An Irish female pioneer in geology:

Mary Katherine Andrews (1852 - 1914)

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Abstract: Mary Katherine Andrews (1852–1914) was a woman of her time, a Victorian then Edwardian lady interested in science. Raised in an academic household in Belfast, she did not have the opportunity to attend university, because women were not accepted when she was young. This did not discourage her in developing her scientific interests, and she became an accomplished amateur geologist. The quality of her work led to the honorific position of Secretary of the Geological Section of the Belfast Naturalists' Field Club (BNFC). She was attracted to several fields of geology, but focussed her attention and researched in aspects of geomorphology and petrology. Part of her work in the Geological Section involved discerning the direction of ice flow, which she and others based on extensive collecting and documentation of glacial erratics across. She was a curator of geological specimens for the BNFC, photographer of landscapes and specimens, researcher, defender of geological heritage, a good communicator, and an international collector. Her legacy is not restricted to the rock samples she collected and the thin sections she prepared, but she also collected fossils, wrote papers, took many geological photographs that she deposited with the British Association for the Advancement of Science, and most tellingly, the enthusiasm she transmitted to young females.

Key words: female geologist, pioneer, Belfast, Ireland, geomorphology, petrology, geological heritage

Fig. 1—Drawing of 12 College Gardens, Belfast

Consuelo Sendino

Biography

Mary Katherine Andrews was born in Belfast on 5 October 1852. She was one of the six children and the youngest of the four daughters to Jane Hardie and the eminent chemist Dr Thomas Andrews F.R.S. (Creese 2004) of whom numerous works have been written. One of this was donated by his daughter Mary to the Chester Society of Natural Science Literature and Art (Newstead 1904). Dr. Andrews will also be remembered for his defence of women's right to be admitted in colleges (Lunney 2009).

There is not too much written about Mary's private life, but it is possible to follow her in the Census of Ireland. It seems she lived in 12 College Gardens, Belfast (Northern Ireland) (Fig. 1) with one brother, two sisters and two servants, and left this address, along her brother Thomas John between 1901 and 1911, to move to Victoria Terrace in Portstewart (Northern Ireland) (personal communication from Michael Simms, National Museums Northern Ireland). She died while she was travelling around France. In July 1914, as a tireless geologist, Mary was collecting volcanic and plutonic rocks for the Geological Section of the Belfast Naturalists' Field Club (BNFC) a few weeks before her death (BNFC 1916), in what is now a UNESCO World Heritage site, the Chaîne des Puys (Fig. 2), in the French northern Massif Central. This chaîne contains volcanoes formed in eruptions about 10,000 years ago that are currently dormant. On 14 August 1914 Mary died in Royat (Anonymous 1914), a village (Fig. 2) built on a lava flow in Puy-de-Dôme.

The BNFC only published a few words acknowledging Mary's work on glacial erratics for the BNFC Geological Section Committee in their Annual Report of 1914 (Robertson 1915): "*During the year the Club has sustained a serious loss in the death of Miss M. K. Andrews, whose work in recording the occurrence of Erratics in the district is monumental*." Unfortunately, her work on plutonic and volcanic rocks was not acknowledged, nor were all those images of the landscapes she studied that document how landscape has changed over time. She did not only collect rocks, curated them and exhibited them, but also published on them and participated of research projects which were based on the samples she collected (Greenly 1900) and gave or lend specimens to male colleges for research (Gough 1907, Wright 1911).

