences. The research and learning in the 2007 publication followed the first-ever conference to be held on the work of early female geologists, held at the Geological Society in 2005.

To celebrate the centenary 18 papers have been brought together to highlight recent research that has been carried out by 24 authors (Fig. 1a and b). The papers include detailed accounts of the lives and work of some early female Fellows, such as Margaret Crosfield and Mabel Tomlinson, as well as personal remembrances of some women from colleagues, students or family members, for example of Gertrude Elles, one of the first female Fellows, and Rosemary Hutton, an important academic role model at the University of Edinburgh.

Why are we doing this work?

This centenary Special Publication introduces several individuals whose stories were in danger of being 'lost' to the history of the science. It investigates the reasons why not all of these women received due recognition from their contemporaries/peers. The work has identified a number of common issues that sometimes led to original work and personal achievements being undocumented or unacknowledged, and consequently histories being unwritten.

The publication also builds on stories introduced in Burek and Higgs (2007*a*) and Burek (2009), and serves to fill in some of the gaps in knowledge with detail that has only recently been uncovered, leading to more in-depth analysis and reporting. We were encouraged to do this in part by reviews, such as those from Alonso-Zarza (2008), who referred to Burek and Higgs (2007*a*) as 'a starting point for other studies and monographs in this field. It should certainly encourage researchers to carry out more studies on the subject', and Newell (2009), who concluded that Burek and Higgs (2007*a*) provides 'a wealth of starting points for further study' (p. 144–45). The broad interest in the 2007*a* publication is evidenced by citations not only by geologists but also by researchers in other

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Fig. 1. (**a**) Centenary celebration cake; (**b**) authors with centenary celebration cake; and (**c**) cutting the centenary celebration cake.

disciplines, in particular by sociologists and historians in the fields of female education and gender studies. These include citations in foreign language articles, in particular French, Spanish and German.

Although still uncovering nineteenth century histories, the current publication includes more examples from the twentieth century, and a small number into the present century, allowing some trends to be identified. In some cases, communications with those who knew these women have been possible, and have allowed a link from the past to the present via someone still alive today. This research is timely as some contributors who remember these women during their post-1919 contributions to the science are elderly and have sadly died since being interviewed.

The collective work is finding connections previously undocumented and is illustrated appropriately by the award-winning *Geoscientist* cover illustration 'linking today with the past' (Pickett 2019 and front cover of this special publication). Table 1 is a representative list of the women geoscientists included in this book, and the period of history to which they belong, to show the breadth of time covered and to contextualize the research. We are pleased to say that histories of women who made significant contributions to geoscience, reported in Burek and Higgs (2007*a*, *b*) as needing to be told, are included in the current publication, for example those of Doris Reynolds and Marie Tharp. Without the work that is captured in this collection, valuable information may have been lost to science.

Burek and Higgs (2007*b*) recognized a number of characteristics, of both personality and circumstances, that female geoscientists who contributed to and influenced the development of the science of geology had in common. It is important to recognize and report these characteristics, in order to increase

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Table 1. *Range of women and their dates that are covered in the book chapters*

Name	Dates	Chapter author
Margaret Cavendish Bentinck, Duchess of Portland	1715–85	Sendino, C. and Porter, J.
Louisa Thynne Finch, Countess of Aylesford	1760–1832	Sendino, C. and Porter, J.
Etheldred Benett	1776–1845	Kölbl-Ebert, M.
Elizabeth Philpot	1780–1857	Panciroli, E., Wyse Jackson, P. N. and Crowther, P. R.
Mary Somerville	1780–1872	Kölbl-Ebert, M.
Maria Graham	1785–1842	Thompson, C.
Charlotte Murchison	1788–1869	Orr, M.
Sarah Bowdich	1791–1856	Orr, M.
Mary Morland (later Mrs Buckland)	1797–1857	Kölbl-Ebert, M.
Barbara, Marchioness of Hastings	1810–58	Kölbl-Ebert, M.
Eliza Gordon Cumming	1798–1842	Orr, M.
Elizabeth Anderson Gray	1831–1924	Burek, C. V.
Baroness Anna Allnutt Brassey	1839–87	Sendino, C. and Porter, J.
Phoebe Anna Traquair	1852–1936	Panciroli, E., Wyse Jackson, P. N. and Crowther, P. R.
Gertrude Woodward	1854–1939	Panciroli, E., Wyse Jackson, P. N. and Crowther, P. R.
Mary Jane Longstaff née Donald	1855–1935	Burek, C. V.
Catherine Raisin	1855–1945	Burek, C. V.
Margaret Chorley Crosfield	1859–1952	Burek, C. V.
Alice Woodward	1862–1951	Panciroli, E., Wyse Jackson, P. N. and Crowther, P. R.
Dame Maria Matilda Ogilvie Gordon	1864–1939	Burek, C. V.
Ethel Skeat (Mrs Woods)	1865–1939	Burek, C. V.
Ethel Mary Reader Wood (Dame Shakespear)	1871–1946	Panciroli, E., Wyse Jackson, P. N. and Crowther, P. R.
Gertrude Elles	1872–1960	Tubb, J. and Burek, C. V.
Harriett Mary Hutton	1873–1937	Turner, S.
Mary Sophia Johnston	1875–1955	Burek, C. V.
Eileen Barnes	1876–1956	Panciroli, E., Wyse Jackson, P. N. and Crowther, P. R.
Dorothea 'Dorothy' Minola Alice Bate	1878–1951	Turner, S.
Helen Drew	1881–1927	Burek, C. V.
Ida Lilian Slater	1881–1969	Burek, C. V.
Rachel Workman Lady MacRobert	1884–1954	Burek, C. V.
Fanny Carter Edson	1887–1952	Gries, R. R.
Eileen Mary Lind Hendriks	1887–1978	Mather, J. D. and Bennett, J. A.
Doris Livesey Reynolds	1899–1985	Cherry, C. L. E.
Hedwig Kniker	1891–1985	Gries, R. R.
Alva Ellisor	1892–1964	Gries, R. R.
Elinor Wight Gardner	1892–1980	Turner, S.
Isabel Ellie Knaggs	1893–1980	Burek, C. V.
Mabel Elizabeth Tomlinson	1893–1978	Burek, C. V.
Helen Muir-Wood	1895–1968	Burek, C. V.
Esther Applin Nee Richards	1895–1972	Gries, R. R.
Dollie Radler Hall	1897–1995	Gries, R. R.
Marjorie Elizabeth Jane Chandler	1897–1983	Panciroli, E., Wyse Jackson, P. N. and Crowther, P. R.
Phoebe Selina Walder	1899–1992	Turner, S.
Eleanor Violet Colebrook	1900–75	Turner, S.
Hilda Kathleen Hawkes (née Cargill)	1902–91	Turner, S.
Nelly Hooper Ludbrook	1907–95	Turner, S.
Dorothy Hill	1907–97	Turner, S.
Dorothy Helen Rayner	1912–2003	Boylan, P. J.
Mary Leakey	1913–96	Burek, C. V.
Natalia Sarsadskhih	1916–2013	Kiseeva, E. S. and Yuzmukhametov, R. N.