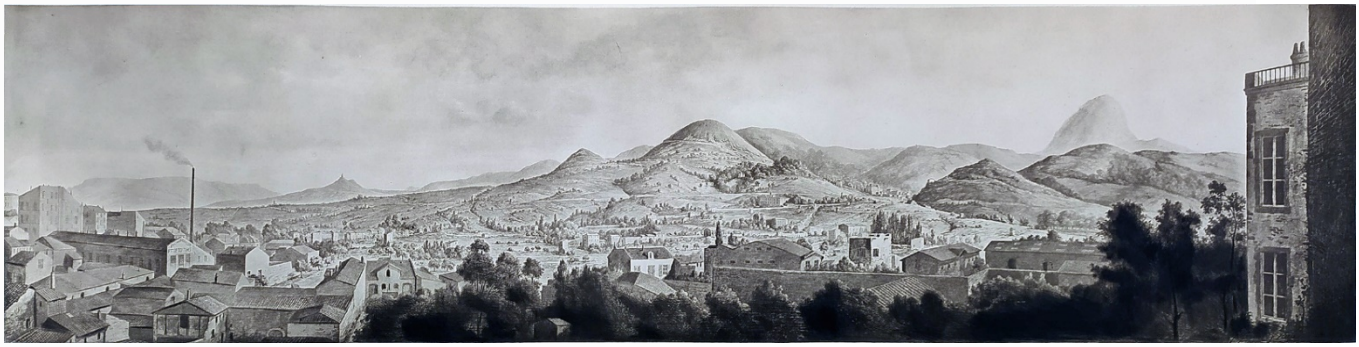

Fig. 2—Royat in Puy-de-Dôme (Auvergne-Rhône-Alpes, France), with volcano landscape in the background

Henri Gonnard, 1891. Image GRA 2106, Bibliothèque du Patrimoine de Clermont Auvergne Métropole, CC BY

She belonged to a time when women were not admitted in Irish universities. The first Irish university to open its doors to women was Royale University, Dublin, where they could have their degrees from 1892 (Higgs and Wyse Jackson 2007). At that time Mary was in her forties and had already written a paper, and worked in a field club for at least two

years. She was involved in the Belfast geological society with numerous activities, mainly for the BNFC, one of the first naturalist association to accept women as fully members (Creese 2004). Apart from her work on geology, Mary also helped her father with his scientific papers making handwritten copies and preparing a list of errata and explanatory notes (Queen's University Belfast Library). These papers form part of Thomas Andrews' legacy at the Queen's University Belfast. Mary's work is not focused on a single subject or confined to a specific area of expertise; rather, it spans a diverse range of fields. Despite this broad scope, the legacy she has left behind is immense, showcasing her versatility across various disciplines.

Beginnings and her work for the BNFC

It is not known when Mary started to study geology as an amateur, but her first acknowledged work dates from 1876 with *The Early History of Magnetism* (Andrews 1876) that she signed as 'K.' (Deane 1924: p. 119). Mary was only 24 years old, and she had already written an article in the prestigious journal *Nature*. She was probably the first Irish woman to publish in *Nature* and one of the few female pioneers to publish in that journal, following Mary Philadelphia Merrifield and Mary Jane Plarr. Currently, in 2024, only 17% of researchers who declare their gender in Nature are female (Nature 2024). At her time the proportion would be insignificant. The fact that she was a pioneer in her time makes her work relevant. But why did she not sign the article with her name? The main possible reasons are gender bias, lack of recognition and institutional barriers, factors that created an environment where women often felt compelled to either publish anonymously or use a male pseudonym to ensure their research was taken seriously and disseminated widely. This Nature article she wrote deals with magnetism, providing a state-of-art overview for that time, focusing on a period from over 2000 years BP to the astronomer Edmond Halley in 1692. In other words, since the earliest reference to the

Chinese Emperor Hoang-Ti, who invented the magnetic chariot in 2634 BP to guide travellers across the Asian plains, long before it was applied for maritime purposes, to Halley who considered the earth has magnetic poles which do not necessarily coincide with the geographical poles. This work was commented on in the same journal, recognising her excellent synthesis capacity and knowledge of the subject (Chappell 1876).

There is nothing written about her interest in geology after her supposed first paper and when she joined the BNFC in 1890. Although this club admitted women from its foundation, in 1863, it seems she joined 14 years after her first paper, becoming actively involved and dedicated to the BNFC. Her active role in the BNFC as a member led to her being cited as one of its female Club's builders (BNFC 1904a). Initially, her role was likely social, providing tea to other members during social meetings before meetings and exhibitions. It was common for women who joined this Club without presenting exhibitions or participating in meetings to serve tea to other BNFC members, in contrast to their male colleagues, who did not have to serve tea when they were not engaged in scientific activities. The names of those females who contributed to household tasks were often given until 1903 and always recorded from 1903 onward in their annual reports and proceedings. It is probable that she could have helped during the first years, until 1895 (winter 1894, BNFC 1894; BNFC 1895a), the last year her name is associated with serving tea, probably because her role was more scientific, involving exhibits and reading scientific papers for the BNFC. At that time, she has already read and written three papers and participated in an international congress on geology (see Table). Her membership can be followed in the BNFC Proceedings from 1890 to 1914 coinciding with her sister Elisabeth Andrews from 1893 with residence at the same

address, 12 College Gardens, in Belfast. It seems Mary recorded the same address for the BNFC, although she left that home in 1901.

Her dedicated work and contributions within the BNFC earned her recognition and invitations to significant geological events, such as the World's Congress on Geology in 1893 and the Geological Society of London (GSL) centenary dinner in 1907. She was designated as a delegate of Queen's College Belfast in the Woman's Section of the World's Congress on Geology that was held in Chicago, from 21 to 26 August 1893; for what she travelled about 6,000 Km from Belfast to Chicago to participate at a time when women were not used to travelling alone. This Congress was included in the World's Columbian Exposition which commemorated the 400th anniversary of Columbus's landfall in the Americas. The Exposition celebrated Western 'progress,' including women's achievements. For this a specific building was erected for female activities. There, Mary was one of the pioneering Irish women in geology, alongside other international female teachers and notable students in the field, such as Mary Holmes (first woman to be elected a GSA fellow), Louise Foster (**f**ull Professor of Biochemistry at Smith College in 1908), Agnes Crane (a palaeontologist expert in fossil brachiopods), Jennie McGowen and Ella F. Boyd (amateur geologists) (Broadhead 1893). Her participation was on *Physical Geology* (TCC 1893; Ami 1893) one of her favourite areas of expertise. Her role as a delegate of Queen's College Belfast was criticized by Herries Davies (2007), partly because she was more involved with the BNFC than with Queen's College Belfast and also due to her limited number of publications. The exact number of her publications remains unknown. If she published a paper in *Nature* anonymously, she might have done the same with other papers. Nonetheless, her significant legacy is evident in the photographs, rock samples, and thin sections she prepared, which we will examine later. She was indeed an accomplish field geologist.

Mary served on the BNFC Committee starting in 1910 (BNFC 1911), where she proposed motions during the annual meetings (BNFC 1909a) and secured donations not only for the BNFC Geological Section, of which she was a member, but also for the BNFC Library (BNFC 1912). There are some texts naming Mary as a participant of meetings and exhibitions until a few months before her death, in 1914 (January and February 1914: Irish Naturalist 1914a, b). Her eldest sister, Elisabeth, helped Mary with taking photographs of geological sections for the BNFC Geological Section Committee, but Elisabeth's main work was with the ethnographic committee and worked mainly on Irish folklore. Meanwhile Mary's work was focused on geology. She was a tireless geologist for the BNFC from the time she joined the Club until shortly before his death, attending meetings, helping with exhibits, and writing reports. She was recognised in her time, and her work led her to attend the GSL centenary dinner in 1907 (Fig. 3) with a dual representation, as the Queen's College Belfast delegate and as a member of the BNFC (Burek 2019), taking her niece, an enthusiast of geology, as a companion. Two years after this event the BNFC Committee gave Mary the honorific role of Honorary Secretary of the BNFC Geological Section. It took her 19 years to be recognised by her work.

Fig. 3—On the left are attendees at the GSL's centenary dinner in 1907, and on the right is Mary K Andrews, who was at table C, seat 123. © GSL. Reproduced by permission of the Geological Society of London. Image coloured

Overall, this woman's journey in geology demonstrates how she overcame initial lack of recognition to become a valued member of the BNFC and a respected figure in the geological community, earning her invitations to important geological events.

Contribution to the glacial geology in Belfast

One of Mary K. Andrews first works in the BNFC was to study the glacial geology of Belfast area. She was one of the two female Committee members, with the Honorary Secretary Miss Thompson, who were appointed to the BNFC Geological Section Committee on 9 August 1893. This Committee reported to the Secretary of the British Association Erratic Blocks Committee (British Association for the Advancement of Science -BAAS-). Her first piece of work for this Committee started only 3 days after she

was appointed, on 12 August 1893, visiting the Greenisland Railway Station, County Antrim (Christen 1906). There, erratics rocks which were not Triassic were collected randomly to try to identify the direction of ice flow. During the time she was part of this Section, she visited some areas in the Northern Ireland including Gweedore, Carthall Brickyards, Ballintoy, Greenisland and Ballywater (Fig. 4). Most of the samples she collected are currently housed in the National Museums Northern Ireland. Mary also collected fossil specimens, including shells, and clay samples, which she sent to Wright. While collecting, she took photographs of the sites for future reference. She would use these images for exhibits and research.

Fig. 4—On the left are sites where she collected erratics. On the right are some samples collected in Ballywalter with original labels, probably in her handwriting (upper left label).