(*Continued*)

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Table 1. *Range of women and their dates that are covered in the book chapters* (*Continued*)

Name	Dates	Chapter author
Sonia Mary Cole	1918–82	Turner, S.
Pamela Lamplugh Robinson	1919–94	Turner, S.
Diana Mary (May) Lally Loranger	1920–2004	Turner, S.
Marie Tharp	1920–2006	Higgs, B. M.
Larisa Popugaeva	1923–77	Kiseeva, E. S. and Yuzmukhametov, R. N.
Janet Vida Watson	1923–85	Burek, C. V.
Rosemary Hutton	1925–2004	Hobbs, B. A. and Jones, Alan. G.
Rhoda Rappaport	1935–2009	Burek, C. V.
Gwendoline Margaret 'Peigi' Wallace	1941–2001	Turner, S.
Kirsty 'Bang' Brown	1974–2003	Turner, S.

our understanding. For example, these women have frequently been described as: pioneering; formidable; quirky; unmarried; influenced by a family member; amateur; from a wealthy family. Did societal norms mean that women had to remain single, be eccentric and have a private income in order to succeed in the field of geology?

The same work also identified a number of common challenges that female geoscientists faced. These challenges are still evident in the current investigations, but by building on what went before, filling in some of the gaps in knowledge and enriching the histories, more nuanced insights have emerged. It is important to name these common challenges and explore their implications. In order to understand some of the gender biases that may occur at the present we need to study the social norms of the past two centuries that affected the work and lives of women and their interest in geoscience (Higgs *et al.* 2005). What this exploration uncovers is that, although attitudes have changed and are still changing, there is a legacy that affects the role of women today. The past is still the key to understanding the present. Although we acknowledge that important contributions by some past male scientists may also be in danger of being 'lost', we note that a report on 'Women in scientific careers' commissioned by the UK government (Anon 2014) calls for more female role models to be included in the science curricula. The female role models of the past are still being discovered, and by studying and highlighting them we may influence the future.

This Special Publication includes investigations of women who worked not only in the UK and Ireland but also in Finland, Russia, Australia, Africa and the USA. It considers women working in a variety of contexts from the cut and thrust of academia and learned societies to the harsh realities of Siberian field exploration and the strategic necessity of the 'petroleum girls' in early American oil exploration and production.

A mix of styles

Why is the work of some past female geoscientists considered remarkable? To answer this question, we must understand not only the geological achievements themselves, but also the historical context and times in which these women lived. We must chart the social norms as they evolved through the nineteenth and twentieth centuries, and their impact on women.

Thus, uncovering the contributions of past female geoscientists requires interdisciplinary research. This necessity of looking from different perspectives has produced a variety of styles of reporting within this publication. We welcome this diversity. The style varies from one paper to another depending on the preference of the author and nature of the story being told. Some papers contain personal reflections, or are auto-ethnographical, and some are more analytical. Many are a mix of styles. Some authors use first names of the women they write about, which is not the scientific norm, but may give a more personal reflection. Others use a standard scientific protocol using the last name only.

Each paper has benefited from feedback from a minimum of two peer-reviewers. It was difficult to get reviewers to agree to review, as several colleagues felt they knew little about the subject. This confirmed our belief that these stories needed to be told. The reviewers with geological backgrounds sought more scientific content and the historians sought more social history. They also differed on whether to accept a personal reflective style of writing or a more scientific style. We hope the right balance has been struck, bringing together a diverse, interesting and important collection.

Setting the scene: pre-1919

The Geological Society had agreed to accept women as Fellows in 1919. Why was that? Prior to this,

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women had been allowed to read papers at Burlington House, the Society headquarters, although most were read by men on behalf of the women, and under certain circumstances use the library, but they had not been allowed to become Fellows (Burek 2009). What was the stimulus for the change of heart? The papers in this publication explore the lives of female geoscientists and provide further insights into the factors that led to the necessary bye-law amendments.

The GSL website states that

> The first eight women to become Fellows of the Geological Society were elected on 21 May 1919. They included pioneering graptolite researcher Gertrude Elles, eminent palaeontologist and politician Dame Maria Ogilvie and stratigrapher and palaeontologist Ethel Skeat. Their admission followed decades of campaigning, and was finally achieved following a curiously mundane amendment to the Society's bye-laws:
>
> *Article XXIII. Interpretation – In the interpretation of these Bye-Laws words in the masculine gender only, shall include the feminine gender also.*
>
> It was a major victory in a long campaign by female geologists to be recognized by their peers. (https://www.geolsoc.org.uk/100years)

After considerable resistance from existing members, what enticed the Society to open its doors to women and nominate them for Fellowship? Was it the long campaign by female geologists and their male supporters? There were certainly many activities that in their own small way contributed to the movement that resulted in this amendment to the Society's bye-laws. However, a number of other factors led to this 'major victory' for women (Herries Davies 2007; Burek 2009). The papers in this publication enrich our understanding of why this change took place and the impact it had in the years that followed.

An investigation of the formal study of geology and examinations undertaken by female students in mid-nineteenth century Dublin (**Hegarty 2020**) provides a detailed window into the activities and successes of women that were taking place well before the vote that led to the Geological Society amendment. Hegarty looks at the time period in context to find the reasons for the growth in desire for geological knowledge. Records of the academic performance of those early female students of geology have been uncovered and provide a unique insight into the considerable activity that was taking place.