Map image: Consuelo Sendino

Specimens image: Michael Simms

She also used to write reports for this Committee (Andrews 1910, 1911; BAAS 1911) such as the one on Carthall Brickyards erratics (Coleraine, County Londonderry) (BNFC 1907a). Mary was appointed Honorary Secretary of the BNFC Geological Section in 1909 and held the position until the 7th of April 1914, when she was succeeded by her

niece Elisabeth L. Andrews (BNFC 1914), a few months before her death. An important part of her work for the committee involved awarding prizes for the best collections of scientific objects in the district. So, she acknowledged the Robert Bell Collection of 22 zeolites from counties Antrim and Derry. This collection contains a sample of gyrolite that it is the first record of this mineral in Ireland (BNFC 1910b).

Photography

Her work well deserved a mention regarding photographs, specifically, the Ballintoy photographs, in County Antrim, (BAAS 1909). She was aware of the value of the photographs and specialized in taking images of different rocks and landscapes she visited. This means that Mary recognized the importance of visual documentation in geological research and exploration. Geological photographs can be valuable for various reasons, including recording the characteristics of rock formations, geological features, and landscapes for scientific purposes and educational materials. They can also serve as references for future research and comparisons with other geological sites, as well as with the site where she took the images, to observe changes over the time. She was a pioneer to show different rocks and their mineralogical compositions on an image**.** For this she used letters on the images. One of these was published with her copyright (Andrews 1903: Plate 1) (Fig. 5). She was a woman of her time and probably the first Irish woman to publish a photograph with copyright and the first one to publish a geological image with copyright. Photography was one of the tools used by Victorian women for scientific purposes (Tucker 2006).

Many of the photographs Mary took were during field trips with the BNFC Geological Section and the London Geologists' Association. These photographs illustrated the landscape and rock formations, which she used as lantern slides in BNFC exhibits (BNFC 1896b). These images now serve as a legacy, showcasing her work and

providing a record of how the landscape has changed over time. Some photographs are from the Mourne Mountains in County Down and Tardree in County Antrim, Northern Ireland. Other images supported her research, such as those from Cultra, or her colleagues' research, like the ones from Templepatrick Quarry. The images of the quarry's north face were used to support Miss Thompson’s paper on the controversy regarding the ages of rhyolites and basalts (Cole, 1896). A few years later, these images, along with thin sections of Mourne rock samples and fossils, were chosen for display during the first joint meeting of the BNFC with the Belfast Art Society and the Ulster Amateur Photographic Society in the Microscopic Section on 10 November 1897 (BNFC, 1898a). This reflects her skills as a keen observer and talented photographer.

According to the BNFC and Belfast Natural History and Philosophical Society (BNHPS) publications, Mary was a good communicator, participating in numerous exhibits and using photographic techniques available at her time to show geological structures, forms and specimens. Her work demonstrates a high level of expertise and dedication to her field, ensuring that her contributions continue to be recognized and appreciated. Her ability to capture and document geological features not only contributed to scientific research and exhibitions but also provided valuable historical records of the changing landscapes.

Fig. 5—Image published with © of the junction of granite and Silurian at Glen River, Newcastle, co. Down (after Andrews 1903). On the left there are letters to distinguish how a dioritic lamprophyde dyke (D) intrudes between granite (G) and Silurian shale (S), highlighted in different colours on the right image.

Image: After Mary K Andrews, 1903

Interest in geomorphology

Her first paper at the BNFC was on geomorphology and was titled *Denudation at Cultra, County Down*. It was the first of three papers she wrote on this topic. The Junior Secretary of the Club read the paper on 20 December 1893, during the Winter Session (BNFC 1893). It was later published in the Irish Naturalists' Journal (Andrews 1893a, 1893b). Her research was based on landscape changes due to marine transgression at Cultra. For this study, she interviewed the oldest residents of the area and examined local maps. She realized that the sea was advancing and covering more land than other historic times. Her detailed study included maps from the Ordnance Survey, demonstrating that Cultra Quay, visible on an 1834 map, had disappeared by 1858 because of the marine transgression. She also showed that the old shore pump in Cultra was gradually being submerged by the sea. A photograph of coast erosion at Cultra was donated by herself

to the BNHPS (BNHPS 1903a). This transgression led her to consider landscape changes, concluding that some present land areas were once underwater in prehistoric times and other areas are now being reclaimed by the sea. She tried to fit these geomorphological changes with the most recent geological theories of her time, such as the Huttonian theory and the establishing of the uniformitarianism.