However, the rise in interest in geology and the demand for admission to lectures, both formal and informal, by women in the first half of the nineteenth century was not enough to persuade the Geological Society Fellows to allow the election of women members to that learned society (**Kölbl-Ebert 2020**). Even the opening up of university courses to women in the late 1800s was not enough, although the women's efforts in educating themselves added to the whole suffrage movement. In Kölbl-Ebert's intriguing account, we learn who were the supporters and who were the dissenters, and we see how it took a world war and an act of Parliament to drag some male diehards into the twentieth century.

Both Hegarty and Kölbl-Ebert help us to understand the history that led to the election of the first female Fellows 100 years ago. While participation by women was resisted in some quarters, work as 'collectors' and illustrators was seen as acceptable activities for women (**Orr 2020**). This 'amateur' work was important, but crucially it was not seen as a threat to the men. Indeed, the men made good use of these collections and sometimes without acknowledgement so that the link with the collector remained hidden. Orr uses the life and work of Eliza Gordon Cumming to make the case for the importance of reconnecting the discoverer–collector to the world collections. Even when considerable curatorial expertise was evident, and used in the development of important geological collections, women were not allowed to be members of the existing learned societies (**Sendino and Porter 2020**). Our understanding of these women collectors is enriched by Sendino and Porter's exceptionally detailed insights into the work of three women (Duchess of Portland, Countess of Aylesford and Baroness Brassey) who made extensive collections in the nineteenth century, collections now housed in the British Museum.

Although women were educating themselves, collecting specimens and making competent field observations, they faced challenges in being accepted as scientists (**Thompson 2020**). Thompson argues for the late recognition of women who, in the nineteenth century, had considerable knowledge and experience of geology, including field observations, and yet were thought to be 'inferior' essentially on the basis that they were women. He illustrates his point through the life and work of Maria Graham, a woman who stood up to the members of the Geological Society, in particular the president Sir George Greenough, when they tried to ridicule her following a controversy of Greenough's own making. Graham was the first female to have an article published in the *Transactions of the Geological Society*, and it was this paper that drew Greenough's criticism. Thompson explores the diverse forms geological enquiry took at the time and discovers not only hurdles but also opportunities for women as they sought to participate in research and debate.

The opening up of opportunities for women in the late 1800s is demonstrated by the small group of women who were recognized for their achievements in the form of research funds and medals (**Burek**

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Fig. 2. (**a**) Professor Cynthia Burek posing as Dr Catherine Raisin; (**b**) Dr Natasha Stephes posing as Charlotte Murchison; and (**c**) Professor Jane Francis posing as Dr Marie Stopes.

2020*a*). Burek lists the funds and medals awarded to female geoscientists by the Geological Society of London before 1919, beginning in 1883 with Catherine Raisin (Fig. 2a). The detail illustrates the considerable work that was being undertaken by women, despite their being barred from fellowship. Recognition by the Society gave these women not only status but also a renewed sense of purpose, encouraging them to continue their research. These awards helped to change attitudes towards women as geoscientists, and Burek considers whether or not this early progress continued.

Several male members of the Geological Society, prior to 1919, were outspoken against the inclusion of women in their activities. In a letter dated 15 March 1889 to Professor Lapworth, J.J.H. Teall tells him of the discussion at the last meeting debating the admission of women:

> The anti-lady party had no arguments. Evans thought that the admission of young ladies might take off the interest of some fellows – lower the tone of the Society etc. In reply to this Hinde made the greatest point of the evening – he should object as much as Evans to anything tending to convert the G.S, into a Flirtation Society – but there was no danger – 'we are not attractive enough'.
>
> A Gorilla-faced person got up and in the most solemn tones implored the fellows to pause before taking such an important step. 'Why' said he 'the proposal is absolutely revolutionary'. This was too much for us and we absolutely roared.
>
> (Letter in the Lapworth Archive)

In the nineteenth century senior figures such as Sir Roderick Murchison wielded much influence in support of the exclusion, although his own wife was responsible for encouraging him to become a geologist (Fig. 2b). Women were thought by some members to have inferior scientific intellect. As schooling and third-level education became available to women, men could no longer use the excuse that women were untutored and inexperienced. Women were gaining degrees and even PhDs. They were becoming accomplished field geologists. Some men relied on descriptions of women as 'silly' and 'frivolous' to keep up the resistance a little longer. However, the women who were seeking recognition and a seat at the table were neither silly nor frivolous. Women had their male supporters within the Society, such as Professor Lapworth and Sir Archibald Geike (Burek 2019), and when the law forced the acceptance of women, the crucial amendment was made.

History: the 1919 elections and post-1919 activity

The conferring of Geological Society Fellowship on women in 1919 was very significant, both for their status as geoscientists and for their careers and/or independent research. It gave improved legitimacy to the work of these women. It meant that they could read their own papers at meetings and join in the discussions. It was also significant for all of the other women who were involved in the science of geology: they had role models to follow and could at last aspire to Fellowship status. Did all go well for women in the Geological Society, and other learned societies after 1919?

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An investigation of the relationship of women with the Palaeontographical Society, where women were members from its setting-up in 1847, follows the move from women as collectors and illustrators in the nineteenth century to twentieth-century research, authoring and council membership (**Panciroli *et al.* 2020**). The study shows clearly that women were not absent from geological activity during the nineteenth and twentieth centuries, but that their contributions were often overlooked. Panciroli, Wyse Jackson and Crowther bring us up to the present and ask if gender parity has been reached in the Palaeontographical Society, in the 170 years since it was set up, through membership, contribution and recognition.

Although their curated collections were being used by men, their expert advice was being sought after, and their research was even being published, the mid-1900s were not an easy time for female geologists. Not all women succeeded in their quest to gain employment. This is illustrated by the experience of Eileen Mary Lind Hendriks who, apart from a brief position in the University of Belfast, failed to secure paid employment throughout her life (**Mather and Bennett 2020**). She had gained a Bachelor of Science degree from the University of Aberystwyth (1919) and a PhD from Imperial College (1933), had published papers, and was an accomplished field geologist, but essentially remained an 'amateur' all of her life. Mather and Bennett detail how she became respected for her knowledge and understanding of Cornish geology and was the 'go-to' person on the subject in her later years.

The twentieth century saw a widening of access to schooling, particularly for those women from well-off families. However, it was not uncommon for women who had a private income to retain amateur status all of their lives, while carrying out significant geological research. One example was Margaret Chorley Crosfield, who sought fellowship of the Geological Society to enable her to use the library and attend meetings, and to gain recognition for her research by including FGS after her name (**Burek 2020*c***). Perhaps owing to her persistence over many years, she became the first female Fellow to be elected in 1919. Even though Crosfield never completed her full degree at Cambridge, she had earned this honour through her detailed work mapping the geology of the Carmarthen area and later the Clwydian Hills in NE Wales with Ethel Skeat (later Mrs Woods). Alongside this research, she gave a lifetime of commitment to her local natural history club, the Geologists' Association and the Palaeontographical Society.

Mabel Tomlinson, who had studied for two Bachelor's degrees, one of which was in Geology, became the 27th woman to be elected a Fellow of the Geological Society (**Burek 2020*b***). She had gained employment as a teacher in a secondary school in 1917 until her retirement in 1959, and successfully influenced secondary school geology curriculum policy from 1946 to 1962. As a teacher, she inspired and influenced a generation of successful geologists, while at the same time carrying out significant research on Pleistocene chronology, dammed lakes and river terraces. Burek (2020*b*) also details the life and work of Ellie Knaggs, the 20th woman to be elected a Fellow, who was perhaps 'forgotten' because she was born and died in the Southern Hemisphere. With both a Bachelor's and Doctorate degree to her name, Knaggs' research focused on X-ray crystallography. She was employed by The Royal Institution from 1927 to her retirement at the age of 60 in 1953. Her lack of visibility in the history of geology is partly because her publications were not cited by her male contemporaries even when they had benefited from her original work. Burek notes that after Knaggs' retirement, she was given Visitor status to The Royal Institution, such was the esteem in which she was held by that institution.

During the twentieth century, some women aspired to and achieved academic status in the universities. Dorothy Rayner was one of the first women to be appointed to a tenured academic post in a university geology department in England (**Boylan 2020**). She served for 38 years in the University of Leeds from 1939 until 1977, finishing her career when the subject was only just opening up to female geologists. She focused her research on vertebrate palaeontology of the Paleozoic and Mesozoic, and field mapping of the Paleozoic of Northern England. She must have been an unusual sight in a male-dominated discipline.

Another early academic was Rosemary Hutton, who was even more unusual in that she was a field geologist, working in Africa for many years and using geophysical techniques to study the Earth's crust and upper mantle (**Hobbs and Jones 2020**). In 1969, 50 years after the election of the first female Fellows, Hutton began her role as an academic in the University of Edinburgh where she initiated important international collaborations and inspired a large group of young geophysicists until her retirement in 1991.

Gertrude Elles, one of the first female Fellows, was an early academic and the first female to be appointed Reader at the University of Cambridge (**Tubb and Burek 2020**). She gained this recognition for her detailed work which included the *Monograph of Graptolites* (Elles and Wood 1901–18). She influenced a large number of geology students both male and female and, like others in the twentieth century, such as Mabel Tomlinson and Janet Watson, was responsible for ensuring that a future generation of geologists was primed for successful careers.

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Not all women had paid employment while working in the universities. Doris Reynolds contributed significantly to the debate on the origin of granite during the mid-twentieth century, but worked without pay at the University of Edinburgh (**Lewis 2020**). She had been employed by the University of Durham, but on her marriage to Arthur Holmes and a subsequent move to Edinburgh, she was not allowed to be employed in the same department as her husband. She continued her work, relying on her husband's income, and in later life was recognized by the Geological Society for her significant contribution.

Women geoscientists in industry in the twentieth century faced their own challenges. The two world wars had seen a step-change for women's employment as geologists, particularly in the petroleum industry in the USA (**Gries 2020**). By focusing on a small number of these women, Gries illustrates the challenges these women faced in having a voice, and having their own work credited to them. In the mid-twentieth century in the USA, geologist Marie Tharp moved from the petroleum industry into paid employment at Columbia University. Like other women, she did not receive the recognition she was due, in this case for her discovery of the Mid-Atlantic Rift Valley in the 1950s, and for a lifetime of work now identified as remarkable (**Higgs 2020**). Her discoveries were at first suppressed, and eventually published by her close male colleagues. Such stories show how social norms still mitigated against the equal treatment of women in the mid-twentieth century, and they chart the slowly changing attitudes towards women as scientists that saw some progress by the end of the century.

The social norms that impacted the careers of female geoscientists in the mid-twentieth century were not restricted to Western Europe and North America. In Russia, women were officially employed as field geoscientists much earlier than in the UK, and endured harsh conditions for the good of the state. For example, Larisa Popugaeva and Natalia Sarsadskhih, two female geoscientists who worked together, made important strategic discoveries during diamond exploration in Siberia (**Kiseeva and Yuzmukhametov 2020**). Their successes in the field involved skill and ingenuity, along with extreme dedication to the task, yet a combination of prejudice, politics and academic competition deliberately robbed the women of the credit for their discoveries. Kiseeva and Yuzmukhametov describe the effect that this treatment had on the personal and professional lives of these women.

The early women geologists acted as role models and inspired others to follow in their footsteps. They affected the lives and career pathways of several authors in this publication. **Turner (2020)**, in an auto-ethnographical work, uncovers the histories of female geoscientists and makes explicit the connections with women who have influenced her. In so doing, Turner encourages us all to reflect on how those that went before have influenced us.

Discussion

The research captured in this Special Publication highlights common themes in the personal and professional circumstances of early female geoscientists. It extends the findings of Burek and Higgs (2007*a*, *b*) and allows some trends from the nineteenth century to the present day to be discerned.

In the nineteenth century women scientists were often influenced by family members and usually had to have an independent income in order to pursue their interests and carry out research. The contributions of many female scientists remained hidden in the past as their pioneering work could only be presented to the world by male researchers, sometimes husbands or brothers, and the work remained credited to those men.

The increase in the availability of school education in the late nineteenth century was highly significant and saw a widening of the sphere of influence. Individual teachers inspired their pupils in the natural sciences and introduced them to outdoor investigation. The twentieth century saw a further widening of access to schooling when The Fisher Education Act of 1918 made secondary education compulsory up to the age of 14 and gave responsibility for secondary schools to the state. Influences were widening, moving from 'influenced by a male family member' to include 'influenced by a teacher', for example Gertrude Elles, who was influenced by Miss McLeod (**Tubb and Burek 2020**).