Almost one year later of her first paper on geomorphology, on 18 December 1894, she was protagonist of the third winter meeting with *Notes on Moel Tryfaen*, a rounded hill of Snowdon, in northern Gwynedd (Wales), with Cambrian deposits on the top (BNFC 1895b). She summarised the studies carried out there, making Moel Tryfan (current transcript) a foremost place in the geological history. She not only wrote about the necessity of preservation of the fossils, mainly molluscs, found in the Alexandra Slate Quarry, but also about the microfossils studied within thin sections and mechanical analysis of rock samples. Most of the fossils which were on display during the presentation of her paper were collected by Mr Hughes, assistant manager of the Quarry, and by herself. She recognised typical Avalonian palaeofauna confirmed by the American Irish geologist Samuel Alexander Stewart (1826-1910). She also acknowledged the presence of microfossils that were possibly cited for first time in Moel Tryfan (Greenly 1900). With the help of Joseph Wright (1834-1923), a Scottish palaeontologist and Keeper of Hancock Museum in Newcastle-upon-Tyne, the fossil foraminifers were identified (Mellard Reade 1900). Most of the rock samples examined were sands and gravels and a few plutonic rocks collected by herself were shown as well. She accredited again the help of another colleague, Percy Fry Kendall (1856-1936) regarding the rock samples. With this she demonstrated she was able to collaborate to follow her research that in the case of Moel Tryfan was to find out how the marine layers were deposited to that height of about 700 m. It was at the end of the 19th century when the diluvialism

theory, the earth's history was shaped by a universal flood, started to lose strength and other theories were formulated. Mary made a list with those theories which explained the marine deposits by glacial phenomena or submergence, but without taking a clear opinion.

Her third paper read in the BNFC was *The Altels Avalanche, 11 Sept., 1895*, within the BNFC Geological Section in April 1896 (BNFC 1896a). The consequences of this disaster were published in Nature one week after it occurred (Nature 1895). This has been the largest icefall event ever observed in the Alps (Faillettaz et al. 2011). On 11 Sep 1895, at 4.00 am, an ice mass from the Altels Glacier in Switzerland collapsed onto the hamlet of Spitalmatte in the Upper Gemmi Pass. This avalanche, with approximately 4.5 million cubic meters of ice, caused the deaths of six people and hundreds of cattle. The names of those who lost their lives are recorded on a memorial at Spittelmatte. Additionally, the air blast destroyed ten hectares of forest. Much has been speculated about the possible triggers of this avalanche, with the most plausible being the high temperatures of previous summers. Faillettaz et al. (2011) could not find any evidence of seismic instability. Many other researchers specializing in geohazards have studied this catastrophe to identify signals that could predict future avalanches, but the mechanisms leading to this event are still not fully understood. Mary was impacted enough by this avalanche to give a talk, which she prepared based on the Swiss Glacier Commission (Gletscher-Kommission) reports (Carpenter and Praeger 1896). This demonstrates her versatility in being able to read in other languages. Unfortunately, there is no record of this lecture in the Proceedings of the BNFC.

Her work on geomorphology continued in 1900s, with short papers on erosion, e.g. *Erosion at Newcastle, Co. Down* (Andrews 1901) and *Notes on Coast Erosion*, read on

21 January 1902 (BNFC 1904b). These papers show her curiosity about the different sea levels and the effects of erosion on shorelines, how some houses have been covered by the sea and other areas have seen their waters recede. The latter paper is based on the BNFC fieldwork to Coast Road from July 11-13, 1901. During the lecture, lantern slides from County Antrim were shown, including some of Fair Head (in Irish, An Bhinn Mhór) (Fig. 6). Fair Head is a dolerite cliff with characteristic vertical columns. Additionally, slides of Colliery Bay were shown, highlighting a noticeable decrease in elevation and relief, shaped by a smooth rock platform that has been worn down by water and wind erosion (BNFC 1904c). This paper tried to show how marine transgression also occurred in prehistoric times and how historic maps show sites now vanished by the sea. She showed photographs of County Down, exactly of Black Island, in Newcastle, and of Cultra as she did during her first paper, considering it was primordial the preservation of the land from inroads of the sea. She was one of the pioneers in heritage preservation, acknowledging the work of the Committee of the British Association on the Erosion of the Sea Coasts.