These developments continued the rise in demand from women who wished to attend scientific lectures and study, and resulted in the eventual provision of tertiary education and professional qualifications. Although access by women to education played a crucial role in enabling them to contribute to the developing geological sciences, it was the associated support networks that helped many of the early women to persist in their work. For example, at Bedford College, University College London, Newnham College Cambridge and Girton College, life-long friendships and collaborations were made (Burek 2007). The current research continues to uncover how these contacts provided support and built confidence for those women involved.

The early women geoscientists who were teaching in secondary and tertiary education acted as role models and raised the aspirations and expectations of those that followed. However, even into the twentieth century, women most often acted as

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assistants to their male colleagues. For those women without female role models or support networks, life could be particularly tough, and they depended on male colleagues who could be either hostile or supportive. Such were the social norms that even supportive male colleagues did not always see the need to acknowledge women's contributions, no matter how significant.

In these histories the importance of amateur societies is evident, for example the Geologists' Association, which admitted women from its foundation in 1857, 62 years before the Geological Society. In the late nineteenth and early twentieth centuries, regional natural history societies and field clubs gained prominence and not only included women members from their inception, but also gave women freedom to contribute academically by leading field trips and presenting their research (Burek and Hose 2016). These societies and field clubs often had an eclectic mix of professional and amateur members and provided links for some women into academia, where they were encouraged to volunteer their skills. Although many women were amateurs in the nineteenth and early twentieth centuries, and volunteering was considered an acceptable female occupation, the line between the amateur and professional scientist was somewhat blurred (Creese and Creese 2006). The word 'scientist' was still quite new in the mid-nineteenth century. This situation provided opportunities, as women saw legitimacy in their involvement during times when people, differing in gender, rank and depth of experience, not only talked about science but in so doing also contributed directly to its making (**Thompson 2020**).

Amongst other learned societies, The Royal Geographical Society allowed 22 women to become Fellows in 1892–93 but there was much antagonism against this, and no further women were allowed in until 1913, a period of 20 years (Evans *et al.* 2013). The controversy on the admission is explored by Bell and McEwan (1996), showing the heated debate that ensued to be similar to the one held in the Geological Society. Interestingly two prominent first Fellows of the Geological Society were elected Fellows of the Royal Geographical Society six years earlier in February 1913. They were Catherine Raisin, who taught geography as well as geology at Bedford College (Burek 2007), and Mary Johnston (Bell and McEwan 1996).

However, women who carried out serious geological research over a lifetime, perhaps supported by a private income or employment as a teacher, continued to be considered amateurs by the geological establishment. There were some exceptions but this widespread perception that women were not professional scientists could persist even after they were actually employed as geologists.

Several women carried out painstakingly detailed work that others may not have undertaken, meaning that the work might not have been done at all. An example is the detailed work of Marie Tharp in producing the first physiographic maps of the ocean floor topography. She was considered an assistant, even when doing her own research, which was incorporated into the publications of men. Some women went along with this behaviour. They knew they were unusual, and they felt privileged to be carrying out exciting work. Marie Tharp was satisfied that the team was making progress and getting credit. She was loyal and she was supporting the man at the helm (**Higgs 2020**). Ellie Knaggs was another example of this acceptance of their role by women (**Burek 2020*b***).

The social norms that restricted women's roles in scientific endeavours, which we think of as 'Victorian', continued into the mid- to late-twentieth century. For example, women continued to lose their jobs on marriage or when moving location with a husband, such as Doris Reynolds, whose research, after her marriage was considered a 'hobby' by the Vice Chancellor of the University of Edinburgh in 1943, even though she was an internationally recognized petrologist (**Lewis 2020**).

The marriage barrier was not such an issue globally. For example, Russian women, as wives and mothers, endured long absences from their families while carrying out field-work (**Kiseeva and Yuzmukhametov 2020**) in the first half of the twentieth century. In the USA some women had broken the mould, and not taken the traditional role of 'office geologist' that was on offer in the mid-twentieth century (**Gries 2020**).

Critique and misrepresentations of the work of female geologists were not uncommon, and for women to be portrayed as not knowing or understanding what they had discovered. Male geologists could adhere to traditional dogma, which included not trusting the word of a woman reporting scientific observations, and being willing to believe that women could bring 'bad luck'. Indeed, a man reporting work previously reported by a woman, perhaps years later, was taken more seriously. For this reason, women had difficulty raising funds for their research, and so receiving Geological Society funds was particularly significant. The characters of the women themselves undoubtedly played a role. When women presented their work they sometimes used self-deprecating disclaimers. Those that succeeded usually had to be determined individuals who challenged societal norms and that was not always an easy or popular thing to do. Even into the late twentieth century, recognition of women's work was not seen as a right but rather as a struggle, and recognition, if forthcoming, was begrudgingly given. Slowly women began to object and claim

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back the discoveries which were theirs in order to set the records straight.

Looking at the broader context, these circumstances did not just apply to geoscientists. Similar challenges existed for women in other disciplines, such as in chemistry, engineering, medicine and law. In 1870 a crowd of protesters pelted seven women with rubbish. Their crime was to dare to sit a science exam (BBC news 2013). In each discipline, there were always notable women who met the challenges. In the geosciences, some of those women became Geological Society Fellows.

100 years on: the influence and legacy of the first female Fellows

In the late 1960s, there was some loosening-up of 'Victorian' societal norms following the austerity of the post Second World War years. In 1969, exactly 50 years after the election of the first female Fellows, the British Geological Survey employed their first female field geologist. However, that same year, women undergraduates in the UK were still being told that they could study geology but that there were no jobs for women geologists, thus lowering their aspirations (Higgs and Wyse Jackson 2007). Although 1969 was a significant year, there seems to have been no celebration under the presidency of Thomas Neville George of the 50th anniversary of the first female Fellows. (It is interesting to note the etymology of the word **fellow**, which has traditionally been used for 'man or male person' (*Oxford English Dictionary*), but thankfully is not etymologically masculine.)