Fig. 6—Fair Head. Striking geological formation that has been shaped by a combination of volcanic activity, glaciation, and weathering processes over millions of years

Image: Wikipedia 2016 © CCBY

Already in Mary's time, her work was a reference by other colleagues as Sydney M. Thompson when the latter recalled Mary's studies on marine transgression at the Point cross-dykes (BNFC 1895b).

Interest in petrology

Her background is particularly distinguished in the field of petrology, as evidenced by her contributions to BNFC exhibits from 1895 onwards. She participated in numerous geological exhibits focused on igneous and metamorphic rocks, featuring rock sections (Carpenter and Praeger 1895). Part of her work was educational, showing how to recognize different rocks. To support this, she collected rock samples from various locations. She curated and recorded the specimens she collected and those acquired

through donations. Her meticulous curation is notable (Fig. 7). Some samples include crush conglomerates from the Isle of Man, for which she prepared thin sections, Tertiary dykes from County Down (BNFC 1897; BAAS 1900) and dolerite dykes in thin sections from Scawt Hill, County Antrim (BNFC 1909b). She also included volcanic rocks such as trachytes from Auvergne, France, and rhyolites from County Antrim (BNFC 1900, 1907b). Numerous thin sections prepared by her were borrowed by contemporary geologists (Andrews 1903: p. 54, Gough 1907). Mary also collected boulders that were borrowed by her colleagues for study. For example, the boulder clay from Annadale Brickfield in Belfast and Carthill Brickfield in Coleraine were studied by Wright for their foraminifera. (Wright 1911). Her contributions were mainly through developing exhibitions, which she later presented in papers (Andrews 1894; BNFC 1898b). She displayed orbicular granite from Mullaghderg, County Donegal, and orbicular diorite from Corsica (a French island in the Mediterranean), along with their thin sections and photographs (BNFC 1904d, 1910c) to help BNFC members identify them both in situ and in the lab. Orbicular rocks are known for their unique patterns of concentric circles or spheres, and they are often admired for their aesthetic qualities. These rocks are sometimes used in architecture and other decorative applications due to their striking appearance, possessing an intrinsic economic value that Mary acknowledged. Volcanic ashes from St Vincent (West Indies) and plutonic rocks were also displayed with their thin sections (BNFC 1904e).

Photographs were commonly used in BNFC exhibits. She used her own images, such as one with copyright, showing an intruded dyke between granite and Silurian shale at Glen River, Newcastle, in County Down (BNFC 1904a), and borrowed others, such as those from the British Association series (BNFC 1905).

Fig. 7—Specimens collected and curated by Mary, currently kept in the National Museums Northern Ireland. On the left is Carnmoney dolerite. On the right is Slemish basalt, with what is surely Mary's handwriting providing detailed information about their origin (899 feet from the top). Their origin is indicated on the map in the centre.

She was so comfortable in her educational role displaying samples in exhibits that she also presented minerals and fossils on behalf of other BNFC members (BNFC 1907c). One particularly emotive exhibit for her was in October 1908, when she presented andrewsite from Cornwall (England), a rare phosphate mineral named in honour of her father, Dr Andrews (BNFC 1909b).

She not only presented papers in the BNFC but also in the BNHPS, displaying specimens, slides, and thin sections of plutonic rocks (BNHPS, 1903b). In these presentations, she discussed the controversy between neptunists and vulcanists (plutonists) (Andrews 1903).

Mary, a field geologist, made several discoveries that she did not publish herself. Instead, she shared her findings with colleagues who published them. One notable example is the first record of metamorphosed white chalk, published by Gough (1907). Gough acknowledged Mary's expertise and credited her for the samples and thin sections he borrowed from her.

Her research papers on petrology were combined with those on geomorphology. Her first petrology paper, written in 1894 (Andrews 1894), discussed dykes in counties Antrim and Down. In this paper, she summarized global volcanic activity and wrote about Northern Ireland's plutonic rocks. She illustrated examples from County Antrim, including the cross dyke at Macedon Point, Whitehouse, and the rhomboidal basalts forming a dyke that traverses the Carboniferous, which she photographed at Ballycastle. After this, her subsequent papers delved deeper into her knowledge of the plutonic rocks. *Notes on the Granite and other rocks at Newcastle* (BNFC 1898b) focused on the granite-rich area of County Down. The origin of these plutonic rocks had been a controversial subject since James Hutton’s times, which caught Mary’s attention (Andrews 1903), as did the origin of the Derbyshire ‘toadstones’ (Andrews 1908). These specific volcanic rocks were formed from basaltic lava flows interbedded with sedimentary rocks in the Carboniferous Limestone of the region. Historically, these rocks were called ‘toadstones’ due to their warty appearance, which was thought to resemble the skin of a toad. At the time when she presented this paper, the topic of the basalts' origin was debated. However, she took a clear stance on the matter by acknowledging the work of the engineer John Whitehurst, who proposed a volcanic origin for these basalts. By acknowledging Whitehurst's work and supporting the volcanic origin theory, she demonstrated her involvement in the ongoing scientific debate and took a definitive position on the matter. While reading her