Burek and Higgs (2007*b*) reported on research carried out into the public awareness of female scientists and concluded that even in the twenty-first century there was a severe deficiency of female role models in the geological sciences. Follow-up research was presented to the Women in Science Research Network at the Royal Society in March 2014 for the 'Revealing Lives: Women in Science' conference and made headlines in the *Independent on Sunday* (Green 2014). Analysis of 1774 questionnaires shows that Mary Anning was the most well-known female geoscientist, listed by 8.6% of respondents. This is down on a figure of 10% in the 2007 data. Marie Stopes (Fig. 2c) was also named by 6.3% of the participants, although probably not for her geological expertise but for her birth control work. To assess the importance of schooling in providing role models, an additional question was included in 2014. We asked 556 respondents 'have you ever been taught about female scientists at school?' Of the 25% who responded 'yes', none listed Mary Anning. Just over 50% listed Marie Curie and 2.3% listed Rosalind Franklin. The deficiency of female role models in the curriculum has implications. Mabel Tomlinson after the Second World War fought to include geology within the UK National Curriculum and partially succeeded, but devolution resulted in the splitting up of the education curricula and the inclusion of geology has suffered. In 2013 Mary Anning was named in the England and Northern Ireland National Curriculum along with Charles Darwin under Evolution, but more recently she has been dropped by name. Geology is no longer a separate subject in secondary school in the UK, although can be included within biology (Evolution), chemistry (Climate change through time) and physics (Renewable and non-renewable energy). Mabel Tomlinson would be most disappointed.

Today with TV and social media increasingly responsible for public awareness, we need highly visible female role models in geoscience to stimulate female interest and career expectations, similar to Alice Roberts in anthropology, Maggie Aderin-Pocock in astronomy and Jane Goodall within primatology. The survey data collected by Burek and Higgs show that Mary Anning at present is our best hope, even if she has been dead for 170 years.

In 2007 there were 20 female professors in geological science in the UK in 16 institutions, and none in Ireland (Burek and Higgs 2007*b*). The numbers have certainly increased. Today, a search of the websites of 26 universities that teach Earth and environmental sciences suggests there are now 65 female professors with chairs across a broad range of subdisciplines, from geoconservation to geophysics, volcanology to palaeobiology, and sustainable mining to petroleum engineering. It suggests that students studying today have considerably more role models. However, we should not get complacent, as this number represents less than 16% of the total number of professors in the geological sciences in the UK. The exact numbers are becoming difficult to estimate as research areas become increasingly interdisciplinary. We suggest that a research project to 'map the terrain' would be a worthy pursuit.

Burek and Higgs (2007*b*) reported 2 (FTE) female academics in geology departments in Irish higher education institutions. We are pleased to report that the numbers have increased and there are now (13 years later) 5.5 (FTE) women with permanent academic positions. If physical geographers and environmental scientists are included, this number increases. However, the ratio of female to male geoscience academics is still very low. An increase in national funding has created many female postdoctoral geoscientists, and so the past refrain that 'women don't apply for academic positions' is unlikely to be used again.

There have been a number of initiatives in the past decade that may have increased the

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representation of women geoscientists in academia or industry. In 2007 the Geological Society planned the mentoring of junior academics by senior members, to encourage female geoscientists into new territories. Mentoring workshops were held and it would be interesting to gauge their impact. In another initiative, in February 2017 the Geological Society hosted the launch of a photographic exhibition *Raising Horizons – Portraits highlighting women in archaeology and geoscience, past and present*, by pioneering equality photographer Leonora Saunders. Fourteen portraits of contemporary 'Trowelblazers' posing as their historic counterparts (Fig. 2) toured the UK for two years before coming back to the Geological Society in time for the 21 May 2019 celebrations. These initiatives provide support and raise awareness of the gendered history of the Society but are they making a difference?

The proportion of female membership of the Geological Society is increasing and stands at 29% of total membership, but female participation in authorship of articles in the *Geoscientist* is just 6.7% and the proportion of letters from females to the Geological Society journal is only 6% (Whitchurch 2019). This is disappointing, but not surprising as it reflects the situation in other publications. Rhoton (2011) and Holman *et al.* (2018) suggest that women are often overloaded with multi-tasking and consequently dedicate less time to something they consider peripheral to their professional lives.

Since the election of the first female Fellows in 1919, there have only been two female Presidents of the Geological Society. The first was Professor Janet Watson (1982–84) whose 'legacy lives on in the huge number of female geoscientists who have followed in her footsteps and for whom she was an inspiration and formidable role model' (Easterbrook 2019). She not only supported female geoscientists, but was also appreciated as

> an outstanding intellect, a brilliant field observer and synthesizer, a dedicated and empathetic teacher, an accomplished poet, and a kind gentle person. Her great discovery of the Scourian and Laxfordian phases of the Lewisian, separated by the Scourie dykes, was the result of very detailed and meticulous six-inch mapping over a large area of Northwest Scotland. As a graduate student in Imperial College in the late 1950s, I benefited from her help and advice even though I was not one of her students
>
> (John Dewey, pers. comm. 2020).

Dewey goes on to note her dedication to student development and recognizes that

> she was a student and young academic at a time when it was a tough struggle for women to be fully accepted in a man's geological world, but she established herself in the academic world through her brilliance, good humour, humility, and smiling kindness

The main lecture theatre at the Geological Society is named in Janet Watson's honour, in which her portrait hangs prominently. The Janet Watson Meeting has been held annually since 2016, and is now a flagship event of the Geological Society. The conference focuses specifically on early career geoscientists presenting their research both to their peers and to potential industry employers in a discussion-led environment. Professor Lynne Frostick was the second female President of the Geological Society (2008–10), and has written the Foreword to this book. She too had a large photograph on display which now seems to have been mislaid.

In 2018 the Girls into Geosciences project, which focuses on introducing school children to geoscience, won the RH Worth prize from the Geological Society, the first time a mainly female group had won the award for their outstanding work towards gender parity. To date, the GSL medal distribution is showing greater equality in the twenty-first century than in the two centuries before (**Burek 2020*a***).

In another positive development for learned societies, Jane Francis (Fig. 2c) was appointed the first female Vice-President of the Palaeontographical Society since its inception 163 years ago, serving from 2016 to 2019, and Jenny Clack (1947–2020) was the first woman to win the Palaeontographical Society Medal, awarded in 2020, although sadly posthumously. Although the situation in learned societies has undoubtedly changed, there is still a long way to go to reach gender parity. To strike a note of caution, the first female President of the Royal Society of Chemistry was told by a member, at her inauguration, that it was a disgrace that she was President as she should be at home bringing up her children. That was in 2012.