paper, she displayed the thin sections she had prepared and hand specimens of the local basalts. All these papers show a wide knowledge of the geology of her time.

She was acknowledged as one of the few members who used a microscope to show specimens for their paper lectures (BNFC 1895c) and in exhibits. Her thin sections were recognised to be a valuable source for petrological research, about cement between rock grains and particle decomposition.

By collecting rock samples and displaying them alongside other samples from elsewhere, with hand specimens and thin sections, she gained a deep knowledge of volcanic and plutonic rocks from Europe and the West Indies (Fig. 8). This demonstrates her extensive knowledge of different igneous rocks.

Fig. 8—Worldwide map with sites where Mary exhibited samples, including the Caribbean, Northern Ireland, Ireland, Wales, Scotland, England, Central France and Corsica.

Legacy and inspiration

As a dedicated field geologist, she made significant discoveries of rocks and fossils, for which she was recognized. During the fourth Annual Report of the BNFC Geological Section, she was credited with finding the first record of eurite, an aphanitic rock of granitic composition, in Northern Ireland (Thompson 1897), as well as erratics of Shap Granite from Yorkshire drifts.

Mary's contributions might have been overshadowed compared to other contemporary female geologists. Although she was not an academic, she devoted herself to teaching in BNFC exhibits and helping new generations, writing papers and doing fieldwork. Unfortunately, her work has remained hidden until now, and it is currently unknown how many papers she has written anonymously. We must remember that Mary was a pioneer in geology in Ireland. Despite not having the opportunity to study at a university, she gained recognition as an accomplished geologist and one of her papers (Andrews 1903) was highlighted at her time by the British Association as one of the four most important papers regarding local scientific investigations carried out by the BNFC, a British Association-affiliated society, during a monthly meeting in April 1906 (BNFC, 1906).

Mary was surely the first woman to publish a geological paper in *Nature* and the first Irish woman to publish a photograph with copyright. She discovered the first records of various rocks and fossils in Ireland. Her papers were structured with a state-of-art overview of existing research followed by her new observations. For this, she masterfully used photography, which has cemented her place in the history of geological photography. She also took numerous photographs that she donated to different institutions, including BNFC (1905), BNHPS (1903a), and BAAS (1894, 1909). She was also a pioneer in heritage preservation, concerned about landscape

preservation. Additionally, she was ahead of her time in studying petrology and conducting fieldwork, specializing in plutonic rocks. She has been regarded as a solid fieldwork geologist who braved all kinds of weather (Collins 1992).

Mary was also an active specimen collector who significantly increased the number and quality of specimens in her club through meticulous curation (Fig. 7). This curation involved not only the hundreds of specimens she personally collected and donated but also those managed by the Natural History and Philosophical Society for the BNFC Geological Section. Her collections were initially part of the People's Palace Museum (Patterson Museum Collection) and are now housed in the Ulster Museum, dispersed throughout the general collection (personal communication from Michael Simms, National Museums Northern Ireland). Additionally, she prepared thin sections, conducted research, and wrote papers.

She devoted much of her activity to education through hand specimens and thin sections displayed in BNFC exhibits. Her dedication inspired her niece, Elisabeth L. Andrews, who followed in her footsteps at the BNFC. Unlike Mary, Elisabeth had the advantage of studying geology at the prestigious University of Lausanne in Switzerland. Elisabeth became an extension of Mary in many tasks; she joined the BNFC in 1910 (BNFC, 1913), succeeded her aunt as Honorary Secretary of the BNFC Geological Section when Mary left her position, accompanied Mary to the Geological Society of London centenary dinner in 1907 (Herries Davies, 2007), and prepared an exhibit of volcanic and igneous rocks from Auvergne, France, that her aunt had collected before her death (BNFC, 1916).