Burek and Higgs (2007*b*) discussed the teaching of science in higher education institutions and advocated changing the often unreflective traditional curricula and assessment approaches and designing more empowering curricula with an increase in collaborative work. This has certainly drawn attention during the past decade with increased focus on group work, undergraduate research and staff/student partnerships in third-level education. This change to the traditional hierarchy and power dynamic is seen as good for women (Higgs and McCarthy 2008). It is important to continue to experiment with new pedagogies which give more consideration to students' ideas and confidence building. At present there is an increase in blended learning and working from home, which may well show some new trends in the future. It remains to be seen. One thing is certain – academia must be cognizant of the diverse needs of students, as everyone scrambles to cope with online teaching and learning, or we could be in danger of losing some of the gender parity ground that we have gained.

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In attempts to increase the number of women studying geoscience, Burek and Higgs (2007*b*) reiterated calls that we must not just add women to science, but also change the structure and perception of science to make it more accessible to women who would like to pursue a career in science. There are positive signs, for example organizations such as GETSET have made some progress in neutralizing gender stereotypes in science.

An inquiry initiated by the UK House of Commons Science and Technology Committee on Women in Scientific Careers, received extensive evidence-based submissions and provoked much informal discussion. The findings indicated that all was not well for women in scientific careers. The Report highlights that more must be done to increase the representation of women in science and technology, where only 9% of professors are female. There are 35 recommendations contained in the report including the need to monitor recruitment, provide mentors and promote an environment that is inclusive, supportive and flexible.

The report did not uncover any new issues on the topic of gender diversity in STEM subjects, indicating that the problems and solutions have long been identified. While the report commends initiatives to inspire school children to study STEM subjects, it states that such efforts are wasted if women are then disproportionately disadvantaged in scientific careers compared with men. While recognizing the challenge of unconscious bias the report states 'It is disappointing that biases and working practices result in systematic and cumulative discrimination against women throughout STEM study and academic careers' (Anon 2014, para. 77, p. 53).

The government response agreed that women are under-represented, and that a more diverse workforce could create an environment that fosters creativity and innovation. Both the report and the response from government (May 2014) placed emphasis on the Athena SWAN charter, and applicants for research grants must now demonstrate a commitment to equality and diversity. However, in practice, responsibilities for commitments may get passed down the line and result in women having to stand up for themselves and risk being viewed as troublemakers. Large amounts of anecdotal evidence, even in the twenty-first century, have uncovered some distressing behaviours in academic institutions. A formal study of these behaviours is long overdue.

The Athena SWAN initiative has grown in visibility and importance, provoking institutional action plans that aim to make a role in academia more accessible to those with caring responsibilities, and that necessitate the systematic collection of gender-related data. The initiative is being embraced by the institutions, partly because certain avenues of funding depend on their engagement, but is it working? There is still evidence of policy and practice not aligning. The good news is that the debate no longer focuses entirely on 'women as the problem'. Athena SWAN points to institutional structures, attitudes and policies as part of the problem. In a recent development, UNESCO issued an IGCP 2020 call for proposals which has included early career researchers, and international participation including female scientists in its criteria for award funding in science. To quote from the UNESCO flier 'Proposals will be ranked taking into account gender equality' (http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/IGCP_flyer_2020.pdf).

An emerging insight is that the accepted practice of self-deprecation by women in the nineteenth and twentieth centuries (**Thompson 2020**) has not entirely gone away. Today, calls for confidence-building and mentoring support as important requirements for women in geoscience exist because women are more likely to make apologies for their contribution, suffer imposter syndrome or be over-modest. An example of positive action to address the under-representation of women in leadership positions is the Aurora project supported by inspirational women role models and networks of early career women who share good practice, insights and experiences (https://www.ucc.ie/en/hr/wellbeingdevelopment/training/leadership/#aurora-2020–2021).

In recent positive developments in the UK, Marie Cowan was appointed Director of the Geological Survey of Northern Ireland and Karen Hanghøj took up the role of Director of the British Geological Survey in October 2019. The Dorothy Hodgkin Fellowship scheme (Dorothy Hodgkin remains the UK's only female Nobel science prize winner to date) was set up to provide for outstanding scientists in the UK (both men and women) at an early stage in their research career who require a flexible working pattern owing to circumstances of parenting, caring or ill health. The Tomlinson–Brown Trust has been partly set up by Mabel Tomlinson's former geology students to encourage young geologists in fieldwork. Other awards have been instigated such as the Marie Tharp Fellowship by Columbia University to benefit young female researchers. We see the emerging practice of naming institutions, buildings and research and teaching spaces after women scientists, such as the Dorothy Hodgkin building at Keele University and the *Mary Anning* research and survey vessel operated by Swansea University, as an important development in the road to gender equality.

Conclusion

The continued uncovering of the lives and contributions of female geoscientists in the nineteenth and

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twentieth centuries has not changed the conclusions of Burek and Higgs (2007*b*), but has allowed new insights into the issues women faced in their pursuit of a career and recognition for their discoveries. Trends from the nineteenth century to the present can be discerned and show that, although recognition of women geoscientists has occurred, it came late and was met with resistance. The casual acceptance of women as assistants rather than leaders, by both men and women, has not quite gone away.

Some women have bucked the trend. The early women who were recognized by the Geological Society through Fellowship, Funds and Medals began to change the perception of women as geologists and are worthy of their place in the history of the science. This Geological Society recognition was important for their status, self-esteem and career, and they were role models for women who came later. We are grateful for those first trailblazers and celebrate them. There is still a long way to go, but without them the path would be longer.

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References

Alonso-Zarza, A.M. 2008. The Role of Women in the History of Geology book review. *SEPM Journal of Sedimentay Research*. https://www.sepm.org/files/brburek. t0lq2ricqam76rd8.pdf (accessed 18 December 2020)

Anon. 2013–14. House of Commons Science and Technology Committee Women in scientific careers Sixth Report of Session. HC 701, 58p. https://publications.parliament.uk/pa/cm201314/cmselect/cmsctech/701/701.pdf (accessed 02/12/2020).

BBC News 2013. Call to arms over sexism in science https://www.bbc.com/news/uk-scotland-23567476

Bell, M. and McEwan, C. 1996. The admission of women Fellows to the Royal Geographical Society, 1892–1914: the controversy and the outcome. *The Geographical Journal*, **162**, 295–312, https://doi.org/10.2307/3059652

Boylan, P.J. 2020. Dr Dorothy Helen Rayner FGS (1912–2003): vertebrate palaeontologist and academic. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2020-44

Burek, C.V. 2007. The role of women in higher education – Bedford College and Newnham College. *Geological Society, London, Special Publications*, **281**, 9–38, https://doi.org/10.1144/SP281.2

Burek, C.V. 2009. The first female Fellows and the status of women in the Geological Society of London. *Geological Society, London, Special Publications*, **317**, 373–407, https://doi.org/10.1144/SP317.21

Burek, C.V. 2019. Archibald Geikie and his influence on female geologists. *Geological Society, London, Special Publications*, **480**, 67–91, https://doi.org/10.1144/SP480.6

Burek, C.V. 2020*a*. Female medal and fund recipients of the Geological Society of London: a historical perspective. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-190

Burek, C.V. 2020*b*. Mabel Elizabeth Tomlinson and Isabel Ellie Knaggs: two overlooked early female fellows of the Geological Society. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-235

Burek, C.V. 2020*c*. Margaret Chorley Crosfield, FGS: the very first female fellow of the Geological Society. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-209

Burek, C.V. and Higgs, B. (eds) 2007*a*. *The Role of Women in the History of Geology*. Geological Society, London, Special Publications, **281**, https://doi.org/10.1144/SP281.0

Burek, C.V. and Higgs, B. 2007*b*. The role of women in the history and development of geology: an introduction. *Geological Society, London, Special Publications*, **281**, 1–8, https://doi.org/10.1144/SP281.1

Burek, C.V. and Hose, T.A. 2016. The role of local societies in early modern geotourism: a case study of the Chester Society of Natural Science and the Woolhope Naturalists' Field Club. *Geological Society, London, Special Publications*, **417**, 95–116, https://doi.org/10.1144/SP417.6

Creese, M.R.S. and Creese, T.M. 2006. British Women who contributed to research in the geological sciences in the nineteenth century. *Proceedings of the Geologists' Association*, **117**, 53–83, https://doi.org/10.1016/S0016-7878(06)80030-1

Easterbrook, G. 2019. Janet Watson, presentation at the GSL 'Celebration of the first female Fellows of the Geological Society' conference, Geological Society, Burlington House, London May 2019.

Elles, G.L. and Wood, E. 1901–18. A *Monograph of British Graptolites*. Palaeontographical Society, London, https://doi.org/10.1080/02693445.1901.12035498

Evans, S.I., Keighren, I M. and Maddrell, A. 2013. Coming of age? Reflections on the centenary of women's

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admission to the Royal Geographical Society. *The Geographical Journal*, **179**, 373–376, https://doi.org/10.1111/geoj.12051

Green, C. 2014. Could you name more than one female scientist? *The Independent on Sunday*, 15 May (last accessed 23 November 2019).

Gries, R.R. 2020. Buried discoveries of early female petroleum geologists. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-216

Hegarty, S. 2020. Female students of geology in Victorian Dublin. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-222

Herries Davies, G.L. 2007. *Whatever is Under the Earth, The Geological Society of London 1807 to 2007*. Geological Society, London, https://www.geolsoc.org.uk/HIST

Higgs, B.M. 2020. Understanding the Earth: the contribution of Marie Tharp. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-248

Higgs, B.M. and McCarthy, M. 2008. The changing roles and identities of teachers and learners in higher education: introduction. *In*: Higgs, B. and McCarthy, M. (eds) *Emerging Issues II: The Changing Roles and Identities of Teachers and Learners in Higher Education*. National Academy for the Integration of Research, Teaching and Learning.

Higgs, B.M. and Wyse Jackson, P.N. 2007. The role of women in the history of geological studies in Ireland. *Geological Society, London, Special Publications*, **28**, 137–154, https://doi.org/10.1144/SP281.9

Higgs, B., Burek, C.V. and Wyse Jackson, P.N. 2005. Is there gender bias in the geological sciences in Ireland?. *Irish Journal of Earth Sciences*, **23**, 132–133, https://doi.org/10.3318/IJES.2005.23.1.65

Hobbs, B.A. and Jones, A.G. 2020. A pioneering geophysicist: Rosemary Hutton. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-211

Holman, L., Stuart-Fox, D. and Hauser, C.E. 2018. The gender gap in science: how long until women are equally represented? *PLOS Biology*, **16**, e2004956, https://doi.org/10.1371/journal.pbio.2004956

Kiseeva, E.S. and Yuzmukhametov, R.N. 2020. Women at the dawn of diamond discovery in Siberia or how two women discovered the Siberian diamond province. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2020-11

Kölbl-Ebert, M. 2020. Ladies with hammers – exploring a social paradox in early nineteenth-century Britain. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-193

Lewis, C.L.E. 2020. Two for the price of one: Doris Livesey Reynolds (1899–1985). *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-162

Mather, J.D. and Bennett, J.A. 2020. Eileen Mary Lind Hendriks (1887–1978), whose meticulous research resolved the Paleozoic stratigraphy and structure of SW England. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-194

Newell, J.R. 2009. Book reviews. *Earth Sciences History*, **28**, 144–145, https://www.jstor.org/stable/24138843

Orr, M. 2020. Collecting women in geology: opening the international case of a Scottish 'cabinétière', Eliza Gordon Cumming (*c.* 1798–1842). *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-205

Panciroli, E., Wyse Jackson, P.N. and Crowther, P.R. 2020. Scientists, collectors and illustrators: the roles of women in the Palaeontographical Society. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2020-98

Pickett, E. 2019. Cover competition. *Geoscientist*, **29**, 7.

Rhoton, L.A. 2011. Distancing as a gendered barrier: understanding women scientists' gender practices. *Gender and Society*, **25**, 696–716, https://doi.org/10.1177/0891243211422717

Sendino, C. and Porter, J. 2020. Female aristocrats in the Natural History world before the establishment of the GSL. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-164

Thompson, C. 2020. Maria Graham and the Chilean Earthquake of 1822: contextualising the first female-authored article in *Transactions of the Geological Society*. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2020-22

Tubb, J. and Burek, C.V. 2020. Gertrude Elles: the pioneering graptolite geologist in a woolly hat. Her career, her achievements and personal reflections of her family and colleagues. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-203

Turner, S. 2020. Farflung female (and fossil bone hunting) Fellows: an autoethnographic approach. *Geological Society, London, Special Publications*, **506**, https://doi.org/10.1144/SP506-2019-225

Whitchurch, A. 2019. Make your voice heard. *Geoscientist*, **29**, 5, https://doi.org/10.1144/geosci2019-019