Conclusion

Mary’s multifaceted contributions to geology made her a trailblazer for women in science. She conducted extensive research on the direction of ice flow by meticulously collecting and documenting glacial erratics, a testament to her dedication and scientific rigor. As a curator of geological specimens for the BNFC, she not only preserved important geological materials but also enhanced the scientific community’s understanding of them through her photography, research, and papers. Her involvement extended to defending geological heritage and inspiring future generations, particularly young women, to pursue scientific endeavours.

Mary was ahead of her time who earned recognition for her work in a field historically dominated by men. She was one of the few BNFC members, including males, who used a microscope to show specimens, and her thin sections contributed to enhancing the research of her and her colleagues. Another aspect of her advanced thought is she was aware of the economic value of rocks in architecture and documented changes in geomorphology through her landscape photography. As a researcher, she was referenced by colleagues for her studies on marine transgression and was acknowledged by the BA for her paper *Notes on Some Igneous Rocks in Down and Antrim.* She contributed to science with a total of 11 recognized papers to date. Mary was a good communicator, an international collector specialized in plutonic rocks, and collaborated with geologists of her time. She was surely the first female to write a paper in Nature and the first Irish geologist to publish an image with copyright. Mary's contributions and achievements in geology were not only groundbreaking for a woman in a male-dominated field but also had a lasting impact on the next generation, inspiring her niece to pursue a career in geology, which was uncommon for women at the time.

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YEAR	Career milestones
1876	Paper: *The Early History of Magnetism*
1890	BNFC member
1893	Congress: Participation in the Woman's Section of the World's Congress on Geology BNFC Geological Section Committee member Paper: *Denudation at Cultra, County Down*
1894	Papers: *Notes on Moel Tryfaen* *Dykes in Antrim and Down*
1895	Fieldtrip: Mourne Mountains, in County Down, with the London Geologists' Association
1896	Paper: *The Altels Avalanche, 11 Sept., 1895*
1897	Exhibit: Mourne rock samples and fossils were shown in thin sections during the first join meeting of the BNFC with the Belfast Art Society and the Ulster Amateur Photographic Society
1898	Paper: *Notes on the Granite and other rocks at Newcastle*
1901	Paper: *Erosion at Newcastle, Co. Down*
1902	Paper: *Notes on Coast Erosion*

1903	Paper: *Notes on Some Igneous Rocks in Down and Antrim*
1907	Representing the Queen's College Belfast and as a member of the BNFC at the Geological Society of London, during the centenary dinner
1908	Paper: *The Derbyshire Toadstone*
1909	Honorary Secretary of the BNFC Geological Section
1910	BNFC Committee member
1914	Leave her role as Honorary Secretary of the BNFC Geological Section

FIGURE CAPTIONS

Fig. 1—Drawing of 12 College Gardens, Belfast

Fig. 7—Royat in Puy-de-Dôme (Auvergne-Rhône-Alpes, France), with volcano landscape in the background. Henri Gonnard, 1891. Image GRA 2106, Bibliothèque du Patrimoine de Clermont Auvergne Métropole, CC BY

Fig. 8—On the left are attendees at the GSL's centenary dinner in 1907, and on the right is Mary K Andrews, who was at table C, seat 123. © GSL. Image coloured

Fig. 9—On the left are sites where she collected erratics. On the right are some samples collected in Ballywalter with original labels, probably in her handwriting (upper left label).

Fig. 10—Image published with © of the junction of granite and Silurian at Glen River, Newcastle, co. Down (after Andrews 1903). On the left there are letters to distinguish how a dioritic lamprophyde dyke (D) intrudes between granite (G) and Silurian shale (S), highlighted in different colours on the right image.

Image: After Mary K Andrews, 1903

Fig. 11—Fair Head. Striking geological formation that has been shaped by a combination of volcanic activity, glaciation, and weathering processes over millions of years

Fig. 7—Specimens collected and curated by Mary, currently kept in the National Museums Northern Ireland. On the left is Carnmoney dolerite. On the right is Slemish basalt, with what is surely Mary's handwriting providing detailed information about their origin (899 feet from the top). Their origin is indicated on the map in the centre.

Fig. 8—Worldwide map with sites where Mary exhibited samples, including the Caribbean, Northern Ireland, Ireland, Wales, Scotland, England, Central France and Corsica. Therefore, she had a wide knowledge of different igneous rocks